



Mr John Hahn  
Commission Panel Member  
Independent Planning Commission  
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SYDNEY NSW 2001



Dear Mr Hahn

I refer to your letter of 8 April 2019 requesting a Greenhouse Gas (GHG) Assessment for the Shoalhaven Starches Ethanol Expansion Project Modification 16.

The Applicant has provided the GHG Assessment including a comparative assessment of the original approval, current approval and Modification 16, as requested. Please find the GHG Assessment attached.

Should the Commission have any further enquiries about this matter, please contact me on (02) 9274 6413 or [chris.ritchie@planning.nsw.gov.au](mailto:chris.ritchie@planning.nsw.gov.au)

Yours sincerely

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**Director**  
**Industry Assessments**

29/5/19.



# **Shoalhaven Starches**

## **Greenhouse Gas Emissions Assessment**

May 2019

## Assessment results – Approved Facility Scenario

The proposed upgrades to the approved plant are estimated to produce a net total increase in greenhouse emissions from current levels by 120,710 t CO<sub>2</sub>-e. This is primarily attributed to the increase in coal consumption as a result of the proposed coal-fired boiler and coal-fired cogeneration plant.

The facility's scope 1 emissions will increase to a total of 707,744 t CO<sub>2</sub>-e per annum, which would significantly exceed Shoalhaven Starches' baseline of 338,959 t CO<sub>2</sub>-e as reported under CER's safeguard mechanism.

**Table 1 Greenhouse gas assessment results: Approved Emissions**

	Baseline Emissions	Current Emissions	Proposed Emissions	Net Emissions <sup>1</sup>
	t CO <sub>2</sub> -e/a	t CO <sub>2</sub> -e/a	t CO <sub>2</sub> -e/a	t CO <sub>2</sub> -e/a
Natural Gas	349,044	349,044	299,911	-49,133
Coal	260,249	260,249	442,534	182,285
Diesel	1,781	1,781	1,799	18
Wastewater	-	-	-	-
Carbon Capture <sup>2</sup>	-	-36,500	-36,500	0
<b>Scope 1</b>	<b>611,074</b>	<b>574,574</b>	<b>707,744</b>	<b>133,170</b>
Electricity	12,460	12,460	-	-12,460
<b>Scope 2</b>	<b>12,460</b>	<b>12,460</b>	<b>-</b>	<b>-12,460</b>
<b>Total</b>	<b>623,534</b>	<b>587,034</b>	<b>707,744</b>	<b>120,710</b>

1 – Net emissions = Gross MOD 16 emissions minus gross current emissions

2 – Carbon Capture given negative symbol to represent net reduction in emissions

Whilst the facilities gross approved emissions are expected to increase, the greenhouse intensity is expected to decrease. Current greenhouse intensity is 0.553 t CO<sub>2</sub>-e / t throughput, this is expected to improve to 0.536 tCO<sub>2</sub>-e / t throughput. Assessment results – Actual Facility Scenario

The stage 1 assessment shows that if the 15 MW coal-fired cogeneration plant was installed (without increasing throughput) the total facility emissions is expected to decrease to 460,725 t CO<sub>2</sub>-e per annum. This is attributed to the reduction in natural gas consumption and grid electricity demand. In this case, the facility's Safeguard baseline would not be exceeded.

In the event that all of the proposed Modification 16 upgrades are implemented/installed, the gross operational emissions of the Shoalhaven Starches facility are expected to increase to 642,555 t CO<sub>2</sub>-e per annum. The facility's scope 1 emissions will increase to a total of 410,230 t CO<sub>2</sub>-e per annum, exceeding the Safeguard baseline by 71,271 t CO<sub>2</sub>-e.

Furthermore, if all past approved and proposed modifications are implemented (stage 3), a reduction of 63,126 t CO<sub>2</sub>-e from current levels can be achieved. In this case, there are no scope 2 emissions associated with the facility, as the entire electricity demand is met by the combined 55 MW generation capacity of the two cogeneration plants. The facility would exceed the Safeguard baseline by 114,802 t CO<sub>2</sub>-e.

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# Glossary

Abbreviation	Definition
CER	Clean Energy Regulator
CH <sub>4</sub>	Methane
CO <sub>2</sub>	Carbon Dioxide
EF	Emissions Factor
EPA	Environment Protection Authority
GHD	GHD Pty Ltd
GHG	Greenhouse Gas
GJ	Gigajoule
GWP	Global Warming Potential
IPC	Independent Planning Commission
IPCC	International Panel on Climate Change
KL	Kilolitre
kWh	Kilowatt hour
MOD 15	Modification 15
MOD 16	Modification 16
MW	Megawatt
N <sub>2</sub> O	Nitrous Oxide
NGA	National Greenhouse Accounts
NGER	National Greenhouse and Energy Reporting
NSW	New South Wales
SSEP	Shoalhaven Starches Expansion Project
t CO <sub>2</sub> -e/a	Tonnes carbon dioxide equivalents per year
YTD	Year to date

**Table 3 Shoalhaven Starches - Modification 15 and Modification 16**

Modifications	Details
Modification 15	<ul style="list-style-type: none"><li>• Construction of SupaGas CO<sub>2</sub> plant at the Argyle Meats site</li></ul>
Modifications 16	<ul style="list-style-type: none"><li>• Installation of a third flour mill C within the existing flour mill B building</li><li>• Undertaking modifications to flour mills A and B</li><li>• The construction of a new industrial building adjoining the Starch Dryer No. 5 building containing:<ul style="list-style-type: none"><li>– The new product dryer</li><li>– Plant and equipment associated with the processing of specialised speciality products</li></ul></li><li>• Addition to Starch Dryer No 5 building to house a bag house for this dryer</li><li>• Conversion of two existing gluten dryers (1 and 2) to starch dryers</li><li>• Additional sifter for the interim packing plant</li><li>• Construction of a coal-fired co-generation plant to the south of the existing boiler house complex. The co-generation plant will house a new boiler (No. 8)</li><li>• Construction of lime silos: The lime injection system will consist of two storage silos and associated equipment for injecting powdered lime into each of the coal fired boilers</li><li>• Relocation of the existing boiler no. 7 to the northern side of the overall boiler house complex</li><li>• Construction of an indoor electrical substation on the northern side of Bolong Road</li><li>• Construction of an additional rail intake pit for the unloading of rail wagons</li><li>• Extension of the existing electrical substation located within the main factory area</li></ul>

### 1.3 Scope

This report contains two greenhouse gas assessments. The first assessment covers the facility as it was originally approved in 2008. The second assessment analyses the emissions of the facility, using actual and predicted data.

Both greenhouse gas assessments include quantitative analysis of scope 1 and 2 emissions for the project, during three periods:

- Emissions from the original facility
- Emissions from current operations
- Predicted emissions from the modification, with a total for the approved facility up to and including MOD 16

The assessment is limited to facilities under operational control of Shoalhaven Starches, more specifically, only the Shoalhaven Starches Bomaderry site.

A general summary of the different scenarios is provided in Table 4.

## 2. Methodology

This assessment estimates scope 1 and scope 2 emissions associated with the Bomaderry facility. Scope 3 emissions were not considered for the purpose of this assessment. For this report, the scopes are defined as follows:

- Scope 1 emissions are the release of greenhouse gases into the atmosphere as a direct result of an activity, or series of activities (including ancillary activities) that constitute the facility. These are considered to be 'direct' emissions.
- Scope 2 emissions are the release of greenhouse gases into the atmosphere as a direct result of one or more activities that generate electricity, heating, cooling or steam that is consumed by the facility but do not form part of the facility. These are considered to be 'indirect emissions'.

### 2.1 Greenhouse gases considered

The greenhouse gases considered in this assessment and the corresponding global warming potential (GWP) for each GHG are listed in Table 5. The GWPs from the *Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment* report were used in this assessment for consistency with the IPCC guidelines.

**Table 5 Greenhouse gases and 100 year global warming potentials**

Greenhouse gas	Global warming potential
Carbon dioxide (CO <sub>2</sub> )	1
Methane (CH <sub>4</sub> )	25
Nitrous Oxide (N <sub>2</sub> O)	298

Use of the *Measurement Determination 2018* is in accordance with EPA Victoria requirements and guidance provided in EPA Victoria's *Protocol for Environmental Management – Greenhouse Gas Emissions and Energy Efficiency in Industry (PEM)*, Publication 824 (EPA 2002).

The annual emissions from the facility are calculated from data estimates provided by Shoalhaven Starches.

In accordance with the Guidelines, where the proposal is modifying or augmenting an existing operation or activity, the net greenhouse emissions are calculated, where:

- Baseline emissions : greenhouse emissions of the existing plant
- Gross project emissions : greenhouse emissions of the modified project proposal
- Net project emissions : Gross project emissions minus baseline emissions

## 2.4 Organisational boundary

The organisational boundaries refer to the coverage and extent that was taken into account for the assessment process. The sections below provides details on what was included in the approved facility and actual facility assessments. Scope 1 and Scope 2 emissions and associated energy use were estimated.

For both the assessments, three scenarios were considered:

- Baseline scenario
- Current scenario
- Proposed scenario

### 2.4.1 Organisational boundary – Approved facility

#### Baseline scenario

The baseline scenario for the approved facility GHG assessment includes the Shoalhaven Starches facility as originally approved in 2008. The assessment boundary includes a 40 MW gas-fired cogeneration plant, as specified in the original approval. Approved emissions data has been taken from the original GHG assessment (GHD, 2008).

In this case, the site was comprised of the factory and an adjacent environmental farm, which contains the wastewater treatment plant, storage ponds and an irrigation system. Figure 2 shows the location of the factory, outlined in blue. The facility processed wheat to produce a range of products.



**Figure 2 Location of original facility**



## 2.4.2 Organisational boundary – Actual Facility

### Baseline Scenario

The baseline scenario for the actual facility GHG assessment includes the Shoalhaven Starches facility as operated in 2008. 2006/07 production data was used in this assessment, as per the original GHG assessment for the facility (GHD, 2008).

### Current Scenario

The current scenario of this GHG assessment estimates the emissions from the facility as it is being currently operated. To date, whilst the Modification 15 upgrades have been approved, they are currently not operational. For this reason, they are excluded from this scenario.

Emissions have been calculated based on estimated provided by Shoalhaven Starches

### Post MOD 16 Scenario

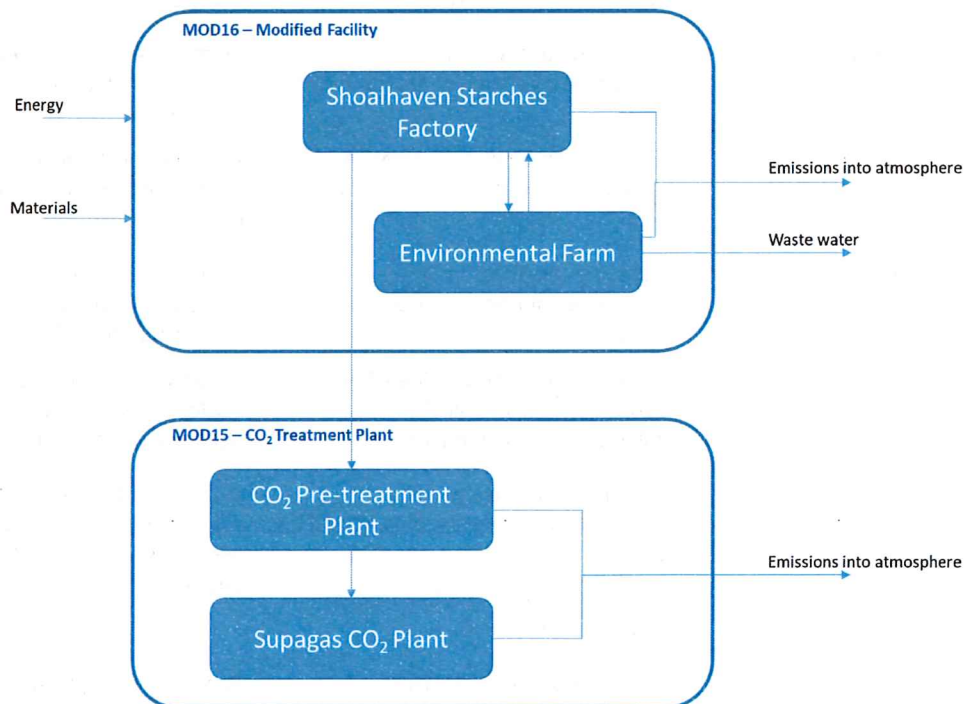
This scenario estimates the emissions from the facility as it is expected to be operated post the implementation of Modification 16 upgrades. This scenario is presented in three stages:

Stage 1: Current emissions plus the addition of the 15 MW coal-fired cogeneration plant

Stage 2: Stage 1 plus increased throughput and SupaGas carbon capture plant

Stage 3: Stage 2 plus the approved 40 MW gas-fired cogeneration plant

A simplified system boundary diagram is presented in Figure 5. The assessment analyses emissions from the factory (with proposed MOD 16 upgrades), environmental farm and adjacent CO<sub>2</sub> plant.



**Figure 5 Assessment boundary diagram**

Parameter	Assumptions	
	Approved	Actual
Electricity consumption	<p>Based on quantities in GHG assessment for original approval (GHD, 2008)</p> <p>Whilst a portion of the total electricity demand is met by on site generation, the remaining load is met by importing grid electricity.</p> <p>Emissions factor (EF) based on Table 5 of the NGA Factors publication (2008) for NSW</p>	<p>Quantity based on YTD estimates provided by Shoalhaven Starches</p> <p>Annualised estimates based on extrapolated YTD data</p> <p>EF based on part 6 of the NGER Determination 2008 (2017) for NSW. This EF is used by Shoalhaven Starches in their 2018 NGER report.</p>
Electricity Generation	<p>It is assumed that the approved 40 MW gas-fired cogeneration plant is operating at full capacity for 8000 hours of the year.</p>	<p>There is currently no electricity being generated on site.</p>
Natural Gas	<p>Based on quantities in GHG assessment for original approval (GHD, 2008)</p> <p>It is assumed that a 40 MW gas-fired cogeneration plant is operating at full capacity for 8000 hours of the year.</p> <p>EF based on Table 2 of the NGA Factors publication (2008) for natural gas distributed in a pipeline</p>	<p>Quantity based on estimates provided by Shoalhaven Starches</p> <p>EF based on Table 2 of the NGA Factors publication (2018) for consumption of natural gas</p>
Sludge Biogas	-	<p>Quantity based on estimates provided by Shoalhaven Starches</p> <p>EF based on Table 2 of the NGA Factors publication (2018) for consumption of natural gas</p>
Coal	<p>Based on quantities in GHG assessment for original approval (GHD, 2008)</p> <p>EF based on Table 1 of the NGA Factors publication (2008) for black coal</p>	<p>Quantity based on estimates provided by Shoalhaven Starches</p> <p>EF as reported in Shoalhaven Starches 2018 NGER report. It is understood that Method 2 was used to determine the specific EF for the coal being used and as such, use of the default values is not required.</p>
Diesel (on site)	<p>Based on quantities in GHG assessment for original approval (GHD, 2008)</p> <p>EF based on Table 3 of the NGA Factors publication (2008) for automotive fuel combustion</p>	<p>Quantity based on YTD estimates provided by Shoalhaven Starches</p> <p>Annualised estimates based on extrapolated YTD data</p> <p>EF based on Table 4 of the NGA Factors publication (2018) for fuels used for transport energy purposes</p>

Parameter	Assumptions	
Natural Gas	<p>It is assumed that a 40 MW gas-fired cogeneration plant is operating at full capacity for 8000 hours of the year.</p> <p>EF based on Table 2 of the NGA Factors publication (2018) for consumption of natural gas</p>	<p>Quantities based on predicted estimates provided by Shoalhaven Starches.</p> <p>EF based on Table 2 of the NGA Factors publication (2018) for consumption of natural gas</p>
Sludge Biogas	-	<p>Quantity based on current usage and not anticipated to change</p> <p>EF based on Table 2 of the NGA Factors publication (2018) for consumption of natural gas</p>
Coal	<p>Quantity based on currently approved coal consumption, in addition to the estimated increase in consumption. This estimate is provided by Shoalhaven Starches – increase due to the addition of a new coal fired boiler (boiler 8) and coal-fired cogeneration plant.</p> <p>EF as reported in Shoalhaven Starches 2018 NGER report. It is understood that Method 2 was used to determine the specific EF for the coal being used and as such, use of the default values is not required.</p>	<p>Quantity based on estimates provided by Shoalhaven Starches – significant increase due to the addition of a new coal fired boiler (boiler 8) and coal-fired cogeneration plant.</p> <p>EF as reported in Shoalhaven Starches 2018 NGER report. It is understood that Method 2 was used to determine the specific EF for the coal being used and as such, use of the default values is not required.</p>
Diesel (on site)	<p>Quantity based on approved consumption usage and not anticipated to change.</p> <p>EF same as for the current scenario.</p>	Quantity based on current usage and not anticipated to change.
Wastewater	<p>Quantity based on approved consumption usage and not anticipated to change.</p> <p>EF same as for the current scenario.</p>	Quantity based on predicted estimates provided by Shoalhaven Starches.
Carbon Capture	<p>It is assumed that the approved SupaGas CO<sub>2</sub> capture plant is operating for 365 days per year. The plant operates at 100 tpd of captured CO<sub>2</sub>.</p> <p>This estimate excludes the BOC CO<sub>2</sub> plant.</p>	<p>Stage 1: It is assumed that the operational BOC plant and approved SupaGas CO<sub>2</sub> capture plant are operating for 365 days per year. Both plants operate at a capacity of 155 tpd of captured CO<sub>2</sub>.</p> <p>Stage 2 and 3: It is assumed that the operational BOC plant and approved SupaGas CO<sub>2</sub> capture plant are operating for 365 days per year. Both plants operate at a capacity of 155 tpd of captured CO<sub>2</sub>.</p>
Throughput	As per Modification 16, throughput will increase to 1,320,800 t/a.	<p>Stage 1: Quantity based on current estimates provided by Shoalhaven Starches</p> <p>Stage 2: As per Modification 16, throughput will increase to 1,320,800 t/a.</p>

## 2.6 Exclusions

Exclusions from the GHG assessment include:

- Scope 3 emissions including:
  - Transmission and distribution emissions of electricity imported
  - Embodied emissions of construction materials
  - Emissions from extraction and transport of fuels and materials
- Emissions from the generation, storage, or use of perfluorocarbons. The development is unlikely to store, generate, or use perfluorocarbons.
- Emissions associated with the leakage of hydrofluorocarbons. The project may use negligible quantities of hydrofluorocarbons for refrigeration and air conditioning during construction and operation. However, the associated emissions are likely to be negligible compared with other emissions from the project and therefore were excluded from the assessment.

### 3.1.2 Current operations emissions

The total emissions for the plant, including all currently approved upgrades, amount to 587,034 t CO<sub>2</sub>-e per annum. These emissions include the Scope 1 and 2 emissions associated with the production of ethanol and other products at the Shoalhaven Starches site at Bomaderry.

The emissions are identical to the baseline scenario with one difference; a reduction in emissions attributed to the approved SupaGas CO<sub>2</sub> plant. This carbon capture plant is capable of capturing 100 tpd of CO<sub>2</sub> and operation of this plant slightly offsets the emissions from the rest of the facility.

### 3.1.3 Proposed emissions

After the implementation of the proposed Modification 16 upgrades, the gross operational emissions of the Shoalhaven Starches facility are expected to increase to 707,744 t CO<sub>2</sub>-e per annum.

The operation of all approved and proposed upgrades would result in a net increase in greenhouse gas emissions of 120,710 t CO<sub>2</sub>-e. This increase would be primarily attributed to the operation of a new coal-fired cogeneration plant and boiler (boiler 8). Coal requirements of the facility will increase dramatically, and the combustion of this fuel would be responsible for 442,534 t CO<sub>2</sub>-e per annum (59.46% of emissions).

As with all scenarios in this assessment, natural gas combustion is responsible for a significant portion of the emissions, in this case 40%.

In this scenario, the entire electricity demand is being met by the facility's generation capabilities. There are therefore no scope 2 emissions associated with this scenario.

Overall, the estimated scope 1 emissions are 707,744 t CO<sub>2</sub>-e (taking into account carbon capture), which is significantly higher than Shoalhaven Starches Safeguard Baseline of 338,959 t CO<sub>2</sub>-e as reported under CER's safeguard mechanism.

## 3.2 Greenhouse intensity

Greenhouse intensity is generally expressed as the quantity of emissions per unit of production. In this way, the greenhouse intensity can be used to benchmark against an industry sector or the organisation's previous performance.

Given the range of products that have been manufactured at the Bomaderry site over the past decade, it is difficult to express greenhouse intensity in terms of only one production unit. Instead, greenhouse intensity will be expressed as emissions per unit of feedstock throughput.

A summary of the greenhouse intensity results for this assessment is presented in Table 10.

**Table 10 Greenhouse emissions intensity - Approved**

Emissions intensity	Units	Baseline	Current	Predicted
Total emissions	t CO <sub>2</sub> -e /a	623,534	587,034	707,744
Total throughput	t throughput/a	1,062,200	1,062,200	1,320,800
Emissions intensity	t CO <sub>2</sub> -e / t throughput	0.587	0.553	0.536

**Table 11 Energy Use Summary – Approved Scenario**

Energy Source	Energy Content	Units	Baseline Energy Use		Current Energy Use		Proposed Energy Use			
			Consumption	Units	Consumption	Units	Consumption	Units		
<b>Scope 1</b>										
Coal	28.85 <sup>1</sup>	GJ/t	109,000	t/a	109,000	t/a	2,835,000	221,792	t/a	6,398,699
Natural Gas	38.6	GJ/m <sup>3</sup>	6,800,000	GJ/a	6,800,000	GJ/a	6,800,000	5,820,124	GJ/a	5,820,124
Diesel	38.6	GJ/kL	660	kL/a	660	kL/a	25,476	660	kL/a	25,476
Biogas	0.0377	GJ/m <sup>3</sup>	-	t/a	-	t/a	-	-	t/a	-
<b>Scope 2</b>										
Electricity	0.0036	GJ/kWh	14,000,000	kWh/a	14,000,000	kWh/a	50,400	0	kWh/a	0
			<b>Total</b>		<b>Total</b>		<b>9,818,876</b>	<b>Total</b>	<b>Total</b>	<b>12,244,299</b>

1 - Baseline and current coal energy content factor = 27 GJ/t (as per original approval), proposed coal energy content factor = 28.85 GJ/t

### 4.1.3 Proposed emissions

In the event that all of the proposed Modification 16 upgrades are implemented/installed, the gross operational emissions of the Shoalhaven Starches facility are expected to increase to 642,555 t CO<sub>2</sub>-e per annum.

This represents a net increase of 125,668 t CO<sub>2</sub>-e per annum from current actual emissions.

Again, the increase would be primarily attributed to the operation of a new coal-fired cogeneration plant and boiler (boiler 8). Coal consumption would be responsible for 429,641 t CO<sub>2</sub>-e per annum (60% of emissions).

A more detailed analysis shows the expected emissions if the Modification 16 upgrades are implemented in stages. Three stages are described:

1. Current facility + 15 MW coal-fired cogeneration plant
2. Current facility + 15 MW coal-fired cogeneration plant + increased throughput + SupaGas CO<sub>2</sub> plant (as detailed in Table 12)
3. Current facility + 15 MW coal-fired cogeneration plant + 40 MW gas-fired cogeneration plant + increased throughput + SupaGas CO<sub>2</sub> plant

This step-wise analysis is detailed in Table 13.

**Table 13 Forecasted Emissions**

	Current Emissions	Stage 1	Stage 2	Stage 3
	t CO <sub>2</sub> -e/a	t CO <sub>2</sub> -e/a	t CO <sub>2</sub> -e/a	t CO <sub>2</sub> -e/a
Natural Gas	85,667	35,174	35,174	198,421
Coal	204,591	299,948	429,641	309,925
Sludge Biogas	1,334	1,334	1,334	1,334
Diesel	656	656	656	656
Carbon Capture <sup>1</sup>	-20,400	-20,075	-56,575	-56,575
<b>Scope 1</b>	<b>271,848</b>	<b>317,075</b>	<b>410,230</b>	<b>453,761</b>
Electricity	245,039	143,687	232,325	0
<b>Scope 2</b>	<b>245,039</b>	<b>143,687</b>	<b>232,325</b>	<b>0</b>
<b>Total</b>	<b>516,887</b>	<b>460,725</b>	<b>642,555</b>	<b>453,761</b>

1 – Carbon Capture given negative symbol to represent net reduction in emissions

The stage 1 assessment shows that if the 15 MW coal-fired cogeneration plant was installed (without increasing throughput) the total facility emissions is expected to decrease to 460,725 t CO<sub>2</sub>-e per annum. This is attributed to the reduction in natural gas consumption and grid electricity demand.

Furthermore, if all approved and proposed modifications are implemented (stage 3), a reduction of 63,126 t CO<sub>2</sub>-e from current levels can be achieved. In this case, there are no scope 2 emissions associated with the facility, as the entire electricity demand is met by the combined 55 MW generation capacity of the two cogeneration plants.

**Table 15 Energy Use Summary – Approved Scenario**

Energy Source	Energy Content	Units	Baseline Energy Use			Current Energy Use			Proposed Energy Use – Stage 2		
			Consumption	Units	GJ/a	Consumption	Units	GJ/a	Consumption	Units	GJ/a
<b>Scope 1</b>											
Coal	28.85 <sup>1</sup>	GJ/t	105,000	t/a	2,835,000	102,538	t/a	2,958,221	215,330	t/a	6,212,271
Natural Gas	38.6	GJ/m <sup>3</sup>	168,536	GJ/a	168,536	1,662,466	GJ/a	1,662,466	682,590	GJ/a	682,590
Diesel	38.6	GJ/kL	660	kL/a	25,476	241	kL/a	9,297	241	kL/a	9,297
Biogas	0.0377	GJ/m <sup>3</sup>	-	t/a	-	7,328,170	t/a	276,272	7,328,170	t/a	276,272
<b>Scope 2</b>											
Electricity	0.0036	GJ/kWh	129,910,812	kWh/a	467,679	295,227,587	kWh/a	1,062,819	283,322,883	kWh/a	1,019,962
			<b>Total</b>		<b>3,496,691</b>		<b>Total</b>	<b>5,969,076</b>		<b>Total</b>	<b>8,200,392</b>

1 - Baseline coal energy content factor = 27 GJ/t (as per original approval), current and proposed coal energy content factor = 28.85 GJ/t



## 6. Opportunity for improvement

The greenhouse gas assessment of Shoalhaven Starches Bomaderry site has revealed a number of emission reduction opportunities. Some high level recommendations are described in this section.

### **Renewable energy sources**

In the event that Modification 16 is approved, it is predicted that the electricity demand at the Shoalhaven Starches facility will be 1,019,962 GJ/a. Shoalhaven Starches can reduce the emissions associated with importing electricity by utilising renewable energy sources. If renewable energy technologies are used on site to generate electricity, the opportunity exists to reduce emissions by up to 232,325 t CO<sub>2</sub>-e per year.

### **Alternative fuel sources - biodiesel**

Shoalhaven Starches currently uses 241 kL of diesel fuel per annum; this is not proposed to change after the upgrades. Whilst not a major emission source, consumption of diesel fuel for transportation purposes currently contributes 656 t CO<sub>2</sub>-e. By switching to an alternate fuel source a reduction can be achieved. A 10% biodiesel blend would result in total emissions of 593 t CO<sub>2</sub>-e, a reduction of 63 t CO<sub>2</sub>-e. This accounts for 0.1% of total emissions and is an immaterial amount.

# **Appendix A** – Emissions Inventories – Approved Scenarios

**Table A2 Approved Current Emissions Inventory**

Data	Value		Units	Scope 1 EF	Scope 2 EF	Total EF	Units	Scope 1 Emissions (t CO <sub>2</sub> -e)	Scope 2 Emissions (t CO <sub>2</sub> -e)	Total Emissions (t CO <sub>2</sub> -e/a)	Proportion of Total Inventory %
	(Q)	(Q)									
Electricity (plant)	14,000,000		kWh/a	0.89	0.89	0.89	kg CO <sub>2</sub> -e/kWh	0	12,460	12,460	2.00%
Natural Gas	6,800,000		GJ/a	51.33		51.33	kg CO <sub>2</sub> -e/GJ	349,044	0	349,044	55.98%
Coal	2,943,000		GJ/a	88.43		88.43	kg CO <sub>2</sub> -e/GJ	260,249	0	260,249	41.74%
Diesel (transportation)	660		kl/a	2698.14		2698.14	kg CO <sub>2</sub> -e/kl	1,781	0	1,781	0.29%
Wastewater Treatment	23,725,000		kg COD/a	0		0	kg CO <sub>2</sub> -e/kg COD	0	0	0	0.00%
Carbon Capture	36,500		t CO <sub>2</sub> /a	1		1	t CO <sub>2</sub> -e/t CO <sub>2</sub>	36,500	0	36,500	100%
<b>Total Emissions</b>								<b>611,074</b>	<b>12,460</b>	<b>623,534</b>	<b>100%</b>
<b>Total Capture</b>								<b>36,500</b>	<b>0</b>	<b>36,500</b>	<b>100%</b>
<b>Net Total Emissions</b>								<b>574,574</b>	<b>12,460</b>	<b>587,034</b>	

# **Appendix B** – Emissions Inventories - Actual Scenarios

**Table B2 Actual Current Emissions Inventory**

Data	Value		Units	Scope 1 EF	Scope 2 EF	Total EF	Units	Scope 1 Emissions (t CO <sub>2</sub> -e)	Scope 2 Emissions (t CO <sub>2</sub> -e)	Total Emissions (t CO <sub>2</sub> -e/a)	Proportion of Total Inventory %
	(Q)	(Q)									
Electricity	295,227,587		kWh/a	0.83	0.83	0.83	kg CO <sub>2</sub> -e/kWh	0	245,039	245,039	45.61%
Natural Gas	1,662,466		GJ/a	51.53		51.53	kg CO <sub>2</sub> -e/GJ	85,667	0	85,667	15.94%
Sludge Biogas	276,272		GJ/a	4.83		4.83	kg CO <sub>2</sub> -e/GJ	1,334	0	1,334	0.25%
Coal	2,958,221		GJ/a	69.16		69.16	kg CO <sub>2</sub> -e/GJ	204,591	0	204,591	38.08%
Diesel (transportation)	241		kL/a	2725.16		2725.16	kg CO <sub>2</sub> -e/kL	656	0	656	0.12%
Wastewater Treatment	23,725,000		kg COD/a	0		0	kg CO <sub>2</sub> -e/kg COD	0	0	0	0.00%
<b>Carbon Capture</b>	<b>20,400</b>		<b>t CO<sub>2</sub>/a</b>	<b>1</b>		<b>1</b>	<b>t CO<sub>2</sub>-e/t CO<sub>2</sub></b>	<b>20,400</b>	<b>0</b>	<b>20,400</b>	<b>100%</b>
<b>Total Emissions</b>								<b>292,248</b>	<b>245,039</b>	<b>537,287</b>	<b>100%</b>
<b>Total Capture</b>								<b>20,400</b>	<b>0</b>	<b>20,400</b>	<b>100%</b>
<b>Net Total Emissions</b>								<b>271,848</b>	<b>245,039</b>	<b>516,887</b>	

**Table B4 Predicted Actual Emissions Inventory – Stage 2**

Data	Value	Units	Scope 1 EF	Scope 2 EF	Total EF	Units	Scope 1 Emissions (t CO <sub>2</sub> -e)	Scope 2 Emissions (t CO <sub>2</sub> -e)	Total Emissions (t CO <sub>2</sub> -e/a)	Proportion of Total Inventory %
	(Q)									
Electricity	283,322,883	kWh/a	0.82	0.82	0.82	kg CO <sub>2</sub> -e/kWh	0	232,325	232,325	33.23%
Natural Gas	682,590	GJ/a	51.53		51.53	kg CO <sub>2</sub> -e/GJ	35,174	0	35,174	5.03%
Sludge Biogas	276,272	GJ/a	4.83		4.83	kg CO <sub>2</sub> -e/GJ	1,334	0	1,334	0.19%
Coal	6,212,271	GJ/a	69.16		69.16	kg CO <sub>2</sub> -e/GJ	429,641	0	429,641	61.45%
Diesel (transportation)	241	KL/a	2725.16		2725.16	kg CO <sub>2</sub> -e/KL	656	0	656	0.00%
Wastewater Treatment	27,995,000	kg COD/a	0		0	kg CO <sub>2</sub> -e/kg COD	0	0	0	0.09%
<b>Total Emissions</b>							<b>466,805</b>	<b>232,325</b>	<b>699,130</b>	<b>100%</b>
Carbon Capture	56,575	t CO <sub>2</sub> /a	1		1	t CO <sub>2</sub> -e/t CO <sub>2</sub>	56,575	0	56,575	100%
<b>Total Capture</b>							<b>56,575</b>	<b>0</b>	<b>56,575</b>	<b>100%</b>
<b>Net Total Emissions</b>							<b>410,230</b>	<b>232,325</b>	<b>642,555</b>	

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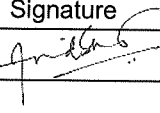
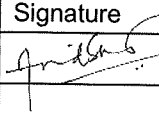
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