TotalEnergies E&P North Sea UK Ltd

Culzean - Floating Offshore Wind Turbine Pilot Project

Appendix A: Carbon Assessment

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Aberdeen

The Capitol Building
431 Union Street.
AB11 6DA. UK

T +44 1224 219 955
E deborah.morgan@xodusgroup.com
www.xodusgroup.com

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CONTENTS

ACRONYMS AND ABBREVIATIONS

ACRONYM/ ABBREVIATION	DEFINITION
AHCV	Anchor Handling Control Vessel
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CPF	Culzean Central Processing Facility
EIAR	Environmental Impact Assessment Report
ERRV	Emergency Rescue and Response Vessel
FG	Fuel Gas
FPV	Fall Pipe Vessel
GHG	Greenhouse Gas
GT	Gas Turbine
IEMA	Institute of Environmental Management and Assessment
IMO	International Maritime Organisation
INTOG	Innovation and Targeted Oil and Gas
MD-LOT	Marine Directorate Licensing Operations Team
MW	Megawatt
MWh	Megawatt-hour
PSV	Platform Supply Vessel
t	Tonnes
TEPNSUK	TotalEnergies Exploration and Production North Sea UK Limited
UK	United Kingdom
WTG	Wind Turbine Generator

1 INTRODUCTION

TotalEnergies Exploration and Production North Sea UK Limited (TEPNSUK) is proposing to install a 3 megawatt (MW) floating Wind Turbine Generator (WTG) that will connect to the existing Central Processing Facility (CPF) at the Culzean Floating Offshore Wind Turbine Pilot Project ('the Project'). The Culzean Field is currently powered by two Gas Turbines (GTs) (with an additional GT on standby).

TEPNSUK were awarded an exclusivity offer for the Project under the Innovation and Targeted Oil and Gas (INTOG) leasing process. Under the leasing process, the Project is defined as one which connects directly to oil and gas infrastructure to support the decarbonisation of the oil and gas sector. The aim of the Project is to support the decarbonisation of the oil and gas installations by piloting the integration of a floating WTG with an oil and gas installation for the provision of power alongside conventional GTs. TEPNSUK intends on demonstrating the possibility of electrifying existing oil and gas assets in the North Sea via floating WTGs with a readily available WTG design through the Project. In addition to demonstrating proof of concept, the Project will support cost reduction initiatives, foster cross sector learnings and reinforce the adoption of offshore wind to support the United Kingdom (UK) and Scotland's net zero ambitions whilst further developing Scotland as a centre for innovation and technical excellence.

The Project will consist of:

- One WTG;
- One floating substructure;
- Up to six mooring lines;
- Up to six drag anchors;
- One approximately 2.5 km long export cable to connect to the CPF; and
- Associated scour and cable protection (if required).

As described in Chapter 4: Project Description, the Project will initially consist of three mooring lines and drag anchors as part of a catenary mooring system. An additional three mooring lines and drag anchors is then planned to be installed to trial a taut or semi-taut mooring system.

This Carbon Assessment for the Project has been carried out, as requested by consultees during Scoping (Table 1-1), to estimate:

- The carbon lifecycle emissions which will result from the Project in terms of carbon dioxide equivalent (CO_2e) emissions; and
- The CO_2e emissions which will be avoided as a result of the Project.

Table 1-1 Summary of consultation responses specific to this carbon assessment

CONSULTEE	COMMENT	RESPONSE
Scottish Ministers (via Marine Directorate Licensing Operations Team (MD-LOT))	The Scottish Ministers acknowledge the data sources included with the Scoping Report and highlight the IEMA Environmental Impact Assessment Guide "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 a 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 the significant effects from the Proposed Development on climate. The Scottish Ministers are content that the GHG Assessment included within the EIA Report is to 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 that this Assessment should consist of the pre-construction, construction, operation, and decommissioning phases, as well as benefits beyond the life cycle of the Proposed Development.	Appendix A: Carbon Assessment has been produced to understand the effects of the Project on climate, using a Life Cycle Assessment Approach in line with IEMA's Greenhouse Gas (GHG) Guidance to describe the total carbon emissions associated with all phases of the Project. The potential benefit of the Project, in terms of avoided emissions, is also presented.
Scottish Ministers (via MD-LOT)	The Scottish Ministers note some aspects of climate change effects have been addressed in section 8.6 of the Scoping Report, but recommend, in line with the NatureScot representation, that further consideration is given to such impacts as it will be of potential use in terms of evaluating this Proposed Development overall.	A Carbon Assessment is presented in Appendix A for the Project. It must however be noted that this is a demonstration scale project and that the benefits of the project will be ultimately recognised in the electrification of TotoalEnergies wider global portfolio of assets.
NatureScot	Climate change and carbon costs The impact of climate change effects should be considered, both in futureproofing the project design and in considering both the benefits (production of renewable energy) and carbon costs (manufacturing and disposal of components) i.e. the carbon cycle associated with the project overall. We recognise that some aspects of this topic are addressed in section 8.6, but recommend that this is considered further as it will be of potential use in terms of evaluating this pilot project overall.	

2 METHODOLOGY

All industries produce GHGs, the aim of the Project is to replace a proportion of the electricity generated from gas via the GTs with electricity generated from renewable energy via a WTG. Power generation for the Culzean Field would therefore be partly from the GTs and partly from the WTG.

To calculate the carbon lifecycle emissions which will result from the Project in terms of CO_2e emissions, a variety of possible design scenarios have been considered in this carbon assessment. The results presented herein report on a high and a low GHG emissions scenario within the design envelope. TEPNSUK conducted the carbon assessment summarised in this appendix using tools including SimaPro software and based on the activities and materials included in Section 8 – Supplementary Material: Component Description. The assessment was supplemented by Xodus inhouse carbon calculations.

The assessment boundary defines the scope of a carbon inventory. The assessment boundary comprises the boundary of the Project and all components contained therein, including offshore activities. Emissions associated with activities during pre-construction (surveys), construction (embodied carbon, transportation of components to the Project and offshore installation of components), operation and maintenance and decommissioning are included.

Assumptions (Section 2.2 and Section 3 of this Appendix) have been developed utilising the Ecoinvent 3.8 database, available literature and input from TEPNSUK technical teams. Due to the stage of development of the industry and the availability of validated embodied carbon data, assumptions are developed for the source location of the components which form the Project and the materials constituting these components. Two scenarios were utilised to estimate the high and low-emission scenarios associated with the Project. Estimates were made of the following:

- Pre-construction emissions from vessels associated with surveys;
- Embodied carbon of the components of the Project, their transport to site and installation, including:
  - WTG;
  - Floating substructure;
  - Mooring and anchor systems;
  - Export cable; and
  - Associated scour and cable protection (if required).
- Operation and maintenance (O&M): emissions from vessels required to maintain offshore components during the 10 year operational period of the Project; and
- Decommissioning: emissions from vessels removing and transporting components to shore, following the operational period of the Project.

The following categories of emissions were excluded from the emissions inventory due to the complexity of estimation and the availability of data given the level of maturity of the industry. These emissions are likely to represent a very small part of the total emissions for this assessment, and therefore are likely to have a low potential to alter the outcome or value of the assessment:

- Delivery of materials to the manufacturing plants; and
- Office activity and worker travel.

Emissions associated with activity beyond the return of components to shore for decommissioning at the end of the lifecycle of the Project are not included within the assessment boundary.

Assessment of the emissions avoided as a result of the Project, are laid out and presented in Section 5.

2.1 Development Scenarios

As detailed in Chapter 4: Project Description, the Environmental Impact Assessment Report (EIAR) follows a design envelope approach, where a range of parameter values exist for each component of the Project. High and low-emissions scenarios are reported within this carbon assessment, representing the range of potential emissions for relevant components of the design envelope where flexibility has been maintained. The vessel requirements are the same for both the high and low-emissions scenario.

Table 2-1 High-emissions and comparison (low-emissions) scenarios used in the carbon assessment

EMISSIONS SCENARIO	WTG	WTG FOUNDATION	EXPORT CABLE	VESSEL ACTIVITY[1]
High	x1 WTG of 3 MW	• x1 semi-submersible • x6 mooring lines • x6 anchors	x1 cable, 2.5 km length	• 86 vessel days during pre-construction and construction. • 240 vessel days during O&M • 82 vessel days during decommissioning.
Low	x1 WTG of 3 MW	• x1 semi-submersible • x3 mooring lines • x3 anchors	x1 cable, 2.5 km length	• 86 vessel days during pre-construction and construction. • 82 vessel days during decommissioning.

2.2 Assumptions

The following assumptions have been made when calculating and presenting the CO_2e emissions for the Project:

- The total mass of major materials for the WTG is based on the use of a refurbished Vestas V112 3 MW floating WTG composed of a tower, nacelle and blades;
- The total mass of major materials for the semi-submersible floating substructure is based on the use of an Ocergy four-column triangular OCG-WIND substructure;
- All emissions factors used to determine tCO2e are from the Ecoinvent database (version 3.8);
- Scour and cable protection has been assumed to be gravel / rock;
- Vessels will require up to 14 tonnes of fuel per day;
- Transportation of components from the manufacturing location to the Project location, the following source locations have been assumed:
  - WTG:

[1] *Vessel days are inclusive of mobilisation, demobilisation, transit and working vessel days.*

    - Denmark for the nacelle, blades and hub;
    - Transportation of a single tower is assumed conservatively to be associated with emissions equivalent to those arising from transportation of scour and cable protection;
  - Floating substructure:
    - Europe (Spain) for the semi-submersible;
    - UK (Aberdeen) for anchors, mooring lines and the export cable; and
  - Scour and cable protection:
    - Europe (Norway);
  - Emissions associated with the transportation of components have been estimated using the Ecoinvent database, supplemented by Xodus inhouse calculations.
- Decommissioning:
  - All removed components will be returned to the UK for subsequent management; and
  - Management and recycling of components is not included within the scope of this assessment. Components are anticipated to be recycled at a 90% recycling rate (Spyroudi, 2021).

3 EMISSIONS INVENTORY

3.1 Introduction

The emissions inventory is categorised into three phases:

- Construction CO_2e – the embodied carbon of the main components, their transportation to the Project and emissions associated with pre-construction and construction vessels;
- Operational CO_2e - the emissions from vessels associated with operation and maintenance; and
- Decommissioning CO_2e - the emissions from vessels associated with the removal of components, following the operational period of the Project.

The emissions inventory is then further categorised to reflect the phase, category (i.e. material or vessel), component, and activity / material. For example, CO_2e emissions associated with the steel used in the manufacture of the WTG would be captured as shown in Figure 3-1.

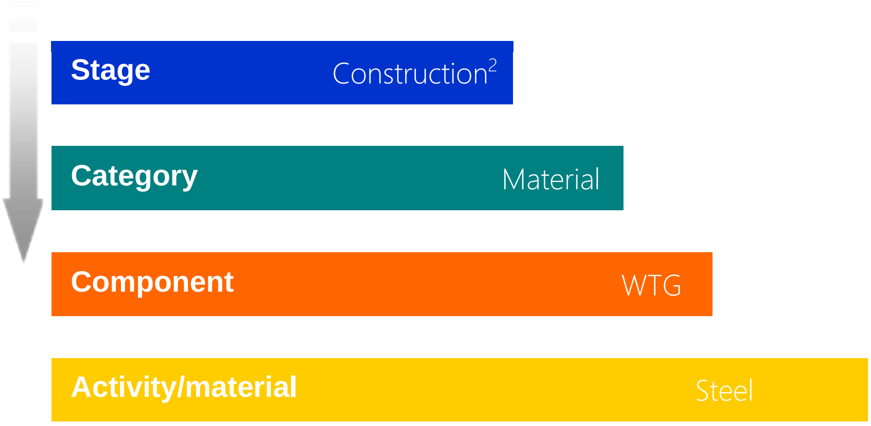

Figure 3-1 Process for identifying component materials

Each activity or material has an assigned unit of measurement and associated emission factor. The primary data sources used in the assessment include client provided information, the Ecoinvent 3.8 database and data extracted from literature using the Environmental Footprint 3.0 (EF3.0) methodology (European Commission, 2019). The key data source for the WTG components was Kouloumpis and Azapagic (2022).

The sections below outline the activities and materials, for each component and activity within each phase. Section 8 Supplementary Material: Component Description presents the data used to conduct the carbon assessment.

[2] *Including pre-construction*

3.2 Carbon Assessment

3.2.1 Construction CO_2e

For the purposes of this assessment only, it is assumed that all emissions associated with construction occur during 2025.

3.2.1.1 Embodied carbon

The production of materials (mining raw materials, refining, forming, etc.) incurs emissions of CO_2e, termed "embodied carbon". Embodied carbon in the context of the Project relates to the emission of CO_2e associated with the production of new infrastructure, i.e., WTGs, floating substructures and their moorings and anchors, cables and remedial protection.

WTGs

The WTG will be composed of the tower, nacelle, hub and blades. As per Chapter 4: Project Description, TEPNSUK have secured a Vestas V112 3 MW floating WTG[3]. The WTG model is the same in the high-emissions and low-emissions scenario. The total mass of the primary materials which make up the WTG have been estimated by TEPNSUK and the embodied carbon associated with these materials has been estimated using Kouloumpis and Azapagic (2022).

Floating substructure

The WTG will be supported by a semi-submersible substructure (Ocergy OCG-WIND), maintained in position by a mooring and anchoring system. One substructure will be required for the WTG. Under the high-emissions scenario, it is assumed that up to six mooring lines and anchors may be required. Under the low-emissions scenario, it is assumed that only up to three mooring lines and anchors may be required. Scour protection requirements have also been estimated (Section 8).

Export cable

Only one export cable will be required to connect the WTG to the Culzean CPF, of approximately 2.5 km in length. The cable is assumed to be a three-core submarine cable, with the major materials being copper, steel and polymer (plastic). The total mass of the primary materials which make up the cable and the associated embodied carbon have been estimated by TEPNSUK. The assumptions for the composition and length of the export cable are the same for the high-emissions and low-emissions scenarios. Under the high-emissions scenario, it is assumed that up to 7,000 m^2 of the cable route will require rock protection. Under the low-emissions scenario, it is assumed that no rock protection is required (Section 8)

3.2.1.2 Vessel transit and activity

Transportation to Project location

Component transport is considered within the EcoInvent 3.8 database emission factors. The transport data is estimated according to the methodology developed by Borken & Weidema (2013) based on the average transport

[3] *For the purposes of the assessment, it has been assumed that a new WTG will be installed. Should any WTG components consist of refurbished material, this would likely reduce the quantity of embodied CO_2e associated with the WTG.*

distance. The source locations of the WTG, floating substructure and export cable components are described in Section 2.2.

Pre-construction vessels

Vessels for the survey activities required prior to the start of construction have been considered as light construction vessels.

Construction vessels

Emissions resulting from construction vessels installing the components were determined. The emissions for the two emission scenarios do not differ (Section 8 Supplementary Material: Component Description). The vessel types included light construction vessels, anchor handling control vessels, anchor handling tubs, trenching vessels and Fall Pipe Vessel (FPV).

3.2.2 Operational CO_2e

It has been assumed that the operation and maintenance phase of the Project will not produce any emissions beyond the emissions from vessels required in the inspection and maintenance of the various offshore components. It is planned that the dual-purpose Emergency Rescue and Response Vessel (ERRV) already serving the Culzean Field will be utilised for operation and maintenance (see Chapter 4: Project Description). In the low-emissions scenario it is assumed that as this vessel already services the existing assets at the Culzean Field, there would be no additional emissions associated with the Project. In the high-emissions scenario, it is assumed that a Platform Supply Vessel (PSV) remains on site for an additional 24 days per year throughout the 10-year operational phase of the Project.

3.2.3 Decommissioning CO_2e

In line with the Scottish Government's default position for the decommissioning of Offshore Renewable Energy Installations (BEIS, 2019; Scottish Government, 2019), the starting presumption is that at the end of the operational lifetime of the Project, there will be a requirement for all offshore components (above and below seabed) to be completely removed to shore for re-use, recycling, incineration with energy recovery, or disposal at a licensed site. As the Project's anticipated lifetime is up to 10 years from full commissioning, there may have been advances in technological capabilities for decommissioning and/or changes to legislation by this time, therefore decommissioning best practice and legislation will be applied at that time of the Project's decommissioning. Under international standards such as those published by the International Maritime Organisation (IMO), there is the potential to consider leaving components *in situ*, however it is understood that this would require a robust and compelling justification to be presented to Marine Directorate in order to be granted approval for partial removal of the Project. In this instance, a comparative assessment would be undertaken to provide a recommendation, based on the performance against five main criteria: Safety, Environmental, Societal, Technical Feasibility and Economic.

For the purposes of this assessment, emissions from the offshore decommissioning vessels have been assumed to be roughly equivalent to those required for construction but with the exclusion of the days require for cable lay. This is a conservative assumption as, given drivers such as the IMO (2023) GHG Strategy, vessels are likely to decarbonise over the period of the Project. This is due to reduced vessel emission intensities (i.e. low-carbon shipping fuels and improved vessel efficiency) and more efficient shipping operations (i.e. more fuel efficient voyages).

4 TOTAL CO_2e EMISSIONS

The final calculated high-emissions and low-emissions total life cycle CO_2e emissions for the Project are presented in Table 4-1 and graphically in Figure 4-1. The total CO_2e emissions from the Project are estimated at 13,150 tCO_2e under the low-emissions scenario and 27,302 tCO_2e under the high-emissions scenario.

Table 4-1 CO_2e emissions from the Project

PROJECT PHASE		TOTAL CO_2e (t)	
		HIGH-EMISSIONS SCENARIO	LOW-EMISSIONS SCENARIO
Construction	Embodied carbon and component transport	5,311	4,095
	Construction vessel activity (including pre-construction)	4,635	4,635
O&M	Vessel emissions	12,936	0
Decommissioning	Vessel emissions	4,420	4,420
Total		27,302	13,150

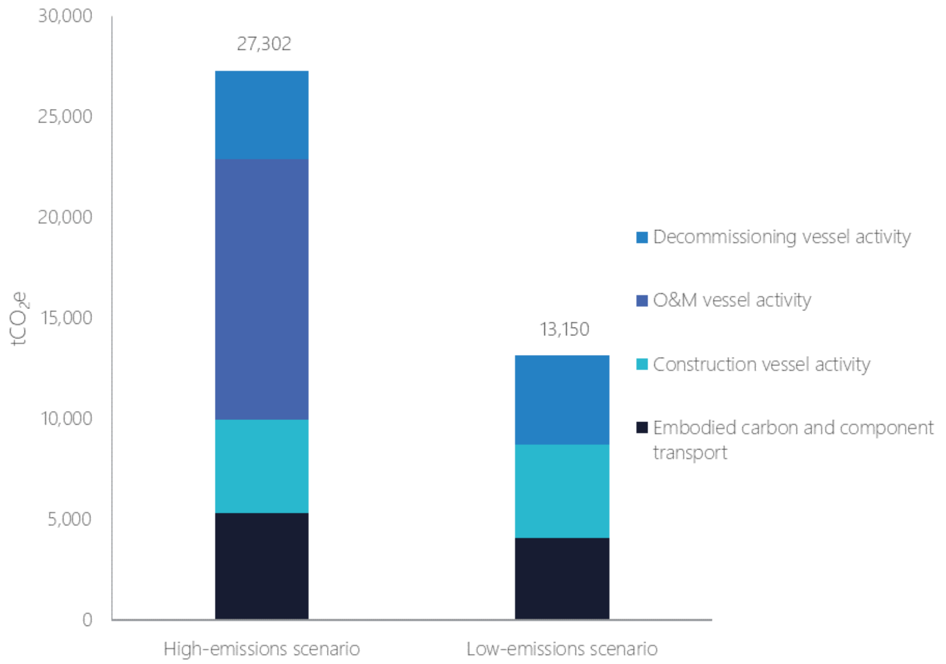

Figure 4-1 Total emissions from the Project, by phase, for high-emissions and comparison low-emissions scenarios

5 AVOIDED EMISSIONS

To calculate the GHG emissions from combustion of gas via the GTs that would be avoided given the utilisation of electricity generated from wind via the WTG, TEPNSUK utilised their in-house "Esteban" tool. The following scenarios were considered to calculate the avoided emissions:

- Reference case (no renewable energy): operation of 2 GTs from 2025 to 2028, and 1 GT from 2029 to 2034.
- Base case: operation of 2 GTs + 1 WTG from 2025 to 2028, and 1 GT and 1 WTG from 2029 to 2034.

A range of assumptions were made to develop this calculation.

5.1 Assumptions

5.1.1 Total Power Demand

Power demand over the life of the Project was provided from the Culzean Long Term Plan 2023 as an average monthly power level assuming a 10-year Project lifetime.

5.1.2 Renewable Energy Power Production

The following assumptions were made to determine WTG annual energy production:

- Wind data: A year representative of the long-term period (the last 20 years) obtained from downscaled global reanalysis ERA5 using Large Eddy Simulation from Vortex;
- WTG Model: Vestas V112-3.3/3.45 MW (and associated power and thrust curves from Vestas documentation);
- WTG Capacity: 3 MW;
- Total Losses (including availability and curtailment) 15.3%; and
- Annual net energy production: 13,640 Megawatt-hour (MWh).

5.1.3 Gas Turbine Power Generation

The following assumptions were made for the reference and base cases to calculate GT power generation and associated CO_2e emissions from gas combustion (with turbine-specific load and temperature dependent efficiency/power curves input directly into the Esteban model):

- Model: 7 MW Siemens STG 300 GTs;
- Minimum power: 30% of the maximum power (at a given temperature); and
- A carbon dioxide (CO_2) emission factor of 2.7 tCO_2/t Fuel Gas (FG) and a gas energy density of 13.3 MWh/tFG.

5.1.4 Maximum Renewable Energy Contribution

The maximum contribution of renewable energy to fulfilling power demand on Culzean was calculated as follows:

*Maximum wind energy injection = power demand – (number of GTs * minimum power of a GT)*

5.2 Results

Table 5-1 presents the avoided emissions (tCO_2e) per year from 2025 to 2034, representing the emissions avoided by the base case with renewable energy (operation of 2 GTs + 1 WTG from 2025 to 2028, and 1 GT and 1 WTG from 2029 to 2034), relative to the reference case with no renewable energy (operation of 2 GTs from 2025 to 2028, and 1 GT from 2029 to 2034). The avoided emissions have been calculated by estimating the fuel gas savings associated with the relative reduction in power generation by GTs at the Culzean Field as a result of WTG operation.

As a result of fuel gas savings, a total of 60,838 tCO_2e emissions are avoided over the 10-year operational life of the Project (Table 5-1).

Table 5-1 Avoided emissions as a result of fuel gas savings

PARAMETER	UNIT	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	TOTAL
Renewable energy production	MWh	8,423	10,391	8,578	13,679	13,676	13,671	13,664	13,653	13,653	13,653	123,041
Fuel Gas savings	MMS m^3	2.0	2.5	2.1	3.0	2.9	2.9	2.9	2.9	2.9	2.9	27
Avoided emissions	tCO_2e	4,555	5,634	4,658	6,690	6,501	6,500	6,536	6,588	6,588	6,588	60,838

6 CONCLUSIONS

The life cycle carbon emissions which will result from the Project have been determined in this Carbon Assessment and are presented in this report. The assessment has used a CO_2e emission inventory for the Project to quantify the total CO_2e emissions attributed to each phase of the Project (construction, operation and maintenance and decommissioning).

The total CO_2e emissions associated with the Project were calculated as 13,150 tonnes for the low-emissions scenario and 27,302 tonnes for the high-emissions scenario. Of these CO_2e emissions, approximately 19% (31% for the low-emissions scenario) is associated with embodied carbon and component transport, 17% (35% for the low-emissions scenario) with construction vessel activity, 47% with O&M vessel activity (high-emissions scenario) and the remaining 16% (34% for the low-emissions scenario) with decommissioning vessel activity.

The Project will generate electricity to replace some of the electricity generated from gas via GTs at the Culzean Field. Solely based on fuel gas saving, it is estimated that the Project will avoid 60,838 tCO_2e over a 10-year operational life time. Taking into account the high-emissions scenario, it is estimated that 33,536 tCO_2e will be avoided as a minimum. This is a clear demonstration of progress towards the Project aim, i.e., realising a reduction in CO_2e emissions associated with electricity generation at this demonstration scale.

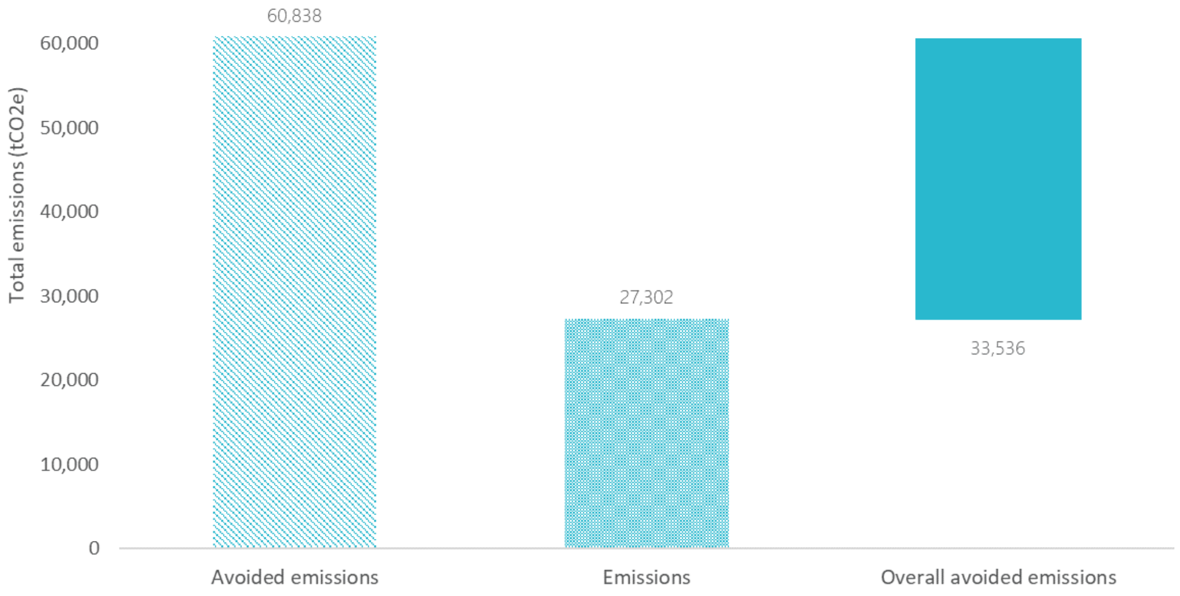

Figure 6-1 High-emissions scenario: Overall avoided emissions

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8 SUPPLEMENTARY MATERIAL: COMPONENT DESCRIPTION

Table 8-1 Assumptions used in the Project scenarios

PHASE	ACTIVITY	HIGH-EMISSIONS SCENARIO		LOW-EMISSIONS SCENARIO (WHERE DIFFERENT)	
		QUANTITY (VESSEL DAYS / TONNES)	VESSEL TYPE / MATERIAL	QUANTITY	VESSEL TYPE / MATERIAL
Construction	Pre-construction surveys	5 days	Light Construction Vessel	As per high-emissions scenario.	
	Mooring line pre-lay	14 days	Anchor handling control vessel (AHCV)		
	Mooring line hook up	30 days total (12 days AHCV and 18 days anchor handling tug)	AHCV Tug		
	Export cable hook up to WTG and initial cable lay	7 days	Light Construction Vessel		
	Export cable hook-up to Culzean CPF	7 days	Light Construction Vessel		
	Cable trending and remediation	18 days total (12 days trench & burial and 6 rock protection/scour	Trenching vessel and Fall Pipe Vessel		
	Post-lay installation	5 days	ROV on a Light Construction Vessel		
	WTG - tower	157 tonnes	Steel		
		2.9 tonnes	Aluminium		

PHASE	ACTIVITY	HIGH-EMISSIONS SCENARIO		LOW-EMISSIONS SCENARIO (WHERE DIFFERENT)	
		QUANTITY (VESSEL DAYS / TONNES)	VESSEL TYPE / MATERIAL	QUANTITY	VESSEL TYPE / MATERIAL
	WTG – blades	14 tonnes	Glass fibre		
		5.7 tonnes	Epoxy		
		1 tonnes	Wood		
		0.4 tonnes	Polypropylene		
	WTG – nacelle main body	29 tonnes	Cast iron		
		29 tonnes	Steel		
		1.7 tonnes	Chromium steel		
		1 tonnes	Copper		
		0.5 tonnes	Aluminium		
	WTG – power/transformer unit	6 tonnes	Steel		
		1.6 tonnes	Copper		
		0.4 tonnes	Aluminium		
		0.3 tonnes	High density polyethylene		
	WTG - hub	9 tonnes	Cast iron		
		5 tonnes	Chromium steel		
		5 tonnes	Steel low alloyed		
		0.5 tonnes	Glass fibre		
	Semi-submersible	866 tonnes	Steel		

PHASE	ACTIVITY	HIGH-EMISSIONS SCENARIO		LOW-EMISSIONS SCENARIO (WHERE DIFFERENT)	
		QUANTITY (VESSEL DAYS / TONNES)	VESSEL TYPE / MATERIAL	QUANTITY	VESSEL TYPE / MATERIAL
		17 tonnes	Aluminium		
		4 tonnes	Anticorrosive paint		
	Anchors	36 tonnes	Steel	18 tonnes	Steel
	Mooring lines	1,138 tonnes	Steel	569 tonnes	Steel
		6 tonnes	Polyester	3 tonnes	Polyester
	Export cable: cable	27 tonnes	Steel	As per high-emissions scenario.	
		19 tonnes	Copper		
		8 tonnes	Polymer		
	Export cable: dynamic control	1.5 tonnes	Steel		
		2.6 tonnes	Polymer		
	Export cable: auxiliaries	0.7 tonnes	Steel		
	Scour protection	560 tonnes	Rock	336 tonnes	Rock
	Cable protection	11,200 tonnes	Rock	0 tonnes	Rock
Operation and maintenance	Operation and maintenance activities	0	n/a	240 days	Platform Supply Vessel
Decommissioning	Pre-decommissioning surveys	5 days	Light Construction Vessel	As per high-emissions scenario.	
	Mooring disconnection from floating substructure	12 days	Anchor handling control vessel		
		18 days	Tugs		

PHASE	ACTIVITY	HIGH-EMISSIONS SCENARIO		LOW-EMISSIONS SCENARIO (WHERE DIFFERENT)	
		QUANTITY (VESSEL DAYS / TONNES)	VESSEL TYPE / MATERIAL	QUANTITY	VESSEL TYPE / MATERIAL
	Mooring line pick up	14 days	Anchor handling control vessel		
	Export cable disconnection from WTG	3 days	Light construction vessel		
	Export cable disconnection from Culzean	3 days	Light construction vessel		
	Cable decommissioning: de-burial and reverse reel	16 days	Trenching vessel		
	Seabed remediation	6 days	Light construction vessel		
	Post-decommissioning survey	5 days	Light construction vessel		