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REPORT

KEMBLA GRANGE RESOURCE RECOVERY FACILITY GREENHOUSE GAS ASSESSMENT

Bicorp

Job No: **7326-01**

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EXECUTIVE SUMMARY

Pacific Environment was commissioned by Benviron Group to conduct this greenhouse gas assessment to form part of the Environmental Impact Statement (EIS) to support a development application for the Kembla Grange Resource Recovery facility.

The Director-General's environmental assessment requirements (DGRs) for the preparation of the greenhouse gas part of the EIS are a quantitative assessment of the potential scope 1, 2 and 3 greenhouse gas emissions of the development, a qualitative assessment of the potential impacts of these emissions on the environment and a detailed description of the measures that would be implemented on-site to ensure that the development is energy efficient.

The scope 1 and 3 greenhouse gas emissions of the development have been estimated in accordance with the World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) *Greenhouse Gas Protocol* (GHG Protocol) and the Department of Climate Change and Energy Efficiency (DCCEE) *National Greenhouse Accounts* (NGA) *Factors Workbook* (NGA Workbook). It is assumed that all electricity required on-site during construction and operation will be generated by diesel power. Therefore, there are no Scope 2 emissions associated with electricity purchased from the grid.

The Scope 1 and Scope 3 construction emissions are 37,372 tonnes of carbon dioxide equivalent (t CO_2-e). The Scope 1 and Scope 3 emissions during operation are 1,669 t CO_2-e per annum.

The project's estimated contribution to regional, national and global emissions of greenhouse gases was determined. As expected, the project's contribution during operation (Scope 1 emissions only) to global greenhouse impacts is negligible, at 0.000002%, when compared to global anthropogenic 2004 emissions.

A number of energy efficient measures have been identified for the project, including the development of an energy management system in accordance with ISO 50001:2011(E) and energy efficient measures for on-site facilities and for road transport vehicles. These measures include:

- Implementing energy metering and monitoring.
- Employing efficient lighting and lighting control technologies (timers and light level sensors).
- Utilising energy efficient appliances and office equipment.
- Investigating possibilities to backload trucks.
- Choosing the most direct haulage routes possible.
- Adopting fuel efficient driving practices.
- Considering fuel efficiency when selecting vehicles.

The greenhouse gas emissions intensity for the project, in terms of emissions per tonne of waste processed is five times greater than the greenhouse gas emissions intensity for other facilities in the NSW GMR. The majority of Scope 1 emissions during operation are from composting. The emissions intensity for the project may be higher than for other facilities in the NSW GMR as not all these facilities are likely to have on-site composting. It is also likely that many other similar facilities would not have on-site electricity generation. That is, a large part of the emissions inventory for other facilities may comprise of Scope 2 emissions. When taking this difference in reporting boundaries into account, the emissions associated with this project would likely be more comparable with those of other facilities.

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1 INTRODUCTION

Benviron Group on behalf of Bicorp Pty Ltd (Bicorp) has been appointed consultant for the preparation of the Environmental Impact Statement (EIS) to support a development application for the Kembla Grange Resource Recovery facility. Pacific Environment was commissioned by Benviron Group to conduct this greenhouse gas assessment to form part of the EIS.

Based on information that has been provided to date, the Department of Planning and Infrastructure (NSW) provided a list of Director-General's environmental assessment requirements (DGRs) for the preparation of the EIS.

The DGR's state that the following matters relating to greenhouse gases must be addressed in the EIS:

- A quantitative assessment of the potential scope 1, 2 and 3 greenhouse gas emissions of the development, and a qualitative assessment of the potential impacts of these emissions on the environment.
- A detailed description of the measures that would be implemented on-site to ensure that the development is energy efficient.

1.1 Scope of Work

The Scope of Work for this assessment includes:

- A quantitative assessment of the potential scope 1, 2 and 3 greenhouse gas emissions of the development.
- A qualitative assessment of the potential impacts of these emissions on the environment.
- A detailed description of the measures that would be implemented on site to ensure that the development is energy efficient.

2 PROJECT DESCRIPTION

The proposed development is for the construction of a resource recovery centre that has the capacity to accept up to 230,000 m^3 of waste per year within Kembla Grange. The proposed development area is shown in Figure 2.1.

The size of the site is approximately 21.7 hectares and the size of the construction area associated with the resource recovery centre is approximately 4 hectares.

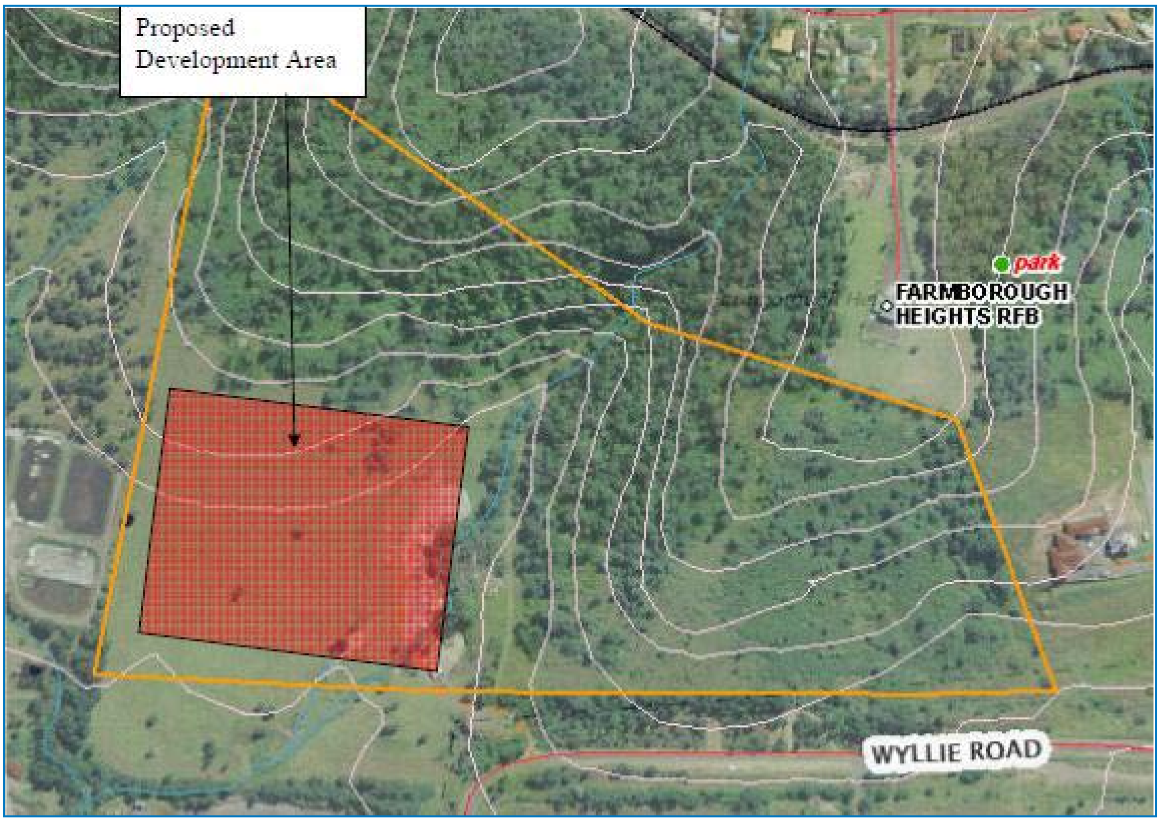

Figure 2.1: Proposed Development Area

3 GREENHOUSE GAS EMISSIONS INVENTORY

A quantitative assessment has been conducted to determine the potential Scope 1, 2 and 3 greenhouse gas (GHG) emissions of the development.

3.1 Emission Scopes

The World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) *Greenhouse Gas Protocol* (GHG Protocol) nominates three categories ('scopes') of activities that are likely to produce GHG emissions (WBCSD & WRI, 2004). Activities are categorised based on whether they are considered to have a 'direct' or 'indirect' contribution to a facility's GHG emissions. The three scopes are:

- **Scope 1:** Direct emissions – Emissions from sources owned or controlled by a company, such as company vehicles and office machinery.
- **Scope 2:** Indirect emissions from electricity consumption – emissions associated with the generation of electricity used by an entity.
- **Scope 3:** Indirect emissions that are a consequence of the activities of an entity, but which arise from sources not owned or controlled by the entity (excluding electricity consumption).

3.2 Assessment Boundaries

The boundaries of this assessment are shown in Figure 3.1.

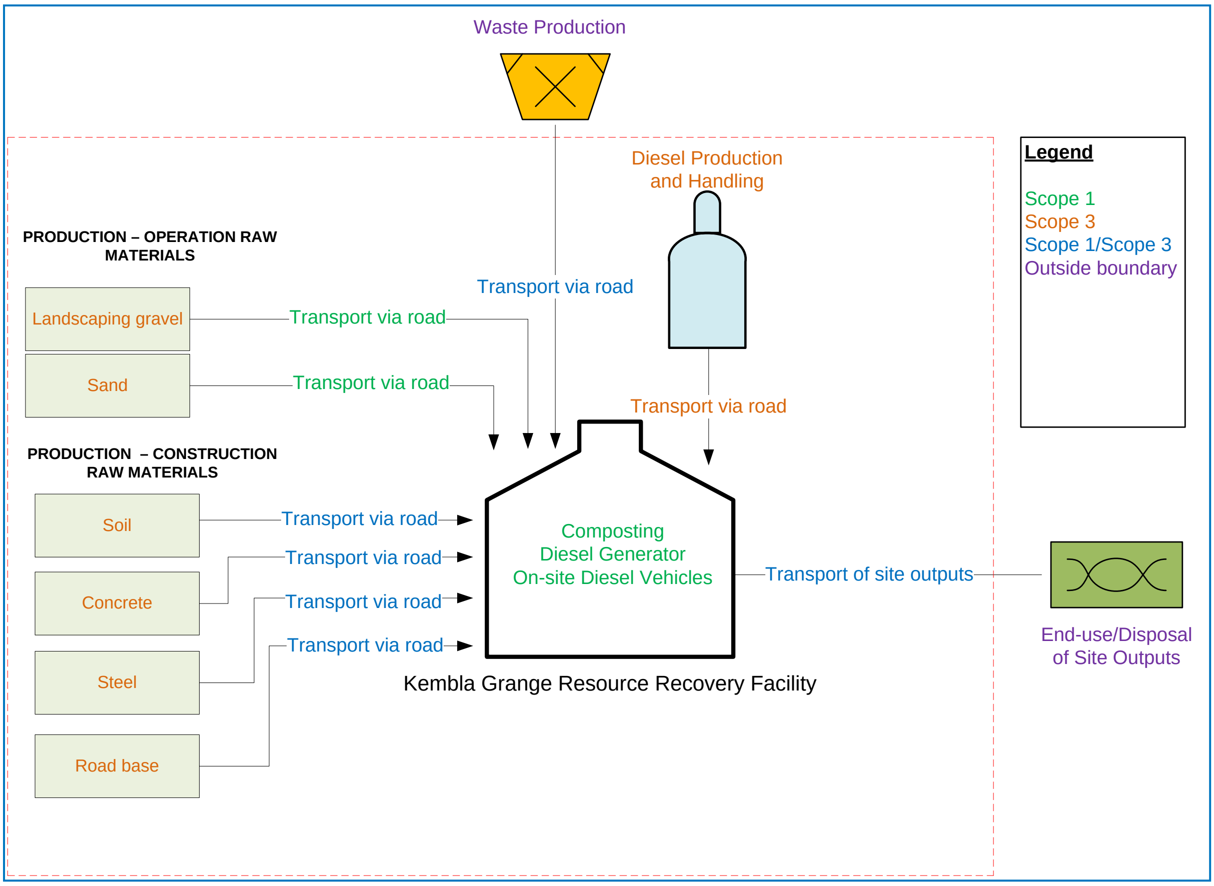

Figure 3.1: Assessment Boundaries

Waste inputs include green waste, soil, building and demolition waste and non putrescibles rubbish. Site outputs include road base, compost, soil for engineering purposes and soil for landscaping purposes. GHG emissions associated with production and handling of the waste itself and with the end-use/disposal of site outputs recovered from waste are outside of the boundaries of this assessment. For the purposes of comparison with other similar facilities, the emissions associated with the production of input material and disposal of output material would not vary between facilities.

In addition, the following emissions sources are considered to be negligible compared to the major emissions sources and have therefore not been considered in this assessment:

- Fugitive emissions of hydrofluorocarbons (HFCs) from any air-conditioning or refrigeration systems on-site.
- Emissions associated with decommissioning the facility and vehicles associated with the facility.
- Emissions associated with staff and visitors travelling to the site and staff business trips.

3.3 Emissions Sources

The Scope 1 and Scope 3 emissions sources considered in this assessment during construction and operation are provided in Table 1. The construction phase of the project is assumed to be one year in duration and the project lifespan is assumed to be 50 years.

It is assumed that all electricity required on-site during construction and operation will be generated by diesel power. Therefore, there are no Scope 2 emissions associated with electricity purchased from the grid.

Table 1: Emissions Sources Considered in this Assessment

Scope	Emissions Sources
Construction	
Scope 1	Diesel combustion for stationary energy purposes
	Diesel use in on-site construction vehicles
	Diesel use in vehicles transporting construction materials to site [a]
Scope 3	Emissions associated with the production of diesel
	Emissions associated with the production of construction materials
Operation	
Scope1	Diesel combustion for stationary energy purposes
	Diesel use in on-site vehicles
	Diesel used in vehicles owned/operated by Bicorp transporting operation raw materials and waste to site and transporting outputs from site to end-use/disposal locations [b]
	Composting Emissions
Scope 3	Emissions associated with the production of diesel
	Emissions associated with the production of operation raw materials
	Diesel used in vehicles not owned/operated by Bicorp transporting operation raw materials and waste to site and transporting outputs from site to end-use/disposal locations [b]

a. It is assumed that all vehicles transporting construction materials to the site will be owned/operated by Bicorp.
b. It is assumed that 50% of operation raw materials and waste to site and outputs from site to end-use /disposal locations will be transported by vehicles owned/operated by Bicorp.

3.4 Greenhouse Gases

The greenhouse gases considered in this assessment are:

- Carbon dioxide (CO_2).
- Methane (CH_4).

- Nitrous oxides (N_2O).

The GHG Protocol covers the six greenhouse gases listed in the Kyoto Protocol namely, CO_2, CH_4, N_2O, HFCs, perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). As stated above, fugitive emissions of HFCs from any air-conditioning or refrigeration systems on-site would be negligible. It is assumed that PFCs and SF_6 would not be used, stored or generated on-site.

3.5 Emissions Estimation Methodology

Where possible, emission factors have been obtained from the Department of Climate Change and Energy Efficiency (DCCEE) *National Greenhouse Accounts* (NGA) *Factors Workbook* (NGA Workbook) (DCCEE, 2012a). As the NGA Workbook did not contain embodied emission factors for construction materials and operation raw materials, these emission factors were obtained from the Inventory of Carbon and Energy (Hammond & Jones, 2008).

The emission estimation methodologies for each emission source considered in this assessment are described in the following sections.

3.5.1 Diesel Combustion for Stationary Energy Purposes – Scope 1

An on-site diesel generator is to provide all power to the site during construction and operation. GHG emissions from the combustion of diesel for stationary energy purposes have been estimated using the following equation, in accordance with Section 2.1.3 of the NGA Workbook:

$$E_{ij} = \frac{Q_i \times EC_i \times EF_{ijoxec}}{1000}$$

where:

E_{ij}	=	Emissions of gas type *j* (CO_2, CH_4, N_2O) from fuel type *i*	t CO_2-e
Q_i	=	Quantity of fuel type *i* combusted for stationary energy purposes	kL
EC_i	=	Energy content of fuel type *i* for stationary energy purposes	GJ/kL
EF_{ijoxec}	=	Emission factor for each gas type *j* (which includes the effect of an oxidation factor) for fuel type *i*	kg CO_2-e/GJ

The energy content and emission factors for each gas type for diesel were obtained from Table 3 of the NGA Workbook and are shown in Table 2.

Table 2: Parameters for Diesel Combustion for Stationary Energy Purposes

Parameter	Value	Unit
Energy content factor	38.6	GJ/kL
Carbon dioxide emission factor	69.2	kg CO_2-e/GJ
Methane emission factor	0.1	kg CO_2-e/GJ
Nitrous oxide emission factor	0.2	kg CO_2-e/GJ

Source: DCCEE (2012a)

It is assumed that the diesel generator will consume 0.5 kilolitres of diesel per annum during construction and operation.

3.5.2 Diesel Combustion for Transport Purposes – Scope 1

Diesel is used in on-site vehicles during construction and operation. In addition, it is assumed that diesel vehicles will be used to transport construction materials, operations raw materials and waste to the site and to transport outputs from the site to end-use/disposal locations.

GHG emissions from the combustion of diesel for transport purposes have been estimated using the following equation, in accordance with Section 2.2 of the NGA Workbook:

$$E_{ij} = \frac{Q_i \times EC_i \times EF_{ijoxec}}{1000}$$

where:

E_{ij}	=	Emissions of gas type *j* (CO_2, CH_4, N_2O) from fuel type *i*	t CO_2-e
Q_i	=	Quantity of fuel type *i* combusted for transport purposes	kL
EC_i	=	Energy content of fuel type *i* for transport purposes	GJ/kL
EF_{ijoxec}	=	Emission factor for each gas type *j* (which includes the effect of an oxidation factor) for fuel type *i*	kg CO_2-e/GJ

The energy content and emission factors for each gas type for diesel were obtained from Table 4 of the NGA Workbook and are shown in Table 3.

Table 3: Parameters for Diesel Combustion for Transport Purposes

Parameter	Value	Unit
Energy content factor	38.6	GJ/kL
Carbon dioxide emission factor	69.2	kg CO_2-e/GJ
Methane emission factor	0.2	kg CO_2-e/GJ
Nitrous oxide emission factor	0.5	kg CO_2-e/GJ

Source: DCCEE (2012a)

Bicorp advised that all vehicles owned/operated by Bicorp will consume 65 kilolitres per annum during construction and operation. It is assumed that all vehicles transporting construction materials to the site will be owned/operated by Bicorp. Therefore, the 65 kilolitres of diesel per annum consumed during construction includes the transport of construction materials to the site by vehicles owned/operated by Bicorp.

It is assumed that 50% of operation materials (operation raw materials and waste to site and outputs from site to end-use/disposal locations) will be transported by vehicles owned/operated by Bicorp. Therefore, the 65 kilolitres of diesel per annum consumed during operation only includes the transport of operation materials by vehicles owned/operated by Bicorp. It is assumed that an additional 65 kilolitres of diesel per annum will be used in vehicles not owned/operated by Bicorp to transport operation materials.

3.5.3 Composting Emissions – Scope 1

Green waste will be treated on-site by composting. GHG emissions from composting have been estimated using the following equations, in accordance with Section 4.2 of the NGA Workbook:

$$CH_4\ Emissions = (Q_i \times EF_i) - R$$

where:

$CH_4\ Emissions$	=	Methane emissions	t CO_2-e
Q_i	=	Mass of wet organic waste treated by composting	t
EF_i	=	Methane mission factor for composting	t CO_2-e/t waste treated
R	=	Amount of methane recovered	t CO_2-e

$$N_2O\ Emissions = (Q_i \times EF_i)$$

where:

$N_2O\ Emissions$	=	Nitrous oxide emissions	t CO_2-e
Q_i	=	Mass of wet organic waste treated by composting	t
EC_i	=	Nitrous oxide mission factor for composting	t CO_2-e/t waste treated

The methane and nitrous oxide emission factors for compositing are 0.08 tonnes CO_2-e/tonne waste treated and 0.09 tonnes CO_2-e/tonne of waste treated respectively (DCCEE, 2012a). Under Development Consent 2009/1153/A, the site may only accept up to 5,000 tonnes per year of non-putrescible organics. It is therefore assumed that 5,000 tonnes of green waste per annum will be treated by compositing on-site during operation.

3.5.4 Diesel Combustion in Vehicles not Owned/Operated by Bicorp – Scope 3

As stated in Section 3.5.2, it is assumed that 50% of operation materials (operation raw materials and waste to site and outputs from site to end-use/disposal locations) will be transported by vehicles owned/operated by Bicorp. Therefore, the 65 kilolitres of diesel per annum consumed during operation only includes the transport of operation materials by vehicles owned/operated by Bicorp. It is assumed that an additional 65 kilolitres of diesel per annum will be consumed in vehicles not owned/operated by Bicorp to transport operation materials.

The same methodology as described in Section 3.5.2 has been used to estimate Scope 3 emissions associated with the transport of operation raw materials and waste to site and transport of outputs from site to end-use/disposal locations in vehicles not owned/operated by Bicorp.

3.5.5 Embodied Emissions – Scope 3

Embodied emissions have been estimated for diesel combusted, construction materials and operation raw materials. The usage and embodied emission factors for site inputs are shown in Table 4.

The diesel embodied emission factor was obtained from the NGA Workbook. As the NGA Workbook did not contain embodied emission factors for construction materials and operation raw materials, these emission factors were obtained from the Inventory of Carbon and Energy (Hammond & Jones, 2008).

The system boundary for all embodied emission factors obtained from ICE was “cradle to gate” except for soil which was “cradle to site”. Therefore, Scope 3 emissions associated with soil will be conservative as emissions associated with transporting soil to the site have already been considered under Scope 1 emissions.

Table 4: Usage and Embodied Emission Factors for Site Inputs

Input	Amount	Unit	Emission Factor	Unit	Source of Emission Factor
Fuel					
Total diesel combusted during construction (for stationary energy and transport purposes)	65.5	kL/a	5.3	kg CO_2-e/GJ	Table 39, NGA Workbook
Total diesel combusted during operation(for stationary energy and transport purposes)	130.5	kL/a	5.3	kg CO_2-e/GJ	Table 39, NGA Workbook
Construction Materials					
Soil	40,000	tonnes/a	0.023	kg CO_2-e/kg	ICE (Hammond & Jones, 2008)
Concrete	1,000 [a]	m^3/a	0.13	kg CO_2-e/kg	ICE (Hammond & Jones, 2008)
Steel	20,000	tonnes/a	1.77	kg CO_2-e/kg	ICE (Hammond & Jones, 2008)
Road base	20,000	tonnes/a	0.031 [b]	kg CO_2-e/kg	ICE (Hammond & Jones, 2008)
Water	10,000	litres/a	ND	ND	ND
Operation Raw Materials					
Landscaping gravel	20,000	tonnes/a	0.017	kg CO_2-e/kg	ICE (Hammond & Jones, 2008)
Sand	20,000	tonnes/a	0.005	kg CO_2-e/kg	ICE (Hammond & Jones, 2008)

a. Converted to mass using density of 1,940 kg/m^3 for concrete block, medium weight, 300 mm (Hammond & Jones, 2008).
b. Average of emission factors for sand and stone.

3.6 Emissions

The Scope 1 and Scope 3 emissions associated with the construction stage (one year) and operation stage (50 years) of the project are shown in Table 5 and Table 6 respectively.

The Scope 1 and Scope 3 construction emissions are 37,372 tonnes of carbon dioxide equivalent (t CO_2-e), occurring during one year only. The Scope 1 and Scope 3 emissions during operation are 1,669 t CO_2-e per annum.

Table 5: Scope 1 and Scope 3 Construction Emissions

Emissions Source	Quantity Consumed	Units	Scope 1 Emissions (t CO_2-e)	Scope 3 Emissions (t CO_2-e)
Diesel combustion for stationary energy purposes	0.5	kL	1.3	0.10
Diesel use in construction vehicles [a]	65	kL	175	13
Construction Materials Embodied Emissions				
Soil	40,000	t	-	920
Concrete	1,000	m^3	-	252
Steel	20,000	t	-	35,400
Road base	20,000	t	-	610
Water	10,000	L	-	ND
Subtotal			177	37,196
Total Scope 1 and Scope 3 Construction Emissions (t CO_2-e)			37,372	

a. Including the transport of construction materials to site.

Table 6: Scope 1 and Scope 3 Operations Emissions

Emissions Source	Quantity Consumed/ Processed Annually	Units	Scope 1 Emissions ($t\ CO_2$-e/y)	Scope 3 Emissions ($t\ CO_2$-e/y)
Diesel combustion for stationary energy purposes	0.5	kL	1.3	0.10
Diesel use in vehicles owned/operated by Bicorp [a]	65	kL	175	13
Diesel use in vehicles not owned/operated by Bicorp [a]	65	kL	-	189
Composting	5,000	t	850	-
Operation Raw Materials Embodied Emissions				
Landscaping gravel	20,000	t	-	340
Sand	20,000	t	-	100
Subtotal			1,027	642
Total Scope 1 and Scope 3 Operations Emissions per year ($t\ CO_2$-e/y)			1,669	
Total Scope 1 and Scope 3 Operations Emissions for Project ($t\ CO_2$-e)			83,440	

4 POTENTIAL IMPACTS OF THE PROJECT

The *Synthesis Report of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC, 2007) includes an up to date description of projected impacts of future climate change on global systems, sectors and regions.

Projected regional greenhouse impacts for Australia include (IPCC, 2007):

- By 2020, it is projected that there will be a significant loss of biodiversity in certain sites of high ecological significance, including the Great Barrier Reef and Queensland Wet Tropics.
- By 2030, in southern and eastern Australia, water security problems are expected to intensify and production from agriculture and forestry is projected to decline.
- By 2050, in some areas of Australia, it is anticipated that risks from sea level rise and increases in the severity and frequency of storms and coastal flooding will be exacerbated due to continuing coastal development and population increase.

Table 7 shows the project's estimated contribution to regional, national and global emissions of greenhouse gases. As expected, the project's contribution during operation (Scope 1 emissions only) to global greenhouse impacts is negligible, at 0.000002%.

Table 7: Estimated Contribution to Greenhouse Gas Emissions

Greenhouse Indicator	Value	Units	Project Contribution (%)
Project emissions per annum during operation (Scope 1 emissions)	1,027	t CO_2-e	-
NSW Total Emissions for 2009/10 [a]	157.4	Mt CO_2-e	0.0007
Australia's Total Emissions for 2009/10 [a]	560.8	Mt CO_2-e	0.0002
Global Anthropogenic 2004 Emissions [b]	49.0	Gt CO_2-e	0.000002

a. *Australian National Greenhouse Accounts, State and Territory Greenhouse Gas Inventories, 2009-10* (DCCEE, 2012b).
b. *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC, 2007).

It should be noted that composting of green waste produces less greenhouses emissions than if this waste was sent to landfill. A sensitivity analysis[a] showed that if the 5,000 tonnes of green waste received at the facility per annum was sent to landfill rather than composted, emissions would be approximately 82% greater over the lifespan of the project.

[a] Landfill emissions for the project lifespan (50 years) were calculated using the *National Greenhouse and Energy Reporting (NGER) Solid Waste Emissions Calculator Version 1.7* (CER, 2012), assuming that all green waste received is classified as "garden and park" waste and that no flaring or combustion in engines of methane occurs.

5 ENERGY EFFICIENT MEASURES

5.1 Energy Consumption Processes

The following processes that consume energy have been indentified for the project:

- Diesel usage in on-site generator during construction and operation to provide all power to the site.
- Diesel usage in on-site vehicles.
- Diesel usage to transport construction materials, operation raw materials and waste to the site and to transport site outputs to end-use/disposal location.

5.2 Energy Efficiency Measures

If the Project is approved, a number of design features and management measures can be implemented to ensure that the process is energy efficient. Details of these measures are provided in the sections below.

5.2.1 Energy Management System

It is recommended that the Project establishes an energy management system in accordance with ISO 50001:2011(E), *Energy management systems – requirements with guidance for use*. Implementation of ISO 50001:2011 "is intended to lead to reductions in greenhouse gas emissions and other related environmental impacts and energy cost through systematic management of energy".

The energy system model from this International Standard is shown in Figure 5.1. This model is based on the Plan – Do – Check – Act (PDCA) continual improvement framework. The model involves defining the organisation's energy policy, conducting and documenting an energy planning process and then implementing the resulting energy plans and outputs of the planning process. Top management should review the energy management system at planned intervals to guarantee its ongoing suitability, adequacy and effectiveness. Checking is a key part of the model involving addressing actual and potential nonconformities, performing internal audits and monitoring, measuring and analysing key characteristics that determine energy performance.

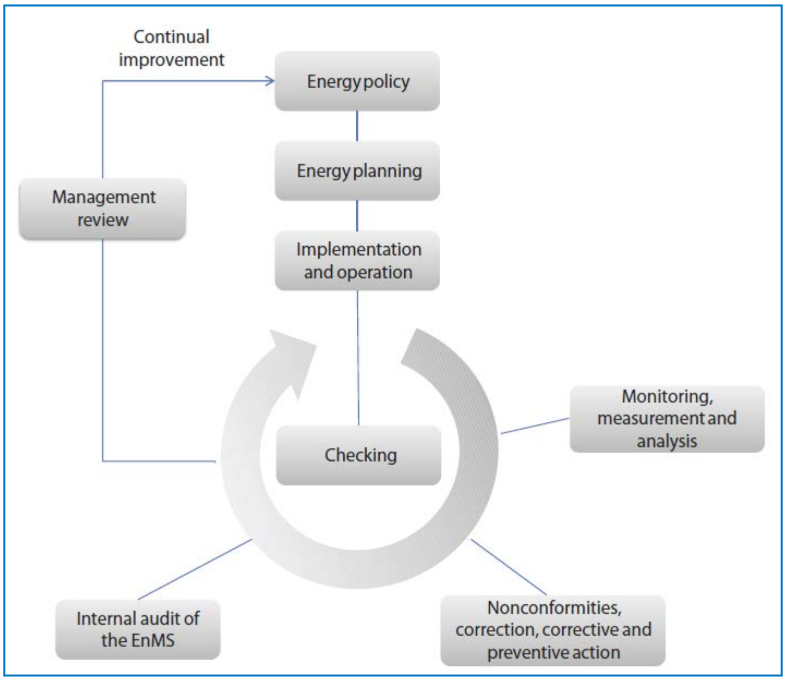

Figure 5.1: Energy System Model (ISO 50001:2011(E))

5.2.2 On-Site Facilities

The following energy efficient measures are recommended for on-site facilities:

- Implement energy metering and monitoring.
- Employ efficient lighting and lighting control technologies (timers and light level sensors).
- Utilise energy efficient appliances and office equipment.

5.2.3 Road Transport

The following energy efficient measures are recommended for road transport vehicles:

- Investigate possibilities to backload trucks.
- Choose most direct haulage routes possible.
- Adopt fuel efficient driving practices, including anticipatory driving (accelerating and braking), optimised gear shifting and astute speed selection (OECD, 2011). Studies have shown that adopting such techniques can reduce fuel consumption by 5-15% on average (OECD, 2011).
- Consider fuel efficiency as part of vehicle purchasing policies.

5.3 Benchmarking Emissions Intensity

Total greenhouse gas emissions from the project have been benchmarked against other facilities in the New South Wales Greater Metropolitan Region (NSW GMR) in terms of a comparison of emissions per tonne of waste processed.

Sector specific greenhouse gas emissions data and activity rates have been sourced from the *NSW EPA's Air Emissions Inventory for the Greater Metropolitan Region in New South Wales, 2008 Calendar Year, Industrial Emissions: Results* (NSW EPA, 2012). Data from the "Recovery of Waste" industry was used for comparison.

Table 8 shows the greenhouse gas emissions intensity for the project during operation (Scope 1 emissions only) benchmarked against other facilities in the NSW GMR.

The greenhouse gas emissions intensity for the project, in terms of emissions per tonne of waste processed is five times greater than the greenhouse gas emissions intensity for other facilities in the NSW GMR. The majority of Scope 1 emissions during operation are from composting. The emissions intensity for the project may be higher than for other facilities in the NSW GMR as not all these facilities may have on-site composting. It is also likely that many other similar facilities would not have on-site electricity generation. That is, a large part of the emissions inventory for other facilities may comprise of Scope 2 emissions. When taking this difference in reporting boundaries into account, the emissions associated with this project would likely be more comparable with those of other facilities.

Table 8: Benchmarking Emissions Intensity

Source	kg CO_2-e/tonne waste processed
Project emissions per annum during operation [a]	4.5
NSW GMR [a]	0.90

a. Scope 1 emissions only.

b. Calculated using activity data listed in Table 3-327 and emissions data listed in Table A-62 (NSW EPA, 2012) and greenhouse gas global warming potentials listed in Table 26 of *Australian National Greenhouse Accounts, National Greenhouse Accounts Factors, July 2012* (DCCEE, 2012a).

6 LIMITATIONS

Several limitations with this assessment have been identified, as follows:

- The embodied emission factors for construction materials and operation raw materials were obtained from the Inventory of Carbon and Energy (ICE) (Hammond & Jones, 2008). While data incorporated in ICE is obtained from world-wide sources, preference is given to United Kingdom sources.
- Scope 3 embodied emissions for water, a construction material, were not calculated as an embodied emission factor could not be obtained.
- Fuel usage in vehicles not owned/operated by Bicorp was assumed based on the assumption that 50% of operation materials (operation raw materials and waste to site and outputs from site to end-use/disposal locations) will be transported by vehicles owned/operated by Bicorp.

7 CONCLUSION

The Scope 1 and Scope 3 construction emissions are 37,372 t CO_2-e. The Scope 1 and Scope 3 emissions during operation are 1,669 t CO_2-e per annum. The project's contribution during operation (Scope 1 emissions only) to global greenhouse impacts is negligible, at 0.000002%, when compared to global anthropogenic 2004 emissions.

It should be noted that composting of green waste produces less greenhouses emissions than if this waste was sent to landfill. A sensitivity analysis showed that if the 5,000 tonnes of green waste received at the facility per annum was sent to landfill rather than composted, emissions would be 82% greater over the lifespan of the project.

A number of energy efficient measures have been identified for the project, including the development of an energy management system in accordance with ISO 50001:2011(E) and energy efficient measures for on-site facilities and for road transport vehicles.

The greenhouse gas emissions intensity for the project, in terms of emissions per tonne of waste processed is five times greater than the greenhouse gas emissions intensity for other facilities in the NSW GMR. The majority of Scope 1 emissions during operation are from composting. The emissions intensity for the project may be higher than for other facilities in the NSW GMR as not all other facilities are likely to include on-site composting. It is also unlikely that many other similar facilities would have on-site electricity generation. That is, a large part of the emissions inventory for other facilities may comprise of Scope 2 emissions. When taking this difference in reporting boundaries into account, the emissions associated with this project would likely be more comparable with those of other facilities.

Several limitations of this assessment have been identified however these limitations are not expected to significantly impact the outcome of the assessment.

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