HEGGIES
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Revision 2

Coca-Cola Amatil
Proposed Industrial Development Northmead
Greenhouse Gas Assessment

PREPARED FOR

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Coca-Cola Amatil

Proposed Industrial Development Northmead

Greenhouse Gas Assessment

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EXECUTIVE SUMMARY

Heggies Australia Pty Ltd was commissioned by Burns Bridge Pty Ltd on behalf of Coca-Cola Amatil Pty Ltd to conduct a greenhouse gas assessment for the proposed industrial development at the Northmead facility. The assessment compares current (baseline) operations with operations under the proposed development for 2008, 2015 and 2020. Emissions from road transport of product, internal handling of product, and electricity consumption are assessed.

The proposal by Coca-Cola Amatil (CCA) to develop a High Bay Warehouse (HBW) at the Briens Road facility in Northmead presents an opportunity for significant greenhouse gas reductions associated with the transport of product currently relied upon for daily operations, storage and distribution.

Greenhouse gases were quantified for each of the three key greenhouse gas generating activities and compared against a baseline scenario. The baseline scenario assumes operations required if the HBW is not commissioned. The following summarises the total predicted CO_2-equivalent emissions for the baseline and proposed scenarios:

- A total saving of 973.37 tonnes/year CO_2-equivalent emissions is predicted for 2008, representing a 56 percent saving on baseline operations.
- A total saving of 1335.25 tonnes/year CO_2-equivalent emissions is predicted for 2015, representing a 54 percent saving on baseline operations.
- A total saving of 1659.50 tonnes/year CO_2-equivalent emissions is predicted for 2020, representing a 52 percent saving on baseline operations.

The results of the greenhouse gas assessment indicate that the construction of the bulk warehouse will significantly reduce greenhouse gas emissions associated with operations at CCA Northmead. This is due mostly to the significant reduction of the transfer of product off site for storage and distribution, and the reduction in double and triple-handling of product prior to distribution. The total calculated anticipated greenhouse gas savings attributable to the development of the HBW at Northmead represents a significant saving in the food and beverage industry, and a significant saving for National and NSW State greenhouse reduction objectives.

TABLE OF CONTENTS

1 INTRODUCTION

The proposal by Coca-Cola Amatil (CCA) to develop a High Bay Warehouse (HBW) at the Briens Road facility in Northmead presents an opportunity for significant greenhouse gas reductions associated with the transport of product currently relied upon for daily operations, storage and distribution.

Currently, CCA has four production lines at the Northmead facility, with limited warehouse capacity. Most of the product warehousing is offsite at a number of smaller warehouses around western Sydney. Typically, product is transferred from the Northmead production facility to various warehouses, where product is stored or sorted for further distribution. At times, product can also be sent back to Northmead for redistribution based on circulation of stock.

The only direct transfer from the Northmead site is to bulk customers such as Coles or Woolworths, or to storage facilities at Eastern Creek.

The focus of the proposed development with respect to greenhouse gas (GHG) reduction centres on the construction of a new automated storage facility, adjoining the existing manufacturing operation. The construction of this bulk warehouse will significantly reduce transfer of product off site for storage and distribution, and will reduce double and triple-handling of product prior to distribution.

Heggies Australia Pty Ltd has been commissioned by Burns Bridge Pty Ltd on behalf of Coca-Cola Amatil Pty Ltd to conduct a greenhouse gas assessment for the proposed industrial development at the Northmead facility. The assessment was based on current (baseline) operations and operations under the proposed development for 2008, 2015 and 2020 for emissions from road transport of product, internal handling of product, and electricity consumption.

2 GREENHOUSE GAS EMISSIONS

2.1 General Methodology

As discussed in **Section 1**, operations at the CCA Northmead site generate greenhouse gas emissions from three key activities:

- Road transport of product.
- Internal handling of product.
- Electricity consumption.

Carbon dioxide (CO_2) is produced during fuel combustion as a result of the oxidation of the fuel carbon content. CO_2 is likely to make the largest contribution to greenhouse gas emissions from fuel combustion as approximately 99% of automotive diesel oil (ADO) fuel is oxidised during the combustion process (Australian Greenhouse Office, 2002).

Other greenhouse gases emitted as a result operations at the CCA Northmead site may include carbon monoxide (CO), methane (CH_4), oxides of nitrogen (NO_X) and non-methane volatile organic compounds (NMVOCs). These are produced by incomplete fuel combustion, reactions between air and fuel constituents during fuel combustion, and post-combustion reactions. Fugitive emissions of NMVOCs may also be expected due to fuel evaporation.

For comparative purposes, non-CO_2 greenhouse gases are awarded a "CO_2-equivalence" (CO_2-e) based on their contribution to the enhancement of the greenhouse effect. The CO_2-equivalence of a gas is calculated using an index called the Global Warming Potential (GWP). The GWPs for a variety of non-CO_2 greenhouse gases are contained within the Intergovernmental Panel on Climate Change (IPCC) document "*Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*". The GWPs of relevance to this assessment are:

- **Methane**: GWP of 21 (21 times more effective as a greenhouse gas than CO_2).
- **Nitrous Oxide**: GWP of 310 (310 times more effective as a greenhouse gas than CO_2).

The short-lived gases such as CO, NO_2, and NMVOCs vary spatially and it is consequently difficult to quantify their global radiative forcing impacts. For this reason, GWP values are generally not attributed to these gases nor have they been considered further as part of this assessment.

An assessment of the current and predicted greenhouse gas emissions from the operations at the CCA Northmead facility has been undertaken for each of the aforementioned sources and is outlined below.

Each of the three key greenhouse generating activities are assessed against a baseline. Due to the changes in production capacity, the baseline is not considered to be current operations for 2006. Rather, the "baseline" scenario is the predicted emissions associated with operations that *will be required* if the HBW is not commissioned. The "proposed" scenario reflects operations with the development of the HBW. This reflects the most accurate representation of future scenarios, and provides the best basis for comparison of greenhouse gas emissions associated with the proposed development.

3 EMISSIONS FROM ROAD TRANSPORT

3.1 Baseline and Proposed Road Transportation

Currently, CCA operates a major production facility at Northmead, a smaller production facility at Smithfield, and a separate distribution centre also at Smithfield. Due to current capacity constraints in the supply chain, approximately 40% of product is double-handled (Masson Wilson Twiney 2006). Currently, product is loaded, taken off-site and stored, then loaded back onto trucks and returned to Northmead prior to despatch to customers.

The construction of the HBW at CCA's Northmead facility will result in significant savings in vehicle kilometres travelled (VKT) by heavy vehicles in the transfer and distribution of product. Calculations for savings in vehicle kilometres travelled are based on the assumption that an alternate warehouse location will be required at the CCA site in Eastern Creek, if the HBW is not approved. The alternate storage facility at Eastern Creek will be required as the existing storage space at Northmead is to be replaced with an additional production line. Additionally, production capacity constraints would lead to a requirement by 2020 to import a total of 4,000 B-double loads of additional product from interstate.

A representative distance from Northmead to Eastern Creek, and the number of pallet transfer loads required per year were used to calculate the total vehicle kilometres saved through the development of the HBW at Northmead. Calculations are presented in full in **Appendix A**. **Table 1** summarises the VKT savings attributable to the development of the HBW.

Table 1 Summary of Vehicle Movements for Proposed Operations

B-Double Transfers	2008	2015	2020
Route Transfer Movements	23,800	30,800	37,100
Bulk Transfer Movements	26,300	34,900	42,400
Total Transfer Movements	50,100	65,700	79,500
Bulk Saving due to Proposal	26,300	34,900	42,400
Fraction of Total Transfer Movements	52%	53%	53%
VKT Saving	460,250	610,750	742,000
Diesel Consumption Saving (L/yr)	239,790	318,201	386,582

Road transfers cannot be adequately compared to current (2006) road transfers, as the development of the HBW will eliminate off-site transport for product storage. As such, the assumption is not that there will be no external road transfer of product; rather that the development of the HBW will eliminate road transfer that would otherwise be necessary for anticipated volumes of product for 2008, 2015 and 2020.

3.2 Emissions Estimations from Road Transport

The annual emissions of carbon dioxide and other greenhouse gases from road transport emissions have been estimated using Table 56 and Table 57 of the Australian Greenhouse Office (AGO) document "*Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2002 – Energy (Stationary Sources)*". The primary fuel source for heavy vehicles is Automotive Diesel Oil (ADO). It has been assumed that the energy content of ADO is 38.6 MJ/L (ABARE, 2004) and the average rate of fuel consumption for heavy vehicles is 0.521 litres/km (AGO, 2004).

A summary of the predicted saving in greenhouse emissions from reduced road transport is provided in **Table 2**. Greenhouse gas calculations for road transport are presented in their entirety in **Appendix B**.

Table 2 Predicted GHG Reductions from Road Transport

Emissions (tonnes/yr)	2008	2015	2020
CO_2	638.69	847.53	1029.67
CH_4	1.52	2.01	2.45
N_2O	3.57	4.73	5.75
Total CO_2-e (tonnes/yr)	**643.77**	**854.28**	**1037.86**
Saving (tonnes/yr)	**643.77**	**854.28**	**1037.86**

As indicated above, total CO_2-equivalent greenhouse emissions attributable to road transport of product if the HBW at CCA Northmead is not developed are in the order of 600 to 1000 tonnes per annum up to 2020.

These findings are supported by Masson Wilson Twiney (2006) in their evaluation of transport costs associated with the expansion of facilities at Northmead. Additionally, Masson et al estimated the resource value of avoided greenhouse gas emissions would start at $375,000 per annum for distribution and $110,000 per annum for importation, growing over the life of the project to $550,000 per annum for distribution and $610,000 per annum for distribution.

4 EMISSIONS FROM INTERNAL MOVEMENTS

4.1 Baseline and Proposed Internal Handling Movements

Under current operations, forklifts are used extensively to transport product from manufacture to storage, and to load and unload product from storage into heavy vehicles. The development of the automated warehouse will result in a significant decrease in forklift use for transporting of product and loading.

Forklift use has been estimated by CCA for both baseline and proposed scenarios, and is summarised in **Table 3**.

Table 3 Estimated Forklift Hours under Current and Proposed Scenarios

Forklift Running Hours	**2008**	**2015**	**2020**
Baseline Scenario	41,300	52,300	62,000
Proposed Scenario	4,000	6,600	8,000
Net Saving	37,300	45,700	54,000

4.2 Emissions Estimation from Forklifts

The annual emissions of CO_2 and other greenhouse gases from this source have been estimated using the Australian Greenhouse Office (AGO) document *Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2002 - Energy (Transport)*, and the estimated forklift hours for baseline and proposed scenarios as detailed in **Table 3**.

The annual LPG consumption rate has been estimated using the following assumptions:

- Estimated Fuel Efficiency of Forklift = 2.2 kg per hour
- Specific liquid volume of 1 kg LPG = 1.96 litres
- Estimated Fuel Efficiency of Forklift = 4.3 litres per hour
- Average Forklift Speed = 7.5 kilometres per hour

The energy content of LPG is taken as 25.7 MJ/L (ABARE, 2004).

A summary of the predicted GHG emissions is provided in **Table 4**. Full calculations are presented in **Appendix C**.

Table 4 Predicted Annual (Baseline and Future) GHG Emissions from LPG Forklifts

Emissions (tonnes/yr)	**2008**		**2015**		**2020**	
	Baseline	**Proposed**	**Baseline**	**Proposed**	**Baseline**	**Proposed**
CO_2	269.14	26.07	340.83	43.01	404.04	52.13
CH_4	0.57	0.05	0.72	0.09	0.85	0.11
N_2O	0.76	0.07	0.96	0.12	1.14	0.15
Total CO_2-e	**270.47**	**26.20**	**342.51**	**43.22**	**406.03**	**52.39**
Saving	**244.3**		**299.3**		**353.6**	
Saving (%)	**90**		**87**		**87**	

As shown in **Table 4**, it is predicted that the total annual emissions of CO_2-equivalent as a result of the planned future forklift operations at the CCA Facility are likely to be significantly reduced. The introduction of the automated warehouse has been estimated to result in an 87-90% reduction in GHG emissions from the facility.

5 EMISSIONS FROM ELECTRICITY CONSUMPTION

5.1 Baseline and Proposed Electricity Consumption

The assessment for greenhouse savings associated with electricity consumption has been based on an approximation of anticipated energy consumption of the proposed HBW, and an approximation of energy consumption at warehouses that will be decommissioned following commissioning of the HBW at CCA Northmead.

Current operations, as discussed above, involve product storage at several (up to five) smaller warehouses in western Sydney. The installation of the HBW at Northmead will render existing warehouse space redundant.

The most significant electrical energy consuming activity at existing warehouses is lighting. The following approximate calculation in **Table 5** gives an indication as to the energy saving from the replacement of existing warehouse space. The calculations in **Table 5** represent a conservative estimate of the energy requirements of existing warehouses, and it is estimated that the energy requirements for these warehouses may be significantly higher than calculated.

Table 5 Lighting Energy Requirements Calculations – Existing Warehouses

Parameter	2008	2015	2020
Weighted Average Warehouse Area Eliminated (m^2)	63,209	81,789	98,319
Lighting Requirement (Fixtures)	632	818	983
Energy Output assuming 350W Fixture (W)	221,232	286,263	344,117
Annual Consumption (kWh)	1,380,490	1,786,282	2,147,290

In contrast, the new HBW at Northmead has a reduced lighting requirement due to increased automation within the warehouse. As such, the most significant energy consuming activity at the new warehouse is plant and equipment. The estimate for the electrical consumption of the new HBW at Northmead has been estimated based on actual consumption figures for a similar warehouse in Melbourne, and is detailed in **Table 6**.

Table 6 Projected Energy Consumption of the HBW

Parameter	2008	2015	2020
Finished Beverage Throughput (litres)	609,389,760	788,518,505	947,877,942
Finished Beverage Throughput (L/kWh)	473	495	509
Electrical Energy Consumption Projected (kWh)	1,289,714	1,593,001	1,862,815

The annual electricity consumption for both current and proposed scenarios is presented in **Table 7**.

Table 7 Estimated Electricity Consumption for Current and Proposed Scenarios

Annual Electricity Consumption (kWh)	2008	2015	2020
Baseline Scenario	1,380,490	1,786,282	2,147,290
Proposed Scenario	1,289,714	1,593,001	1,862,185
Net Saving	90,776	193,281	285,105

5.2 Emissions Estimation from Electricity Consumption

An estimate of the change in annual emissions of carbon dioxide from the consumption of electricity at the CCA Northmead site (accounting only for changes in warehousing) has been derived using the Australian Building Greenhouse Rating (ABGR) Performance Calculator emission factor of 940 kg CO_2-equivalent/MWh. A summary of the predicted Greenhouse Gas (GHG) Emissions from electricity consumption is provided in **Table 8**. Full calculations are presented in **Appendix D**.

Table 8 Current and Predicted GHG Emissions from Energy Consumption

CO_2 Emissions (tonnes/yr)	**2008**	**2015**	**2020**
Baseline	1298	1679	2018
Proposed	1212	1497	1750
Net Saving	85	182	268
Saving (%)	6.5	10.8	13.3

As indicated in **Table 8**, the development of the HBW at Northmead will result in a net decrease in greenhouse gas emissions associated with electricity consumption. This represents a 6.5 to 13 percent saving on baseline greenhouse emissions associated with electricity consumption.

6 SUMMARY OF FINDINGS

Table 9 presents a summary of the total predicted CO_2-equivalent emissions for the baseline and proposed scenarios.

Table 9 Summary of Greenhouse Gas Reductions for HBW, CCA Northmead.

Year	Predicted CO_2-Equivalent Emissions (tonnes/year)			
	Baseline Scenario	**Proposed Scenario**	**Total Saving**	**Percent Saving on Baseline**
2008	2211.90	1238.53	973.37	56
2015	2875.89	1540.64	1335.25	54
2020	3462.35	1802.84	1659.50	52

The results of the greenhouse gas assessment indicate that the construction of the bulk warehouse will significantly reduce ongoing greenhouse gas emissions associated with warehouse and distribution operations at CCA Northmead. This is due mostly to the significant reduction of the transfer of product off site for storage and distribution, and the reduction in double and triple-handling of product prior to distribution.

It is noted that future improvements in clean energy technologies and improved vehicle performance have not been accounted for in this greenhouse assessment; however, the total calculated anticipated greenhouse gas savings attributable to the development of the HBW at Northmead represents a significant saving in the food and beverage industry, and a significant saving for National and NSW State greenhouse reduction objectives.

6.1 Greenhouse Gas Objectives

The *1990 National Greenhouse Gas Inventory* (Australian Greenhouse Office, 1990) provides estimates of the greenhouse emissions in Australia. In 1990, the total Australian emissions were 392,061 kilotonnes CO_2-equivalent. A comparison of the predicted maximum emissions from the CCA Northmead facility with the 1990 estimate demonstrates that processing operations will represent decrease of up to 0.00042% on the total Australian emissions.

The NSW Greenhouse Plan sets out action for the NSW Government for the next three years and beyond – to reduce the emissions of its own activities and to work with other stakeholders to reduce the emissions from their activities. Two key objectives of the NSW Greenhouse Plan are to put NSW on track to meeting its targets of limiting 2025 emissions to 2000 levels, and reducing emissions by 60% by 2050.

The actions proposed by CCA with the installation of the new HBW at Northmead achieve the first target of limiting future emissions to 2000 levels within CCA warehousing and distribution activities. The 52 to 56 percent reduction on baseline emissions within warehousing and distribution activities demonstrated through the proposed commissioning of the HBW is also close to achieving the 60 percent reduction target in GHG emissions as adopted by the NSW government by 2020.

The proposed activities place CCA in an advantaged position with regard to achieving emissions reductions into the future, to meet both State objectives, and their requirements under the *Greenhouse Challenge Plus* program.

7 CONCLUSION

Heggies Australia Pty Ltd was commissioned by Burns Bridge Pty Ltd on behalf of Coca-Cola Amatil Pty Ltd to conduct a full greenhouse gas assessment for the proposed industrial development at the Northmead facility. The assessment compares current (baseline) operations with operations under the proposed development for 2008, 2015 and 2020. Emissions from road transport of product, internal handling of product, and electricity consumption are assessed.

The results of the greenhouse gas assessment indicate that the construction of the bulk warehouse will significantly reduce ongoing greenhouse gas emissions associated with warehouse and distribution operations at CCA Northmead. This is due mostly to the significant reduction of the transfer of product off site for storage and distribution, and the reduction in double and triple-handling of product prior to distribution.

The total calculated anticipated greenhouse gas savings attributable to the development of the HBW at Northmead represents a significant saving in the food and beverage industry, and a significant saving for National and NSW State greenhouse reduction objectives.

REFERENCES

Australian Greenhouse Office (AGO) document *Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2002 - Energy (Transport)*.

ABARE (Australian Bureau of Agricultural and Resource Economics) (2004) *Energy Abbreviations and Definitions*. www.abareconomics.com/research/energy/ENERGYDEFINITIONS.pdf.

AGO (Australian Greenhouse Office) (2002) *Factors and Methods Workbook, August 2004*.

AGO (Australian Greenhouse Office) (1990) *1990 National Greenhouse Gas Inventory*.

IPCC (Intergovernmental Panel on Climate Change) (1996) “Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories”.

Masson Wilson Twiney *Draft Evaluation of Transport Costs of Proposed Expansion of Manufacturing Plant and Associated Warehouse at Northmead.* August 2006. Prepared for Burnsbridge Services Pty Ltd on behalf of Coca-Cola Amatil.

GLOSSARY

ADO	Automotive Diesel Oil
AGO	Australian Greenhouse Office
CCA	Coca-Cola Amatil
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide equivalent
GHG	Greenhouse Gas
GWP	Global Warming Potential
HBW	High Bay Warehouse
Heggies	Heggies Australia Pty Ltd
N_2O	Nitrous oxide
NMVOCs	Non-methane Volatile Organic Compounds

PROJECTED ROAD TRANSPORTATION CALCULATIONS

Transfer Saving Calculation Assuming alternate location for Bulk Warehouse at CCA site in Eastern Creek

Cases per Pallet	62	Average for Bulk loads
Pallets per Load	32	Assuming 100% B-double
Distance Travelled (km)	17.5	Briens Road Northmead --> Old Wallgrove Road Eastern Creek 15.63 km by whereis.com. Add 500m travel on Briens Rd and 1.4km from Old Wallgrove Road to CCA site.

Category		**2005**	**2008**	**2015**	**2020**
NSW Route Sales	cases	21,170,000	23,650,000	30,600,000	36,800,000
Transfer Loads per Year	loads	10,670	11,920	15,423	18,548
Movements per Year (Two-Way)	movements	21,341	23,841	30,847	37,097
NSW Bulk Sales	cases	19,700,000	22,000,000	28,470,000	34,220,000
Northmead Interstate Despatch	cases	2,542,500	4,101,500	6,120,000	7,848,000
Total Bulk Despatch	cases	22,242,500	26,101,500	34,590,000	42,068,000
Northmead Capacity*	cases	9,174,324	-	-	-
Net Transfer	cases	13,068,176	26,101,500	34,590,000	42,068,000
Transfer Loads per Year	loads	6,587	13,156	17,434	21,204
Movements per Year (Two-Way)	movements	13,174	26,312	34,869	42,407
Fraction of Total	%	38.2	52.5	53.1	53.3
Total Bulk VKT	km	230,537	460,460	610,207	742,127

* Installation of new production line in 2007 eliminates current warehouse capacity

B-Double Transfers	**2008**	**2015**	**2020**
Route Transfer Movements	23,800	30,800	37,100
Bulk Transfer Movements	26,300	34,900	42,400
Total Transfer Movements	50,100	65,700	79,500
Bulk Saving Due to Proposal	26,300	34,900	42,400
Fraction of Total Transfer Movements	52%	53%	53%
VKT Saving	460,250	610,750	742,000

Source: CCA 2006.

GHG CALCULATIONS

EMISSIONS FROM ROAD TRANSPORT

B-Double Transfers	2008	2015	2020
Route Transfer Movements	23,800	30,800	37,100
Bulk Transfer Movements	26,300	34,900	42,400
Total Transfer Movements	50,100	65,700	79,500
Bulk Saving Due to Proposal	26,300	34,900	42,400
Fraction of Total Transfer Movements	52%	53%	53%
VKT Saving	460,250	610,750	742,000
Consumption L/year	239,790.25	318,200.75	386,582.00

Average Fuel Consumption (l/km)	0.521

Carbon Dioxide Emissions	Diesel Consumption (L/year)[2]	Energy Content (MJ/L)	Oxidation Factor	Emission Factor (g/MJ)	CO2 Emissions (g/year)	CO2 Emissions (tonnes/year)
2008	239,790.25	38.6	0.99	69.70	638685119.56	638.685
2015	318,200.75	38.6	0.99	69.70	847532725.20	847.533
2020	386,582.00	38.6	0.99	69.70	1029667265.00	1029.667

Non-Carbon Dioxide Emissions 2008		CH4	N2O
	Emission Factor (g/km)	0.16	0.03
	Emissions (tonnes/year)	0.0723	0.0115
	Global Warming Potential (GWP)	21.00	310.00
	Carbon Dioxide Equivalent (tonnes/year)	1.52	3.57

Non-Carbon Dioxide Emissions 2015		CH4	N2O
	Emission Factor (g/km)	0.16	0.03
	Emissions (tonnes/year)	0.0959	0.0153
	Global Warming Potential (GWP)	21.00	310.00
	Carbon Dioxide Equivalent (tonnes/year)	2.01	4.73

Non-Carbon Dioxide Emissions 2020		CH4	N2O
	Emission Factor (g/km)	0.16	0.03
	Emissions (tonnes/year)	0.1165	0.0186
	Global Warming Potential (GWP)	21.00	310.00
	Carbon Dioxide Equivalent (tonnes/year)	2.45	5.75

Total CO2-Equivalent	
2008	643.770
2015	854.280
2020	1037.864

GHG CALCULATIONS

EMISSIONS FROM INTERNAL MOVEMENT

FLT Running Hours	2008	2015	2020
Current Practice	41,300	52,300	62,000
Proposal	4,000	6,600	8,000
Net Saving	37,300	45,700	54,000
Total Consumption per year (litres) Baseline	178,085.60	225,517.60	267,344.00
Total Consumption per year (litres) Projected	17,248.00	28,459.20	34,496.00
Km per Year Baseline	309,750.00	392,250.00	465,000.00
Km per Year - Projected	30,000.00	49,500.00	60,000.00

Specific Liquid Volume of 1 kg LPG in litres	1.96
Fuel Efficiency of LPG Forklift (kg/hr)	2.2
Fuel Efficiency of LPG Forklift (l/hr)	4.312

Total CO2-Equivalent	Baseline	Projected	Saving
2008	270.47	26.20	244.27
2015	342.51	43.22	299.28
2020	406.03	52.39	353.64

Forklift Baseline

Carbon Dioxide Emissions	Consumption (L/year)	Energy Content (MJ/L)	Oxidation Factor	Emission Factor (g/MJ)	CO2 Emissions (g/year)	CO2 Emissions (tonnes/year)
2008	178,085.60	25.7	0.99	59.40	269143296.10	269.14
2015	225,517.60	25.7	0.99	59.40	340827951.23	340.83
2020	267,344.00	25.7	0.99	59.40	404040783.48	404.04

Non-Carbon Dioxide Emissions 2008		CH4	N2O
	Distance Travelled (km/year)	309,750.00	309,750.00
	Emission Rate (g/km)	0.087	0.01
	Emissions (g/year)	26948.25	2447.03
	Emissions (tonnes/year)	0.027	0.0024
	Global Warming Potential (GWP)	21.00	310.00
	Carbon Dioxide Equivalent (tonnes/year)	0.57	0.76

Non-Carbon Dioxide Emissions 2015		CH4	N2O
	Distance Travelled (km/year)	392,250.00	392,250.00
	Emission Rate (g/km)	0.087	0.01
	Emissions (g/year)	34125.75	3098.78
	Emissions (tonnes/year)	0.034	0.0031
	Global Warming Potential (GWP)	21.00	310.00
	Carbon Dioxide Equivalent (tonnes/year)	0.72	0.96

Non-Carbon Dioxide Emissions 2020		CH4	N2O
	Distance Travelled (km/year)	465,000.00	465,000.00
	Emission Rate (g/km)	0.087	0.01
	Emissions (g/year)	40455.00	3673.50
	Emissions (tonnes/year)	0.040	0.0037
	Global Warming Potential (GWP)	21.00	310.00
	Carbon Dioxide Equivalent (tonnes/year)	0.85	1.14

Forklift Projected

Carbon Dioxide Emissions	Consumption (L/year)	Energy Content (MJ/L)	Oxidation Factor	Emission Factor (g/MJ)	CO_2 Emissions (g/year)	CO_2 Emissions (tonnes/year)
2008	17,248.00	25.7	0.99	59.40	26067147.32	26.07
2015	28,459.20	25.7	0.99	59.40	43010793.08	43.01
2020	34,496.00	25.7	0.99	59.40	52134294.64	52.13

Non-Carbon Dioxide Emissions 2008		CH_4	N_2O
	Distance Travelled (km/year)	30,000.00	30,000.00
	Emission Rate (g/km)	0.087	0.01
	Emissions (g/year)	2610.00	237.00
	Emissions (tonnes/year)	0.003	0.0002
	Global Warming Potential (GWP)	21.00	310.00
	Carbon Dioxide Equivalent (tonnes/year)	0.05	0.07

Non-Carbon Dioxide Emissions 2015		CH_4	N_2O
	Distance Travelled (km/year)	49,500.00	49,500.00
	Emission Rate (g/km)	0.087	0.01
	Emissions (g/year)	4306.50	391.05
	Emissions (tonnes/year)	0.004	0.0004
	Global Warming Potential (GWP)	21.00	310.00
	Carbon Dioxide Equivalent (tonnes/year)	0.09	0.12

Non-Carbon Dioxide Emissions 2020		CH_4	N_2O
	Distance Travelled (km/year)	60,000.00	60,000.00
	Emission Rate (g/km)	0.087	0.01
	Emissions (g/year)	5220.00	474.00
	Emissions (tonnes/year)	0.005	0.0005
	Global Warming Potential (GWP)	21.00	310.00
	Carbon Dioxide Equivalent (tonnes/year)	0.11	0.15

GHG CALCULATIONS

EMISSIONS FROM ELECTRICITY CONSUMPTION

Annual Electricity Consumption (kWh)	2008	2015	2020
Current Practice	1,380,490	1,786,282	2,147,290
Proposal	1,289,714	1,593,001	1,862,185
Net Saving	90,776	193,281	285,105

ELECTRICITY - Baseline[1]

Carbon Dioxide Emissions	Electricity usage (MWh/year)	Emission Factor (kg/MWh)	CO2-Equivalent Emissions (kg/year)	CO2-Equivalent Emissions (tonnes/year)
2008	1380	940	1297660.6	1297.66
2015	1786	940	1679105.08	1679.11
2020	2147	940	2018452.6	2018.45

ELECTRICITY - Projected[1]

Carbon Dioxide Emissions	Electricity usage (MWh/year)	Emission Factor (kg/MWh)	CO2-Equivalent Emissions (kg/year)	CO2-Equivalent Emissions (tonnes/year)
2008	1290	940	1212331.16	1212.33
2015	1593	940	1497420.94	1497.42
2020	1862	940	1750453.9	1750.45

Total CO2-Equivalent	Baseline	Projected	Saving
2008	1298	1212	85
2015	1679	1497	182
2020	2018	1750	268

1 The emission factor for electricity has been derived from Australian Building Greenhouse Rating (ABGR) Performance Calculator (http://www.abgr.com.au
The annual consumption of electricty per year as has been estimated used information supplied by CCA Pty Ltd.