16.0 Greenhouse gas

16.1 Introduction

This chapter presents information on the estimation of greenhouse gas (GHG) emissions with regards to the Ensham Life of Mine Extension Project (the proposed project, hereafter referred to as 'the Project'). The extension of the underground mine into an area identified as the Project Site which includes zones 1, 2 and 3 as shown in **Figure 4-1 Chapter 4** (Project description and alternatives) will enable the extension of the Ensham Life of Mine (LOM) by up to nine years to approximately 2037, to maintain a steady supply of coal to markets and ongoing long-term employment within the Central Highlands region.

This chapter estimates GHG emissions from the Project activities, discusses the potential GHG implications of the Project, and, identifies abatement measures to reduce emissions for the Project. GHG emissions from the existing Ensham Mine activities are not considered in this assessment.

Environmental objectives and outcomes

The Project seeks to manage greenhouse gas (GHG) emissions in accordance with the requirements of the *National Greenhouse and Energy Reporting Act 2007* (Cth) (NGER Act). The Project seeks to protect environmental values established under the Environmental Protection Regulation 2019 (EP Regulation).

The existing Ensham Mine manages GHG contributions and impacts in accordance with the existing Idemitsu Energy Management Policy. As the Project is an extension of the current underground operation at Ensham Mine, GHG emission impacts are not significant and are not considered a critical matter in the environmental impact statement (EIS).

16.1.1 Background and scope

GHGs in the atmosphere trap incoming radiation from the Sun, which insulates the planet from the cold temperatures of space. This process is known as the greenhouse effect.

The main GHGs influenced by human activities, and therefore of most importance to the Project, are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3), and synthetic gases such as chlorofluorocarbons (CFCs) and hydrofluorocarbons (HFCs).

This GHG assessment seeks to:

- identify the legislative framework for GHG emissions and management in Queensland, Australia
- provide an outline of Idemitsu's Energy Management Policy
- quantify scope 1 and 2 GHG emissions generated from the Project's operation
- identify abatement measures to reduce GHG emissions generated from the operation of the Project.

This GHG assessment estimates only the GHG emissions due to the Project, and not the existing operation approved under the current EA.

16.2 Legislation and policy

16.2.1 International policy and legislation

Currently, there are two key international agreements that Australia have commitments to. These are the Kyoto Protocol (1997) and the Paris Agreement (2016). These overarching international agreements target GHG emission reduction and limiting this century's global temperature rise to under two degrees Celsius above pre-industrial levels.

Kyoto Protocol

The Kyoto Protocol was concluded and agreed on in 1997 by the United Nations Framework Convention on Climate Change (UNFCCC) and enforced in 2005, with Australia ratifying the Kyoto Protocol in 2007. The Kyoto protocol aims to reduce the impact of human-induced climate change by setting nation-specific GHG emissions targets.

The Kyoto Protocol involves the reduction of emissions of six specific GHGs - carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6).

The Protocol designated two commitment periods for emissions targets; the first commitment period started in 2008 and ended in 2012 and the second commitment period (the Doha Amendment) began 1 January 2013 and will end in 2020. As part of the second commitment period, Australia has set a target to reduce GHG emissions to five per cent below 2000 levels by 2020.

Paris Agreement

The Paris Agreement was finalised and entered into force in 2016, with an objective to build upon the mechanisms and targets put forward by the Kyoto Protocol. The Paris Agreement has been ratified by 185 of the 197 Parties to the UNFCCC.

The Paris Agreement demonstrates the Australian Government's commitment to reducing human-induced climate change with a central aim is to strengthen the global response to climate change. This is achieved by limiting the global temperature rise to under two degrees Celsius above pre-industrial levels, and reducing GHG emissions by encouraging technological innovation and clean energy

A special report by the Intergovernmental Panel on Climate Change (IPCC) in 2018 stressed the importance of limiting the temperature increase even further to 1.5 degrees Celsius against pre-industrial levels.

16.2.2 Commonwealth policy and legislation

The Australian federal government has many programs, policies, and tools in place to act on climate change. The key aspects of the federal action on climate change are summarised below.

National Greenhouse and Energy Reporting Act 2007

The NGER Act introduces a single national framework for reporting and disseminating company information about GHG emissions, energy production, and energy consumption.

The NGER Act requires that individuals or corporations who exceed certain GHG emission thresholds to publicly report their GHG emissions, energy consumption and energy production each financial year.

The current GHG reporting thresholds for corporations are as follows:

- emission of more than 50,000 tonnes (t) of carbon dioxide equivalent (CO_2-e)
- production of 200 terajoules (TJ) or more of energy, or
- consumption of more than 200 TJ of energy per year.

The Project's annual GHG emissions, energy consumption and energy production are expected to be reported in the annual NGER reporting for Idemitsu.

Emissions Reduction Fund

To meet its targets set under the Kyoto Protocol and Paris Agreement, the Department of Agriculture, Water and the Environment (DAWE) has commissioned The Emissions Reduction Fund (ERF). The ERF provides incentives for Australian businesses, farmers, land holders and citizens to reduce their GHG emissions by adoption of more efficient practices and technologies.

Key elements of the ERF are as follows:

- crediting emissions reductions that go beyond business as usual standards
- selling emission reductions in the form of Australian Carbon Credit Units (ACCU)
- a Safeguard Mechanism that provides a framework for Australia's largest emitters to measure, report and manage emissions.

Australia's 2030 climate change target

Australia has set a target to reduce GHG emissions by 26-28 per cent below 2005 levels by 2030. This builds on previous targets set out by the Kyoto Protocol to reduce emissions by five per cent below 2000 levels by 2020.

Australia is expected to meet this 2030 target through policies built on by a "Direct Action" approach, which aims to improve productivity, reduce costs and drive energy innovation.

16.2.3 State policy and legislation

The Queensland Climate Change Response sets out the Queensland Government's strategy to transition to a low carbon economy and address the impacts of climate change. The Queensland Climate Change response includes the following two key strategies:

Queensland Climate Transition Strategy

The Queensland Government has set a state target to reach zero net emissions by 2050, along with the interim target aligned with the Australian Government's target for at least a 30 per cent reduction in emissions on 2005 levels by 2030.

Queensland Climate Adaptation Strategy

Queensland Climate Adaptation Strategy (Q-CAS) aims to address the impacts of climate change and build an innovative and resilient Queensland by understanding risks, providing information, integrating climate adaptation into policy and collaborating with stakeholders.

16.3 Idemitsu Energy Management Policy

Idemitsu recognises the importance of identifying and implementing sustainable energy efficiency programs designed to deliver sustainable resource management for all its operations. The Idemitsu corporate Energy Management Policy that promote these values include the following strategies:

- improve the management of energy and greenhouse gas emissions across Idemitsu operations
- comply with all relevant legislation, policies and energy efficiency improvement strategies and obligations
- seek and implementing energy savings technology and practices where cost effective
- accelerate energy efficient technology uptake through:
  - involvement in relevant research initiatives, and
  - ongoing research conducted through the Idemitsu Coal and Environment Research Laboratory
- integrate energy management strategies into business decision making
- communicate the Energy Management Policy and provide training opportunities for Idemitsu employees.

16.3.1 Greenhouse gas inventory methodology

Under the NGER Act, companies that meet threshold levels for GHG emissions, energy consumption, or energy production are required to report their GHG emissions annually. The six GHG's that are reported under the NGER Act include the following compounds and groups of compounds:

- carbon dioxide (CO_2)
- methane (CH_4)
- nitrous oxide (N_2O)
- specified hydrofluorocarbons (HFCs)
- specified perfluorocarbons (PFCs)
- sulfur hexafluoride (SF_6).

GHG emissions are generally reported in terms of carbon dioxide equivalent (CO_2-e). This is to provide a standardised unit for reporting due to different gases having varying effects of global warming impacts or global warming potential (GWP). The GWP refers to the GHG potential to trap heat in the atmosphere for a certain period (generally 100 years), relative to carbon dioxide (with a GWP of one). At the time of writing, the most recent available National Greenhouse Accounts Factors (DoEE, 2019a) equates Methane with a GWP of 25, which means for every tonne of methane emitted, it has the same global warming effect of 25 tonnes of carbon dioxide. As such, gases such as methane or nitrous oxide are relatively potent GHGs.

Table 16-1 presents the GWP of the key GHGs that are associated with the Project, namely carbon dioxide, methane, and nitrous oxide.

Table 16-1 GHG global warming potential

Gas	Chemical formula	Global warming potential
Carbon dioxide	CO_2	1
Methane	CH_4	25
Nitrous oxide	N_2O	298

Reporting under the NGER Act requires that GHG emissions are separated into three categories referred to as scopes. This is the internationally accepted method of reporting on GHG emissions. The three scopes of emissions as per the NGER (Measurement) Determination 2008, are described below and summarised in **Figure 16-1**.

Scope 1 emissions

- Direct emissions where the point of emission release is owned by the organisation, such as:
  - fuel combustion, which result in emissions from fuel combustion, e.g. from diesel fuelled vehicles or generators
  - fugitive emissions from fuels, which are used in the extraction, production, processing and distribution of fossil fuels such as coal (e.g. methane emissions from coal mines)
  - industrial process emissions, which result from the consumption of carbonates and the use of fuels as feedstocks or as carbon reductants, and the emission of synthetic gases
  - waste emissions, which result from the decomposition of organic material in landfill or wastewater handling facilities.

Scope 2 emissions

- Indirect GHG emissions that occur inside the Project footprint. Electricity generation, emissions arise principally at an electricity generator, or through the loss of electricity from an electricity transmission network or distribution network, as a result of the purchase of electricity by a corporation.

Scope 3 emissions

- Other indirect GHG emissions that occur outside the Project footprint. For example, third party emissions from transportation of coal and subsequent use of the coal.

The purpose of differentiating between the scopes of emissions is to avoid the potential for double counting, where two or more organisations assume responsibility for the same emissions.

Reporting under the NGER Act requires that organisations report scope 1 and scope 2 emissions, but not scope 3 emissions. Scope 3 emissions may be reported voluntarily and have not been included in this GHG assessment for the Project.

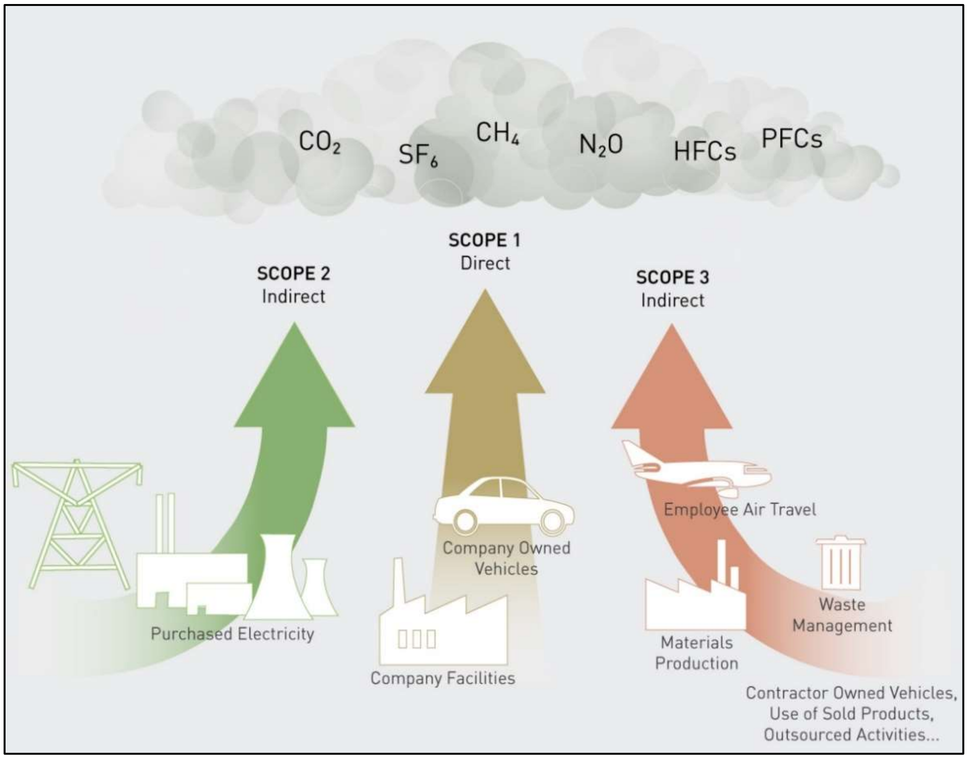


Figure 16-1 Overview of scope and emissions across a reporting entity

16.4 Greenhouse gas emission estimation

The following sections outline the GHG assessment completed for the Project, detail the main GHG emitting activities, and, provide yearly estimates of GHG emissions from the Project.

16.4.1 Emissions activities

Ensham Mine currently has gas drainage infrastructure in place as part of the existing underground operations on the approved mining leases. Existing infrastructure includes a network of risers and drainage pipelines that take the gas to the surface where it is flared.

To date, approximately 8 million m^3 of gas emissions has been drained from Ensham Mine's existing underground operation.

The main sources of scope 1 and scope 2 GHG emissions from the Project would be:

- direct CO_2 emissions from fuel combusted by mining equipment and vehicles
- fugitive emissions of CH_4 and CO_2 due to underground air ventilation processes
- flaring of coal mine waste gas

- fugitive emissions from post-mining activities from gassy underground coal mining, which include fugitive emissions from coal stockpiles, and fugitive emissions during conveying of coal from underground to the CHP
- fugitive emissions from the underground mine after decommissioning
- indirect CO_2 emissions from off-site electricity generation.

16.5 Calculation methods

This section presents the calculations used to determine the annual GHG estimates for each emission activity, which are detailed by DoEE (2016).

Fuel combustion emissions (scope 1)

The following equation presents the calculation methodology for estimating total GHG emissions from the combustion of diesel fuel.

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

Where,

E_{ij}, is the total emissions of each gas type (CO_2, CH_4, or N_2O in CO_2-e tonnes)

Q_i, is the quantity of diesel fuel used annually (kilolitre (kL))

EC_i, is the energy content factor for diesel (gigajoule (GJ) per kL)

EF_{ijoxec}, is the emission factor for diesel (kilogram (kg) CO_2-e per GJ)

Fugitive emissions from underground coal mining (scope 1)

The following equation presents the calculation method for estimating fugitive emissions from underground coal mining, including release of methane and carbon dioxide from coal seams and post mining emissions from stockpiling and transport of coal.

$$E_j = Q \times EF_j$$

Where,

E_j, is fugitive emissions of methane (CO_2-e tonnes)

Q, is the quantity of ROM coal extracted (tonnes)

EF_j, is taken as 0.017, which is the emission factor for methane (CO_2-e tonnes per tonne of ROM coal)

Underground ventilation air (scope 1)

Emissions from ventilation air were calculated based upon monthly measurements of carbon dioxide and methane from ventilation air specific to the Project Site. Mass emission rates for carbon dioxide and methane were calculated using projected ventilation volumetric flow rates from the Ensham Extended Fugitive Emissions Assessment - Addendum (GeoGAS, 2020) report.

The below presents the calculation method used to determine annual GHG emissions for underground ventilation air.

$$E_i = Q_i \times GWP_i$$

Where,

E_i, is the released methane or CO_2 emissions as carbon dioxide equivalent tonnes (CO_2-e tonnes)

Q_i, is the annual release methane or CO_2 emissions (tonnes)

GWP_i, the global warming potential of methane or CO_2

Flaring ventilation air (scope 1)

Volumetric estimates of emissions from flaring of ventilation air were reported by GeoGAS (2020), and converted to mass estimates using density coefficient for methane (0.657) and CO_2 (1.98) respectively.

The below is the calculation method used to determine annual GHG emissions for flared ventilation air.

$$E_i = F \times d \times GWP_i$$

Where,

E_i is the Project contribution of released emissions from flared ventilation air expressed as carbon dioxide equivalent tonnes (CO_2-e tonnes)
F is the Project contribution of flared exhaust emissions of either methane or CO_2 as provided by GeoGAS
d is the density of either methane or CO_2
GWP_i, the global warming potential of methane or CO_2

Decommissioned mine emissions (scope 1)

The following steps outline the calculation used to determine GHG emissions from the decommissioned mine.

$$E_{dm} = [E_{tdm} \times EF_{dm} \times (1 - F_{dm})]$$

Where,

E_{dm}, is the fugitive emissions of methane from the mine during the year (CO_2-e tonnes)
E_{tdm}, is the emissions from the mine from the last full year that the mine was in operation (CO_2-e tonnes)
F_{dm}, is the proportion of the mine flood at the end of the year (calculated as per below)
EF_{dm}, is the emissions factor for the mine (calculated as per below)

F_{dm} was calculated using the following equation:

$$\frac{M_{WI}}{M_{VV}} \times years$$

Where,

M_{WI}, is the rate of water flow into the mine in cubic metres per year, 74 000 m^3 has been used as per guidance from DoEE (2016), which is the default recommended value for a mine located in Queensland.
M_{VV}, is the mine void volume in cubic metres, is the total ROM coal extracted from the mine prior to decommissioning divided by 1.425
years, is the number years since the mine was decommissioned

EF_{dm} is the integral under the curve of the following equation:

$$(1 + A \times T)^b - C$$

Where,

A, is 0.23 for a gassy mine or 0.35 for a non-gassy mine
T, the number of years since the mine was decommissioned

B, is -1.45 for a gassy mine or -1.01 for a non-gassy mine
C, is 0.024 for a gassy mine, or 0.088 for a non-gassy mine

For the purposes of calculating the GHG from the decommissioned mine, it is assumed that the mine is a "gassy" mine.

Indirect emissions from consumption of purchased electricity (scope 2)

The following equation presents the methodology of calculating the scope 2 emissions from consumption of purchased electricity.

$$Y = Q \times \frac{EF}{1000}$$

Where,

Y, is the scope 2 emissions measured in CO_2-e tonnes

Q, is the quantity of purchased electricity (kilowatt hours (kWh))

EF, is the scope 2 emission factor for the state of Queensland (kg CO_2-e per kWh).

16.6 Emissions factors

The emissions factors relevant to the GHG emissions for the Project have been collated from the most recent available National Greenhouse Accounts Factors (DoEE, 2019a) at time of writing, and presented in **Table 16-2**.

Table 16-2 Emission factors of scope 1 and 2 activities

Emission source	Energy content factor	Scope of emissions	GHG emission factor			Units
			CO_2	CH_4	N_2O	
Fugitive emissions	-	1	-	0.017	-	t CO_2-e/t raw coal
Combustion of diesel fuel	38.6 GJ/kL	1	69.9	0.1	0.2	kg CO_2-e/GJ
Purchased electricity (QLD)	-	2	0.81	-	-	kg CO_2-e/kWh

Source: DoEE, 2019a

16.7 Emissions inventory

Forecast ROM coal production rates used in the GHG assessment have been provided by Idemitsu. Ventilated underground air discharge rates (cubic metres (m^3)/year) and CH_4 and CO_2 composition data for the base case and mitigated case have been provided by GeoGAS and presented in **Table 16-3**. This summarises the operational information which has been used to estimate the annual GHG emissions for the Project.

For electricity and diesel usage, usage rates from the 2018/2019 National Pollutant Inventory (NPI) facility report provided by Idemitsu, have been factored based on the ratio of Project only ROM coal (forecast production) to Ensham Mine ROM coal produced for the year 2020.

Idemitsu has committed to mitigation of GHG emissions from underground ventilation air. Therefore, GHG emissions have been estimated for a base case and for a mitigation scenario to investigate the amount of greenhouse gas reduction by pre-drainage remediation, drainage capturing and flaring of underground air. The mitigation scenario considered the following:

The base case scenario considered the following:

- 100 per cent of the underground air which is vented directly to the atmosphere.

The mitigation scenario considered the following:

- Prior to venting of underground air, the gas reservoir would undergo a gas drainage process to achieve a residual gas content of 2.0 m^3/t (GeoGAS, 2020). The gas drainage will be released via flaring which is expected to convert 80 per cent of the CH_4 in the drained gas to CO_2, which has a lower global warming potential (refer **Table 16-1**).
- Following the gas drainage process achieving a residual gas content of 2.0 m^3/t the remainder of the underground mine gas, now with a lower CH_4 concentration than the unmitigated case, will be ventilated using the existing ventilation infrastructure.
- The conversion of CH_4 to CO_2 reduces the total CO_2-e content of the released air due to the GWP for CO_2 being 25 times lower than that of CH_4,, and therefore 25 times less potent.

The estimated annual GHG emissions for the base case are presented in **Table 16-4**. The estimated GHG emissions for the mitigation scenario are presented in **Table 16-5**. GHG emissions for both scenarios are presented for each year of operation for the Project.

Table 16-3 Average annual emissions inputs from Project activities

Year	Project only ROM coal	Electricity usage	Diesel usage	Project ventilation air[1]	Base case		Mitigated case			
					CH_4 in Project ventilation air[1]	CO_2 in Project ventilation air[1]	CH_4 in Project ventilation air[1]	CO_2 in Project ventilation air[1]	CH_4 in Project Flare Exhaust[1]	CO_2 in Project Flare Exhaust[1]
	Mt	Megawatt hour (MWh)	kL	m^3/year	%	%	%	%	m^3/year	m^3/year
2020	-	6	1	0	0.13	0.08	0.13	0.08		
2021	0.42	6,610	978	3,324,520,000	0.13	0.07	0.07	0.04	392,487	2,626,646
2022	1.05	16,674	2,468	5,671,240,000	0.19	0.05	0.11	0.03	956,314	5,020,648
2023	1.51	23,925	3,541	7,822,400,000	0.26	0.03	0.15	0.02	1,740,854	7,930,558
2024	1.57	24,967	3,695	10,169,120,000	0.20	0.02	0.13	0.01	1,272,733	5,798,007
2025	1.23	19,509	2,888	0	0.21	0.02	0.09	0.01	-	-
2026	-	-	-	5,475,680,000	0.18	0.02	0.11	0.01	682,809	3,110,574
2027	1.16	18,377	2,720	9,778,000,000	0.27	0.05	0.13	0.02	2,838,945	13,860,729
2028	1.29	20,529	3,038	7,626,840,000	0.19	0.02	0.14	0.02	785,377	3,577,827
2029	2.40	38,129	5,643	7,431,280,000	0.25	0.03	0.16	0.02	1,399,961	6,377,600
2030	3.99	63,299	9,369	17,404,840,000	0.27	0.03	0.16	0.02	3,716,068	16,928,754
2031	4.23	67,187	9,944	18,382,640,000	0.28	0.01	0.16	0.01	4,159,093	17,730,869
2032	4.07	64,664	9,571	17,991,520,000	0.25	0.01	0.15	0.01	3,444,781	14,685,644
2033	4.02	63,874	9,454	16,427,040,000	0.15	-	0.09	-	2,027,239	8,211,344
2034	3.93	62,424	9,239	16,622,600,000	0.29	0.02	0.17	0.01	4,202,302	17,915,078
2035	3.87	61,513	9,105	15,644,800,000	0.24	0.01	0.14	0.01	3,025,886	12,899,832
2036	3.14	49,900	7,386	16,231,480,000	0.19	0.01	0.12	0.01	2,302,633	9,816,489
2037	0.13	2,006	297	19,556,000,000	0.01	-	0.01	-	84,082	340,576
Total	**38**	**603,593**	**89,337**	**195,560,000,000**					**33,031,565**	**146,831,174**

1. GeoGAS, 2020.

Emissions for 2038-2057 (**Table 16-4** and **Table 16-5**) are the sum of total emissions over that time period.

Table 16-4 Base case GHG emissions from the Project over the life of mine

Year	Scope 1				Scope 2	Total
	Fugitive coal emissions	Underground ventilation air	Diesel	Decommissioned mine	Electricity	
	t CO_2-e	t CO_2-e	t CO_2-e	t CO_2-e	t CO_2-e	t CO_2-e
2020	7	-	2	-	5	14
2021	7,075	77,682	2,651	-	5,354	92,761
2022	17,848	188,153	6,687	-	13,506	226,193
2023	25,609	349,537	9,595	-	19,379	404,120
2024	26,724	348,954	10,013	-	20,223	405,915
2025	20,882	0	7,824	-	15,802	44,509
2026	-	169,312	-	-	-	169,312
2027	19,670	457,157	7,370	-	14,885	499,083
2028	21,974	248,772	8,233	-	16,628	295,607
2029	40,813	319,448	15,292	-	30,884	406,437
2030	67,755	807,258	25,387	-	51,272	951,673
2031	71,917	876,961	26,946	-	54,421	1,030,245
2032	69,216	766,700	25,935	-	52,378	914,228
2033	68,371	418,183	25,618	-	51,738	563,910
2034	66,819	824,302	25,036	-	50,564	966,721
2035	65,843	640,144	24,671	-	49,825	780,484
2036	53,413	526,415	20,013	-	40,419	640,260
2037	2,147	33,189	805	-	1,625	37,766
2038-2057	-	-	-	209,890	-	209,890
Total	**646,084**	**7,052,166**	**242,081**	**209,890**	**488,908**	**8,639,130**
		8,150,221				

Table 16-5 Mitigated GHG emissions from the Project over the life of mine

Year	Scope 1					Scope 2	Total
	Fugitive emissions	Mitigated ventilation air (vented)	Mitigated ventilation air (flared)	Diesel	Decommissioned mine	Electricity	
	t CO2-e	t CO2-e	t CO2-e	t CO2-e	t CO2-e	t CO2-e	t CO2-e
2020	7	-	-	2	-	5	14
2021	7,075	41,971	11,647	2,651	-	5,354	68,699
2022	17,848	109,042	25,648	6,687	-	13,506	172,731
2023	25,609	202,048	44,296	9,595	-	19,379	300,927
2024	26,724	226,252	32,385	10,013	-	20,223	315,598
2025	20,882	0	0	7,824	-	15,802	44,509
2026	0	103,242	17,374	0	-	0	120,616
2027	19,670	219,371	74,074	7,370	-	14,885	335,370
2028	21,974	184,053	19,984	8,233	-	16,628	250,872
2029	40,813	204,558	35,622	15,292	-	30,884	327,169
2030	67,755	479,095	94,555	25,387	-	51,272	718,066
2031	71,917	502,587	103,420	26,946	-	54,421	759,292
2032	69,216	461,360	85,658	25,935	-	52,378	694,546
2033	68,371	250,910	49,556	25,618	-	51,738	446,193
2034	66,819	482,678	104,495	25,036	-	50,564	729,592
2035	65,843	374,631	75,242	24,671	-	49,825	590,213
2036	53,413	333,586	57,257	20,013	-	40,419	504,689
2037	2,147	33,189	2,055	805	-	1,625	39,821
2038-2057	-	-	-	-	209,890	-	209,890
Total	**646,084**	**4,208,574**	**833,269**	**242,081**	**209,890**	**488,908**	**6,628,806**
			6,139,898				

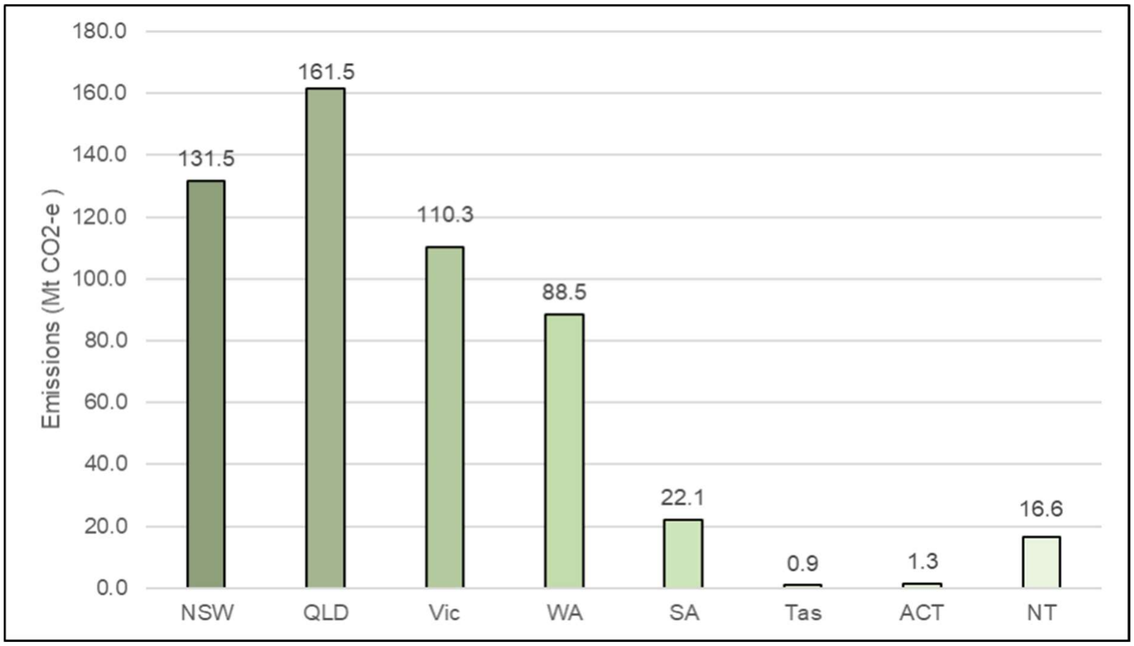
16.8 Project comparison with State and Federal emissions

For the 2017/18 reporting year, which is the most recent available data available at time of writing, Australia's total scope 1 emissions were 533 Mt CO_{2-e} , with 161.5 Mt CO_{2-e} contributed by Queensland. The total state and territory reported emissions for 2017/18 reporting year are presented in **Figure 16-2**.

For the base scenario, the estimated emissions intensity is 0.23 tonnes of CO_{2-e} per tonne of ROM coal produced. Over the life of the Project it is calculated that the total base GHG emissions will be 8.6 Mt CO_{2-e} , with an average annual emission rate of 0.47 Mt CO_{2-e}. The unmitigated average annual GHG emissions from the Project operations impacts on the state and national greenhouse gas inventories with emissions representing 0.09 per cent of Australia's 2017/18 emissions, and 0.29 per cent of Queensland's 2017/18 emissions.

For the mitigated scenario, the estimated emissions intensity is 0.16 tonnes of CO_{2-e} per tonne of ROM coal produced. Over the life of the Project it is calculated that the total mitigated GHG emissions will be 6.6 Mt CO_{2-e}, with an operational average annual emission rate of 0.36 Mt CO_{2-e} . The mitigated average annual GHG emissions from the Project operations impacts on the state and national greenhouse gas inventories with emissions representing 0.07 per cent of Australia's 2017/2018 emissions, and 0.22 per cent of Queensland's 2017/2018 emissions.

The major emissions over the life of the Project are CO_2 and CH_4 in ventilation air from the underground mining operations, which represents 82 per cent of total GHG emissions. Other significant emissions sources include fugitive emissions from mined coal (direct/scope 1) and from the consumption of purchased electricity (indirect/scope 2). The estimated scope 1 and 2 emissions intensity is 0.23 tonnes of CO_{2-e} per tonne of ROM coal produced for the unmitigated scenario, and 0.16 tonnes of CO_{2-e} per tonne of ROM coal produced for the mitigated scenario.



(Source: DoEE, 2019b)

Figure 16-2 State reported total GHG emission for 2017/18

16.9 Potential abatement measures

Idemitsu has considered the best practice environmental management options for the management of incidental coal seam gas in accordance with the Carbon Credits(Carbon Farming Initiative - Coal Mine Waste Gas) Methodology Determination 2015. The Method sets criteria for projects that can reduce emissions from flaring, oxidation, destruction or conversion of waste gas to operate an electricity production device.

The *Mineral Resources (MR) Act 1989* defines conditions of flaring or venting of coal seam gas. Section 318CO of the *MR Act* states that flaring of incidental mine gas is authorised if it not commercially or technically viable to capture/reuse. s318CO also states that venting of incidental coal seam gas is authorised if it is not safe to capture/reuse.

The potential for capturing/reusing CO_2 emissions was considered for the Project, however, based on the relatively low Gas Reservoir Size (GRS) for the Castor/Aries seams in the Rangal coal measures at Ensham, and given the low average flow rates, this approach was not considered commercially viable.

Alternatives considered for the management for in-situ gas include venting which would release methane directly to the atmosphere or flaring of the incidental coal seam gas. Flaring of the gas converts the majority of CH_4 to CO_2 which has a lower global warming potential, and therefore a lower CO_{2-e} content, before release to the atmosphere. GHG emissions have therefore been assessed considering mitigation in the form of pre-drainage remediation and flaring as the preferred abatement measure representing best practice environmental management as described in Carbon Credits(Carbon Farming Initiative- Coal Mine Waste Gas) Methodology Determination 2015.

Seam gas pre-drainage will be required to manage gas emissions in the underground workings in Zones 1, 2 and 3. Gas from this underground collection system will be designed to exit the underground in Zone 2 and Zone 3 where it will be flared to reduce GHG emissions.

Best practice GHG minimisation and energy efficiency strategies which have been outlined will continue to be implemented at Ensham Mine for the Project and include:

- Continuation of reporting to the Clean Energy Regulator as part of the NGER Act 2007
- Selection of fuel-efficient engines
- Adoption of a mining method that uses large equipment and economies of scale to significantly reduce greenhouse emissions. In particular, use of conveyers, where possible, to minimise truck haul operations.
- Ensuring extraction and transportation of coal from the underground operations to the ROM stockpile is performed in the most efficient manner to minimise fuel/electricity consumption
- Regular monitoring and maintenance of plant and equipment to ensure operational and fuel efficiency
- Prioritising energy efficiency through selection of energy-efficient equipment and devices for site fleet, within site offices and camp
- Recycling of refrigerants in equipment and air conditioning
- Segregation of waste into recycling materials and general waste
- Investigate opportunities to further prioritise local industries such that GHG emissions from the procurement and transportation of products and consumables are minimised
- Consideration of maximising the use of renewable electricity sources as either a component of purchased electricity or generated onsite through photovoltaics or similar
- Avoid burning vegetation within the Project footprint
- Limiting vegetation clearance within the Project footprint as much as practical
- ‘Greenhouse’ awareness training for all staff
- Development and maintenance of an inventory of emissions and sinks

Energy efficiency will be prioritised amongst the minimisation of emissions by selection of fuel efficient engines, equipment, and offices.

Abatement measures which promote energy efficiency will continue to be prioritised throughout the Project. Continuous improvement in reducing emissions by ongoing reporting and monitoring of GHG emissions to the NGER scheme will be undertaken.

16.10 Summary and conclusions

For the base case scenario (unmitigated), the estimated emissions intensity is 0.23 tonnes of $CO_{2\text{-}e}$ per tonne of ROM coal produced. The Project is estimated to result in 8.6 Mt of $CO_{2\text{-}e}$ of GHG emissions over the life of the Project, with an average annual GHG emission rate of 0.47 Mt $CO_{2\text{-}e}$. The average annual GHG emissions from the Project for the base scenario represent 0.09 per cent of Australia's 2017/18 emissions and 0.29 per cent of Queensland's 2017/18 emissions.

For the mitigated scenario which utilises flaring as the preferred method, the estimated emissions intensity is 0.16 tonnes of CO2-e per tonne of ROM coal produced. The Project is estimated to result in 6.6 Mt of CO2-e of GHG emissions over the life of the Project, with an average annual GHG emission rate of 0.36 Mt CO2-e. The average annual GHG emissions from the Project for the mitigation scenario represent 0.07 per cent of Australia's 2017/18 emissions and 0.22 per cent of Queensland's 2017/18 emissions.

Based on the potential reduction of 2.0 Mt of CO2-e of GHG emissions over the life of the Project, the mitigated scenario is assessed to be the preferred method using best practice environmental management to avoid and/or minimise greenhouse gas emissions directly resulting from activities of the proposed Project. The base case (unmitigated) scenario is assessed to be the less preferred alternative method.