GREEN VOLT

Chapter 18

Climate Change

Offshore EIA Report: Volume 1

Royal HaskoningDHV

GREEN VOLT

Revision history

Revision	Date	Description	Prepared	Checked	Approved
1	10/06/2022	First draft	CG (Royal HaskoningDHV)	JP (Royal HaskoningDHV)	VC (Flotation Energy)
2	29/08/2022	Second draft,	CG (Royal HaskoningDHV)	JP (Royal HaskoningDHV)	VC (Flotation Energy)
3	06/01/2023	Final for submission	CG (Royal HaskoningDHV)	JP (Royal HaskoningDHV)	VC (Flotation Energy)

Table of Contents

Table of Tables

Table of Figures

Appendices (Volume 2)

Acronyms

Acronym	Description
BEIS	Department for Business, Energy and Industrial Strategy
CCC	Climate Change Committee
CCGT	Combined Cycle Gas turbine
CCPu	Climate Change Plan 2018-2032
CCRA	Climate Change Risk Assessment
CH_4	Methane
CO_2	Carbon Dioxide
COP	Conference of Parties
COP21	21st Climate Change Conference of the Parties
COP22	22nd Climate Change Conference of the Parties
EIA	Environmental Impact Assessment
GHG	Greenhouse Gas
GWh	Gigawatt Hours
GWP	Global Warming Potential
HFC	Hydrofluorocarbons
HPS	Hydrogen Policy Statement
IAC	Inter-array cables
ICE	Inventory of Carbon and Energy
IEMA	Institute of Environmental Management and Assessment
INTOG	Innovation and Targeted Oil and Gas
LCA	Life Cycle Analysis
LEPS	Local Energy Policy Statement
MGO	Marine Gas Oil
MHWS	Mean High Water Springs
MS-LOT	Marine Scotland Licensing operations Team
MW	Megawatt
N_2O	Nitrous Oxide
NF_3	Nitrogen Triflouride

NPF3	Third National Planning Framework
NPF4	Fourth National Planning Framework
O&M	Operation and Maintenance
OCGT	Open Cycle Gas turbine
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
OWPS	Offshore Wind Policy Statement
PFC	Perfluorocarbons
SCCAP1	First Scottish Climate Change Adaptation Programme
SCCAP2	Second Scottish Climate Change Adaptation Programme
SF_6	Sulphur Hexafluoride
UK	United Kingdom
UNFCCC	United Nations Framework Convention on Climate Change
WTG	Wind Turbine Generators

Glossary

Term	Description
Applicant	Green Volt Offshore Windfarm Ltd.
Buzzard	Buzzard Platform Complex.
Buzzard Export Cable Corridor	The area in which the export cables will be laid, from the perimeter of the Windfarm Site to Buzzard Platform Complex.
Green Volt Offshore Windfarm	Offshore windfarm including associated onshore and offshore infrastructure development (Combined On and Offshore Green Volt Projects).
Horizontal Directional Drilling	Mechanism for installation of export cable at landfall.
Inter-array cables	Cables which link the wind turbines to each other and the offshore substation platform.
Landfall Export Cable Corridor	The area in which the export cables will be laid, from the perimeter of the Windfarm Site to landfall.
Mean High Water Springs	At its highest and 'Neaps' or 'Neap tides' when the tidal range is at its lowest. The height of Mean High Water Springs (MHWS) is the average throughout the year, of two successive high waters, during a 24-hour period in each month when the range of the tide is at its greatest (Spring tides).
Moorings	Mechanism by which wind turbine generators are fixed to the seabed.
NorthConnect Parallel Export Cable Corridor Option	Landfall Export Cable Corridor between NorthConnect Parallel Landfall and point of separation from St Fergus South Export Cable Corridor Option.
NorthConnect Parallel Landfall	Southern landfall option where the offshore export cables come ashore.
Offshore Development Area	Encompasses i) Windfarm Site, including offshore substation platform ii) Offshore Export Cable Corridor to Landfall, iii) Export Cable Corridor to Buzzard Platform Complex.
Offshore export cables	The cables which would bring electricity from the offshore substation platform to the Landfall or to the Buzzard Platform Complex.
Offshore Export Cable Corridor	The proposed offshore area in which the export cables will be laid, from offshore substation to landfall or to the Buzzard Platform Complex.
Offshore infrastructure	All of the offshore infrastructure, including wind turbine generators, offshore substation platform and all inter-array and export cables.
Offshore substation platform	A fixed structure located within the Windfarm Site, containing electrical equipment to aggregate the power from the wind turbine generators and convert it into a more suitable form for export to shore.
Onshore Export Cable Corridor	The proposed onshore area in which the export cables will be laid, from landfall to the onshore substation.

Project	Green Volt Offshore Windfarm project as a whole, including associated onshore and offshore infrastructure development.
Safety zones	An area around a structure or vessel which must be avoided.
St Fergus South Export Cable Corridor Option	Landfall Export Cable Corridor between St Fergus South Landfall and point of separation from NorthConnect Parallel Export Cable Corridor Option.
St Fergus South Landfall	Northern landfall option where the offshore export cables come ashore.
Windfarm Site	The area within which the wind turbine generators, offshore substation platform and inter-array cables will be present.

CHAPTER 18: CLIMATE CHANGE

18.1 Introduction

1. This chapter considers climate change and comprises a Greenhouse Gas (GHG) assessment for the Project (in this instance the Project refers to the offshore elements of the Green Volt Offshore Windfarm only, up to Mean High Water Springs (MHWS)). The GHG assessment predicts the contribution of the offshore aspects of Project to national and regional GHG emissions in Scotland and the United Kingdom (UK), and its 'net effect' compared to a baseline of 'do nothing'.

2. A whole Project GHG assessment will be presented separately in the Green Volt Offshore Windfarm Onshore EIA Report, and a Summary of Offshore and Onshore Environmental Impact Assessments live document will be made available at https://greenvoltoffshorewind.com/ in the interim.

3. This chapter was prepared by Royal HaskoningDHV. The assessment was undertaken in accordance with Institute of Environmental Management and Assessment (IEMA) guidance 'Guide: Assessing GHG Emissions and Evaluating their Significance' (2022). This guidance document provides a topic-specific methodology for assessment of GHGs and determining the significance of GHG emissions generated by a project, and therefore the assessment methodology differs from that presented in **Chapter 6: EIA Methodology**. The GHG assessment methodology used is described in **Section 18.4**.

18.2 Policy

18.2.1 International Agreements

18.2.1.1 United Nations Framework Convention on Climate Change

4. The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty addressing climate change which entered into force on 21st March 1994. Its main objective is 'to stabilise GHG concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system'. In its early years it facilitated intergovernmental climate change negotiations and now provides technical expertise. Its supreme decision-making body, the Conference of the Parties (COP) meets annually to discuss and assess progress in addressing climate change.

5. The first agreement was the Kyoto Protocol which was signed in 1997 and entered into force in 2005. which committed industrialised countries to limit and reduce GHG emissions in accordance with individual targets to reduce the rate and extent of global warming. It applies to seven GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3) which was incorporated into the second Kyoto Protocol compliance period in 2012. The Kyoto Protocol recognises that the economic development of a country is an important determinant in the country's ability to combat, and adapt to, climate change. Therefore, developed countries have an obligation to reduce their current emissions particularly due to their historic responsibility for the current concentrations of atmospheric GHGs.

6. Subsequently, the meetings of COP have resulted in several important and binding agreements, including the Copenhagen Accord (2009), the Doha Amendment (2012) and the Paris Agreement (2015).

7. The Copenhagen Accord raised climate change policy to the highest political level and expressed a clear political intent to constrain carbon and respond to climate change in the short and long term. It introduced the potential commitment to limiting global average temperature increase to no more than 2°C above pre-industrial levels.

8. The Doha Amendment to the Kyoto Protocol in 2012 included a commitment by parties to reduce GHG emissions by at least 18% below 1990 levels in the eight-year period from 2013 to 2020. The UK Climate Change Act 2008 has an interim 34% reduction target for 2020, which would allow the UK to meet and exceed its Kyoto agreement target.
9. The United Nations Climate Change Conference in Paris in 2015 (known as 'COP21') led to the following key areas of agreement (the Paris Agreement):
   - Limit global temperature increases to below 2°C, while pursuing efforts to limit the increase to 1.5°C above the pre-industrial average temperature;
   - Parties to aim to reach a global peak of GHG emissions as soon as possible alongside making commitments to prepare, communicate and maintain a Nationally Determined Contribution;
   - Contribute to the mitigation of GHG emissions and support sustainable development whilst enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change;
   - Commitment to transparent reporting of information on mitigation, adaptation and support which undergoes international review; and
   - In 2023 and every five years thereafter, a global stocktake will assess collective progress toward meeting the purpose of the Agreement.
10. At the 22nd Climate Change Conference of the Parties (COP22) in November 2016, the UK ratified the Paris Agreement to enable the UK to "help to accelerate global action on climate change and deliver on our commitments to create a safer, more prosperous future" (Department for Business, Energy and Industrial Strategy (BEIS), 2016). At the COP24 meeting, held in Katowice, Poland in December 2018, a set of rules for the Paris climate process were agreed.
11. COP26 was held in 2021 in Glasgow. The four specific objectives that were aimed to be achieved for COP26 were (UK Parliament, 2022):
    1. Securing global net zero by mid-century and keep 1.5°C within reach by:
       - Accelerating the phase-out of coal;
       - Curtailing deforestation;
       - Speeding up the switch to electric vehicles; and
       - **Encouraging investment in renewables.**
    2. Adapt to protect communities and natural habitats;
    3. Mobilise at least $100 billion in climate finance per year; and
    4. Work together to deliver, finalising the Paris Rulebook and accelerate action to tackle the climate crisis.
12. For the first time, nations have been called upon to 'phase down' unabated coal power and inefficient subsidies for fossil fuels (UNFCCC, 2022). The two main headlines of COP26 were the (1) signing of the Glasgow Climate Pact, which is a series of decisions and resolutions that build on the Paris Agreement setting out what needs to be done to tackle climate change but does not specify what each country must do and is not legally binding, and (2) agreeing the Paris Rulebook, which gives the guidelines on how the Paris Agreement is delivered. Agreements in the finalised Rulebook include enhanced transparency framework for the reporting of emissions, common timeframes for emissions reduction targets and mechanisms and standards for international carbon markets (UK Parliament, 2022).

18.2.2 Legislation

18.2.2.1 The Climate Change Act 2008 and Climate Change (Scotland) Act 2009

13. The Climate Change Act 2008 requires the UK Government to set legally-binding ‘carbon budgets’ to provide a constraint of GHG emissions in a given time period. The carbon budgets are set by the Committee for Climate Change and provide a legally binding five-year limit for GHG emissions in the UK. The six carbon budgets that have been placed into legislation and will run up to 2037, and are identified in Table 18.1**.**

Table 18.1:The Six UK Carbon Budgets

Budget	Carbon Budget Level (MtCO2e)	Reduction Below 1990 Levels (UK targets)	Reduction Below 1990 Levels (achieved by the UK)
1st Carbon Budget (2008 to 2012)	3,018	25%	30%
2nd Carbon Budget (2013 to 2017)	2,782	31%	38%
3rd Carbon Budget (2018 to 2022)	2,544	37% by 2020	47%
4th Carbon Budget (2023 to 2027)	1,950	51% by 2025	-
5th Carbon Budget (2028 to 2032)	1,725	68% by 2030	-
6th Carbon Budget (2033 to 2037)	965	78% by 2035	-

14. The UK outperformed its emission reduction targets set by the first and second Carbon Budgets, achieving a 30% and 38% reduction compared to 1990 levels in 2011 and 2015 respectively. The UK is outperforming the targets set by the third Carbon Budget; the latest Climate Change Committee (CCC) Progress Report to Parliament (CCC, 2022) notes that there was a 47% reduction from 1990 levels achieved in 2021. This represented a decrease in 10% from 2019 levels; however, emissions in 2021 were 4% higher than those in 2020 due to the rebound following the Covid-19 pandemic.

15. The Sixth Carbon Budget was published by the CCC in December 2020, which set out the pathway to the net zero carbon emissions target.

16. As well as being covered by the UK Climate Change Act 2008, Scotland has a separate climate change legislation under the Climate Change (Scotland) Act 2009. The Climate Change (Scotland) Act 2009 provides a framework for Scotland to meet its long-term goals of reducing GHG emissions to ‘net zero’ (i.e. at least a 100% reduction) by 2045. Doing so would allow Scotland to achieve net zero five years ahead of the rest of the UK. This target was introduced by the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019, which amended the previous 2050 GHG target of an 80% reduction compared to 1990 levels. The amended Climate Change (Scotland) Act also set in law a number of interim targets between 2020 and 2045, which includes a 75% reduction in GHG emissions by 2030 compared to 1990 baseline levels. This ambitious target went beyond the 2019 Climate Change Committee’s recommendation for a target set at a 70% reduction (CCC, 2020).

17. The Climate Change Act 2008 and subsequent Climate Change (Scotland) Act 2009 were enacted as part of Scotland’s responsibility and obligations as a signatory of the Kyoto Protocol 1997 (which did not become binding until 2005). The Scotland target covers the seven main GHGs referenced in the Kyoto

Protocol. The interim targets are also in line with what is required to meet Scotland's commitments under the 2015 Paris Agreement.

18. Scotland is on track to achieve net zero well before 2050, however, this pathway does not go through the 2030 interim target of 75%. Instead, current projections suggest this interim target will be reached by 2035 (CCC, 2020).

18.2.2.2 Climate Ready Scotland: Scottish Climate Change Adaptation Programme

19. The Climate Change (Scotland) Act 2009 requires the Scottish Government to prepare strategic programmes for climate change adaptation, which must address the risks identified in the UK Climate Change Risk Assessment (CCRA). The first Climate Ready Scotland: Scottish Climate Change Adaptation Programme (SCCAP1) set out a number of policies and proposals that would help Scotland prepare for the impacts of climate change over the period 2014-2019. SCCAP1 was structured around three cross-sectoral themes and addressed the risks identified by the first CCRA.

20. The second and most recent SCCAP (SCCAP2) was launched in 2019 in response to the 2017 CCRA and adopts an outcomes-based approach to guide Scotland's approach to climate change adaptation over the period to 2024. There are seven outcomes within SCCAP2, which are derived from the UN Sustainable Development Goals and include creating communities which are inclusive, resilient and safe in response to the changing climate (Outcome 1) and ensuring the natural environment is enhanced and has increased resilience to climate change (Outcome 5) (Scottish Government, 2019).

21. The most recent SCCAP2 progress report published in 2021 suggested Scotland was making good progress in achieving key outcomes. This is a result of enhanced government funding and investment targeting Scotland's natural economy, infrastructure and communities, which is also helping to deliver a green recovery from Covid-19 (Scottish Government, 2021).

18.2.2.3 The Climate Change (Duties of Public Bodies: Reporting Requirements) (Scotland) Amendment Order 2020

22. The Climate Change (Duties of Public Bodies: Reporting Requirements) (Scotland) Amendment Order 2020 is an amendment of the Climate Change (Duties of Public Bodies: Reporting Requirements) (Scotland) Order 2015, which required Public Sector Bodies to publish annual climate change reports. The revised Amendment Order 2020 now requires Public Sector Bodies to report on "*targets for reducing indirect emissions of greenhouse gases*" and outline in their annual reports what contribution they have made to delivering key SCCAP2 outcomes, beginning from the reporting year 2021-22 (Scottish Government, 2020). Public Sector Bodies are also now required to set a clear target date for achieving zero direct emissions of GHGs.

23. The purpose of Amendment Order 2020 is to strengthen climate change reporting. The Scottish Government also intends to make these reports publicly accessible, which will allow stakeholders and members of the public to understand the commitment and progress of Public Sector Bodies in tackling climate change.

18.2.2.4 National Planning Framework

24. The current National Planning Framework (NPF3) sets out a vision for development and investment across Scotland over the next 30 years and will support the transition to a low carbon future. With respect to planning for climate change, the NPF3 (Scottish Government, 2014) states:

> *"We must ensure that development facilitates adaptation to climate change, reduces resource consumption and lowers greenhouse gas emissions"*

25. NPF3 outlines a number of areas that need tackling in order to achieve a low carbon Scotland, which include:

- Improving energy efficiency and diversifying Scotland's energy supply by expanding the renewable sector;
- Investing in wind, wave and tidal energy to allow Scotland to become a world leader in offshore renewable energy; and
- Developing facilities in ports and harbours to accommodate for the manufacture, servicing and maintenance of renewable energy infrastructure.

26. Scotland's Fourth NPF (NPF4), which is currently in its preparatory stages, provides a revised approach to achieving a low carbon Scotland, driven by the new ambitious target of achieving net zero by 2045.
27. **Table 18.2** summarises the total amount of renewable energy generated by Scotland between 2009 and 2020.

Table 18.2: Renewable Energy Generated by Scotland and % Contribution to Total Energy Consumption (Scottish Government, 2021b)

Year	Total Renewable Energy (GWh)	Total Renewable Energy (% of total energy consumption)	Renewable Electricity (% of total energy consumption)
2009	12,720	7.6%	6.3%
2010	12,316	7.2%	5.5%
2011	16,900	10.3%	8.4%
2012	17,652	10.8%	9.0%
2013	20,364	12.6%	10.5%
2014	22,936	14.4%	11.9%
2015	26,784	17.1%	13.9%
2016	24,132	15.3%	12.3%
2017	30,860	19.1%	15.7%
2018	32,957	30.7%	16.7%
2019	37,053	24.0%	19.5%
2020	39,318	25.4%	20.7%

28. The latest figures for 2020 indicate that renewable energy sources in Scotland produced 39,318 Gigawatt Hours (GWh), an increase of 2,265 GWh since 2019. The data from **Table 18.2** shows that there has been a gradual increase in renewable energy consumption in Scotland since 2009, with a 17.8% increase from 2009 to 2020. This current trend suggests that energy generated by renewable

energy sources in Scotland will continue increasing, which will support Scotland's third and fourth NPFs and contribute to achieving the 2045 net zero target.

18.2.2.5 Climate Change Plan

29. In 2018, Scotland published the Update to the Climate Change Plan 2018-2032 (CCPu), which lays out the pathway to achieving its world-leading 2032 targets. The CCPu outlines a number of policies and proposals that will contribute towards reducing Scotland's GHG emissions and achieving net zero by 2045.

30. The delivery of the CCPu is supported by a number of other policies, including the Offshore Wind Policy Statement (OWPS), the Local Energy Policy Statement (LEPS) and the Hydrogen Policy Statement (HPS), discussed in further detail below.

18.2.2.6 The Innovation and Targeted Oil and Gas Decarbonisation Sectoral Marine Plan

31. In October 2020, the Scottish Government published a new Sectoral Marine Plan for Offshore Wind Energy in Scottish inshore and offshore waters out to the Exclusive Economic Zone limit. This Plan provides opportunities for development within deeper waters, a consideration not factored into the earlier Blue Seas Green Energy 2011 Plan. It identifies 15 Plan Options, split across 4 regions and recognises the pivotal role Offshore wind energy has in Scotland's energy system.

32. The Scottish Government is now developing a Sectoral Marine Plan for Offshore Wind Energy for Innovation and Targeted Oil and Gas (INTOG) Decarbonisation, which provides the strategic framework for offshore wind projects in sustainable and suitable locations that will help deliver net zero commitments. In August 2021, Crown Estate Scotland announced the INTOG leasing round, which will support the emissions reduction targets from the offshore oil and gas sector agreed as part of the North Sea Transition Deal (BEIS, 2021a). The INTOG process is designed to allow developers to apply for the rights to build offshore wind farms specifically for the purpose of providing low carbon electricity to power oil and gas installations and help decarbonise the sector. INTOG expects to support the delivery of smaller (<100 Megawatt (MW)) innovation projects and specifically targets larger (>100 MW) projects that seek to support the decarbonisation of the oil and gas sector, such as the Project.

18.3 Consultation

33. Consultation is a key feature of the EIA process, and continues throughout the lifecycle of the Project, from the initial stages through to consent and post-consent.

34. To date, consultation with regards to climate change has been undertaken via the **Offshore Scoping Report** (Royal HaskoningDHV, 2021) (**Appendix 1.2**), which was submitted to Marine Scotland Licensing Operations team (MS-LOT) in November 2021. A 30-day consultation process on the **Offshore Scoping Report** was coordinated by MS-LOT, commencing on 3rd December 2021. The Scottish Ministers' **Scoping Opinion** (**Appendix 1.1**) based on the **Offshore Scoping Report** that are relevant to climate change are presented in **Table 18.3**.

Table 18.3 Climate Change Consultation

Consultee	Date / Document	Comment	Response / where addressed in the EIA Report
Marine Scotland – Licensing Operations Team	April 2022, Marine Scotland - Licensing Operations Team: Scoping Opinion for Green Volt Offshore Windfarm	**[Ref: 3.5.1] Climate and Greenhouse Gases:** The Scoping Report proposes that the impact of climate change effects will be considered within the ecological topics of the EIA Report and there will be no standalone topic or chapter on climate. The Scottish Ministers are however mindful that Greenhouse Gas ("GHG") emissions from all projects contribute to climate change. In this regard, the Scottish Ministers highlight the IEMA Environmental Impact Assessment Guide	This chapter provides a GHG assessment for the offshore elements including the construction, operation and maintenance (O&M) and decommissioning activities in **Section 18.7**. The supply chain and benefits beyond the life cycle of the development are also considered in **Section 18.7**.

Consultee	Date / Document	Comment	Response / where addressed in the EIA Report
		"Assessing Greenhouse Gas Emissions And Evaluating Their Significance" ("IEMA GHG Guidance"), which states that "GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit, as such any GHG emissions or reductions from a project might be considered significant." The Scottish Ministers have considered this together with the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 and the requirement of the EIA Regulations to assess significant effects from the Proposed Development on climate. The Scottish Ministers therefore advise that the EIA Report must include a GHG Assessment which should be based on a Life Cycle Assessment approach and note that the IEMA GHG Guidance provides further insight on this matter. The Scottish Ministers highlight however that this should include the pre-construction, construction, operation and maintenance and decommissioning phases, including consideration of the supply chain as well as benefits beyond the life cycle of the Proposed Development.	The referenced IEMA guidance was updated in February 2022 and the latest version of the guidance was used in the assessment, as detailed in **Section 18.4**. A whole Project GHG assessment will be presented separately in the Green Volt Onshore EIA Report, and a Summary of Offshore and Onshore Environmental Impact Assessments live document will be made available at https://greenvoltoffshorewind.com/

18.4 Assessment Methodology

18.4.1 Context

The construction, Operation and Maintenance (O&M) and decommissioning of wind farm projects entail the generation of GHG emissions, both from the standpoint of:

- Embedded carbon and GHGs – the emissions caused by the extraction and refinement of raw materials and their manufacture into the commodities and products that make up the components of the wind turbine generators and their associated physical infrastructure; and
- Carbon and other GHG emissions arising from the combustion of fuels and energy used in constructing, operating and maintaining the Project components over its lifetime and in decommissioning.

35. There are inherent uncertainties associated with carrying out GHG footprint assessments for offshore wind power projects, although the approach to determine emissions from individual source groups (see **Section 18.4.3**) is well defined.

36. A report published by the University of Edinburgh in 2015 (Thomson & Harrison, 2015) examined the lifecycle costs and GHG emissions associated with offshore wind energy projects, comparing data gleaned from the analysis of some 18 studies carried out over the period 2009 to 2013 (Thomson & Harrison, 2015). This report provided useful context for the Project's GHG assessment, and benchmark figures which were used to verify the outcomes of the assessment.

37. **Table 18.4** provides a summary of the percentage of total GHG emissions associated with the different phases of a wind farm development as provided within the report (Thomson & Harrison, 2015).

Table 18.4: Summary of Offshore Wind Farm GHG Emissions (Thomson & Harrison, 2015)

Phase	% of Total GHG Emissions
Manufacture and Installation	78.4

Phase	% of Total GHG Emissions
O&M	20.4
Decommissioning	1.2

38. The report highlighted that the greatest proportion of emissions are associated with the manufacture and installation of the wind farm components. Decommissioning accounted for the smallest proportion, only 1.2%, of total life cycle GHG emissions. A more detailed breakdown of emissions is given in Thomson & Harrison (2015) for an offshore wind farm with steel foundations. This is reproduced in **Table 18.5**.

Table 18.5: Further Detailed Breakdown of GHG Emissions (Thomson & Harrison, 2015)

Component or Phase	% of Total GHG Emissions
Foundations	34.7
Turbines	23.8
Cables & transformers	19.8
Maintenance shipping	14.3
Spare parts	3.7
Maintenance helicopter	2.4
Dismantling and disposal	1.2

39. Of the components or phases listed in **Table 18.5**, GHG emissions associated with foundation fabrication and installation accounted for the largest proportion of emissions (34.7%), followed by manufacture and installation of the turbines (23.8%) and the cables and transformers (19.8%). However, it is acknowledged that the foundation types considered in this study are conventional fixed foundation types and not floating substructures. Floating substructures are a relatively new technology and therefore in the absence of a large dataset of information on floating technology, the above findings are considered to provide a useful benchmark.

40. GHG emissions from shipping movements during maintenance operations over the operational lifetime of the wind farm contributed 14.3%. This value may appear to be unexpectedly high, but the vessel movements contribution is associated with a 20-year operational lifespan of the wind farms considered in the studies. Emissions derived from spare parts (3.7%), helicopter movements (2.4%) and dismantling and disposal (1.2%) are all small in comparison. Whilst the Project's design life is 35 years, which might increase the percentage of emissions arising during the operational phase, the greatest emissions contribution is still expected to occur during construction due to embedded carbon in construction materials.

41. Additional analysis of the data extracted from the 18 technical studies expressed the GHG emissions as grammes (g) of CO_2e per kilowatt-hour (kWh) of electricity generated. These were found to vary quite widely, between approximately 5 and 33 g $CO_2e.kWh^{-1}$. There was no clear relationship between the metrics for either turbine rating (in MW) or capacity factor.

42. A further study in 2012 (Dolan & Heath, 2012), amassed the results of over 200 studies of carbon emissions from wind power and attempted to "harmonise" the results to use only the most robust and reliable data and to align methodological inconsistences. The harmonised results of this study revealed that the range in GHG emissions per kWh of electricity generated varied between approximately 7 and 23 g $CO_2e.kWh^{-1}$, with a mean value of around 12 g $CO_2e.kWh^{-1}$.

43. To place these metrics into context, comparable values for electricity generation by gas are around 372 g $CO_2e.kWh^{-1}$ (31 times that of offshore wind) and, for coal, approximately 1,002 g $CO_2e.kWh^{-1}$ (84 times that of offshore wind) (BEIS, 2022).

44. Although robust and fit for purpose, this assessment should not be taken to be a comprehensive, detailed Life Cycle Analysis (LCA) of the Project. The reason that this assessment does not take the form of a detailed LCA is, because it is not possible to fully define the supply chain for the Project and undertake the relevant detailed assessments at this stage in the Project. Therefore, assumptions and simplifications to the methodology were made in certain areas and a precautionary approach was adopted for the assessment to allow for this. These assumptions and simplifications are referred to in **Section 18.4.3** and the worst case scenario is set out in **Table 18.11**.

18.4.2 Assessment Approach

45. In this assessment the term 'GHG' or 'carbon' encompasses CO_2 and the six other gases as referenced in the Kyoto Protocol (CH_4, N_2O, HFCs, PFCs, SF_6 and NF_3). The results in this assessment are expressed in carbon dioxide equivalent (CO_{2e}), which recognises that different gases have notably different global warming potentials (GWP[1]).

46. GHG emissions arising from the construction and operational phase of the Project were predicted within a defined 'project boundary', in accordance with the GHG Protocol (World Resources Institute and World Business Council on Sustainable Development, 2015), explained in further detail in **Section 18.5.1**. It should be noted that this chapter provides a GHG assessment for the offshore aspects of the Project only and does not take into consideration GHGs associated with the onshore elements.

47. To assist with the determination of the significance of the Project in relation to GHG emissions (as discussed in **Section 18.4.4.2**), three parameters were calculated to contextualise the GHGs emitted during the life cycle of the Project in relation to the benefits of providing renewable energy. These include:

- The GHG intensity of the Project:
  - This takes into account the amount of energy generated by the Project over its lifetime in relation to its total GHG emissions.
- The GHG savings resulting from the Project:
  - This will provide the net reduction in GHGs as a result of the Project.
- GHG 'payback' period:
  - The time it would take for electricity generated by fossil fuels[2] to be displaced. This includes the use of energy generated by the Project to electrify the Buzzard Platform Complex (Buzzard).

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[1] Global Warming Potential (GWP) of a GHG is a measure of how much heat is trapped by a certain amount of gas in the atmosphere relative to carbon dioxide.
[2] Assumed to be from a Combined-Cycle Gas Turbine (CCGT) as this is the most common form of new plant in terms of fossil fuel combustion (BEIS, 2020)

18.4.3 Emission Calculations

48. GHG emission sources arising from the Project were categorised into two main source groups, as detailed in **Table 18.6**.

Table 18.6: Emission Source Groups Considered in the Assessment

Source Name	Definition	Project Sources
Embodied emissions in materials	Embodied emissions within materials comprise GHGs released throughout the supply chain, and includes the extraction of materials from the ground, transport, manufacturing, assembly and its end-of-life profile	Embodied emissions were quantified for the main construction materials to be used for the offshore components of the Project. The components that were considered included the main infrastructure associated with the Project, such as wind turbines, floating substructures, cables and the offshore substation platform (OSP). The requirement for spare (or replacement) parts during operation is not known at this stage, therefore the likely composition of emissions in terms of the overall footprint of the Project was obtained from existing literature.
Marine vessels	GHG emissions are released in exhaust gases from the combustion of fossil fuels on marine vessels.	Emissions associated with the movement of marine vessels for the offshore component of the Project were calculated. Vessels associated with installation of wind turbines, anchors and cables, as well as supply and support and commissioning vessels were also quantified. Marine vessel movements during the O&M phase were also quantified.

49. Activities that will take place during the decommissioning phase are unknown at this stage. Emissions from decommissioning were therefore derived from previous studies (Thomson & Harrison, 2015), which quantified them to be approximately 1.2% of the carbon footprint.

50. The approach to quantifying GHG emissions for each of the source groups detailed in **Table 18.6** are provided in the sections below. Further details with respect to the origin of the values used within the GHG assessment are provided in **Appendix 18.1**.

18.4.3.1 Embodied Emissions in Materials

51. Emissions of ‘cradle to (factory) gate’, a term which includes the extraction, manufacture and production of materials to the point at which they leave the factory gate of the final processing location, were calculated for the Project. GHG emissions were derived from quantities or volumes of known materials that will be used in construction. The key offshore components of the Project comprise:

- Wind turbine generators (WTGs);
- Substructures for wind turbines and moorings;
- Offshore substation platform (OSP);
- Inter-array cables (IAC);
- Cable protection/stabilisation; and
- Export cables from the Windfarm Site to the landfall and Buzzard.

52. To provide a precautionary assessment, it was assumed that there will be no reduction in the emissions intensity during abstraction and manufacturing of materials up until and during the construction phase of the Project (earliest construction would commence is anticipated to be 2025). The quantities of each type of construction material to be used on site were obtained from the Project's design team, and the relevant emission factors sources from the Inventory of Carbon and Energy (ICE) database (Jones & Hammond, 2019), where possible. Alternative sources for emission factors were used for more specific components to wind farms (i.e. cables), these are detailed in **Appendix 18.1**. Precautionary assumptions were adopted with respect to material quantities to be used for each component of the Project which include contingency allowing for the worst case scenario (e.g. maximum number of wind turbines) of the design envelope to be accounted for.

53. The emission factors from the ICE database are 'cradle-to-factory' and, therefore do not include the transportation of materials to site. Emissions associated with the movement of materials to the site for the offshore component of the Project were quantified from the marine vessel source group, detailed in **Section 18.4.3.2**.

18.4.3.2 Marine Vessels

54. Marine vessels will be used to bring materials and components to the offshore project area, install infrastructure (foundations/anchors, wind turbines, substation and cables), provide crew accommodation and support during construction, commissioning and operation and maintenance.

55. Vessels used during construction and operation were assumed to travel to the site from Peterhead. GHG emissions associated with these vessel movements were quantified.

56. Marine vessel information was provided by the design team for the Project to derive estimated fuel consumption during construction and operation. Emission factors for marine gas oil (MGO), in kg $CO_2e.kWh^{-1}$ were obtained from BEIS (BEIS, 2021b). Indicative vessel types and specifications were provided by the Project team, and therefore fuel consumption figures were calculated by multiplying the engine size of the vessels by activity hours on site (accounting for average engine load factors).

57. Emissions were also quantified from the operation and maintenance phase over the anticipated life span of the Project (currently anticipated to be 35-years).

18.4.4 Impact Assessment Methodology

58. This assessment was undertaken in accordance with the general methodology presented within **Chapter 6: EIA Methodology**; however, a topic-specific assessment methodology and approach to determining effect significance is provided within IEMA guidance (IEMA, 2022), as set out in the following sections.

18.4.4.1 Sensitivity

59. The receptor for the GHG assessment is the global atmosphere. As such, it is affected by all global sources of GHGs, and is therefore considered to be of 'high' sensitivity to additional emissions.

18.4.4.2 Assessment Significance

60. Guidance on the assessment of GHG emissions was first released by IEMA in 2017 (IEMA, 2017), which stated that *"…in the absence of any significance criteria or defined threshold, it might be considered that all GHG emissions are significant…"*. However, the recently updated IEMA guidance (IEMA, 2022) recognises *"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 life time, which may be positive, negative or negligible"*.

61. Significance can be evaluated in a number of ways depending on the context of the assessment, i.e. sector-based, locally, nationally, policy goals or against performance standards. The IEMA guidance recommends that significance criteria align with Paris Agreement, the UK's Carbon Budgets up to 2037 and net zero commitments: "the crux of significance is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050" (IEMA, 2022).

62. The updated IEMA guidance provides relative significance descriptions to assist assessments, specifically in the EIA context. Section VI of the updated IEMA guidance (IEMA, 2022) describes five distinct levels of significance which are not solely based on whether project emits GHG emissions alone, but how the project makes a relative contribution towards achieving a science-based 1.5 °C aligned transition towards net zero. These are presented below in **Table 18.7**.

Table 18.7: Assessment Significance Criteria

Significance	Description
Major adverse	The Project's GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy for projects of this type. A project with major adverse impacts is locking in emissions and does not make a meaningful contribution to the UK's trajectory towards net zero.
Moderate adverse	The Project's GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type. A project with moderate adverse impacts falls short of fully contributing to the UK's trajectory towards net zero.
Minor adverse	The Project's GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type. A project with minor adverse impacts is fully in line with measures necessary to achieve the UK's trajectory towards net zero.
Negligible	The Project's GHG impacts would be reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or net zero is achieved well before 2050. A project with negligible impacts provides GHG performance that is well 'ahead of the curve' for the trajectory towards net zero and has minimal residual emissions.
Beneficial	The Project's net GHG impacts are below zero and it causes a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline. A project with beneficial impacts substantially exceeds net zero requirements with a positive climate effect.

63. For the purposes of the EIA, major and moderate effects are deemed to be significant.

18.4.5 Cumulative Impact Assessment

64. The global atmosphere is the receptor for the GHG assessment, therefore there are no common receptors between this assessment and other disciplines considered in the EIA. GHG emissions have the potential to contribute to climate change, and therefore the impacts are global and cumulative in nature. This is taken into account in defining the receptor (i.e. the global atmosphere) as high sensitivity. The IEMA guidance (IEMA, 2022) states that impacts of GHG emissions from specific cumulative projects should therefore not be individually assessed, as there is no basis for selecting which projects to assess cumulatively over any other. The GHG assessment is therefore considered to be inherently cumulative, and no additional consideration of cumulative impacts is required.

18.4.6 Transboundary Impact Assessment

65. As noted above for cumulative impacts, the receptor for the GHG assessment is the global atmosphere, and therefore emissions of GHGs have an indirect transboundary impact. As the GHG emissions are assessed in context of the UK carbon budgets and the aspirations to reduce GHG emissions in line with climate agreements, the cumulative transboundary impacts of GHGs emitted by the Project are not considered to require specific consideration.

18.5 Scope

18.5.1 Study Area

66. The system boundary of the GHG assessment includes material extraction and manufacturing, transport and installation, operation and maintenance and end of life and decommissioning. A schematic diagram of the Project's boundary is provided in **Figure 18.1**; everything within the pale blue box is included within the Project boundary.

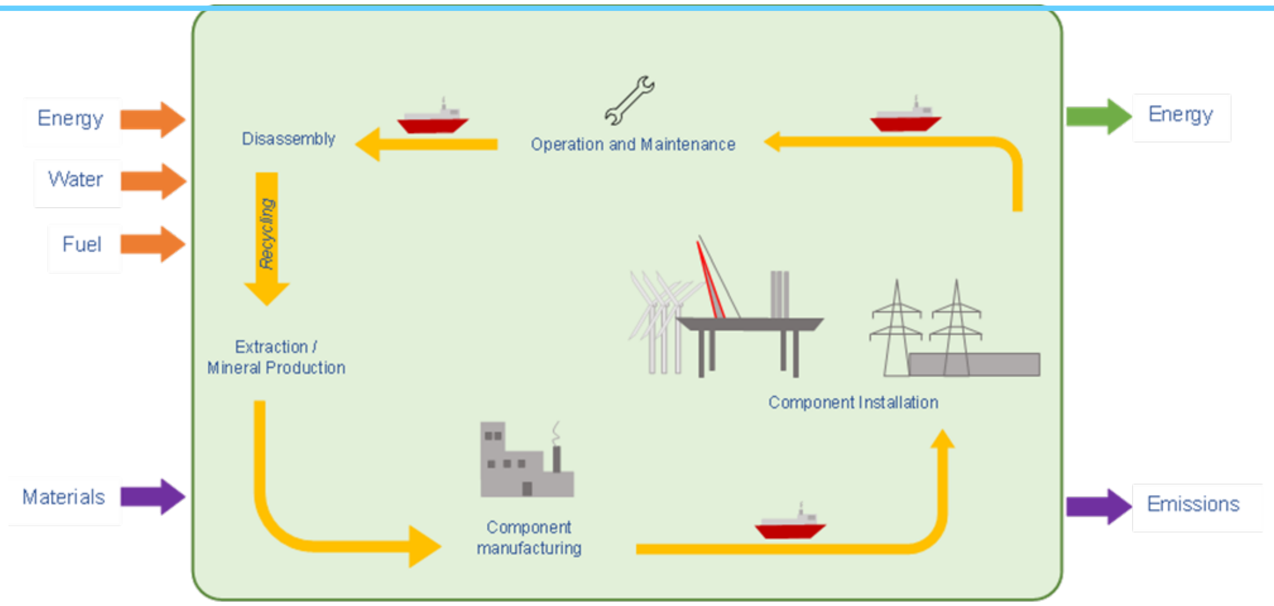

Figure 18.1 System Boundary for the Project's GHG Assessment

18.5.2 Data Sources

67. The assessment was undertaken using data from the sources detailed in **Table 18.8**.

Table 18.8: Data Sources

Data	Year	Coverage	Confidence	Notes
Department for Business, Energy and Industrial Strategy (BEIS) - Greenhouse gas reporting: conversion factors 2021	2022	N/A	High	These conversion factors are provided by the UK Government for use by UK and international organisations to report on GHG emissions
Inventory of Carbon and Energy (ICE) Database v3.0	2019	N/A	High	These emission factors are provided for construction materials

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GREEN VOLT

Data	Year	Coverage	Confidence	Notes
Cableizer Embodied Energy and Carbon Emission Factors	Various	N/A	High	These emission factors are collated from various referenced sources and are provided for cable production
BEIS CO_2e intensity of gas generation	2022	N/A	High	This data provided the GHG intensity of gas generation
BEIS Treasury Green Book supplementary appraisal guidance on valuing energy use and greenhouse gas (GHG) emissions supporting data tables	2021	N/A	High	This data provides the grid-average emission factor for the UK grid

18.5.3 Assumptions and Limitations

68. A number of assumptions were made in the GHG assessment, as set out in **Table 18.9**.

Table 18.9: Assumptions and Limitations of the GHG Assessment

ID	Assumption/Limitation	Discussion
1	The GHG assessment includes the offshore elements only	It is expected that the offshore elements of the Project would be the most intensive in GHG terms due to the embodied GHGs within the offshore infrastructure. As such, although the GHG assessment does not consider all aspects of the Project, it is expected that the inclusion of onshore GHGs would not materially affect the outcomes of the assessment.
2	Quantities for all materials to be used during construction were not available at the time of the assessment.	Quantities of the main and most GHG intensive materials were included in the assessment. Furthermore, precautionary assumptions were adopted for quantities of known materials (i.e. using the maximum quantity). Where specific information on the quantity of materials in cables could not be supplied, assumptions were made based on the cable diameter and the quantities of cable materials used on other OWF projects.
3	Lack of emission factors for future year activities, such as fuel consumption and material extraction.	The most recent available emissions factors were used in the assessment to provide a precautionary assessment.
4	In the absence of any detailed information at this stage, it was assumed that all materials taken to the offshore site originated at Peterhead. As such, any GHG emissions associated with the transport of materials to Peterhead were not accounted for.	Emissions associated with the transportation of materials are likely to be one-off trips and are expected to be lower in magnitude than the emissions associated with embodied carbon and other transportation offshore. As such, it is not expected to significantly affect the outcomes of the assessment.
5	The specific nature and composition of some materials, such as the type of concrete or steel to be used, was unknown which may affect the carbon intensity of the material.	If there was variation across different compositions of the same material, the 'General' option within the ICE database was chosen, if available, or the median value if not.
6	Where there are multiple options for possible project parameters, the worst case was selected in terms of material quantities (e.g. turbine substructures)	This provides a conservative assessment as there may be unrealistic combinations of project parameters which were used in determining the worst case scenario.

ID	Assumption/Limitation	Discussion
7	Emissions from helicopter trips were not included in the assessment	Helicopters are unlikely to be used for routine maintenance trips and the number and frequency of these trips were not known at the time of the assessment.

18.6 Existing Environment

69. To help determine the significance and contextualise the outcomes of the assessment, consideration of a baseline or 'without development' scenario is required. The UK electricity grid is made up from a number of different energy sources, including gas, nuclear, onshore and offshore wind, coal, bioenergy, solar and hydroelectric.

70. The growth of renewable energy is key to Scotland and the UK's Energy Strategy and net zero targets, and a transition away from electricity generated by fossil fuels. Therefore, to evaluate the impact of the Project, it was assumed that electricity produced by fossil fuels is displaced, including that used on Buzzard. For the purposes of the assessment, it was assumed that electricity generated by natural gas is displaced (0.37 kg/kWh), as Combined Cycle Gas Turbine (CCGT) is the most common form of new plant in terms of fossil fuel combustion (BEIS, 2020) and Buzzard uses an Open Cycle Gas Turbine (OCGT) for its power generation.

18.7 Potential Impacts

71. As noted in **Section 18.3**, following receipt of the **Offshore Scoping Report** (**Appendix 1.2**), the Project received a **Scoping Opinion** from MS-LOT (**Appendix 1.1**). While the **Offshore Scoping Report** had proposed to consider climate change impacts within the ecological topics, the **Scoping Opinion** required this to be scoped in as a standalone chapter.

72. A summary of the potential impacts assessed in this Chapter is provided in **Table 18.10.**

Table 18.10 Potential impact pathways on climate change and air quality receptors

Green Volt Project Phase	Potential Impact Pathways	Receptor
Construction	GHG emissions during construction, operation and decommissioning	Global atmosphere
O&M	GHG emissions during construction, operation and decommissioning	Global atmosphere
Decommissioning	GHG emissions during construction, operation and decommissioning	Global atmosphere

18.7.1 Embedded Mitigation

73. The IEMA GHG guidance (IEMA, 2022) notes the importance of embedded mitigation in minimising GHG emissions from a development. The IEMA GHG Management Hierarchy sets out a structure to eliminate, reduce, substitute and compensate (IEMA, 2022). This includes the following principles:

- Do not build:
  - evaluate the basic need for the proposed project and explore alternative approaches to achieve the desired outcome/s.
- Build less:

- realise potential for re-using and/or refurbishing existing assets to reduce the extent of new construction required.

- Design clever:
  - apply low carbon solutions (including technologies, materials and products) to minimise resource consumption and embodied carbon during the construction, operation, user's use of the project, and at end-of-life.
- Construct efficiently:
  - use techniques (e.g. during construction and operation) that reduce resource consumption and associated GHG emissions over the life cycle of the project.

74. In response to these principles, the need for the Project in relation to achieving net zero targets for Scotland and decarbonisation of the energy sector (including Buzzard) is well established and set out within **Chapter 2: Need for the Project**.

75. The floating substructures for the Project provide several benefits over conventional fixed foundations, including reductions in construction materials, piling operations and use of very large offshore construction vessels. As such, there are likely to be GHG savings associated with the Project design, requiring less construction activities and enabling more efficient construction (i.e 'design clever'). As such, it is considered that the Project meets the requirements of the IEMA guidance with regard to mitigation.

18.7.2 Worst Case

76. The worst case scenario with regard to GHG emissions are presented by impact in **Table 18.11**. Where a range of parameters are presented in **Chapter 5: Project Description** and there is an effect on the quantity of materials required, the higher values were used to provide a conservative assessment.

Table 18.11 Worst Case Assumptions

Impact	Parameter	Notes
Construction		
GHG emissions during construction	Installation of 35 wind turbine generators	Maximum amount of construction materials required
	Use of the semi-submersible substructure	This substructure requires a greater amount of more carbon-intensive materials
	6 mooring lines	Maximum amount of construction materials required
	Up to 35 inter-array cables + 7 strings	Maximum amount of construction materials required
Operation		
GHG emissions during operation	Assumed upper estimate of distance travelled by operational vessels to site	This results in a greater quantity of GHGs emitted
	Assumed installation of up to 30 wind turbine generators	This results in a greater quantity of materials required for O&M
Decommissioning		
The contribution from decommissioning was scaled based on the total GHG contribution		
Cumulative		
N/A (see **Section 18.4.5**)		
Transboundary		

Impact	Parameter	Notes
N/A (see **Section 18.4.6**)		

18.7.3 Potential Impacts during Construction, Operation and Decommissioning

18.7.3.1 GHG Quantification

77. The results of the GHG assessment are shown in **Table 18.12**, and include emissions associated with the Project lifetime for the offshore elements, including construction, an operational lifetime of 35 years and decommissioning.

Table 18.12 GHG Emissions Associated with Each of the Source Groups for Each Phase of the Project

Phase	Source	GHG Emissions (Tonnes CO_2e)	Percentage of GHG Footprint per Phase	Total GHG Emissions per Phase (Tonnes CO_2e)	Percentage of Overall GHG Footprint
Construction	Embodied Carbon	1,128,852	97.5%	1,158,251	70.1%
	Vessels	29,398	2.5%		
Operation and Maintenance (35-year period)	Vessels	457,938	96.4%	474,979	28.7%
	Spare Parts	17,041	3.6%		
Decommissioning	1.2% of Total*	19,565	-	19,565	1.2%
Total		**1,652,828**	-	-	-

*Refer to **Table 18.4** for context

78. The results in **Table 18.12** show that the construction phase of the Project has the highest GHG emissions, and this is due to the embodied carbon in construction materials, which accounts for 97.5% of construction phase GHG emissions.

79. The quantity of GHGs emitted by vessels during the operation and maintenance phase is expected to be conservative as, over the 35-year lifetime of the project, it is expected that the shipping industry will decarbonise over this time period, in accordance with the UK government's aspirations to achieve zero emission shipping by 2050, as set out in the 2019 Clean Maritime Plan and associated policy commitments.

GHG Intensity

80. The GHG intensity per unit of electricity produced by the Project was determined by dividing the predicted quantity of emissions by the anticipated energy produced over its lifespan.

81. The approach to estimating the amount of energy produced by the Project was derived from the approach advocated by RenewableUK (2022), where the installed capacity (assumed to be 560 MW) was multiplied by the hours in the year and by the appropriate average load or capacity factor for the Project. For new build offshore wind projects, BEIS advises that the load factor is 63.1% (BEIS 2021c).

82. Using this approach, the annual energy generated by the Project is estimated to be approximately 3,095 GWh per annum. Energy generated by the Project over its 35-year lifespan is estimated to be 108,340 GWh.

83. The GHG intensity of the electricity produced by the Project is therefore 15.3 g $CO_2e.kWh^{-1}$. When compared with other OWF life cycle studies (Thomson & Harrison 2015; Dolan & Heath 2012), the GHG

intensity of the Project is in the mid-range for offshore wind projects. As noted in **Section 18.4.2** and **Section 18.7.2**, a number of conservative assumptions were adopted in the assessment, therefore the offshore GHG footprint of the Project, particularly during the operation and maintenance phase, is likely to be an over-estimation. However, it should also be noted that this assessment does not include the onshore elements of the Project, and although it is expected that the onshore contribution would be less than the offshore GHG emissions, it would contribute to the GHG intensity.

GHG Savings

84. The quantity of GHG emissions produced from the generation of electricity from gas is presented in **Table 18.13**, along with the GHG footprint of the Project as presented in **Table 18.12**, and consequently the total net GHGs offset by the Project. It is noted that the electricity supplied by gas emission factor is in units of CO_2, however CO_2 is likely to form the main contribution to generation of electricity from gas and the factor is likely higher, were other GHGs to be included.

Table 18.13 GHG Savings from the Project Over its Lifetime

Anticipated energy produced by project (gWh)	GHG emissions from electricity generated from gas (tonnes CO_2)	Project GHG emissions (tonnes CO_2e)	Net GHG emission saving Saved (tonnes CO_2e)
108,340	40,302,545	1,652,828	-38,649,717

85. The data presented in **Table 18.13** shows that the estimated level of GHG emission savings would be -38,649,717 tonnes CO2e respectively.

GHG 'Payback'

86. To estimate the 'GHG payback' period of the Project, it was assumed that electricity produced by natural gas combustion is displaced (0.372 kg/kWh) (BEIS 2022). An alternative approach to determining the 'GHG payback' of the Project would be to use the future electricity emission factors of the UK grid, for which projections are available from BEIS (BEIS 2021d). However, these projections will account for renewable energy projects such as the Green Volt Offshore Windfarm becoming operational and decarbonising the UK electricity grid. Therefore, the use of the future projection of the UK grid is not considered to be a reasonable approach when determining the 'GHG payback' of a renewable energy project.

87. The GHG payback of the Project, assuming that electricity produced by natural gas combustion is displaced (on both the UK grid and the electrification of the Buzzard Platform Complex), is less than 1.5 years from the point when the Project becomes fully operational (expected to be 2027), as set out in **Table 18.14**.

Table 18.14 GHG 'Payback'

Parameter	Value
Energy produced by the Project (GWh/year)	3,095
CO_{2e} Intensity of Electricity Generated by Natural Gas (TCO_{2e}/GWh)	372
CO_{2e} saved per year (tonnes)	1,151,501
Total CO_{2e} released by the Project (tonnes)	1,652,828
Time taken for Project-generated CO_{2e} to be paid back (years)	1.44

Comparison to UK Carbon Budgets

88. The provision of renewable energy will play an important role in meeting the UK Carbon Budgets and contributing to Scotland's aspirations for net zero.

89. During construction, the total GHG emissions from the offshore aspects of the Project were predicted to contribute approximately 0.06% of the 4th UK Carbon Budget (between 2023 and 2027) over the five year period. GHG emissions during construction are temporary and form a relatively small component of the 4th UK Carbon Budget.

90. For operation, the total offshore GHG emissions were predicted to contribute 0.01% of the 6th UK Carbon Budget (2033-2037). As such, the Project is not considered to have a significant impact on the 6th UK Carbon Budget, particularly as the benefits of offsetting generation of electricity via fossil fuels would result in a net benefit after 1.5 years of the wind farm's operation, as set out above.

18.7.3.2 Assessment of Significance

91. As noted in **Section 18.4.4.2**, the significance of a Project in relation to GHG emissions is dependent on the net GHG impacts and comparisons to the without-project baseline and net zero aspirations.

92. As noted above, the Project would result in a reduction in atmospheric GHG concentrations compared to the without-project baseline (i.e. electricity produced by natural gas combustion), and will provide a renewable source of electricity which beneficially contributes to Scotland's goal of achieving net zero emissions by 2045 (and the UK's by 2050), and the emissions reductions aspirations of the UK North Sea Transition Deal (see **Chapter 3: Policy and Legislative Context**). It is therefore considered that the impacts of the Project would be of **beneficial significance** in relation to reducing GHG emissions, when compared to a relevant baseline scenario.

18.8 Cumulative Impacts

93. As noted in **Section 18.4.5**, the impact of GHG emissions is inherently cumulative and no specific cumulative assessment is required to be undertaken.

18.9 Transboundary Impacts

94. As described in **Section 18.4.6**, emissions of GHGs have an indirect transboundary impact. However, the cumulative transboundary impacts of GHGs emitted by the Project are not considered to require specific consideration.

18.10 Inter-relationships

95. The receptor for the GHG assessment is the global atmosphere. There are no other topics which have direct impacts on this receptor, and therefore there are no inter-relationships with this topic.

18.11 Summary

96. A summary of the impacts on Climate Change identified in the assessment are provided in **Table 18.15**.

Table 18.15 Summary of Potential Impacts Identified for Climate Change

Potential Impact	Receptor	Value/ Sensitivity	Magnitude of Impact	Significance of Effect	Mitigation	Residual Effect
Construction, Operation and Decommissioning						
GHG emissions during construction, operation and decommissioning	Global atmosphere	High	N/A – not defined as part of the assessment methodology	Beneficial	N/A	Beneficial
Cumulative						
Cumulative impacts in relation to GHGs do not require assessment						
Transboundary						
Transboundary impacts were not explicitly considered within the assessment						

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