GREENHOUSE GAS EMISSIONS ASSESSMENT

SOUTH THOMSON BARGE DEVELOPMENT LANDING

PREPARED FOR:
ROTTNEST ISLAND AUTHORITY

10 MAY 2024

KEWAN BOND PTY LTD

ENVIRONMENTAL ACCOUNTING
AND CONSULTING SERVICES

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1 Introduction

Kewan Bond Pty Ltd (KBPL) was commissioned by the Rottnest Island Authority (RIA) to calculate the estimated greenhouse gas (GHG) emissions associated with the proposed South Thomson Barge Development Landing (the Project).

Emission estimates were calculated based on the available project information and through the application of the latest industry-accepted emission estimation techniques and emission factors. Estimated emissions include consideration of Scope 1, Scope 2 and Scope 3 emissions.

The full emissions inventory for the project is presented in **Attachment 1**.

2 Project Description

The Rottnest Island Authority (RIA) proposes to construct a marine facility in South Thomson Bay at the existing Army Groyne site. The proposed facility will be used primarily for daily supply barge operations which will be relocated from the existing Main Jetty ferry terminal in Thomson Bay, with the intention of separating barge operations from public passenger transfer activities and easing congestion at the ferry terminal.

The marine facility concept also includes the following supporting infrastructure:

- Ferry berth to provide overflow/emergency capacity for passenger transfer during peak seasons.
- Laydown area to support cargo transfer to/from the island.
- Small craft refuelling berth.

Design details have been sourced from consulting engineering firm PAEMAC, who have prepared the design and cost reports associated with the Project.

3 Emission Sources

The calculation and assessment of GHG emissions associated with the Project includes Scope 1, 2 and 3 emissions. This assessment considers estimated emissions associated with the construction phase of the Project, and the first fifty (50) years of operations.

The operational phase involves the relocation of current activities from the existing Main Jetty to the proposed larger barge facility, such that only minimal change to the operational GHG emissions is anticipated to result from the Project. This minor increase is due to the additional distance of the proposed barge landing from the main island settlement. In addition, there is an expected future increase in barge activities, which will involve an increase in fuel consumption and GHG emissions. However, these activities would similarly increase at the existing barge facilities and so are not resulting from the Project itself (the increased activity and emissions would occur even if the Project does not occur).

Scope 1 emissions are the emissions released to the atmosphere as a direct result of an activity, or series of activities at a facility level. Scope 1 emissions are sometimes referred to as direct emissions. Scope 1 emissions associated with the Project will primarily be generated from the consumption of diesel by construction equipment (e.g. barges, earthmoving equipment, dredging equipment).

Emissions resulting from the destruction of sea grass beds have also been assessed and are reported as Scope 1 emissions.

Scope 2 emissions are the emissions released to the atmosphere from the indirect consumption of an energy commodity, such as grid electricity that is generated at another facility. Scope 2 emissions will result from the Project if electricity is sourced from the SWIS (grid supply), but not if electricity is generated on site. Electricity at Rottnest Island is generated on site, so no Scope 2 emissions are expected from the Project.

Scope 3 emissions are indirect GHG emissions other than scope 2 emissions that are generated upstream and downstream of the Project's value chain. They occur as a consequence of the activities of a facility, but from sources not owned or controlled by that facility's business. Examples of scope 3 emissions associated with the Project include:

- Emissions associated with extracting, refining and transporting fuels that are eventually used at the project site
- Emissions associated with the production of key construction materials, including steel and concrete.

4 Emission Calculation Methods

The methods adopted by KBPL for calculating the GHG emissions are aligned primarily with the Australian Government's National Greenhouse and Energy Reporting Scheme (NGERS), which is administered by the Clean Energy Regulator. The greenhouse gases that are reported under the NGER Scheme include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6) and specified kinds of hydro fluorocarbons and perfluorocarbons. The main gases expected to be released from activities associated with the Project are CO_2, CH_4 and N_2O. These are expressed in units of tonnes carbon dioxide equivalent (CO_2-e), which takes into account the 'global warming potential' (GWP) of each gas. Carbon dioxide has a GWP of 1. Methane has a GWP of 28, such that 1 tonne of methane is expressed as 28 tonnes CO_2-e. Nitrous oxide has a GWP of 265.

Energy and emission factors for each of the identified Scope 1 emissions sources are sourced from the latest NGERS Measurement Determination (Compilation 16) (Australian Office of Parliamentary Counsel, 2023).

Some emission sources are not required to be reported by Australian companies under the NGERS. These include Scope 3 emissions and emissions from vegetation clearing. However, these emission sources have been estimated for inclusion within the Project's GHG emission assessment.

Emissions from the decomposition of carbon contained in disturbed seagrass beds have been calculated using emission factors available from recent research papers. The research specifically assessed the emissions associated with seagrass losses in Cockburn Sound, located only 26km to the south east of Rottnest Island. The findings from this research are therefore considered to be closely aligned with the expected results from seagrass losses associated with the Project.

Scope 3 emissions have been calculated based on factors from various sources including:

- Australian National Greenhouse Accounts Factors (2023) – for emission factors for the extraction, refining and delivery of fuels consumed on site.
- NGERS Measurement Determination for emission factors associated with the production of cement used for the Project.
- International Energy Agency for emissions intensity associated with the production of steel used for the Project.

5 Raw Data and Emission Calculations

The following key data, assumptions and emission factors have been applied to the calculation and modelling of GHG emissions for the Project.

5.1 Diesel & LPG Consumption

Estimated volumes of diesel to be consumed during the construction of the Project was provided by PAEMAC. Operational consumption of diesel and LPG was provided by the RIA and is based on current consumption rates by existing operators (Pelagic barge operations and PFM logistics operations), with estimates of anticipated future increased activity. This data is presented in Table 1.

Over the fifty-year operational period modelled, it has been assumed that emissions from diesel and LPG consumption will remain consistent with current operational activities. Although there may be potential for activities to increase over this time, it is assumed that any increase is likely to be more than offset by improvements in energy efficiency and emissions intensity of the activities.

Table 1 Estimated Diesel Consumption

Estimated Fuel Consumption (Litres)				
Construction	**Stage 1**	**Stage 2**	**Annual Operations**	**TOTAL (50 years)**
Diesel - Transport of construction materials and construction personnel to the island	60,108	36,060	-	96,168
Diesel - All construction equipment (including dredging)	512,112	104,938	-	617,050
Operations				
Diesel - Barges	-	-	98,800	4,940,000
Diesel - Trucks & Tow Motors	-	-	15,860	793,000
LPG - Forklifts	-	-	34,515	1,725,750
TOTAL DIESEL	**572,220**	**140,998**	**114,660**	**6,446,218**
TOTAL LPG	**-**	**-**	**34,515**	**1,725,750**

Energy and emission factors for diesel and LPG consumption are sourced from the latest NGERS Measurement Determination (Compilation 16) (Australian Office of Parliamentary Counsel, 2023). These factors include emission estimates for CO_2, CH_4 and N_2O – which are reported in units of CO_2^{-e} and consider the GWP of each gas.

5.2 Seagrass Dredging

The Project will require dredging of the sea floor near the proposed jetty. The dredging will involve the destruction of approximately 2.39 ha of existing seagrass beds. The disturbance of organic carbon (C_{org}) stocks within seagrass meadows can result in the decomposition, remineralization and release of these carbon stocks as CO_2. Research of seagrass meadows in Cockburn Sound estimated that shallow seagrass meadows had C_{org} stocks in 50 cm thick soils of 4.5 ± 0.7 kg C_{org}/m^2. (Salinas, et al., 2020). This carbon content has been assumed for the seagrass beds impacted in Thomsons Bay by the Project.

It is difficult to determine what proportion of organic carbon disturbed during the Project's construction will be remineralized and released as CO_2. For the purposes of the GHG assessment, a worst-case scenario has been assumed, whereby 100% of estimated soil carbon stocks is released as CO_2. This approach is consistent with the approach taken in a recent research project (Dahl, et al., 2023).

Soil organic carbon stocks are converted to CO_2^{-e} emissions by multiplying by 3.67 (the molecular ratio of CO_2 to C).

5.3 Scope 3 Emissions

A process of identifying the likely Project Scope 3 emissions was conducted, with consideration of:

- the relative significance of the emissions
- RIA's level of influence on emission reductions.

Of the various materials and inputs to be consumed for the Project, steel and cement were considered to have significant emission profiles for their upstream production/manufacturing.

Diesel consumption is the main Scope 1 emission source for the Project. Scope 3 emission factors exist for estimating emissions from the upstream extraction, refining and transport of diesel.

The following assumptions were made in relation to the Scope 3 emission calculations:

a) Steel during construction – volumes provided by PAEMAC. Emission factor (1.39 tonnes CO2-e/t) is the direct CO_2 intensity of crude steel production (International Energy Agency https://www.iea.org/reports/iron-and-steel)

b) Cement during construction – volumes of pre-mixed concrete provide by PAEMAC. Assume 420kg cement per m^3 of concrete. Emission factor (0.544 t CO_2^{-e}/t cement) sourced from NGERS Measurement Determination.

c) Diesel refining and transport – volumes are the kL of diesel expected to be consumed for the Project. Emission factor (3.6 kg CO_2^{-e}/GJ) sourced from the National Greenhouse Accounts Factors (Table 8) (Australian Government, Department of Climate Change, Energy, the Environment and Water, 2023).

6 Results

6.1 Scope 1 Emissions

Project construction across Stages 1 and 2 are estimated have scope 1 GHG emissions of 2,328 tonnes CO_2^{-e}. Scope 1 emissions of CO_2, CH_4 and N_2O are presented in Table 2 and Figure 1. Annual scope 1 emissions over the construction and operational phases are presented in Figure 2.

There are no Scope 2 emissions associated with the project because there is no consumption of electricity from the WA State grid supply.

Table 2 Project Emission Estimates by Gas

Scope 1 CO_2 Emissions (CO_2^{-e})	Units	Construction		Operations		TOTAL
		Stage 1	Stage 2	Annual	Over 50 Yrs	
Diesel (Construction)	Tonne	1,382	283	-	-	1,665
Diesel (Transport)	Tonne	162	97	309	15,468	15,728
LPG	Tonne	-	-	80	4,010	4,010
Seagrass disturbance	Tonne	394.7	0	-	-	394.7
Total Scope 1 CO_2 Emissions	**Tonne**	**1,939**	**380**	**390**	**19,479**	**21,798**

Scope 1 CH_4 Emissions (CO_2^{-e})	Units	Construction		Operations		TOTAL
		Stage 1	Stage 2	Annual	Over 50 Yrs	
Diesel (Construction)	Tonne	1.98	0.41	-	-	2.38
Diesel (Transport)	Tonne	0.02	0.01	0.04	2.21	2.25
LPG	Tonne	-	-	0.27	13.32	13.32
Total Scope 1 CH_4 Emissions	**Tonne**	**2.00**	**0.42**	**0.31**	**15.54**	**17.95**

Scope 1 N_2O Emissions (CO_2^{-e})	Units	Construction		Operations		TOTAL
		Stage 1	Stage 2	Annual	Over 50 Yrs	
Diesel (Construction)	Tonne	3.95	0.81	-	-	4.76
Diesel (Transport)	Tonne	1.16	0.70	2.21	110.65	112.50
LPG	Tonne	-	-	0.27	13.32	13.32
Total Scope 1 N_2O Emissions	**Tonne**	**5.11**	**1.51**	**2.48**	**123.97**	**130.59**

Total Scope 1 Emissions (CO_2^{-e})	Units	Construction		Operations		TOTAL
		Stage 1	Stage 2	Annual	Over 50 Yrs	
Diesel (Construction)	Tonne	1,388	284	-	-	1,672
Diesel (Transport)	Tonne	163	98	312	15,581	15,843
Seagrass disturbance	Tonne	395	0	-	-	395
LPG	Tonne	-	-	81	4,037	4,037
Total Scope 1 CO_2^{-e} Emissions	**Tonne**	**1,946**	**382**	**392**	**19,618**	**21,946**

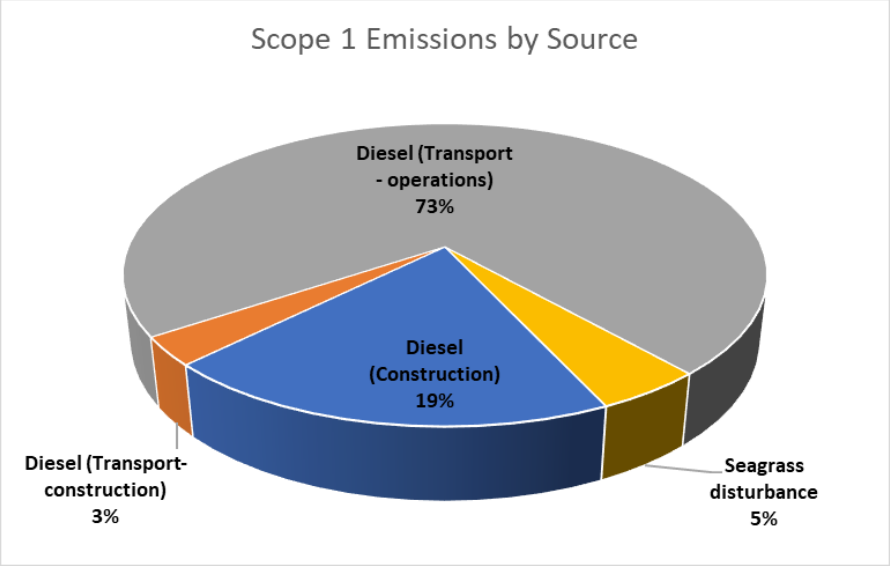

Figure 1 Scope 1 GHG Emissions by Emission Source

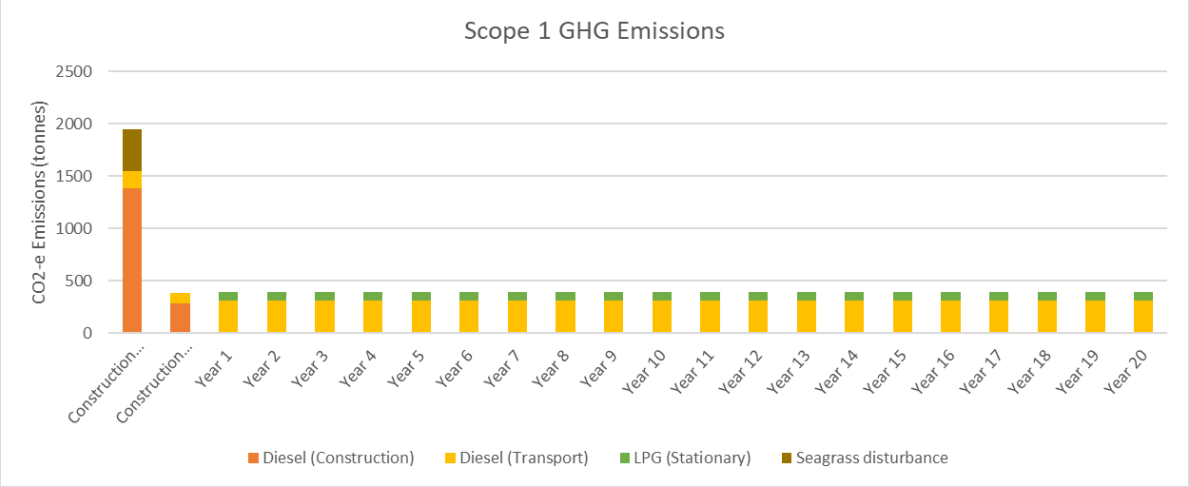

Figure 2 Scope 1 GHG Emissions by Emission Year

6.2 Scope 3 Emissions

Estimated Scope 3 emissions associated with the Project's construction and operations are presented in Table 3. Scope 3 emissions represent 23% of the total Scope 1 and Scope 3 emissions, as shown in Figure 3.

The identification and calculation of Scope 3 emissions was conducted in alignment with the GHG Protocol's 'Corporate Value Chain (Scope 3) Accounting and Reporting Standard', published by the World Resources Institute. The selection of Scope 3 emission sources involved identifying the most significant likely sources of emissions upstream and downstream of the Project's value chain.

The production and manufacturing of cement and steel have a relatively high emissions intensity and are key construction materials for the Project.

Table 3 Project Scope 3 Emission Estimates by Source

Total Scope 3 Emissions (CO_2^{-e})	Units	Construction		Operations		TOTAL
		Stage 1	Stage 2	Annual	Over 50 Yrs	
Diesel	Tonne	382	94	77	3,828	4,305
Cement	Tonne	39	34	-	-	73
Steel	Tonne	39	125	-	-	164
Total Emissions	**Tonne**	**460**	**253**	**77**	**3,828**	**4,542**

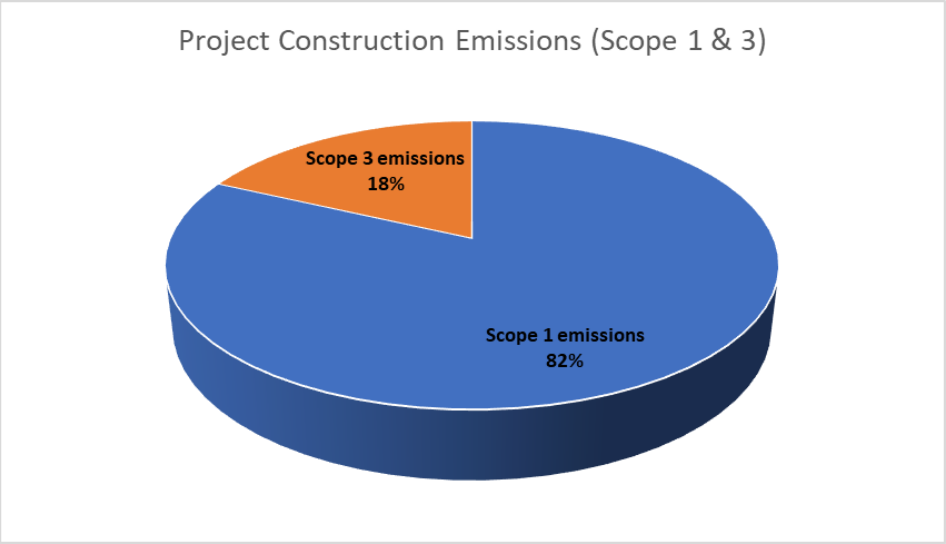

Figure 3 Total Scope 1 and Scope 3 GHG Emissions

7 References

Australian Government, Department of Climate Change, Energy, the Environment and Water. (2023). *Australian National Greenhouse Accounts Factors.* Commonwealth of Australia.

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Dahl, M., McMahon, K., Lavery, P. S., Hamilton, S. H., Lovelock, C. E., & Serrano, O. (2023). Ranking the risk of CO2 emissions from seagrass soil carbon stocks under global change threats. *Global Environmental Change*.

Salinas, C., Duarte, C. M., Lavery, P. S., Masque, P., Arias-Ortiz, A., Leon, J. X., . . . Serrano, O. (2020). Seagrass losses since mid-20th century fuelled CO2 emissions from soil carbon stocks. *Global Change Biology*.

ATTACHMENT 1 – GHG EMISSIONS INVENTORY

Raw Data	Units	Construction Stage 1	Construction Stage 2	Total Operations (over 50 Years)	PROJECT TOTAL
Diesel (Non-Transport)	kL	512	105		617
Diesel (Transport)	kL	60	36	5,733	5,829
LPG (Non-transport)	kL			1,726	1,726
Area of seagrass disturbance	m2	23,900	0.00	0.00	23,900
Organic carbon factor in seagrass beds	kg C_{org}/m^2)	4.50			
Total organic carbon disturbed	t	107.55			
Pre-mix concrete	m3	170.00	150.00	0.00	320
Cement component	t	71.40	63.00	0.00	134
Construction Steel	t	28.00	89.80	0.00	118

Energy Use in GJ	Units	Construction Stage 1	Construction Stage 2	Total Operations (over 50 Years)	PROJECT TOTAL
Diesel (Non-Transport)	GJ	19,768	4,051		23,818
Diesel (Transport)	GJ	2,320	1,392	221,294	225,006
LPG (Stationary)	GJ	0	0	66,614	66,614
Total Energy	**GJ**	**22,088**	**5,443**	**287,908**	**315,438**

Scope 1 CO_2 Emission Factors	Units	Construction Stage 1	Construction Stage 2	Total Operations (over 50 Years)	PROJECT TOTAL
Diesel (Stationary)	Tonne CO2e/GJ	0.0699	0.0699	0.0699	0.0699
Diesel (Mobile)	Tonne CO2e/GJ	0.0699	0.0699	0.0699	0.0699
LPG (Stationary)	Tonne CO2e/GJ	0.0602	0.0602	0.0602	0.0602
Seagrass disturbance	T CO_2^e/t org C	3.67			

Scope 1 CH_4 Emission Factors	Units	Construction Stage 1	Construction Stage 2	Total Operations (over 50 Years)	PROJECT TOTAL
Diesel (Stationary)	Tonne CO2e/GJ	0.0001	0.0001	0.0001	0.0001
Diesel (Mobile)	Tonne CO2e/GJ	0.00001	0.00001	0.00001	0.00001
LPG (Stationary)	Tonne CO2e/GJ	0.0002	0.0002	0.0002	0.0002

Scope 1 N_2O Emission Factors	Units	Construction Stage 1	Construction Stage 2	Total Operations (over 50 Years)	PROJECT TOTAL
Diesel (Stationary)	Tonne CO2e/GJ	0.0002	0.0002	0.0002	0.0002
Diesel (Mobile)	Tonne CO2e/GJ	0.0005	0.0005	0.0005	0.0005
LPG (Stationary)	Tonne CO2e/GJ	0.0002	0.0002	0.0002	0.0002

Scope 2 CO_2-e Emission Factors	Units	Construction Stage 1	Construction Stage 2	Total Operations (over 50 Years)	PROJECT TOTAL
Electricity	Tonne CO2e/MWh	0.51	0.51	0.51	0.51

Scope 1 CO_2 Emissions (CO2-e)	Units	Construction Stage 1	Construction Stage 2	Total Operations (over 50 Years)	PROJECT TOTAL
Diesel (Other Stationary)	Tonne	1,382	283	0	1,665
Diesel (Transport)	Tonne	162	97	15,468	15,728
LPG (Stationary)	Tonne	0	0	4,010	4,010
Seagrass disturbance	Tonne	394.7		0.0	394.7
Total Scope 1 CO2 Emissions	**Tonne**	**1,939**	**380**	**19,479**	**21,798**

Scope 1 CH4 Emissions (CO2-e)	Units	Construction Stage 1	Construction Stage 2	Total Operations (over 50 Years)	PROJECT TOTAL
Diesel (Other Stationary)	Tonne	1.98	0.41	0.00	2.38
Diesel (Transport)	Tonne	0.02	0.01	2.21	2.25
LPG (Stationary)	Tonne	0.00	0.00	13.32	13.32
Total Scope 1 CH4 Emissions	**Tonne (CO2-e)**	**2.00**	**0.42**	**15.54**	**17.95**

Scope 1 N2O Emissions (CO2-e)	Units	Construction Stage 1	Construction Stage 2	Total Operations (over 50 Years)	PROJECT TOTAL
Diesel (Other Stationary)	Tonne	3.95	0.81	0.00	4.76
Diesel (Transport)	Tonne	1.16	0.70	110.65	112.50
LPG (Stationary)	Tonne	0.00	0.00	13.32	13.32
Total Scope 1 N2O Emissions	**Tonne (CO2-e)**	**5.11**	**1.51**	**123.97**	**130.59**

Total Scope 1 Emissions (CO2-e)	Units	Construction Stage 1	Construction Stage 2	Total Operations (over 50 Years)	PROJECT TOTAL
Diesel (Construction)	Tonne	1,388	284	0	1,672
Diesel (Transport- construction)				0	261
Diesel (Transport)	Tonne	163	98	15,581	15,581
LPG (Stationary)	Tonne	0	0	4,037	4,037
Seagrass disturbance	Tonne	395		0	395
Total Scope 1 CO2 Emissions	**Tonne**	**1,946**	**382**	**19,618**	**21,946**

Scope 2 CO_2-e Emissions	Units	Construction Stage 1	Construction Stage 2	Total Operations (over 50 Years)	PROJECT TOTAL
Electricity	Tonne	0	0	0	0

Scope 3 CO_2-e Emission Factors	Units	Construction Stage 1	Construction Stage 2	Total Operations (over 50 Years)	PROJECT TOTAL
Diesel	Tonne CO2e/GJ	0.0173	0.0173	0.0173	0.0173
Cement	Tonne CO2-e/t	0.544	0.5440	0.5440	0.5440
Steel	Tonne CO2-e/t	1.390	1.3900	1.3900	1.3900

Total Scope 3 Emissions (CO2-e)	Units	Construction Stage 1	Construction Stage 2	Total Operations (over 50 Years)	PROJECT TOTAL
Diesel	Tonne	382	94	3,828	4,305
Cement	Tonne	39	34	0	73
Steel	Tonne	39	125	0	164
Total Emissions	**Tonne**	**460**	**253**	**3,828**	**4,542**

TOTAL EMISSIONS (Scope 1&3)	Units	Construction Stage 1	Construction Stage 2	Total Operations (over 50 Years)	PROJECT TOTAL
Scope 1 emissions	Tonne	1,946	382	19,618	21,946
Scope 3 emissions	Tonne	460	253	3,828	4,542
Total Emissions	**Tonne**	**2,406**	**636**	**23,446**	**26,488**