OIKOS STORAGE LTD

OIKOS MARINE & SOUTH SIDE DEVELOPMENT

PRELIMINARY ENVIRONMENTAL INFORMATION REPORT
VOLUME 2

Appendix 13.1: GHG Footprint Technical Methodology

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Appendix 13.1 GHG Footprint Technical Methodology

Introduction

1.1 This appendix sets out the methodology for the calculating the baseline Greenhouse Gas (GHG) footprint, and GHG footprint for the with and without the OMSSD Project scenarios. The GHG footprint considers GHGs released as a result of Oikos' activities in terms of three emissions 'scopes' described in the Greenhouse Gas Protocol, which are explained in Table 1.1.

Table1.1: GHG Emissions Scopes 1, 2 and 3

Scope	Description
Scope 1	These include emissions from activities owned or controlled by Oikos that release GHG emissions into the atmosphere. They are known as direct emissions and can be **controlled** by the Oikos.
Scope 2	These include emissions released into the atmosphere associated with Oikos' consumption of purchased electricity. These are indirect emissions that are a consequence of Oikos' activities. Whilst Oikos does not directly emit these emissions it can **control** them through its energy management and purchasing decisions.
Scope 3	Emissions that are associated with Oikos but occur from sources which are not owned or controlled by Oikos and are not classed as scope 2 emissions. Oikos can **influence** these emissions but not control them.

1.2 Details of the emissions sources that have been included in the GHG footprint are provided in Table 1.2, showing which GHG Protocol scope each emissions source is categorised into and project phase.

Table 1.2: GHG Footprint Emissions Sources Summary

Project Phase	Scope	Description	
Operational	Scope 1	Refrigerant losses	Losses of F-gases from refrigerant units such as air conditioners.
	Scope 2	Oikos electricity consumption	Consumption of metered electricity by Oikos.
	Scope 3	Vessel emissions whilst berthed at jetties	Emissions from vessels using auxiliary generators while berthed at Oikos jetties.
		Vessel emissions within London Port Authority boundary (two-way)[1]	Emissions from vessels while sailing to and from the Oikos facility within the Port of London.

[1] Following consultation with Port of London Authority, it was agreed that two-way shipping emissions within the Port of London would be scoped in. It was agreed that the point at which vessels are judged to enter the Port of London is at the confluence of the River Thames and River Medway.

		Vessel emissions from import of fuel products from suppliers (one way[2])	Emissions from vessels while sailing to Oikos from international fuel suppliers.
		Deliveries, staff and visitor transport to site by road	Emissions from deliveries, staff and visitors travelling to and from the Oikos site.
		Export of fuel products by road tanker	Emissions from road tankers used to export fuel to end users.
		Operational water use	Emissions from supply and treatment of potable (metered) water.
Construction		Materials & products (embodied emissions in construction materials)	Embodied emissions in construction materials.
		Construction transport	Emissions from vehicles delivering materials and goods, removing waste and construction staff travel to and from the site during construction works.

1.3 A GHG footprint for the Oikos facility, covering all the emissions sources outlined in Table 1.2 has been produced for the following scenarios:

- 2019 Baseline (existing operations in 2019);
- 2025 Without OMSSD Project (i.e. existing fuel storage capacity retained); and
- 2025 With OMSSD Project (additional fuel storage capacity from OMSSD).

1.4 Details of the methodology to calculate the GHG emissions from each of the emission sources included in the GHG footprint is provided in the following sections for the Operational and Construction phases.

Operational Phase

Scope 1 Emissions

1.5 Scope 1 emissions cover fuels consumed directly by Oikos. The fuel imported to and exported from the Site is not included in this. The Oikos Facility does not have any combustion sources that consume solid, liquid or gaseous fuels. There is a diesel generator used as an emergency water pump for firefighting, however as an emergency device, this is not regularly used and any fuel consumed during routine testing of the engines will be minor and has been discounted.

[2] To be consistent with international convention of reporting and allocating responsibilities for international shipping (as defined by the United Nations Framework Convention on Climate Change), the assessment quantified one-way emissions from international shipping visiting the facility.

1.6 Scope 1 emissions from the Oikos site are limited to refrigerant losses from cooling equipment.

Refrigerant Losses

2019 Baseline

1.7 Baseline GHG emissions from refrigerant losses have been calculated from a 2019 inventory of refrigerant gas losses provided by Oikos.

1.8 Refrigerant losses have been converted to GHG emissions using Department of Business, Energy and Industrial Strategy (BEIS) greenhouse gas reporting conversion factors for 2019[3], through the following equation:

$$CO_2e_a = Mass_{ab} \text{ x } (\%Loss_{abc} / 100) * GHGf_b$$

Where:

CO_2e_a = Emissions of CO_2e in kilograms, produced by refrigerant unit *a*;

$Mass_{ab}$ = Mass (in kg) of refrigerant *b* (HFC type) in refrigerant unit *a*;

$\%Loss_{abc}$ = %Loss *c* for refrigerant *b* in refrigerant unit *a*;

$GHGf_b$ = GHG emissions factor for refrigerant *b* (as $kgCO_2e$/kgHFC).

1.9 A summary of the 2019 baseline GHG calculation for refrigerant losses is presented in Table 1.3.

Table 1.3: GHG Emissions from Refrigerant Losses

Parameter	Value	Unit	Description
$Mass_{ab}$	73.61	kg	Data provided by Oikos shows that in 2019, there was a total of 73.61 kg of refrigerant use. All refrigerant used is R410A (a Kyoto Protocol blend).
$\%Loss_{abc}$	100	%	Percentage loss of refrigerant is assumed to be 100%.
$GHGf_b$	2,088	$kgCO_2e$/kg	The 2019 BEIS GHG emission factor for R410A gas.
2019 GHG Emissions	**153.7**	**tonnes**	

Future Scenarios

1.10 The OMSSD Project will not have any additional requirement for refrigerant use than the current use of the site. Existing refrigerant use is primarily associated with air conditioning units within the Oikos office spaces. As a worst-case assumption, future refrigerant use, both with and without the OMSSD Project has been assumed to be the same as in 2019. The emission factor for refrigerants remains unchanged in the future scenarios since it is

[3] BEIS, 2019, Greenhouse gas reporting: conversion factors 2019.

assumed there is no change in the refrigerant material used in the future.

1.11 CO_2e emissions from refrigerant losses in both the with and without OMSSD project scenarios in 2025 is therefore 153.7 tonnes.

Scope 2 Emissions

Electricity Consumption

1.12 Emissions from Oikos' electricity consumption are associated with the production of the electricity as well as from transmission and distribution losses on the grid.

2019 Baseline

1.13 Oikos has provided total annual metered electrical consumption for 2019, which has been combined with a GHG emission factors for grid electricity obtained from BEIS[4], to estimate the GHG emissions from Oikos' electricity use in 2019, using the following equation:

$$CO_2e = Elec_{annum} \times (GHGf_{gen} + GHGf_{trans})$$

Where:

CO_2e = Emissions of CO_2e in kilograms;

$Elec_{annum}$ = Annual total consumption of metered electricity in kWh;

$GHGf_{gen}$ = GHG emissions from electricity generation;

$GHGf_{trans}$ = GHG emissions from electricity losses during transmission and distribution.

1.14 A summary of the 2019 baseline GHG calculation for electricity consumption is presented in Table 1.4.

Table 1.4: 2019 Baseline GHG Emissions from Electricity Consumption

Parameter	Value	Unit	Description
$Elec_{annum}$	1,263,990	kWh	Oikos' total annual metered electricity consumption in 2019 was 1,263,990 kWh.
$GHGf_{gen}$	0.2556	$kgCO_2e/kWh$	The 2019 BEIS GHG emission factor for electricity generation.
$GHGf_{trans}$	0.0217	$kgCO_2e/kWh$	The 2019 BEIS GHG emission factor for electricity losses in transmission and distribution.
2019 GHG Emissions	**350.5**	**tonnes**	

[4] BEIS, 2019, Greenhouse gas reporting: conversion factors 2019.

Future Scenarios

1.15 Future electricity consumption for the Oikos Facility without the OMSSD project has been assumed to be the same as 2019. There are no planned works that will increase the electricity demand of the Oikos Facility and although there will potentially be energy saving initiatives to reduce electricity use (e.g. more energy efficient office equipment), reductions in electricity consumption will be minor.

1.16 With the OMSSD project, the grid electricity consumption is estimated to increase by 30% compared to 2019. This is an estimate from Oikos based on the design of the OMSSD project and takes into account that the OMSSD project will lead to reduced energy consumption from site offices due to replacement of existing offices with more energy efficient structures as well as an increase in the supply of renewable electricity through PV cells at the Oikos Facility, but there will also be an increased need for electricity to power pumps and site lighting.

1.17 A GHG factor for electricity consumption in 2025 (including transmission and distribution losses) has been obtained from the BEIS guidance on valuation of energy use and greenhouse gas emissions[5]. Specifically, the long-run marginal consumption-based GHG factors for commercial land uses has been used.

1.18 A summary of the 2025 GHG calculation for electricity consumption with and without the OMSSD project is presented in Table 1.5.

Table 1.5: Future (2025) GHG Emissions from Electricity Consumption

Parameter	Value	Unit	Description
Without OMSSD Project			
$Elec_{annum}$	1,263,990	kWh	Assumed to be the same as Oikos Facility consumption in 2019.
$GHGf_{(gen+trans)}$	0.2199	$kgCO_2e/kWh$	2025 BEIS long-run marginal consumption-based GHG emission factor for commercial electricity (includes transmission and distribution losses).
2025 GHG Emissions	**277.9**	**tonnes**	Without OMSSD project
With OMSSD Project			
$Elec_{annum}$	1,643,187	kWh	30% uplift to 2019 Oikos Facility electricity consumption.
$GHGf_{(gen+trans)}$	0.2199	$kgCO_2e/kWh$	2025 BEIS long-run marginal consumption-based GHG emission factor for commercial electricity (includes transmission and distribution losses).
2025 GHG Emissions	**361.3**	**tonnes**	With OMSSD project

[5] BEIS, 2020, Green Book Supplementary Guidance: valuation of energy use and greenhouse gas emissions for appraisal, Table 1.

Scope 3 Emissions

Vessel emissions

1.19 Emissions from vessels are calculated separately for the in-transit phase, whilst in the PLA zone of influence and from vessels whilst berthed.

In Transit Vessels Emissions from Import of Fuel

2019 Baseline

1.20 Emissions from vessels importing fuel products to Oikos from international suppliers have been calculated for the 2019 baseline using BEIS emission factors[6] for shipping transport and the log of vessel activity provided by Oikos. The data provided includes details of each vessel and its port of origin.

1.21 Vessel emissions have been quantified for imports only, and any emissions associated with the onward or return journey of the vessels has not been calculated. This is to ensure consistency with international accounting and reporting of shipping emissions advised by the UNFCCC (the international body responsible for managing global climate change) and avoids the potential for double counting when GHG emissions are totalled at a global level.

1.22 GHG emissions have been calculated using the following equation:

$$CO_2e_a = Dist_{ab} \times Mass_{ac} \times GHGf_a$$

Where:

CO_2e_a = Emissions of CO_2e in kilograms from vessel a;

$Dist_{ab}$ = One way distance travelled in km by vessel a from origin port b;

$Mass_{ac}$ = Mass of fuel cargo c in tonnes imported on vessel a;

$GHGf_a$ = GHG emissions factor for vessel a per tonne of cargo per km (in $kgCO_2e$/tonne.km) published by BEIS.

Distances to Oikos Facility

1.23 Distances between the origin ports and the Port of London (in which the Oikos Facility sits) have been calculated using the Sea Distances online calculator tool[7]. The Oikos Facility received fuel imports from a large number of global ports in 2019, covering Europe, the Middle East, Russia, India and Asia-Pacific. In order to ensure some consistency with the estimation of future GHG emissions from vessel sailings, and to account for uncertainty on

[6] BEIS, 2019, Greenhouse gas reporting: conversion factors 2019.

[7] Sea-Distances.org, 2020: https://sea-distances.org/

the specific route taken by the vessels, each port has been categorised by its general location. A summary of the fuel import distances assumed in the assessment is presented in Table 1.6. Distances have been extracted from the Sea Distances tool in Nautical Miles (NM) and converted to km using a factor of 1.852.

Table 1.6: Distance of Fuel Imports to the Oikos Facility

Origin Port Location	Distance (NM)	Distance (km)	Comment
UK	221	409	Immingham is the only UK port from which a vessel visited the Oikos Facility in 2019 therefore the distance is based on the distance to Immingham.
Europe	500	926	Most common origin ports are in Belgium and the Netherlands, which are less than 400 km sailing from Oikos, but to account for more distant European ports in Spain and Scandinavia, an average distance has been used.
Russia	1,400	2,593	Most common ports for Russian vessels visiting the Oikos Facility in 2019 are in east Russia, so distance based on ports in St Petersburg.
Middle East	5,000	9,260	Various origins including Saudi Arabia, Kuwait and UAE, so a rounded average distance based on these ports has been used
India	6,500	12,038	Various ports. A rounded average distance based on these ports has been used.
Asia-Pacific	10,000	18,520	Singapore and Korea. One vessel from each of these destinations in 2019, so a rounded average distance for these ports has been used.

Cargo per Vessel

1.24 In order to estimate the GHG emissions from vessels importing fuel, it is necessary to calculate the mass of cargo transported by each vessel.

1.25 The majority of vessels visiting the Oikos Facility unload only a portion of their cargo before onward travel to other UK or European ports, so the cargo per vessel that is delivered to the Oikos Facility does not equal the capacity of the vessel.

1.26 Data revealing the specific fuel volume of each vessel unloaded at the Oikos Facility are not available, however the total mass of fuel delivered to the Oikos Facility in 2019 is known to be 2,188,402 tonnes.

1.27 The mass of cargo per vessel has been estimated as being the same for each vessel that visited the Oikos Facility in 2019. Based on 82 vessels in the 2019 vessel log, the average cargo per vessel imported by Oikos is estimated to be 26,688 tonnes/vessel.

GHG Emission Factors

1.28 Larger vessels have lower GHG emissions per tonne of cargo owing to efficiencies associated with moving cargo in large volumes. As such, the size of vessels visiting the Oikos Facility is an important parameter in the calculation of the 2019 GHG footprint. GHG factors published by BEIS have been used in the assessment[8]. The factors for crude tankers are provided for a range of tanker weight classes, three of which are relevant to the tankers that visit the Oikos Facility. The relevant GHG factor tanker weight classes are:

- Crude tanker 10,000 – 59,999 dwt;
- Crude tanker 60,000 – 79,999 dwt; and
- Crude tanker 80,000-119,999 dwt).

1.29 The Oikos Facility has two jetties; Jetty 1, which is capable of handling vessels up to 55,000 tonnes, and the deep water Jetty 2, which is capable of receiving vessels up to 120,000 tonnes. The specific weight of vessels visiting the Oikos Facility in 2019 are not available, but the name of each vessel has been provided from the 2019 vessel log. From these data, vessel weights have been determined using an online vessel database[9] and each vessel has been assigned into one of the vessel weight classes described in paragraph 1.28.

1.30 A summary of the vessel weight classes and corresponding GHG factors used in the calculation of 2019 baseline GHG emissions are shown in Table 1.7.

Table 1.7: 2019 Vessel Activity and GHG Emissions Factors

Vessel weight class	Number of Vessels in 2019	GHG Emission Factor ($kgCO_2e$/tonne.km)
Crude tanker 10,000-59,999 dwt	71	0.009227
Crude tanker 60,000-79,999 dwt	6	0.007604
Crude tanker 80,000-119,999 dwt	5	0.005982

1.31 The GHG factors are applied by multiplying the factors in Table 1.7 by the average cargo for each vessel (26,688 tonnes) as described in paragraph 1.27 and the distance to origin In Table 1.6.

1.32 A summary of the 2019 baseline GHG calculation for vessel emissions from import of fuel products to the Oikos Facility is presented in Table 1.8.

Table 1.8: 2019 Baseline GHG Emissions from Vessels Importing Fuel

<table>
<tr><th>Origin Port Location</th><th>Vessel weight class (dwt)</th><th>Number of Vessels</th><th>Distance per Vessel (km)</th><th>GHG Emission Factor ($kgCO_2e$/ tonne.km)</th><th>GHG Emissions (tonnes/CO_2e)</th></tr>
<tr><td>UK</td><td>10,000-59,999</td><td>1</td><td>409</td><td>0.009227</td><td>101</td></tr>
<tr><td rowspan="3">Europe</td><td>10,000-59,999</td><td>28</td><td rowspan="3">926</td><td>0.009227</td><td>6,385</td></tr>
<tr><td>60,000-79,999</td><td>1</td><td>0.007604</td><td>188</td></tr>
<tr><td>80,000-119,999</td><td>2</td><td>0.005982</td><td>296</td></tr>
<tr><td>Russia</td><td>10,000-59,999</td><td>24</td><td>2,593</td><td>0.009227</td><td>15,323</td></tr>
<tr><td rowspan="3">Middle East</td><td>10,000-59,999</td><td>13</td><td rowspan="3">9,260</td><td>0.009227</td><td>29,643</td></tr>
<tr><td>60,000-79,999</td><td>1</td><td>0.007604</td><td>1,879</td></tr>
<tr><td>80,000-119,999</td><td>1</td><td>0.005982</td><td>1,478</td></tr>
<tr><td>India</td><td>10,000-59,999</td><td>4</td><td>12,038</td><td>0.009227</td><td>11,857</td></tr>
</table>

[8] BEIS, 2019, Greenhouse gas reporting: conversion factors 2019.

[9] VesselFinder, 2020: www.vesselfinder.com

	60,000-79,999	3		0.007604	7,329
	80,000-119,999	2		0.005982	3,844
Asia-Pacific	10,000-59,999	1	18,520	0.009227	4,561
	60,000-79,999	1		0.007604	3,758
TOTAL 2019 GHG Emissions (tonnes/CO_2e)					**86,642**

Future Scenarios

Vessel Activity

1.33 In the 2025 without OMSSD project scenario, the number of vessels visiting the Oikos Facility, and sizes of the visiting vessels has been assumed to be the same as in 2019, as shown in Table 1.7.

1.34 For the 2025 with OMSSD project scenario, predicted vessel movements for Jetty 1 and Jetty 2 have been provided by Oikos. The OMSSD project is expected to lead to fuel exports from Oikos to other UK terminals, and therefore it is assumed the Jetty 1 will be visited by smaller, 35,000 dwt vessels used for domestic fuel exports, and the deep water Jetty 2 will be visited by larger, 100,000 dwt vessels used for fuel imports. A summary of the assumed 2025 vessel activity data is presented in Table 1.9.

Table 1.9: Predicted Vessel Activity in 2025

Vessel Size	Number of Vessels in 2025 without OMSSD Project	Additional Vessels in 2025 associated with the OMSSD Project	Number of Vessels in 2025 with OMSSD Project
Crude tanker 10,000-59,999 dwt	71	66	137
Crude tanker 60,000-79,999 dwt	6	0	6
Crude tanker 80,000-119,999 dwt	5	69	74

Distances to Oikos Facility

1.35 In the 2025 without OMSSD project scenario, the number of vessel visits from the origin regions used for 2019 have been assumed, as set out in Table 1.8. The distances to each region are assumed to be the same as in 2019, as shown in Table 1.6.

1.36 For the 2025 with OMSSD project scenario, a fuel import distance of 4,581 km has been assumed. This is the weighted average import distance from the 2019 Oikos Facility vessel activity. It has therefore been assumed that the range of origin ports and frequency of fuel imports from each of the origin locations/regions is the same with the OMSSD project than without it, although the volume of vessel activity is greater.

For the domestic fuel exports, an export distance of 409 km has been assumed, which is based on the distance to Immingham, but is sufficient to cover potential customers throughout east and southern England.

GHG Emission Factors

1.37 The shipping sector is beginning to decarbonise, by bringing forward low carbon technologies such as battery storage, solar cells and hydrogen propulsion to reduce marine fuel consumption and associated GHG emissions with vessel activity. To account for this, a conservative 1% per year reduction in GHG emissions from vessels in transit has been assumed in the assessment, detailed further in Appendix 13.2 of the OMSSD PEIR.

1.38 The 2025 GHG emissions factors, taking account of the 1% per year reduction from 2019 are shown in Table 1.10.

Table 1.10: GHG Emissions from Refrigerant Losses 2025 GHG Emissions Factors

Vessel Size	2019 GHG Emission Factor ($kgCO_2e/tonne.km$)	2025 GHG Emission Factor ($kgCO_2e/tonne.km$)
Crude tanker 10,000-59,999 dwt	0.009227	0.00868704
Crude tanker 60,000-79,999 dwt	0.007604	0.00715902
Crude tanker 80,000-119,999 dwt	0.005982	0.00563193

Cargo per Vessel

1.39 For the without OMSSD project scenario, it has been assumed that the average cargo per import/export vessel is the same is in 2019 (26,688 tonnes).

1.40 For the with OMSSD project scenario, to achieve the expected annual fuel throughput, import cargos associated with the OMSSD project will be much larger to minimise the number of vessels visiting the Oikos Facility. The average cargo of fuel imports to Jetty 2 for the OMSSD project vessels is 100,000 tonnes. The average cargo of domestic fuel exports from Jetty 1 is 35,000 tonnes. These values have been calculated by Oikos based on the expected operation of the OMSSD project. The emissions from additional vessels visiting Oikos as a result of the OMSSD project have been calculated and added to the emissions from the without OMSSD project vessels to calculate the total with OMSSD project emissions.

1.41 A summary of the 2025 GHG emissions from vessels importing and exporting fuel products whilst in transit to and from the Oikos Facility in the with and without OMSSD project scenarios is presented in Table 1.11.

Table 1.11: 2025 GHG Emissions from Vessels Importing and Exporting Fuel in transit

Scenario	Vessel Size (dwt)	Cargo Size (T)	Number of Vessels	Distance per Vessel (km)	GHG Emission Factor ($kgCO_2e/$ tonne.km)	GHG Emissions (tonnes/ CO_2e)
Without OMSSD Project	10,000-59,999	26,688	71	See Table 1.8	0.008687	63,898
	60,000-79,999	26,688	6		0.007159	12,384
	80,000-119,999	26,688	5		0.005632	5,289
TOTAL Without OMSSD Project GHG Emissions (tonnes/CO_2e)						**81,572**
With OMSSD Project	10,000-59,999	26,688	71	See Table 1.8	0.008687	63,898
	60,000-79,999	26,688	6		0.007159	12,384
	80,000-119,999	26,688	5		0.005632	5,289
	10,000-59,999	35,000	66	409	0.008687	8,213
	80,000-119,999	1000,000	69	4,581	0.005632	78,011
TOTAL With OMSSD Project GHG Emissions (tonnes/CO_2e)						**267,796**

Vessels Emissions within Port of London

2019 Baseline

1.42 During consultation with Port of London Authority it was agreed that emissions from vessels operating in the Port of London would be accounted for including both the arrival and departure of vessels into and from the port to enable comparison to PLA inventory totals for all shipping within the PLA shipping area.

1.43 GHG emissions have been calculated using the same formula as for emissions from vessels importing fuels, described in paragraph 1.22, where the distance travelled is the distance travelled within the Port of London.

1.44 The Port of London is assumed to cover the River Thames out to the mouth of the River Medway at Sheerness, beyond which there are no ports in the Thames Estuary. The Oikos site is 15 km from Sheerness, therefore calculation of GHG emissions from vessels in the Port of London have accounted for 30 km of sailing distance travelled (15 km on arrival and 15 km on departure).

1.45 As a worst-case assumption, emissions from the arriving vessels and departing vessels are assumed to be the same.

1.46 The 2019 GHG emissions from vessel emissions in the Port of London is 585 tonnes.

Future Scenarios

1.47 For the future scenarios, GHG emissions from vessels operating within the Port of London have been calculated in the same way as the 2019 baseline emissions, based on 15 km travel on arrival and 15 km travel on departure. The emissions have been calculated based on the 2025 vessel numbers and 2025 GHG emission factors presented in Table 1.9 and Table 1.10.

1.48 The 2025 without OMSSD project emissions in the PLA are 551 tonnes. The 2025 with OMSSD project emissions in the PLA are 2,319 tonnes.

Vessels at Berth

2019 Baseline

1.49 GHG emissions from vessels berthed at Oikos' jetties have been calculated based on data on the size of vessel auxiliary generators, the duration of stay at Oikos when delivering fuel products, and published marine fuel emission factor using the following equation:

$$CO_2e_a = Rating_a \ x \ Load_{ab} \ x \ Time_{ab} \ x \ GHGf_a$$

Where:

CO_2e_a = Emissions of CO_2e in kilograms from vessel a;

$Rating_b$ = Fuel input rating (in kWh) of the auxiliary generator on vessel a;

$Load_{ab}$ = Typical load on auxiliary generator on vessel a during berth at jetty b;

$Time_{ab}$ = Duration in hours that vessel a remains berthed at jetty b;

$GHGf_a$ = GHG emissions factor for the consumption of marine gas oil in the auxiliary generator on vessel a (in $kgCO_2e/kWh$).

1.50 A summary of the 2019 baseline GHG calculation for vessel emissions at berth is presented in Table 1.12.

Table 1.12: 2019 Baseline GHG Emissions from Vessels at Berth

Parameter	Value	Unit	Description
$Rating_a$	2,700	kW	Based on information gathered from vessels visiting Oikos, namely the Nave Andromeda and Nautical Sarah tankers.
$Load_{ab}$	67	%	US EPA Shore Power Technology Assessment report also provides typical auxiliary generator loading at berth of 67% for tankers.
$Time_{ab}$	36.5	hours	Oikos have provided data that shows average vessel berth time is 36 hours at Jetty 1 and 37 hours at Jetty 2. An average has been assumed as an even number of vessels berthed at each jetty in 2019.
$GHGf_a$	0.27486	$kgCO_2e/kWh$.	The 2019 BEIS GHG emission factor for combustion of marine gas oil.
2019 GHG Emissions	**1,488**	**tonnes**	

Future Scenarios

1.51 GHG emissions from vessels berthed at the Oikos Facility jetties in the future scenarios have been calculated using assumptions consistent with the 2019 baseline, as set out in Table 1.12. The emissions have been calculated based on the predicted number of vessels visiting the Oikos Facility in each scenario.

1.52 For the 2025 without OMSSD project scenario, in which vessel activity is assumed to be the same in 2019, the GHG emissions from vessels at berth is 1,488 tonnes.

1.53 For the 2025 with OMSSD project scenario, in which increased vessel activity is predicted as summarised in Table 1.9, the GHG emissions from vessels at berth is 3,939 tonnes.

Deliveries, Staff and Visitor Transport

2019 Baseline

1.54 Emissions from deliveries, staff and visitor transport have been estimated from information provided by Oikos. A record of deliveries and staff and visitor arrivals at the site have been provided for four week-long periods in 2019. These data, which are presented in Table 1.13 have been summed to give a total for the 28 days surveyed and then extrapolated to an annual total by multiplying the 28-day totals by 365/28 (13.036).

Table 1.13: Oikos Staff and Visitor Travel Data

Type	Time Period (Number of Arrivals at Oikos)					
	Feb 4th – 11th	May 13th – 20th	August 5th – 12th	November 11th – 18th	TOTAL (28 Days)	Total (Annual)
Staff	103	109	91	119	422	5,501
Contractors	107	82	45	81	315	4,106
Visitors	13	4	6	6	29	378
Deliveries (LDV)	3	4	13	6	26	339
Deliveries (HGV)	Annual total provided by Oikos for nitrogen deliveries.					15
Total Annual Light Vehicle Movements 2019						10,324
Total HGV Deliveries 2019						15

1.55 The GHG emissions associated with these staff and visitor trips has been estimated based on the likely travel distance of each trip and using GHG emissions factors for road vehicles obtained from BEIS[10], using the following equation:

$$CO_2e_a = Dist_a \ x \ GHGf_a$$

Where:

CO_2e_a = Emissions of CO_2e in kilograms from staff/visitor a;

$Dist_a$ = Distance travelled in km by staff/visitor a to and from Oikos;

$GHGf_a$ = GHG emissions factor for staff/visitor a assuming travel by private car (GHG emissions as $kgCO_2e$/km travelled).

1.56 A summary of the 2019 baseline GHG calculation for staff and visitor transport is presented in Table 1.14.

Table 1.14: 2019 Baseline GHG Emissions from deliveries, Staff and Visitor Transport

Parameter	Value	Unit	Description
$Dist_a$	68.5	km	Oikos has advised that the average travel distance for staff to Oikos is 21.3 miles (34.25 km) each way, or 68.5 km round trip. There are no data on visitors, contractors and LDV deliveries, so the a round trip travel distance of 68.5 km has been used to represent all staff and visitors.
	100	km	For HGVs, a single trip distance of 50 km has been assumed in line with RICs whole life carbon guidance[11] for locally manufactured/sourced goods.
$GHGf_a$	0.17336	$kgCO_2e$/km.	The 2019 BEIS GHG emission factor for average passenger cars.
	0.92788	$kgCO_2e$/km.	The 2019 BEIS GHG emission factor for all artic HGVs average laden.

[10] BEIS, 2019, Greenhouse gas reporting: conversion factors 2019.

[11] RICS (2017), Whole life carbon assessment for the built environment, 1st edition.

2019 GHG Emissions	**124**	**tonnes**	

Future Scenarios

1.57 The number of deliveries and staff and visitor transport movements in the 2025 without OMSSD project scenario is assumed to be the same as in 2019 as no increase in activity or Oikos staff numbers are expected.

1.58 For the 2025 with OMSSD project scenario, the number of deliveries and staff and visitor transport movements has been uplifted to account for an anticipated increase in site staff with the OMSSD project. The current number of staff employed at the Oikos Facility is 39 (in 2019) and Oikos anticipate this to increase to 49 staff with the OMSSD project. The 2019 deliveries, staff and visitor transport movements have therefore been uplifted by a factor of 1.256 (39/49). HGV deliveries are anticipated to increase to 25 deliveries per year.

1.59 Average delivery, staff and visitor travels distances of 68.5 km has been assumed in both the with and without OMSSD project future scenarios, which is consistent with the 2019 baseline. The average round trip travel distance of HGVs (100 km) has been assumed in both the with and without OMSSD project future scenarios.

1.60 A 2025 GHG factor for LDVs has been calculated by adjusting the 2019 BEIS GHG factor using fuel efficiency factors obtained from the DfT's WebTAG tool[12]. These factors include an allowance for the future uptake of electric vehicles, which reduce GHG emissions compared to petrol and diesel vehicles. There is no data on expected fuel efficiencies in HGVs over this period, so the HGV emission factor for 2019 has also been applied in 2025.

1.61 A summary of the 2025 with and without OMSSD project GHG emissions from deliveries, staff and visitor transport are presented in Table 1.15.

Table 1.15: Future (2025) GHG Emissions from Deliveries Staff and Visitor Transport

Parameter	Value	Unit	Description
Without OMSSD Project			
Number of Movements	10,324	number	LDVs. See Table 1.13.
	15	number	HGVs. See Table 1.13.
$Dist_a$	68.5	km	For LDVs. As assumed for the 2019 baseline.
	100	km	For HGVs. As assumed for the 2019 baseline.
$GHGf_a$	0.1514	$kgCO_2e/km$.	The 2019 BEIS GHG emission factor for average passenger cars, adjusted using DfT WebTAG to account for decarbonisation of road vehicles.
	0.92788	$kgCO_2e/km$.	The 2019 BEIS GHG emission factor for all artic HGVs average laden.
2025 GHG Emissions	**108.5**	**tonnes**	Without OMSSD project.
With OMSSD Project			

[12] DfT (2019) Transport Analysis Guidance (TAG) Unit A3 environmental impact appraisal.

Number of Movements	12,972	number	2019 movements uplifted by 1.256.
	25	number	Estimated by Oikos.
$Dist_a$	68.5	km	As assumed for the 2019 baseline.
$GHGf_a$	0.1514	$kgCO_2e$/km.	As above.
2019 GHG Emissions	**136.9**	**tonnes**	With OMSSD project

Export of Fuel by Road Tanker

2019 Baseline

1.62 GHG emissions from fuel exports by road tanker have been calculated using data provided by Oikos on the number and destination of road tankers delivering fuel products to end users, and BEIS GHG emission factors using the following equation:

$$CO_2e_a = (Dist_{ab}\ x\ Mass_{ac}\ x\ GHGf_{laden}) + Dist_{abc}\ x\ GHGf_{unladen})$$

Where:

CO_2e_a = Emissions of CO_2e in kilograms for tanker a;

$Dist_{ab}$ = Distance travelled in km by fully laden tanker a to end user b;

$Mass_{ab}$ = Mass of fuel product transported by tanker a to end user b;

$Dist_{abc}$ = Distance travelled in km by empty (unladen) tanker a back to Oikos c from end user b;

$GHGf_{laden}$ = GHG emissions for laden fuel tanker a travelling to the end user per tonne of fuel per km ($kgCO_2e$/tonne.km);

$GHGf_{unladen}$ = GHG emissions for unladen fuel tanker a returning to Oikos per km ($kgCO_2e$/km).

1.63 A summary of the 2019 baseline GHG calculation for emissions from export of fuel products by road tanker is presented in Table 1.16.

Table 1.16: GHG Emissions from Fuel Export by Road Tanker

Parameter	Value	Unit	Description
$Dist_{ab}$/$Dist_{abc}$	106.2	km	Based on the common end users supplied by Oikos for jet fuel (Gatwick Airport, Stansted Airport, Luton Airport, Southend Airport and Jersey Airport) an average travel distance to these end users of 106.2 km has been calculated. Tankers are assumed to return to Oikos so the outbound and return travel distances are the same.
$Mass_{ab}$	29.8	T/tanker	Data provided by Oikos shows at total exported fuel mass of 302,828 tonnes by road tanker in 2019. The fuel was exported in 10,151 tankers. The average mass of fuel per tanker journey is therefore 29.8 tonnes.
$GHGf_{laden}$	0.07634	$kgCO_2e$/tonne.km	The 2019 BEIS GHG emissions for a 100% laden articulated fuel tanker up to 33T.
$GHGf_{unladen}$	0.64224	$kgCO_2e$/km	The 2019 BEIS GHG emissions for an unladen articulated fuel tanker up to 33T.

Number of Tankers	10,151	number	Total number of fuel tanker exports from the Oikos Facility in 2019.
2019 GHG Emissions	**3,147.5**	**tonnes**	

Future Scenarios

1.64 For the 2025 without OMSSD project scenario, it has been assumed that the same number of road tankers are used to export the same volume of fuel to the same destinations as in the 2019 baseline assessment. Conservatively it is also assumed there is no change in the GHG emissions factors for fuel tankers as it is not anticipated that significant decarbonisation of the HGV fleet will have occurred (e.g. by introduction of electric or hydrogen powered tankers). As such the GHG emissions from export of fuel by road tanker in 2025 without the OMSSD project are same as the 2019 baseline (3,148 tonnes).

1.65 In the 2025 with OMSSD project scenario, the predicted number of fuel tanker exports has been calculated based on daily estimates provided by Oikos. The predicted data suggests each road loading bay (there will be 5 bays in total) will service 2 tanker exports per hour, which equates to 87,360 per year[13]. In addition, the average mass of fuel per tanker is assumed to be 30.4 tonnes. This is based on using the largest available fuel tankers for all exports in order to meet the expected fuel throughput requirements of the OMSSD project. Other assumptions including average travel distance and the GHG emissions factors are assumed to be the same as 2019 as described in Table 1.16. The 2025 with OMSSD project GHG emissions from fuel tanker exports are estimated to be 27,489 tonnes.

Water Consumption

1.66 Emissions from metered water consumption are associated with the supply of potable water as well as the treatment of wastewater.

2019 Baseline

1.67 Oikos has provided total annual water consumption for 2019, which has been combined with a GHG emission factors for water supply and treatment obtained from BEIS[14], to estimate the GHG emissions from Oikos' water use in 2019, using the following equation:

$$CO_2e = Waterc_{annum} \times (GHGf_{supply} + GHGf_{treatment})$$

Where:

CO_2e = Emissions of CO_2e in kilograms;

$Water_{annum}$ = Annual total consumption of metered water in m^3;

[13] Assuming 364 days of operation per year.

[14] BEIS, 2019, Greenhouse gas reporting: conversion factors 2019.

$GHGf_{supply}$ = GHG emissions from water supply;

$GHGf_{treatment}$ = GHG emissions from wastewater treatment.

1.68 A summary of the 2019 baseline GHG calculation for water consumption is presented in Table 1.17.

Table 1.17: GHG Emissions from Water Consumption

Parameter	Value	Unit	Description
$Water_{nnum}$	5,393	m^3	Oikos' total annual metered water consumption in 2019 was 5,393 m^3.
$GHGf_{supply}$	0.344	$kgCO_2e/m^3$	The 2019 BEIS GHG emission factor for water supply.
$GHGf_{treatment}$	0.708	$kgCO_2e/m^3$	The 2019 BEIS GHG emission factor for wastewater treatment.
2019 GHG Emissions	**5.7**	**tonnes**	

Future Scenarios

1.69 The 2025 water consumption in the 2025 without OMSSD project scenario is assumed to be the same as the 2019 baseline. The GHG emissions factors for water supply and treatment are also assumed to remain the same, although some decarbonisation of water supply and treatment in the future is likely to occur. The 2025 without OMSSD project GHG emissions from water consumption are therefore 5.7 tonnes.

1.70 Taking conservative assumptions Oikos predict that the OMSSD project will lead to an increase in water demand at the Oikos Facility of 20%. The 2025 with OMSSD project water consumption has therefore been estimated by uplifting the 2019 consumption by 20%, which gives a predicted annual water volume of 6,472 m^3. Using the GHG emissions factors for water supply and treatment presented in Table 1.17, the calculated GHG emissions from water consumption in the with OMSSD project scenario in 2025 is 6.8 tonnes.

Construction Phase

Embodied GHG in Construction Materials

2019 Baseline

1.71 Baseline construction emissions are assumed to be zero as any construction activities undertaken on the Oikos site during 2019 was not related to the OMSSD Project.

Future Scenarios

1.72 The embodied carbon emissions will be calculated as part of the final OMSSD ES, using the quantum of construction materials required to construct the OMSSD project. These data are still being calculated, so for the purposes of the PEIR, no estimate of embodied GHG emissions is provided. This is discussed further in Chapter 13 of the OMSSD PEIR.

1.73 Once the quantum of construction materials required for the OMSSD project has been determined, the GHG emissions will be calculated using emissions factors from the University of Bath's Inventory of Carbon and Energy (ICE)[15] version 3.

Construction Transport

2019 Baseline

1.74 Baseline GHG emissions from construction transport are assumed to be zero as any construction activities undertaken on the Oikos site during 2019 was not related to the OMSSD Project.

Future Scenarios

1.75 The GHG emissions associated with construction staff and HGV trips has been estimated based on the likely travel distance of each trip and using GHG emissions factors for road vehicles obtained from BEIS[3], using the following equation:

$$CO_2e_a = Dist_s \times GHGf_s + Dist_{HGV} \times GHGf_{HGV}$$

Where:

CO_2e_a = Emissions of CO_2e in kilograms from staff/visitor a;

$Dist_s$ = Distance travelled in km by construction staff a to and from Oikos;

$GHGf_s$ = GHG emissions factor for construction staff assuming travel by private car (GHG emissions as $kgCO_2e/km$ travelled).

$Dist_{HGV}$ = Distance travelled in km by construction HGVs to and from Oikos;

$GHGf_{HGV}$ = GHG emissions factor for construction HGVs (GHG emissions as $kgCO_2e/km$ travelled).

1.76 Table 1.18 provides a summary of the GHG calculation for construction transport.

Table 1.18: GHG Emissions from Construction Transport

Parameter	Value	Unit	Description
Construction Staff Movements	143,080	number	Estimated to be 98 staff per day for the 24-month construction period. Assumes one arrival and one departure per staff per day, totaling 196 movements per day.
Construction HGV Movements	116,800	number	Estimated to be a maximum of 80 HGV arrivals per day during construction works which equals 160 movements (arrival + departure) per day. Average/total trips are yet to be determined so as a worst-case assessment the maximum daily trips have been extrapolated over the 24-month construction period.

[15] University of Bath (2019) Inventory of Carbon and Energy, Version 3.0.

$Dist_s$	68.5	km	Consistent with Oikos staff average travel distance in Table 1.15.
$Dist_{HGV}$	300	km	For HGVs, a single trip distance of 300 km has been assumed in line with RICs whole life carbon guidance for nationally manufacturer goods[16].
$GHGf_s$	0.17336	$kgCO_2e$/km.	The 2019 BEIS GHG emission factor for average passenger cars.
$GHGf_{HGV}$	0.88025	$kgCO_2e$/km.	The 2019 BEIS GHG emission factor for all HGV average laden.
2025 GHG Emissions	**31,694**	**tonnes**	

1.77 The total GHG emissions from construction transport are 31,694 tonnes, which is equivalent to 15,847 tonnes per annum based on the 24-month construction period.

[16] RICS (2017), Whole life carbon assessment for the built environment, 1st edition.