Greenhouse Gas Assessment Technical Report

Shoalhaven Starches Modification 23

Shoalhaven Starches

24 May 2021

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Executive summary

GHD was engaged by Manildra Group (Manildra) to conduct a GHG assessment for the proposed modifications (Mod 23) to the existing Shoalhaven Starches facility. The modification involves development of the co – generation (co-gen) facility in 2022. In addition, Manildra also proposes to convert their existing coal fired boilers to gas.

Two scenarios were developed to model the scope 1 and 2 emissions from the proposed on-site modifications, against each other and the emissions associated with financial year ending 2020 as reported for NGER. Those scenarios involved the projection of emissions at an increased level of production using a mixture of increased gas and grid electricity plus consistent coal use; and the proposed scenario of increased natural gas use through a cogen turbine and boilers, but no coal use and greatly reduced grid electricity use as a result of the cogeneration plant.

The assessment boundary is the same as used for the site's annual NGER report. Scope 1 emissions are the direct emissions associated with the on-site combustion of fuels during operations, and scope 2 emissions are indirect emissions associated with the consumption of grid electricity.

The following table summarises the three scenarios involved: the FY20 emissions, future increased production with no co-gen and future with increased production and the co-gen facility in operation. The FY20 emissions scenario refers to the current emissions reported at 866,625 tonnes per annum (TPA) of flour throughput. As allowed under its existing Approval, from 2022 Manildra group proposes to increase production by 37% to 1,300,000 TPA of flour throughput. As the addition of the co – gen unit will dramatically decrease the project's reliance on grid electricity, it is predicted that the scope 2 emissions will fall in comparison to FY2020. Thus, by implementing the modifications, Manildra is projected reduce the facility's operational emissions by 43% in comparison to FY20.

Activity	FY20	Future increased production (no co-gen)	Future increased production (Co-gen facility in operation)
Product (flour) throughput (TPA)	866,625	1,300,000	1,300,000
Steam requirement (TPA)	1,484,873	2,116,800	2,116,800
Emissions	(t CO2-e / year)	(t CO2-e / year)	(t CO2-e / year)
Natural Gas	79,547	182,790	432,543
Coal	269,854	264,190	0
Biogas	1,376	2,710	2,710
Liquified Petroleum Gas (LPG)	50	0	0
Diesel	1,146	1,146	1,146
Scope 1 Total	351,973	450,836	436,400
Electricity	247,016	361,876	35,478
Scope 2 Total	247,016	361,876	35,478
Total	**598,989**	**812,712**	**471,878**
tCO_2-e/ flour throughput (tpa)	**0.69**	**0.62**	**0.36**

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.4 and the assumptions and qualifications contained throughout the Report.

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1. Introduction

1.1 Background

GHD was engaged by Manildra Group (Manildra) to conduct a GHG assessment of the impact of the proposed modifications (Mod 23) to the existing Shoalhaven Starches facility.

Manildra is an agribusiness that produces a range of Australian food and industrial products including wheat flours, gluten and proteins, starch, syrups, ethanol, and stockfeed for domestic and export markets. The largest facility owned by the Manildra is its Shoalhaven Starches facility at Bolong Road in Bomaderry near Nowra, New South Wales (Nowra plant) which manufactures the full range of products.

The key to the process is the generation of steam. Currently this is done through a mixture of natural gas, biogas and coal combustion. The manufacturing process also involves significant electricity consumption. Manildra is planning to expand production at the Nowra plant and to facilitate that it needs to increase its capacity to produce steam.

As part of increasing its steam capacity Manildra is looking to reduce and eventually move away from coal combustion and is considering the installation of natural gas co-generation plant in its place, this installation will require a change to the Shoalhaven Starches Expansion Approval (Mod 23).

As part of Mod 23, Manildra propose to construct a new gas-fired co-generation plant which will consist of two natural gas turbines that will generate an anticipated power output each of 30 MW, providing a total power to the site of 60 MW. The new application for a gas fired co-generation plant will replace the approved gas fired and coal fired co-generators. In addition, Manildra also proposes to convert their existing coal fired boilers to gas as well.

It is assumed that if progressed, the plant will be operating by the end of FY22. As the combustion of coal is considerably more greenhouse gas (GHG) intensive per unit of energy output (electricity or steam) than the combustion of natural gas in a co-generation unit, GHG emission savings in absolute terms and per unit of output are expected.

1.2 Purpose of this report

The purpose of this report is to document the assumptions, inputs and outputs of GHD's assessment of the changes to the annual GHG emissions at the Nowra Plant as a result of the changes associated with Mod 23.

1.3 Scope

This report contains a greenhouse gas assessment. The assessment covers site wise NGER reportable scope 1 and 2 emissions. Scope 1 emissions are the direct emissions associated with the on-site combustion of fuels during operations (eg. biogas, natural gas, coal and diesel), and scope 2 emissions are indirect emissions associated with the consumption of grid electricity.

The greenhouse gas assessment includes quantitative analysis of scope 1 and 2 emissions for the project in the three scenarios:

– Emissions from FY20
– Emissions from Future Production without co-gen
– Emissions from Future Production with co-gen

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

1.4 Limitations

This report has been prepared by GHD for Manildra and may only be used and relied on by Manildra for the purpose agreed between GHD and the Manildra as set out in Section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Manildra arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (section 2.6). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Manildra, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

2. Emissions calculations methodology

2.1 Overview

This assessment has been undertaken in accordance with the principles of ISO 14064-1 and the general principles for measuring emissions in the *National Greenhouse and Energy Reporting (NGER) (Measurement) Determination 2008*. Relevant sections of the following documents were used for the purposes of defining appropriate methods for quantification of emissions from individual sources:

– NGER (Measurement) Determination 2008 (as amended July 2020) and NGER Act 2007, Clean Energy Regulator
– National Greenhouse Accounts Factors (September 2020) workbook, Department of Industry, Science, Energy and Resources

These guidelines are considered representative of good practice GHG accounting in Australia and are applicable to the Project.

2.2 Greenhouse gases and global warming potentials

The greenhouse gases considered in this assessment and the corresponding global warming potential (GWP) for each gas are listed in Table 2.1. GWP is a metric used to quantify and communicate the relative contributions of different substances to climate change over a given time horizon. GWP accounts for the radiative efficiencies of various gases and their lifetimes in the atmosphere, allowing for the impacts of individual gases on global climate change to be compared relative to those for the reference gas carbon dioxide. In this assessment, the GWPs from the National Greenhouse and Energy Reporting (NGER) Regulations 2008 (as amended July 2020) were used. These are reflective of radiative forcing over a 100-year time horizon.

Table 2.1 Greenhouse gases and 100-year global warming potentials

Greenhouse gas	Global warming potential
Carbon dioxide (CO_2)	1
Methane (CH_4)	28
Nitrous oxide (N_2O)	265

2.3 Assessment boundary

The GHG emissions considered for this assessment included those within a whole of site operational boundary. The emissions reported are the material emissions reported for the purposes of FY20 NGER reporting and the emissions projected for future NGER reporting under the two future increased-production operational scenarios. The three scenarios reported are:

– FY20 actual emissions, as reported to NGER in FY20
– Production expansion no Cogen– expanded production with increased gas and grid electricity consumption, stable coal use and no cogen
– Production expansion with Cogen – expanded production with increased gas use, no coal use, and reduced electricity consumption as a result of the installation of a cogen unit

The new cogen facility is planned to be built at the other end of the Nowra plant from the existing boilers, and electricity is used throughout the plant hence the whole of site emissions assessment Figure 2.1.

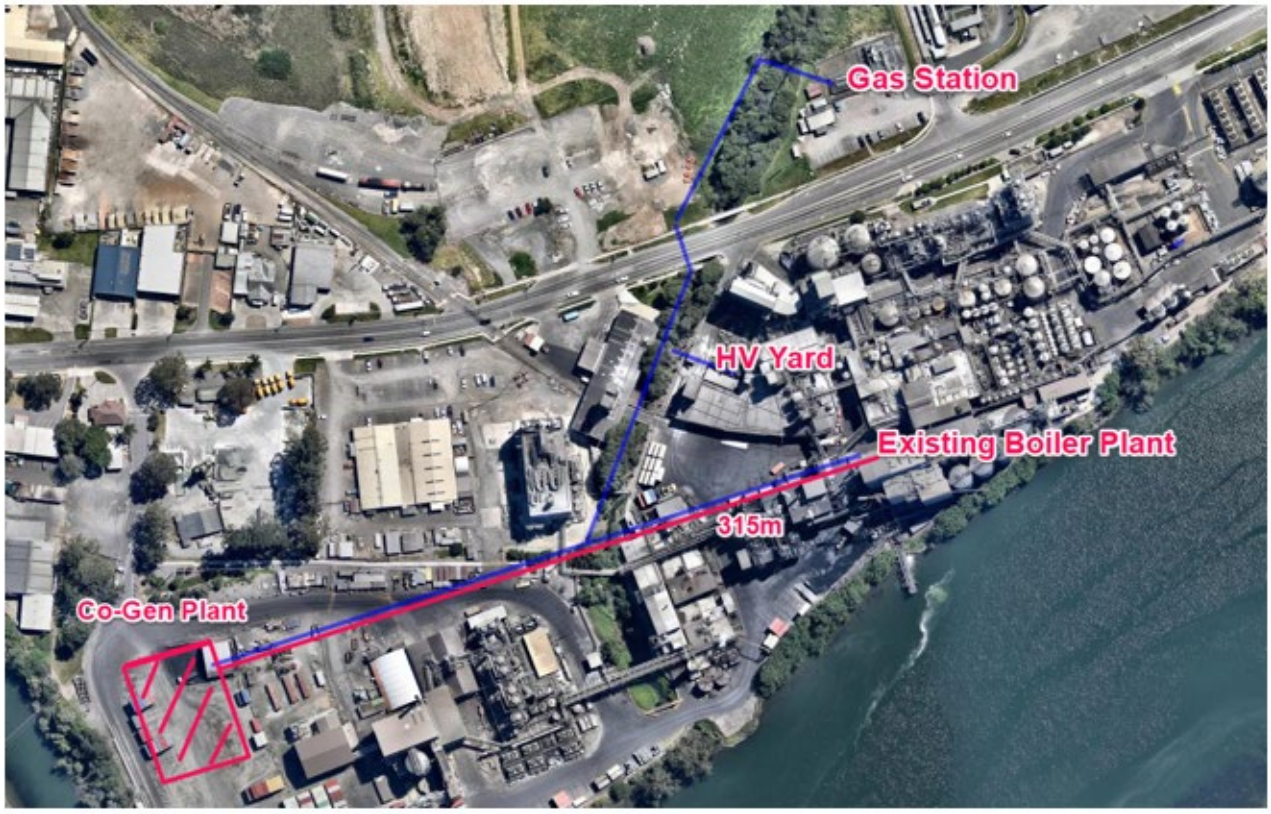

Figure 2.1 Location of the proposed co-generation plant

2.4 Exclusions

This assessment considers only greenhouse gas emissions sources within the boundary of Shoalhaven Starches Nowra plant.

Other specific exclusions from this GHG assessment are:

– Loss of carbon associated with vegetation loss in the disturbed areas during construction.
– Fugitive emissions related to the 5.5-km natural gas high pressure pipeline
– Scope 3 emissions such as those associated with embodied energy of materials, transportation of materials and equipment during construction, or management of waste materials.

2.5 Calculation procedures

The calculation procedures used to create the greenhouse gas emissions inventory were as follows:

– A scope for the greenhouse gas assessment was defined, considering the possible emission sources of greenhouse gases, including carbon dioxide, nitrous oxide, and methane.
– Relevant instances of energy use and emissions from operations were identified.
– Review of the May 2019 Greenhouse Gas (GHG) assessment report (2019 GHG Report) prepared by GHD estimating the GHG emissions due to MOD 16.
– Review of the NGER FY20 submission of the Shoalhaven Starches facility
– For emissions during future increased production operations phase (No co-gen):
    - Coal consumption
    - Combustion of natural gas
    - Combustion of biogas
    - Electricity consumption
    - Diesel consumption

– For emissions during future increased production operations phase with co-generation facility:
  - Combustion of natural gas
  - Combustion of biogas
  - Electricity consumption
  - Diesel Consumption
– Total greenhouse gas emissions for the Project for the three scenarios (FY20, co-gen and no co-gen) were determined.

2.6 Assumptions

Assumptions used in estimating GHG emissions for the two operation scenarios of the Project are listed in Table 2.2. The assessment was based on emission factors available at the time of the assessment, May 2021, and future changes in emission factors were not considered. Emissions factors used in preparation of this inventory are described in Section 2.1 above.

Activity data used for the GHG assessment was assumed based on the Turbine Scenarios 2021 – 03 – 03 spreadsheet, Air Emissions Modelling spreadsheet and the Business Case Co-gen March 2021 Report.

Table 2.2 Greenhouse gas assessment assumptions by source

Parameter	Assumptions	Activity Data and units
Future increased production – no cogen		
Coal consumption	The boiler which uses coal is assumed to produce steam at 117 TPH. Future steam production for the entire facility is assumed 245 TPH. The conversion factor from tonnes of steam to tonnes of coal is estimated to be 9.33. This factor is estimated from the FY20 emissions. It was assumed that the boilers operate for 360 days per year or a total of 8,640 h/year. It is assumed coal used is bituminous. The emission factor used is 2.436 tCO_2-e/t coal from NGER (Measurement) Determination July 2020.	108,431 t coal/year
Natural gas consumption	It is assumed that 342 GJ/hr consumed by the gas boiler and 63 GJ/hr consumed by the dryers. Therefore the average gas consumption is 405 GJ/hr/. It is assumed that the boilers and dryers operate for 8760 h/year. The emission factor used is 0.05153 t CO_2-e/GJ from NGER (Measurement) Determination July 2020.	3,547,256 GJ/year
Biogas consumption	The flowrate of biogas recovery has been assumed to have a 50% increase from FY20 to future 2022 i.e. the flowrate increases from 7,557,507 m^3 /annum to 11,336,260 m^3/annum. This is due to the extra wastewater produced at the increased production level. Assuming 360 days/ year (or 8640 hours/year) operation, the total annual consumption of biogas is estimated to be 427,377 GJ. The emission factor used is 0.0064 t CO_2-e/GJ from NGER (Measurement) Determination July 2020.	421,523 GJ/yr
Electricity consumption	It is assumed that 446,760 MWh of purchased electricity is required by the plant annually. The emission factor used is 0.81 t CO_2-e/MWh from NGER (Measurement) Determination July 2020.	446,760 MWh
Future increased production (Co-gen facility in operation)		
Natural gas consumption	To account for the increased steam demand as a result of the higher production level and the move to gas only boilers and cogeneration. It is assumed that on average 744 GJ/hr is	8,394,011 GJ/yr

Parameter	Assumptions	Activity Data and units
	consumed by the cogeneration turbines, 151GJ/hr is consumed by the boilers and 63 GJ/hr is consumed by the dryers. Therefore the average gas consumption will be 958 GJ/hr. It is assumed that the boilers and dryers operate for 8760 h/year. The emission factor used is 0.05153 t CO_2-e/GJ from NGER (Measurement) Determination July 2020.	
Biogas consumption	Assumed to be the same as the scenario with no cogen. The emission factor used is 0.0064 t CO_2-e/GJ from NGER (Measurement) Determination July 2020.	7,557,506 m^3/yr
Electricity consumption	It is assumed that 5 MW of electricity is purchased every hour resulting to 43,800 MWh purchased from the grid annually. It is assumed that the co-gen unit will produce the difference between the required electricity for the project as per the assumption in the no co-gen scenario. This results to the estimation that 402,960 MWh of electricity will be produced annually by the co – gen unit. The emission factor used is 0.81 t CO_2-e/MWh from NGER (Measurement) Determination July 2020.	43,800 MWh/year

3. Impact assessment

3.1 Current emissions

GHD reviewed and recalculated the FY20 emissions of the Nowra facility, as per the annual submission for NGER. It is summarised in Table 3.1.

Table 3.1 FY20 emissions of Nowra facility

Activity	FY20 emissions (t CO_2-e)
Natural Gas	79,547
Coal	269,854
Biogas	1,376
Liquified Petroleum Gas (LPG)	50
Diesel	1,146
Scope 1 Total	**351,973**
Electricity	247,016
Scope 2 Total	**247,016**
Total	**598,989**

3.1.1 Current Operational Emissions

The total emissions for the plant, including all currently approved upgrades, amount to 598,989 t CO_2-e per annum. These emissions include the Scope 1 and 2 emissions associated with the consumption of natural gas, coal, biogas, LPG, diesel, and electricity. These emissions represent the emissions reported to the CER for NGER for FY20.

3.2 Emissions following proposed expansion

Table 3.2 and Table 2.5 show a summary of estimated annual operational greenhouse gas emissions following the plant expansion with and without the installation of the proposed cogen plant.

As referenced in Section 1.1 Manildra has approval to expand its production. The FY20 the flour throughput of the Nowra plant was 866,625 tonnes per annum (TPA). From the start of FY23, Manildra group proposes to increase production, as allowed under its existing approval to 1,300,000 TPA of flour throughput. This approved expansion will result in increased production of a mixture of products such as gluten, beverage grade ethanol and dried starch. To enable this production expansion the generation of steam on site must increase, in both of the following scenarios it has been assumed that steam production will increase from its current level of 180 tonnes per hour (Tph) to 245 (Tph).

3.2.1 Future increased production (no co-gen) emissions

Table 3.2 Annual estimated operations for future increased production (no co-gen)

Activity	Activity Data	Units	Scope 1 Emissions (t CO_2-e)	Scope 2 Emissions (t CO_2-e)	Total Emissions (t CO_2-e /y)	Percentage of Total
Future increased production (no co-gen)						
Coal consumption	108,431	t/year	264,190		264,190	33%
Natural gas consumption	3,547,256	GJ/year	182,790		182,790	22%
Biogas consumption	421,523	GJ/year	2,710		2,710	0.3%
Diesel	422	kL	1146		1146	0.1%
Purchased Electricity consumption	446,760	MWh		361,876	361,876	45%
Total			**450,836**	**361,876**	**812,712**	**100%**

As can be seen in Table 3.2 in the hypothetical increased production scenario without co-gen, the gross operational emissions of the Shoalhaven Starches facility are projected to increase to 811,566 t CO_2-e per annum. These numbers have been calculated based on the expected consumption of gas of the proposed new boilers and its use at a consistent level to achieve an average of 245 tonnes per hour steam generation, and a throughput of 1,300,000 tonnes per annum of flour.

This increase would primarily be attributable to the increased burning of gas and the increased consumption of grid electricity. Whilst gas increases to 22% of scope 1 emissions, the combustion of coal would still contribute to 264,190 t CO_2-e per annum (33% of total scope 1 and 2 emissions) and the consumption of electricity would account for 361,876 t CO_2-e per annum (45% of total scope 1 and 2 emissions).

Overall, the total estimated scope 1 emissions are 449,860 t CO_2-e whilst scope 2 emissions are 361,876 t CO_2-e, this shows that scope 2 emissions (which is only electricity) makes up a large proportion of emissions.

3.2.2 Future increased production (Co-gen facility in operation)

Table 3.3 shows that after the implementation of the co-gen facility into the operation, the gross operational emissions are expected to decrease to 470,737 t CO_2-e.

Similarly, as above in section 3.2.1, these numbers have been calculated based on the expected consumption of gas of the proposed new boilers (but also new cogen turbines) and its use at a consistent level to achieve an average of 245 tonnes per hour steam generation, and a throughput of 1,300,000 tonnes per annum of flour.

In this scenario, there is no coal combustion and greatly reduced grid electricity consumption which is the reason for the large decrease in emissions (a reduction of 42% against the alternative higher production scenario and 21% against FY20).

The natural gas combustion does increase significantly, rising to 432,543 t CO_2-e, to become about 92% of the facility's total scope 1 and 2 emissions. However it is still a lot less than in the FY20 operations when production was lower.

In this scenario, the grid electricity demand is expected to decrease to 43.8 GWh and the GHG emissions associated with purchased electricity will decrease to 35,478 t CO_2-e.

Overall, the estimated scope 1 emissions are 436,400 t CO_2-e and scope 2 emissions are 35,478 t CO_2-e.

Table 3.3 Annual estimated operational emissions for future increased production with co-gen

Activity	Activity Data	Units	Scope 1 Emissions (t CO_2-e)	Scope 2 Emissions (t CO_2-e)	Total Emissions (t CO_2-e /y)	Percentage of Total
Future increased production (Co-gen facility in operation)						
Natural gas consumption	8,136,138	GJ/y	432,543		432,543	92%
Biogas consumption	421,523	GJ/y	2,710		2,710	0.6%
Diesel	422	kL	1146		1146	0.2%
Purchased Electricity consumption	43,800	MWh/y		35,478	35,478	8%
Total			**436,400**	**35,478**	**471,878**	**100%**

3.3 Impact of emissions

A summary of the estimated scope 1 and scope 2 GHG emissions for the existing and future scenarios is provided in Table 3.4.

Table 3.4 Summary of emissions

Activity	FY20	Future increased production (no co-gen)	Future increased production (Co-gen facility in operation)
Product (flour) throughput (TPA)	866,625	1,300,000	1,300,000
Average steam requirement (Tph)	180	245	245
Emissions	(t CO_2-e / year)	(t CO_2-e / year)	(t CO_2-e / year)
Natural Gas	79,547	182,790	432,543
Coal	269,854	264,190	0
Biogas	1,376	2,710	2,710
Liquified Petroleum Gas (LPG)	50	0	0
Diesel	1,146	1,146	1,146
Scope 1 Total	**351,973**	**450,836**	**436,400**
Electricity	247,016	361,876	35,478
Scope 2 Total	**247,016**	**361,876**	**35,478**
Total	**598,989**	**812,712**	**471,878**
tCO_2-e/ flour throughput (tpa)	**0.69**	**0.62**	**0.36**

3.3.1 Summary impact of emissions

Overall, there is a significant difference in the emissions associated with the two future increased production scenarios. The scenario without co-gen would see annual emissions of 812,712 t CO_2-e and with co-gen scenario would see emissions of 471,878 t CO_2-e. This represents a 58% difference in emissions between the two scenarios. The major differences between the two scenarios are the elimination of coal, decrease in electricity usage and the increase in natural gas usage. The amount of grid electricity is reduced as the co-gen is in operation.

Between the two future increased production scenarios, there is 42% increase in natural gas consumption from 182,790 t CO_2-e to 432,543 t CO_2-e. However, despite the large increase in natural gas consumption, the decrease in coal consumption and electricity is much higher. The coal consumption decreases from 264,190 t CO_2-e to zero and electricity decreases from 361,876 t CO_2-e to 35,478 t CO_2-e (10% decrease in emissions).

As per Table 3.5 Australian GHG emissions for the year up until September 2020 are estimated to be 510.1 Mt CO_2-e. Compared with the estimated GHG of 0.8 Mt CO_2-e and 0.4 Mt CO_2-e for the future increased production without and with co-gen, respectively, the impact of increases in annual greenhouse gas emissions is minor in the context of Australia's greenhouse gas emissions as a whole.

Table 3.5 Impact of project emissions on national totals

Emissions Source	Total Emissions 2019 (Mt CO_2-e)[1]	Year to September 2020 Australian Emissions (Mt CO_2-e)[2]	Potential Annual Contribution of Operations emissions- no cogen (%)	Potential Annual Contribution of Operations emissions- with cogen (%)
Overall Total	518.9	510.1	0.16%	0.09%

1. Table 2.1, Department of the Environment and Energy "State and Territory Greenhouse Gas Inventories 2019" April 2021

2. Table 3, Department of the Environment and Energy "Quarterly Update of Australia's National Greenhouse Gas Inventory: June 2020" Incorporating emissions from the NEM up to September 2020.

A comparison of all assessed scenarios is presented in Figure 3.1.

The introduction of a co-gen facility and the elimination of coal would result in a decrease in emissions from current levels but an increase in scope 1 emissions. Overall, there is a large reduction in emissions as a result of the introduction of the co-gen facility.

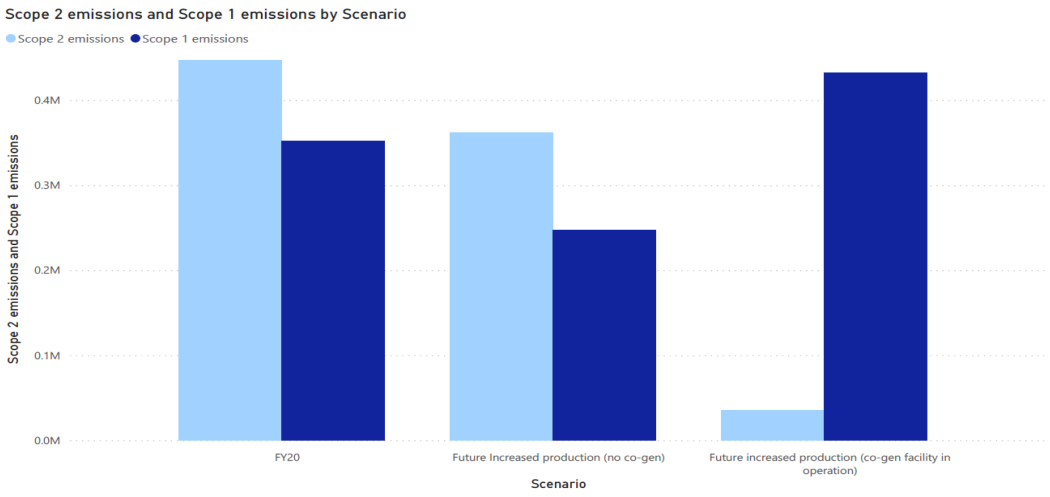

Figure 3.1 Scope 1 and 2 emissions by scenario

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