APPENDIX 11

Greenhouse Gas Assessment

GREENHOUSE GAS EMISSIONS STUDY

FOR

MANILDRA PARK

MARINE FUEL STORAGE AND DISTRIBUTION AND BIODIESEL PRODUCTION FACILITY, KOORAGANG ISLAND

BY

SEE SUSTAINABILITY CONSULTING

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1 Introduction

Manildra Park Pty Limited proposes to construct and operate a marine fuel / diesel distribution and biodiesel production facility off Greenleaf Road, Kooragang Island, referred to hereafter as “the Project”. A Greenhouse Gas Assessment (referred to hereafter as the Assessment) has been completed for the project, in accordance with the Director Generals requirements issued for the Project.

The scope of the Assessment includes:

- An estimate of the energy consumption and greenhouse gas emissions from the project in accordance with recognised assessment guidelines;

- Identification and evaluation of the benefits of reduced emissions as a result of
  - reduced fuel consumption due to the distribution of fuels from a local distribution facility; and
  - biodiesel use rather than diesel.

The Assessment is based upon the methodologies outlined in:

- the World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI) Greenhouse Gas Protocol; and

- the Australian Greenhouse Office (AGO) Factors and Methods Workbook December 2006.

The Assessment has been prepared using information from Manildra Park provided by Umwelt Environmental Consultants regarding annual production schedules, annual electricity consumption, and annual diesel consumption for the barge and trucks for the Project.

2 Energy Consumption and Greenhouse Gas Emissions

This section provides an assessment of the energy consumption and greenhouse gas emissions from the Project.

2.1 Scope of Emissions Inventory

The above mentioned guidelines define three “scopes” of emissions categories for a project:

- Scope 1 covers direct emissions from the combustion of fuels (e.g. diesel) and industrial processes within the boundary of the operation;
- Scope 2 covers indirect emissions from the operation’s consumption of purchased electricity produced by another organisation;
- Scope 3 includes other indirect emissions as a result of the operation’s activities that are not from sources owned or controlled by the organisation (for example, product transport by truck).

Direct emissions are produced from sources within the boundary of an operation as a direct result of its activities e.g. combustion of diesel fuels in a boiler.

Indirect emissions are produced outside the boundary of the operation by other organisations but are directly linked to the operation’s activities. **Table 1** below shows how the physical source of the emissions, i.e. direct or indirect, relates to the Scope of Emissions.

The term “operation’s activities” refers to the activities associated with the Project that occur within the Project Area.

Full Fuel Cycle emission factor gives the quantity of emissions released per unit of energy for the entire fuel production and consumption chain. For fuel combustion, the full fuel cycle emissions factor is the sum of the direct emissions factor for the fuel and the specific “scope 3” emissions factor for the emissions from the extraction, production and transport of the fuel. For the consumption of purchased electricity, the full fuel cycle emissions factor is the sum of the “Scope 2” indirect emissions factor for emissions from fuel combustion at the power station and the specific “scope 3” emissions factor for the emissions from the extraction, production and transport of that fuel and for the emissions associated with electricity lost in transmission and distribution (AGO, 2006, p.1-4).

Table 1 – Direct & Indirect Emissions versus Scope of Emissions

	Scope 1	Scope 2	Scope 3
Direct (Within the boundary of the operation)	Diesel consumption by the operation		
Indirect (Outside the boundary of the operation)			Upstream emissions due to the operation's consumption of diesel[a]
		Electricity consumption by the operation	Upstream emissions due to the operation's consumption of electricity[b]
			Diesel consumption for product transport
			Emissions from the combustion of fuel products
			Upstream emissions associated with the production of biodiesel

a Indirect emissions attributable to the extraction, production and transport of those fuels
b Indirect emissions from the extraction, production and transport of fuel burned at the point of electricity generation and the indirect emissions attributable to the electricity lost in delivery in the transmission and distribution network
(Energy Strategies, 2000; AGO, 2006, p.1-4.)

Scope 3 diesel combustion emissions associated with the road transport of fuel have been included in the inventory calculation for the Project. The World Business Council for Sustainable Development and World Resources Institute *Greenhouse Gas Protocol* 2004 considers the reporting of Scope 3 emissions to be optional. If an organisation believes that Scope 3 emissions are a significant component of the total emissions inventory, these can be reported along with Scope 1 and 2. However, it should be noted that reporting Scope 3 emissions can result in double counting of emissions and can also make comparisons between organisations and/or projects difficult because reporting is voluntary. Despite the Project not controlling Scope 3 emissions, an assessment of Scope 3 emissions have been included in the tables below.

Consistent with the methodologies previously described, Scope 3 emissions not included in the greenhouse inventory for the assessment are:

- disposal of waste generated;
- disposal (end of life) of products sold;
- employee business travel;

- employees commuting to and from work;
- extraction, production and transport of other purchased materials and goods;
- delivery of material to the project i.e. ship, train or truck transport. The transport of fuel from its point of origin to the Project has not been included as the greenhouse gas emissions associated with this operation are considered to be equivalent to transport of fuel to existing facilities from overseas destinations to either Port Kembla or Sydney;
- out sourced activities; and
- transport of miscellaneous materials and waste off site.

The energy consumption and greenhouse gas emissions assessment for the Project has been broken up into three areas:

- Energy consumption and greenhouse gas emissions occurring at the proposed project site (i.e. directly under the control of the project) – **Table 2**;
- Energy consumption and greenhouse gas emissions from transporting fuel to customers (i.e. not directly under the control of the project, but influenced by the location and output of the project) – **Table 3**; and
- Energy consumption and greenhouse gas emissions associated with the end use of the fuels produced and distributed by the project (i.e. indirectly associated with the project) – **Table 5**.

2.2 Scope 1, 2 & 3 Energy Consumption and Greenhouse Gas Emissions at the Proposed Site

Table 2 shows that most of the Project's estimated annual on-site (Scope 1) energy usage is associated with the production of steam in the diesel fired boiler, which is mostly used in the biodiesel production process in Phase 3 of the operation. The annual electricity consumption when the project is operating at full capacity is 6,696 GJ, while the diesel consumption used by the boiler and the barge refueling operations is 32,568 GJ (844 kL).

Most of the on-site greenhouse gas emissions for the project are associated with the production of biodiesel. However, the end use of biodiesel results in less greenhouse gas emissions compared with using standard diesel, so these emissions are offset, as discussed in Section 3 below.

Greenhouse gas emissions associated with the production of biodiesel upstream from the site (such as agricultural activities associated with growing the crop and extracting & processing the feedstock oil etc) have not been included in **Table 2**. However, these upstream emissions have been taken into account when calculating the net greenhouse gas impact of the use of biodiesel instead of petroleum diesel (see Section 3.3).

The energy use and greenhouse gas emission estimates contained in **Table 2** are based on the following assumptions:

- The electricity (general use) figure was based on electricity usage data for Manildra Park's existing Port Kembla refuelling operations. It is assumed to include electricity used in the pumping of products between ships, on-site storage and tanker trucks, as well as for on-site lighting and administration building requirements. It is assumed that the electricity requirements of the proposed operation will be identical to the Port Kembla site. This figure does not include electricity associated with biodiesel production;

- The energy used in biodiesel production from canola oil (electricity and steam) was calculated based on information in the AGO Biofuels calculator indicating that electricity usage is 0.033kW and steam usage is 0.422MJ per kg refined oil processed (note that 1kg of refined oil processed is equivalent to 1L of biodiesel produced, as the efficiency of the process is approximately 87% and the density of biodiesel is approximately 0.87kg/L). Note that these values will be approximately the same regardless of the raw oil feedstock, but that energy use and emissions further upstream will vary for different feedstocks. The AGO provides emissions factors for three biodiesel feedstocks – canola, tallow and waste oil (eg grease trap waste). The canola emission factors is considered to be representative of crops grown in Australia and a conservative approach as the use of tallow or waste oil will result in the production of less greenhouse gas emissions per litre of biodiesel produced;

- The steam required for the biodiesel plant is assumed to be produced on-site in a 5MW diesel/biodiesel fired boiler. The efficiency of the diesel fired boiler is assumed to be 75%;

- A small portion of the steam is used to heat the Marine Fuel Oil (MFO) storage tanks, to prevent the MFO from solidifying and thus maintaining it in a pumpable state. Based on information provided by Umwelt on steam usage to heat the MFO storage tanks at Port Kembla, around 6.6 GJ of steam (requiring 8.6 GJ fuel in the boiler) will be required for this purpose (compared with 29,259 GJ of fuel required to produce the steam for biodiesel production).

- Diesel consumption for the ship refueling barge was calculated based on the barge having a 1600 T capacity (i.e. approximately 1600 kL), requiring it to make approximately 190 trips per year to deliver 305 ML of fuel (280 ML of marine fuel oil plus 25 ML of diesel). The barge is assumed to be able to pump at 300 T/hr, requiring approximately 5.5 hrs to transfer its load, or 7.5 hrs per trip (allowing for 1 hour each way to travel between the dock and the ships). The barge diesel consumption rate was assumed to be 60 L/hr (conservative figure based on diesel engine consumption), corresponding to 450 L per trip. This all equates to the barge consuming 86 kL of diesel per year;

- The diesel consumption figures were multiplied by 38.6 GJ/kL to arrive at the total GJ of diesel consumed (AGO 2006, Table 3, p. 10);

- For electricity, the scope 2 emissions factor is 0.893 kgCO_2-e/kWhr and the scope 3 emissions factor is 0.176 kgCO_2-e/kWhr (See Table 1, AGO 2006);

- For Diesel, the scope 1 emissions factor is 2.7 TCO_2-e/kL and the scope 3 emissions factor is 0.3 TCO_2-e/kL (See Table 1, AGO 2006).

Table 2 – Manildra Park Kooragang Island Project Scope 1, 2 & 3 Energy Usage & Greenhouse Gas Emissions Estimate (Activities at Proposed Site Only)

Year	Biodiesel Production (ML/yr)	Marine Fuel Oil Distribution (ML/yr)	Diesel Distribution (ML/yr)	Emissions Source	Scope 1 Usage (Direct)	Scope 2 Usage (Indirect)	Scope 3 Usage (Indirect)	Total Usage	Units	Total Usage in GJ	% of Energy Use	Scope 1 Emissions in TCO2e (Direct)	Scope 2 Emissions in TCO2e (Indirect)	Scope 3 Emissions in TCO2e (Indirect)	Total Emissions in TCO2e (Full Fuel Cycle)	% of Emissions
1-3	19	190	110	Electricity, General Use (storage/distribution/admin facilities)		144		144	MWh	518	3.3%		128	25	154	8.4%
				Electricity, Biodiesel Production		627		627	MWh	2,257	14.4%		560	110	670	36.6%
				Diesel (For Production of Steam)	277			277	kL	10,694	68.1%	748		83	831	45.4%
				Diesel (Ship Refuelling via Barge)	58			58	kL	2,239	14.3%	157		17	174	9.5%
				Total						**15,708**	**100%**	**905**	**688**	**236**	**1,829**	**100.0%**
4-6	44	280	245	Electricity, General Use (storage/distribution/admin facilities)		144		144	MWh	518	1.5%		128	25	154	4.0%
				Electricity, Biodiesel Production		1,452		1,452	MWh	5,227	15.5%		1,297	256	1,552	39.9%
				Diesel (For Production of Steam)	642			642	kL	24,765	73.2%	1,732		192	1,925	49.5%
				Diesel (Ship Refuelling via Barge)	86			86	kL	3,300	9.8%	231		26	257	6.6%
				Total						**33,810**	**100%**	**1,963**	**1,425**	**499**	**3,887**	**100.0%**
7-10+	52	280	245	Electricity, General Use (storage/distribution/admin facilities)		144		144	MWh	518	1.3%		128	25	154	3.4%
				Electricity, Biodiesel Production		1,716		1,716	MWh	6,178	15.7%		1,532	302	1,834	40.6%
				Diesel (For Production of Steam)	758			758	kL	29,268	74.5%	2,047		227	2,275	50.3%
				Diesel (Ship Refuelling via Barge)	86			86	kL	3,300	8.4%	231		26	257	5.7%
				Total						**39,263**	**100%**	**2,278**	**1,661**	**580**	**4,519**	**100.0%**

2.3 Scope 3 Energy Consumption and Greenhouse Emissions Resulting from Road Transport of Diesel and Biodiesel to the Hunter Valley

Table 3 shows the estimated energy consumption and greenhouse gas emissions associated with transporting diesel and biodiesel from the proposed Manildra Park Kooragang Island Project to bulk fuel end users in the Hunter Valley. In calculating these values it has been assumed that:

- The trucks have an average capacity of 39.6 kL (60% are 34 kL capacity semi-trailers and 40% are 48 kL B-Doubles), the distance from the Kooragang Island Project to Singleton is approximately 160 km return, and diesel consumption by the trucks is 0.418L/km (based on reported values of 230L for the 550km round trip between Port Kembla and Newcastle) (Umwelt, 2007);

- 220ML of the 245ML of diesel distributed annually by the project goes to Hunter Valley bulk users (Umwelt, 2007). The remaining 25ML is supplied to ships. For the years 1-3 it is assumed that the 110ML of diesel is distributed in the same proportions, i.e. 99ML is supplied to Hunter Valley bulk fuel users and 11 ML is supplied to ships;

- The diesel consumption figures were multiplied by 38.6 GJ/kL to arrive at the total GJ of diesel consumed (AGO 2006, Table 3, p. 10);

- The full fuel cycle emissions factor for diesel consumption is 3.0 TCO_2-e/kL (AGO 2006).

Table 3 – Estimated energy consumption and greenhouse gas emissions associated with transporting diesel and biodiesel to Hunter Valley bulk fuel users

Year	Biodiesel Production (ML/yr)	Diesel for Bulk Fuel Users (ML/yr)	Diesel and Biodiesel Distribution (ML/yr)	Emissions Source	Scope 3 Usage (Indirect) in kL	Usage in GJ	Full Fuel Cycle Emissions Factor	Scope 3 Emissions in TCO2e (Indirect)
1-3	19	99	118	Diesel	199	7,696	3	598
4-6	44	220	264	Diesel	446	17,218	3	1,338
7-10+	52	220	272	Diesel	460	17,740	3	1,379

2.4 Total Energy Consumption and Greenhouse Emissions Associated with the Project

The total energy consumption and greenhouse emissions associated with operations at the proposed site and with the distribution of products to end users is shown in **Table 4** below.

The Table shows that approximately three-quarters of the greenhouse gas emissions for the project are associated with activities at the project site, with the remaining one-quarter associated with truck transportation of the fuel products.

Table 4 – Total Energy Consumption and Greenhouse Emissions Associated with the Project

Year	Emissions Source	Scope 1 Usage (Direct)	Scope 2 Usage (Indirect)	Scope 3 Usage (Indirect)	Total Usage in GJ	% of Energy Use	Scope 1 Emissions in TCO2e (Direct)	Scope 2 Emissions in TCO2e (Indirect)	Scope 3 Emissions in TCO2e (Indirect)	Total Emissions in TCO2e (Full Fuel Cycle)	% of Emissions
1-3	Site	12,933	2,775	0	15,708	67.12%	905	688	236	1,829	75.36%
	Distribution	0	0	7,696	7,696	32.88%	0	0	598	598	24.64%
	Total	**12,933**	**2,775**	**7,696**	**23,404**	**100.00%**	**905**	**688**	**834**	**2,427**	**100.00%**
4-6	Site	28,065	5,745	0	33,810	66.26%	1,963	1,425	499	3,887	74.39%
	Distribution	0	0	17,218	17,218	33.74%	0	0	1,338	1,338	25.61%
	Total	**28,065**	**5,745**	**17,218**	**51,028**	**100.00%**	**1,963**	**1,425**	**1,837**	**5,225**	**100.00%**
7-10+	Site	32,568	6,695	0	39,263	68.88%	2,278	1,661	580	4,519	76.62%
	Distribution	0	0	17,740	17,740	31.12%	0	0	1,379	1,379	23.38%
	Total	**32,568**	**6,695**	**17,740**	**57,003**	**100.00%**	**2,278**	**1,661**	**1,959**	**5,898**	**100.00%**

2.5 Energy Consumption and Greenhouse Gas Emissions from the end use of the Fuels Distributed

Table 5 shows the estimated energy consumption and greenhouse gas emissions associated with the end use of the marine fuel oil and diesel distributed by the Project, based on the assumption that all the fuel is combusted for its energy values.

The Full Fuel Cycle greenhouse gas emissions from the end use of the fuel distributed by the Project are estimated to be 1,659,000 T CO_2-e per annum when the project is operating at full capacity.

In calculating the values it has been assumed that:

- The diesel consumption figures were multiplied by 38.6 GJ/kL to arrive at the total GJ of diesel consumed (AGO 2006, Table 3, p. 10);
- The full fuel cycle emissions factors are 3.3 TCO_2-e/kL for marine fuel oil and 3.0 TCO_2-e/kL for diesel;
- The greenhouse gas emissions from the use of biodiesel are not included in the table as it assumed that an equivalent amount of carbon dioxide is absorbed to grow the feedstock (upstream emissions associated with the production of biodiesel are included in **Section 3.3** of this report).

Table 5 - Estimated greenhouse gas emissions associated with the end use of the fuel distributed by the Project

Year	Marine Fuel Oil Distribution (ML/yr)	Diesel Distribution (ML/yr)	Emissions Source	Scope 3 Usage (Indirect) in kL	Usage in GJ	Full Fuel Cycle Emissions Factor	Total Emissions in TCO2e (Full Fuel Cycle)	% of Emissions
1-3	190	110	Use of MFO products	190,000	7,334,000	3.3	627,000	65.5%
			Use of Diesel product	110,000	4,246,000	3	330,000	34.5%
			Total		**11,580,000**		**957,000**	**100.0%**
4-6	280	245	Use of MFO products	280,000	10,808,000	3.3	924,000	55.7%
			Use of Diesel product	245,000	9,457,000	3	735,000	44.3%
			Total		**20,265,000**		**1,659,000**	**100.0%**
7-10+	280	245	Use of MFO products	280,000	10,808,000	3.3	924,000	55.7%
			Use of Diesel product	245,000	9,457,000	3	735,000	44.3%
			Total		**20,265,000**		**1,659,000**	**100.0%**

3 Greenhouse Gas Reductions Associated with Implementation of the Project

The project will result in reduced greenhouse gas emissions as a result of:

- Reduced fuel consumption due to the distribution of fuels from a local distribution point; and
- End use of the biodiesel produced by the project instead of standard diesel.

3.1 Reduced Diesel Consumption for Fuel Distribution to Ships

Currently, Manildra Park transports MFO and diesel to ships in Newcastle from its Port Kembla facility – a return truck trip of about 550 km. Under the proposed project, MFO and diesel will instead be supplied from the Kooragang Island terminal, eliminating the need for trucks and therefore reducing the consumption of diesel. However, diesel will still be consumed by a barge that will be used to transfer fuels from the terminal out to the ships. Although the diesel consumed by the barge is significantly less than the diesel used to truck the same amount of fuel from Port Kembla, the project is proposing to considerably increase the volume of fuel distributed by Manildra Park – from approximately 33 ML pa to 305 ML pa (280 ML of MFO plus 25 ML diesel).

Note that currently Manildra Park supplies approximately 16 loads of fuel to ships in the Port of Newcastle per week. This equates to approximately 33 ML pa, based on a 60 / 40 split between semi-trailers (34 kL capacity) and B-Doubles (48 kL capacity).

In **Table 6** below, we have compared the diesel consumption associated with fuel distribution to ships expected from the proposed project (i.e. 305 ML via the Kooragang Island barge) with

A. The diesel consumption associated with current Manildra Park ship distribution facilities and volumes (i.e. 33 ML from Port Kembla); and
B. The diesel consumption associated with distributing the proposed volumes of fuel to ships without constructing the proposed new facilities, and using the existing Manildra Park facilities instead (i.e 305 ML from Port Kembla).

The table shows that the proposed project will lead to a reduction in diesel consumption associated with fuel distribution to ships of more than 50% compared with current Manildra Park operations. It is also noted that the volume of fuel distributed by barge is approximately 8.5 times that of the current operations.

Note that although comparing the proposed project with scenario B indicates a much larger reduction in diesel consumption, this assumes that Manildra Park would be able to competitively supply those volumes using its existing facilities.

Table 6 – Greenhouse gas reduction associated with Marine Fuel Oil and Diesel Distribution to Ships

	Proposed Manildra Park Kooragang Island Project	Current Manildra Park Distribution (Scenario A)	Distributing the Proposed Volumes Using Existing Facilities (Scenario B)
Amount distributed to ships per year (ML)	305	33	305
Distribution method	Barge	Trucks from Port Kembla to Newcastle	Trucks from Port Kembla to Newcastle
Return distance (km)	0	550	550
Average capacity (kL)	1600	39.6	39.6
Number of trips required per year	190	832	7702
Diesel consumed per trip (L)	450	230	230
Diesel consumed per year (kL)	**85.5**	**191.7**	**1771.5**
Emissions factor for diesel (TCO_2-e/kL)	3	3	3
TCO2-e per year	**257**	**575**	**5314**

3.2 Reduced Fuel Consumption for Diesel Distribution to Hunter Region Bulk Fuel Users

Diesel is transported to Hunter Valley bulk fuel users from Sydney (e.g. Kurnell) to Singleton – a return truck trip of about 500 km. Under the proposed project, diesel and biodiesel (220 ML and 52 ML respectively) will instead be supplied from the Kooragang Island terminal – a return trip of approximately 160 km. The reduced distance will result in a reduced diesel consumption for the same amount of fuel supplied.

Note that information on the current distribution volume of diesel from Sydney (Kurnell) to Hunter Valley bulk fuel users was not available. It was therefore assumed that the proposed distribution volume of 272 ML is currently being supplied from Sydney based terminals.

In **Table 7** below, we have compared the expected diesel consumption associated with fuel distribution to Hunter Valley bulk fuel users from the Project (i.e. 272 ML from Kooragang to Singleton) with:

A. the diesel consumption associated with the current distribution situation (i.e. 272 ML from Sydney to Singleton); and
B. the diesel consumption associated with attempting to supply the proposed volumes from existing Manildra Park distribution facilities (i.e. 272 ML from Port Kembla to Singleton).

Table 7 shows that due to the significant reduction in the return trip distance, the proposed project results in a reduction of more than 66% in diesel consumption and associated greenhouse gas emissions for this aspect of its operations compared with supplies sourced from Sydney based terminals or from existing Manildra Park facilities.

Table 7 – Greenhouse gas reduction associated with distribution of diesel to Hunter Valley bulk fuel users

	Manildra Park Kooragang Island Project	**Current Distribution (Scenario A)**	**Distributing Proposed Volumes Using Existing Manildra Park Facilities (Scenario B)**
Amount distributed to Hunter Region bulk fuel users per year (ML)	272	272	272
Distribution method	Trucks from Kooragang to Singleton	Trucks from Sydney to Singleton	Trucks from Port Kembla to Singleton
Return distance (km)	160	500	566
Average truck capacity (kL)	39.6	39.6	39.6
Number of trips required per year	6869	6869	6869
Diesel consumed per trip (L)	67	209	236.7
Diesel consumed per year (kL)	**459.6**	**1436**	**1626**
Emissions factor for diesel (TCO_2-e/kL)	3	3	3
TCO2-e per year	**1379**	**4308**	**4878**

3.3 Use of Biodiesel

The use of biodiesel results in less greenhouse gas emissions than using an equivalent amount of standard diesel. However, note that although the carbon dioxide emissions from the combustion of biodiesel do not add to the carbon dioxide in the atmosphere (as an equivalent amount of carbon dioxide is absorbed to grow the crop), there are upstream greenhouse gas emissions associated with the production of biodiesel (such as agricultural activities associated with growing the crop, extracting & processing the oil, converting the oil to biodiesel etc).

The net greenhouse gas benefit from the use of biodiesel (manufactured from canola oil) instead of petroleum diesel is shown in **Table 8** below, and shows a 28% reduction in greenhouse gas emissions compared to the production and combustion of petroleum diesel. The value for Greenhouse gases emitted in the production of biodiesel from canola oil is taken from the AGO/CSIRO biofuels calculator. Note that different feedstock oils will have different upstream emissions associated with their production. The use of the canola emission factors is considered to be representative of crops grown in Australia and a conservative approach as the use of waste oil will result in the production of less greenhouse gas emissions per litre of biodiesel produced.

Table 8 – Greenhouse gas offset associated with the end use of biodiesel

	Emission Factor (TCO_2-e per kL)	Estimated Annual Emissions (TCO_2-e per 52,000kL)
Greenhouse gases emitted in the production and combustion of biodiesel from canola oil	2.18*	113,360
Greenhouse gases emitted in the production and combustion of petroleum diesel	3.0	156,000
Net greenhouse gas impact	**- 0.82**	**-42,640**

***** emission factor adopted from the AGO/CSIRO biofuels calculator

The use of biodiesel also has other environmental benefits. Recent studies commissioned by Camden City Council (2005) found biodiesel to achieve the following reduction in exhaust emissions:

- Smoke reduced by 79 percent;
- Particulates reduced by 91 percent;
- Hydrocarbons reduced by 68 percent (These include many known or suspected cancer causing substances, such as benzene, arsenic and formaldehyde. It is believed that there is no safe level of exposure to these chemicals, as cell mutations which can lead to cancer can occur at very low levels (EPA 2002)); and
- Carbon-dioxide reduced by 4 percent.
- Sulphurous (SOx) emissions are essentially eliminated with pure biodiesel. The exhaust emissions of sulphur oxides and sulphates are major components of acid rain.

3.4 Total Annual Greenhouse Gas Reduction

The total expected annual greenhouse gas reduction associated with the implementation of the Project is shown in **Table 9** below. The Table shows that the project will result in a net decrease in greenhouse gas emissions.

Table 9 – Total annual greenhouse gas reduction associated with the proposed project

	Expected Change in Annual GHG Emissions	
	Compared with Current Distribution Operations	**Compared with Distributing Proposed Volumes using Existing Manildra Park Facilities**
GHG emissions associated with diesel consumption for marine fuel distribution (TCO_2-e per year)	-318	-5,057
GHG emissions associated with diesel consumption for diesel distribution to hunter region bulk fuel users (TCO_2-e per year)	-2,929	-3,499
Total GHG emissions associated with product transport (TCO_2-e per year)	**-3,247**	**-8,556**
Use of biodiesel (TCO_2-e per year)	- 42, 640	- 42,640
Total Change in GHG emissions (TCO_2-e per year)	**- 45,887**	**-51,196**

4 Summary of Energy Consumption and Greenhouse Gas Emissions

The Scope 1, 2 and 3 Greenhouse Gas and Energy Assessment for the Manildra Park Kooragang Island Project has found that:

- When operating at full capacity, annual electricity consumption will be 6,696 GJ, diesel consumption associated with producing steam will be 29,268 GJ (758 kL), diesel consumption associated with operating the barge will be 3,300 GJ (86 kL) and diesel consumption associated with product transport will be 17,740 GJ (460 kL). This corresponds to a **total annual energy consumption of 57,003 GJ**;

- This corresponds to **total greenhouse gas emissions** associated with the Project of **5,898 TCO_2-e pa** (including product distribution). This represents less than 0.001% Australia's total greenhouse emissions of around 559 million TCO_2-e pa (Australian Greenhouse Office, National Greenhouse Inventory 2005);

- The estimated greenhouse gas emissions associated with the end use of the distributed fuel is 1,659,000 TCO_2-e pa;

- When operating at full capacity, the project will consume 57,003 GJ of energy per annum across its production and distribution operations, and produce 52 ML of biodiesel per annum (corresponding to 2,007 terajoules). The project will therefore consume 0.0284 GJ of energy per GJ of biodiesel produced.

- Due to the reduced transport distances required to distribute fuel products, the project will result in a decrease in greenhouse gas emissions associated with product transport of 3,247 TCO_2-e pa (1082 kL of diesel) compared with current distribution operations. When compared with attempting to supply the proposed volumes using existing Manildra Park facilities, the project results in a decrease in greenhouse gas emissions associated with product transport of 8,556 TCO_2-e pa (2,852 kL of diesel);

- The production of biodiesel will result in a net greenhouse gas emissions offset (taking into account upstream emissions) of -42,640 TCO_2-e per year by displacing the greenhouse gas emissions associated with an equivalent volume of standard diesel;

- The project will result in an **overall decrease in greenhouse gas emissions of 45,887 TCO2-e compared with current distribution operations**, and an overall decrease of 51,196 TCO_2-e when compared with expanding distribution volumes to the proposed levels using existing Manildra Park facilities.

5 References

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