Attachment H

Greenhouse Gas Emissions Impact Assessment

Melbourne Jet Pipeline Project

Melbourne Airport Jet Pipeline Project

Greenhouse Gas Emissions Impact Assessment

Viva Energy Australia

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Executive summary

This report assesses the impact of greenhouse gas (GHG) emissions associated with Viva Energy's Melbourne Airport Jet Pipeline Project (the Project), as part of its Pipeline Licence Application. The assessment compares the Project's construction and operation GHG emissions impact against the baseline scenario of jet fuel delivery via truck transportation. The assessment considers future changes to jet fuel demand.

Project overview

The Project is an approximately 6.7 km long buried jet fuel pipeline (DN 350 mm), connecting the existing Altona to Somerton jet fuel pipeline to the jet fuel storage infrastructure at Melbourne Airport. The Project aims to support Melbourne Airport's growing jet fuel needs over the next 20-30 years. In addition, the pipeline will increase the supply security of jet fuel for the airport and reduce the reliance on road transportation for jet fuel supply.

Existing conditions – GHG emissions baseline

The baseline GHG emissions scenario accounts for the current jet fuel delivery process, which includes the existing jet fuel pipeline system (Altona to Somerton pipeline, and Somerton to Tullamarine Airport pipeline) supplemented annually with substantial road deliveries of jet fuel from both Melbourne and Geelong.

The baseline scenario assumes that the existing fuel delivery system would continue for the project timeline of 2025 to 2065. The Melbourne Airport Preliminary Draft Master Plan (Melbourne Airport, 2022) has forecasted the demand until 2042 and the demand estimate beyond 2042 is based on assumptions. The baseline considers three fuel demand growth rates, namely reference, low and high scenarios to capture potential future uncertainties. The baseline GHG emissions are estimated to be 261, 106 and 492 kilo-tonnes of carbon dioxide equivalent (kt CO_2-e) for the reference, low and high scenarios respectively (Table 4-2). GHG emissions are about 95% Scope 1 and 5% Scope 3 emissions.

GHG impact assessment

The estimated GHG emissions for the Project are 45.3 kt CO_2-e with 5.7 kt CO_2-e associated with construction activities and 39.6 kt CO_2-e associated with operation of the jet fuel pipeline. Table E-1 shows a summary of the Project's GHG emissions.

Table E-1 Summary of the Project's GHG emissions[1]

Total GHG emissions	Scope 1 (Direct) (t CO_2-e)	Scope 2 (Indirect) (t CO_2-e)	Scope 3 (Indirect) (t CO_2-e)	Total (t CO_2-e)
Construction	2,499	64	3,178	5,741
Operation	10,575	25,301	3,734	39,610

Although the extent of future road operations is currently unknown, by removing the need to transport jet fuel by road, the pipeline could lead to an overall greenhouse gas emissions reduction of 216.1 kt CO_2-e over the design life, with savings realised after approximately 6 years of operation.

Conclusions and recommendations

This impact assessment found that the Project can reduce GHG emissions by 83% over the design life of the pipeline, when compared to the current delivery system for jet fuel. It is expected that the Project is able to support the growing air traffic (and therefore jet fuel) demand associated with both an increasing number of

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[1] Note: numbers may not add up exactly due to rounding.

passengers and tonnes of air freight forecasted in the Melbourne Airport Preliminary Draft Master Plan (Melbourne Airport, 2022). The assessment indicated the Project's GHG emissions would show savings in comparison with the baseline (reference) GHG emissions after approximately 6 years of operation.

Additionally, implementation of the Project will likely increase the resilience and security of jet fuel supply against the physical and transition risks of climate change, as well as increased safety by reducing the chance of spills related to road accidents.

The following potential initiatives can further reduce the Project's GHG emissions impact during the construction and operation stages. Assessing the feasibility of these initiatives is outside the scope of this report.

1. **Minimise the use of electricity** by selecting energy efficient pumps, plant and equipment during planning and design phases, employing energy efficient operation strategies and incorporating energy management systems for the operation life of the Project.
2. **Maximise the use of green electricity** in operation (up to 10.9% further reduction compared to the baseline). This can be achieved by installing renewable energy sources on-site (e.g., solar panels on terminal sheds/buildings) and/or by purchasing renewable electricity.
3. **Maximise the use of low emission and energy efficient vehicles, plant and equipment** (e.g., hybrid excavators, hybrid site vehicles) to reduce fuel use during construction (up to 0.9% further reduction compared to the baseline) and use of hybrid or electric vehicles during operation (up to 4.3% further reduction compared to the baseline).

Abbreviations

Term	Definition
CO_2-e	Carbon Dioxide equivalent
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EES	Environmental Effects Statement
EP Act	Environmental Protection Act
GHG	Greenhouse gas
HDD	Horizontal Directional Drilling
ICCP	Impressed Current Cathodic Protection
ISO	International Organisation for Standardisation
JUHI	Joint User Hydrant Installation
NGAF	National Greenhouse Account Factors
NGER	National Greenhouse and Energy Reporting
RFI	Request for information
VIC	Victoria

1 Introduction and scope of works

Viva Energy Australia (Viva Energy) is proposing to construct and operate a new jet fuel pipeline, to support growing demand at Melbourne Airport.

Melbourne Airport is Australia's second largest airport. Annual passenger numbers are expected to almost double by 2042 – increasing from 37 million to more than 76 million passengers per year (Melbourne Airport, 2022). The freight tonnes are also expected to increase from 448kT to 980kT. In line with the projected increases in aircraft movements, jet fuel requirements are expected to increase significantly.

Currently, fuel is transported to the joint user hydrant installation (JUHI) facility via a combination of the pipeline system (Altona to Somerton pipeline, and Somerton to Tullamarine Airport pipeline) and trucks. The current pipeline system is supplemented annually with substantial road deliveries of jet fuel from both Melbourne and Geelong. The development of the new pipeline will provide faster replenishment of fuel stocks, reduce traffic on roads and provide a more robust fuel supply chain.

The proposed pipeline aims to:

- help meet the increasing demand for jet fuel and support future growth at Melbourne Airport
- increase the supply security of jet fuel, which will contribute to the Victorian state economy
- reduce the reliance on road transport for jet fuel supply with fewer trucks required to deliver fuel to the airport
- improve safety by reducing the potential for spills in case of road accidents or rollover.

1.1 Purpose of this document

This report assesses the impact to greenhouse gas (GHG) emissions associated with Viva Energy's Melbourne Airport Jet Pipeline Project (the Project), as part of the Pipeline Licence Application. The assessment compares the Project's construction and operation GHG emissions impact with the baseline scenario of jet fuel delivery to Melbourne Airport via road transportation. The report includes potential initiatives to further reduce GHG emissions associated to the Project.

1.2 Project description

The Project proposes the construction and operation of a new pipeline to form a direct connection between the jet fuel storage infrastructure at Melbourne Airport and the existing Altona to Somerton pipeline that follows the southern boundary of Tullamarine (located south of the Western Ring Road (M80)).

The pipeline would commence at a section of the Altona to Somerton pipeline located south of the Western Ring Road (M80) (near the Airport Drive exit) and link into the existing Melbourne Airport JUHI facility (located at Marker Road, Tullamarine). Figure 1-1 shows the proposed pipeline alignment.

Figure 1-1 Melbourne Airport Jet Pipeline location (Source: ESRI)

1.2.1 Project components

The project comprises of the following key operational components:

- A new pipeline to transport jet fuel. The pipeline will be approximately 6.7 km in length and fully buried for its entire length to a minimum depth of 1200 mm below ground level (bgl) with a 7 to 10 m permanent final easement.
- Pig launcher and receiver sites located at each end of the pipeline. These are made of steel and used to launch instruments during initial commissioning of the pipeline to clear any debris or water and during operation to record any defects in the pipe.
- An impressed current cathodic protection (ICCP) system to protect the pipe. The choice of ICCP system will most probably have negligible power consumption.
- Inlet and outlet metering stations which provides flow analysis for the leak detection system.

The pipeline

The proposed pipeline comprises approximately 6.7 km of buried jet fuel pipeline. It has been assumed that the pipe will be manufactured in overseas pipe mills from high grade steel plates. It will be buried for its entire length to a minimum depth of 1200 mm below ground level. Table 1-1 summarises the key information relating to the pipeline.

Table 1-1 Summary of key pipeline data

Key pipeline data	
Length	6.7 km
Material	High strength steel pipe - Manufacturing code API 5L, product specification level PSL 2 with an X56 grade.

Nominal diameter	DN 350 mm
Maximum target flow rate	~800 m3/h. The initial operating flow rate would be 400 m3/h.
Pipe wall thickness	11.8 mm
Design life	40 years

1.2.2 Indicative construction activities and duration

Pipeline construction is proposed to commence in Q3 of 2024 and the pipeline is proposed to be operational by Q3 of 2025. This is subject to Viva Energy Board approvals, land access, finalisation of design, award of Contracts and procurement timeframes and is subject to the grant of project approvals within certain timeframes.

Construction activities for the Project and indicative plant and equipment required are show in Table 1-2. It should be noted that the third column shows the approximate cumulative duration for each activity and does not represent the construction duration as some activities might occur simultaneously. There would be construction site offices and lighting in each construction section.

Table 1-2 Indicative construction activities and plant

Construction activity	Detail of activity	Approximate cumulative duration	Plant and Equipment Used
Setting up work areas	Before construction can commence, work areas must be set up appropriately. These include lay down areas for equipment, construction material stockpiles and setup areas.	4 weeks	35 ton Excavator x 2 14G Grader x 1 D7 Dozer x 1
Clear and grade	Clear and grade involves preparing the pipeline easement and extra workspaces for construction.		
Excavation	A specialised rotary trenching machine or excavator is used to dig the trenches along the pipeline route. Any material removed is placed on the side of the trench (stockpiled), within the construction set up area. Trenchless construction is used in more complex or environmentally sensitive areas. Trenchless construction methods used for this Project include: ▪ HDD ▪ Thrust boring.	Trenching: 15 weeks Horizontal Directional Drilling (HDD): 36 weeks Thrust boring: 1 week	Trenching 45 ton Excavator with Hammer x 2 Rock Chain Trencher HDD HDD rig x 1 35 ton Excavator x 1 Mud tanks Generator (self-bunded or within container) Vacuum Truck x 2 Thrust boring Rotary auger x 1 35 ton Excavator x 1 Mud tanks Generator (self bunded or within container) Vacuum Truck x 2

Construction activity	Detail of activity	Approximate cumulative duration	Plant and Equipment Used
Pipe stringing and welding	Once the pipe lengths have been laid out or ‘strung’ along the construction set up area, qualified welders join the lengths of pipes together. Welds are inspected using x-ray or ultrasonic equipment to ensure their quality and are then coated, to reduce the likelihood of corrosion.	36 weeks	35 ton Excavator with vac lift x 1 572 side boom x 1 Bending machine Prime movers (stringing trucks) x 1 Skid truck x 2 Light Truck with Welding Machines x 2 Tack Rig x 1
Lowering In	After final quality assurance checks, each completed pipe section is lowered into the trench using specialist side boom tractors and excavators.	36 weeks	35 ton Excavator x 2 572 Side Booms x 2 Loader x 2 350 Padding Machine x 1 Trucks to haul in bedding material x 3 Flowcon Truck x 1 Grader x 1 D7 Dozer x 1
Backfill	When the pipe is in place, it is backfilled with suitable fill material (padding) to protect the pipeline coating from stones or other sharp objects. The topsoil is then re-instated over the disturbed trench area to the contour of the land so that groundcover can be rehabilitated.		
Quality Assurance	Rigorous quality assurance, inspection and testing occurs during and after installation to confirm that the pipeline integrity meets or exceeds the design criteria. Using water, the pipe is pressure tested (hydrotested) to ensure it is fit for operational service.	8 weeks	Fill pump High pressure squeeze pump 750cfm Compressor 1200cfm Compressor for drying Vacuum drying unit
Demobilisation and initial rehabilitation	Disturbed areas will be reinstated and may include re-contouring to match existing landforms. Topsoil conserved during the construction process is re-spread over areas used for construction. Rehabilitation is undertaken in accordance with approval requirements and landowner considerations.	4 weeks	35 ton Excavator x 2 Graders 16G x 1 Grader 14G x 1 D7 Dozer Tractor - reseeding

1.2.3 Indicative operation activities

When commissioned, the pipeline would be owned, operated and maintained by Viva Energy. Following the reinstatement of land as part of the pipeline construction, the land would be generally returned to its previous use.

The Project has been designed with an operational life of 40 years. The entire pipeline will require scheduled patrol and monitoring using a utility vehicle to drive along the pipeline on a daily basis (5 days per week). When in operation, instruments (metal loss detection tool) will be used to record any defects in the pipe (wall thickness reduction or other defects such as dents caused by third party interference). This will occur initially every 10 years and then as the pipeline ages it may be necessary to run the metal loss detection tool every 5 years. Material use for maintenance would be negligible.

During operation the pipeline would require general lighting, flood lights and control devices at both ends. The existing Newport terminal pumping station will pump the jet fuel through the new pipeline to Melbourne Airport. The pump has a capacity of 400 m^3/h currently and a potential for an upgrade if needed.

2 Methodology

The GHG emissions impact assessment was undertaken with reference to the following documents:

- *National Greenhouse Gas and Energy Reporting (NGER) (measurement) Determination 2008* under the NGER Act (Australian Government, 2008), and the data available from *National Greenhouse Account Factors (NGAF*) (Department of Industry, Science, Energy and Resour, 2021).
- *Greenhouse Gas Protocol (GHG Protocol)*, the World Business Council for Sustainable Development and the World Resources Institute
- *ISO14064: Greenhouse Gases – Part 1: Specification with guidance at the organisation level for quantification and reporting of greenhouse gas emissions and removals* (The British Standards Institution, 2019) and *Part 2*: *Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements* (The British Standards Institution, 2019)

The GHG emissions were calculated for:

1. The baseline scenario (current situation), with consideration for projected future emissions, should the pipeline not be constructed.
2. The project, including embodied, construction and operation emissions.

The GHG emissions for the Project were then compared to the baseline scenario GHG emissions, for the three jet fuel demand growth scenarios (reference, low and high). Opportunities to reduce the Project's GHG emissions were identified and are discussed in Section 7 of the report.

The baseline GHG emissions considers existing conditions and includes emissions from fuel transportation from Melbourne and Geelong. The categories and scope of the Project's GHG emissions are presented in the next section.

A high-level qualitative comparison of the climate resilience of the baseline and pipeline options and potential resilience enhancement strategies are additionally provided based on the literature (refer to Section 6).

2.1 GHG emissions scopes

This report includes Scope 1, Scope 2 and Scope 3 GHG emissions associated with the construction and operation of the Project, that are described as follows.

- **Scope 1 emissions –** direct GHG emissions from sources that are owned or operated by a reporting organisation (examples include combustion of diesel in company-owned vehicles or used in on-site plant and equipment) (GHG Protocol, 2013)
- **Scope 2 emissions** – Indirect GHG emissions associated with the import of energy from another source (examples include import of electricity from the grid, or heat) (GHG Protocol, 2013)
- **Scope 3 emissions** – Other indirect emissions, other than energy imports (above) which are a direct result of the operations of the organisation, but from sources not owned or operated by them and due to upstream or downstream activities (examples include indirect upstream emissions associated with the extraction, production and transport of purchased construction materials; and business travel (by ship, air or rail)).

An illustration of these definitions is shown in Figure 2-1.

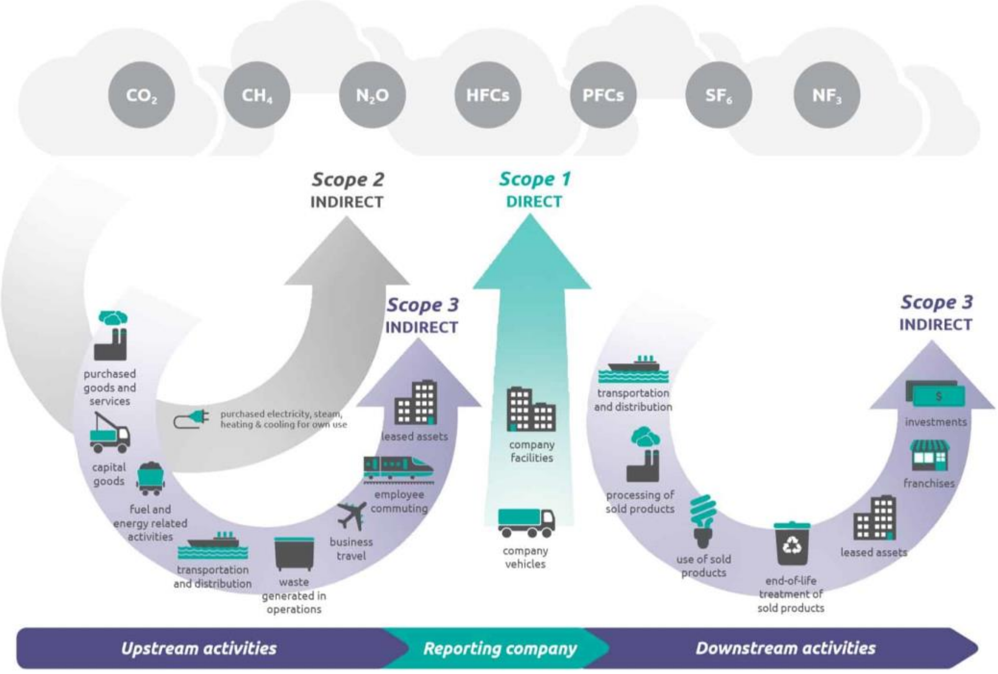


Figure 2-1 An illustration of the definitions of different emissions scopes (GHG Protocol, 2013)

The activities and GHG emission sources have been determined following consultation with the design team and based on past GHG impact assessments for similar infrastructure construction projects. Although Scope 3 emissions are not a mandatory reporting requirement, it is included herein for a holistic inclusion of all significant emissions sources related to the Project. In line with GHG Protocol, the criteria for including Scope 3 emissions within the Project's operational boundary are outlined in Table 2-1.

Table 2-1 GHG protocol criteria for inclusion of Scope 3 emissions in the operational boundary

Criteria	Description
Size	They are large (or believed to be large) relative to the company's scope 1 and scope 2 emissions.
Risk	They contribute to the company's GHG risk exposure
Stakeholders	They are deemed critical by key stakeholders (e.g., customers, suppliers, investors, or civil society)
Influence	There are potential emissions reductions that could be undertaken or influenced by the company.

2.2 Project boundary

The project scope for the GHG emissions impact assessment includes the construction and operation activities related to the installation of the pipeline.

The organisational boundary of this assessment includes all Scope 1 (direct) and Scope 2 (indirect) emissions related to the project activities. Other indirect (Scope 3) emissions that are directly related to the project (for example, emissions associated with construction materials) are also considered.

Construction

The scope of the GHG emission assessment of the construction phase includes:

- construction of the new pipeline, including embodied emissions of materials and emissions related to the construction activities

- transportation of materials and project components to the site
- construction spoil and waste removal
- land use changes

Operation

The scope of the GHG emission assessment of the operation phase includes:

- existing road transport of jet fuel
- pumping jet fuel in the new pipeline
- maintenance of the new pipeline

It should be noted GHG emissions associated with the production of jet fuel and combustion of jet fuel are outside the boundary of this assessment.

A list of relevant GHG emissions sources associated with the Project construction and operation and the scope of the emissions is provide in Table 2-2.

Table 2-2 GHG emissions sources and scopes for relevant construction and operation activities

Emissions category	Emissions source	Activity	Scope 1 (Direct)	Scope 2 (Indirect)	Scope 3 (Indirect)
Construction					
Stationary energy	Fuel use	Stationary construction equipment	✓		✓
Transport fuel	Fuel use	Mobile construction equipment, plant and site vehicles	✓		✓
Transport fuel	Fuel use	Delivery of pipe, concrete and other project components to the site			✓
Waste	Waste	Spoil and waste removal			✓
Stationary energy	Electricity consumption	Electricity used to power construction plant (lighting towers etc) and site offices		✓	✓
Land use changes	Vegetation removal / plantation	Clearance of vegetation because of the project (loss of carbon sink) or planting vegetation	✓		
Embodied emissions	Materials	Embodied energy of construction materials			✓
Operation					
Stationary energy	Electricity consumption	Electricity used for pumping, control, lighting and maintenance		✓	✓
Transport fuel	Fuel use	Mobile construction equipment used for maintenance activities	✓		✓
Embodied emissions	Materials	Materials used for maintenance activities			✓
Transport fuel	Fuel use	Fuel consumption by trucks delivering the jet fuel	✓		✓

2.3 Key assumptions and limitations

This section provides a summary of the key assumptions and limitations related to this GHG emissions impact assessment report. The assessment of impacts, conclusions and potential GHG emissions reduction initiatives recommended in this report are based on the best information and assumptions available at the date of its preparation.

For this assessment, the best available data sources have been used via request for information (RFI) and consultation with the design team. Information that this assessment has been based on, including construction schedules and plant, may change, and works may differ throughout the construction and operation of the Project.

It is assumed that the electricity grid emissions factor will be zero from 2050, consistent with national and international zero emissions targets. Thus, grid emissions factors projections to 2030 are used (Department of Industry, Science, Energy and Resour, 2021) and extrapolated to 2050.

The projection of electrification and new generation of trucks (hydrogen, biodiesel and electric) is not in the scope of baseline estimation of this report. The projections of short distance heavy trucks availability in market (National Renewable Energy Laboratory, 2022) and the transition to zero emission transportation policy (Graham & Havas, 2021; Savvy, 2022) are considered in framing illustrative scenarios in Section 4. However, the capacity of existing infrastructure, roads, fuel system etc, and the availability of trucks to meet the increased jet fuel requirements for the baseline GHG emissions scenario has not been assessed.

Table 2-3 shows the rationale for exclusion of some GHG emission sources.

Table 2-3 Rationale for exclusion of some emission sources

Emission sources	Emissions description	Rationale for exclusion
Purchased electricity	Electricity emissions associated with pumping jet fuel in the existing pipeline system (from Altona to Somerton, and from Somerton to JUHI)	This has not been considered as this would remain almost the same as the existing case once the Project is commissioned.
Fugitive emissions	Fugitive emissions from the jet fuel pipeline	This is assumed to be negligible for a liquid jet fuel under high pressure in a fully welded pipeline with ICCP and frequent monitoring.
Transport fuel	Emissions associated with the transport of work force and construction equipment	The project is located in Melbourne and in the vicinity of several equipment rentals. The work force is assumed to be procured locally with minimal use of private transport as public transport options are available. Thus, emissions from this would be negligible.
Embodied and operation emissions	Emissions associated with the decommissioning, and unplanned replacement and relocation of the pipeline	It is assumed the pipeline does not need to be replaced or relocated during its 40 years life and would be left buried under the ground after decommissioning.
Purchased electricity and fuel	Emissions associated with other baseline components such as JUHI Bridger pumps and similar.	It is assumed that these components will be less than 1% of the GHG emissions in baseline scenario and thus immaterial.

It should be noted that these assumptions are based on the conservativeness principle of ISO14064-2 (The British Standards Institution, 2019). More detailed information on the data sources and assumptions are included in the calculation sheets in Appendix A.

3 Legislation and policy summary

The relevant policy and legislation that applies to the Project, in the context of this GHG emissions impact assessment, is summarised in Table 3-1 below.

Table 3-1 Summary of key relevant legislation and policy

Policy / legislation	Description
National Greenhouse and Energy Reporting Act 2007 ('NGER Act'), and National Greenhouse and Energy Reporting (Measurement) Determination 2008	The NGER Act establishes the legislative framework for the NGER Scheme which is a national framework for reporting Scope 1 and 2 GHG emissions related to projects and corporations in Australia. The NGER Determination describes the methods and criteria for reporting Scope 1 and 2 GHG emissions, in accordance with the NGER Act.
National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 (NGER Rule)	The NGER Rule provides a mechanism to prevent Australia's major GHG emitters to increase their operational Scope 1 annual GHG emissions beyond a threshold and applies to facilities that emit more than 100,000 tCO_2-e per year of Scope 1 emissions.
Climate Change Act 2017 (Vic) ('Climate Change Act')	The Climate Change Act 2017 sets out legislative principles, targets and strategies to manage climate change risks and transition to a climate resilient and net zero emissions economy and community by 2050.
Environment Protection Act 2017 (Vic) ('EP Act')	The Environment Protection Act provides a framework to protect Victoria's air, water and land. It imposes legal obligation on entities and individuals to prevent pollution and environmental damage. The Environment Protection Act establishes the EPA to administer the Act, and its regulations and orders.

4 Baseline GHG emissions impact assessment

The GHG emissions for the baseline scenario are related to the existing pipeline system fuel delivery and supplementary road transportation of jet fuel from both Melbourne and Geelong to Melbourne Airport. The baseline GHG emissions have been established assuming that the existing fuel delivery settings will continue for the operational lifespan from 2025 to 2065. It should be noted that the airport demand is estimated until 2042 in the Melbourne Airport Preliminary Draft Master Plan (Melbourne Airport, 2022). The demand forecast post 2042 to 2065 is assumed to follow the same trend and may be uncertain. The baseline is framed for three scenarios based on changes to the jet fuel demand growth rate (linked to number of flights) and the share of diesel use in trucks in future. These scenarios are posed for illustrative purposes to capture future uncertainties in use of diesel in trucks and variations in jet fuel demand. These scenarios are summarised in Table 4-1.

Table 4-1 Summary of the baseline emissions scenarios

Scenario name	Description	Changing variable
Baseline (reference)	Assumes the airport fuel demand growth rate would constantly increase by 2.45% per year. The jet fuel delivery through the existing pipeline system would be utilised at its maximum capacity and the remaining jet fuel demand would be supplied by truck transportation from Melbourne and Geelong (50:50 split). 50% of jet fuel road transport would be by diesel trucks by the end of the Project design life.	Fuel delivered to the airport Diesel emission factor (related to share of diesel trucks from total jet fuel road transport)

Scenario name	Description	Changing variable
Baseline (low)	Assumes the airport fuel demand growth rate would constantly increase by 1.96% per year (20% decrease compared to the reference case). The jet fuel delivery through the existing pipeline system would be utilised at its maximum capacity and the remaining jet fuel demand would be supplied by truck transportation from Melbourne and Geelong (50:50 split). Zero per cent of jet fuel road transport would be by diesel trucks by the end of the Project design life.	Fuel delivered to the airport Diesel emission factor (related to share of diesel trucks from total jet fuel road transport)
Baseline (high)	Assumes the airport fuel demand growth rate would constantly increase by 2.94% per year (20% increase compared to the reference case). The jet fuel delivery through the existing pipeline system would be utilised at its maximum capacity and the remaining jet fuel demand would be supplied by truck transportation from Melbourne and Geelong (50:50 split). 100% of jet fuel road transport would be by diesel trucks by the end of the Project design life.	Fuel delivered to the airport Diesel emission factor (related to share of diesel trucks from total jet fuel road transport)

The calculations of GHG emissions for the reference, low and high baseline scenarios indicated outputs of 261, 106 and 492 kt CO_2-e respectively (rounded to the nearest whole number), refer to Table 4-2. For the purposes of this assessment, it is assumed that all jet fuel deliveries are by Viva Energy trucks and hence the GHG emissions from these trucks are considered Scope 1 emissions. In reality, a proportion of the deliveries may be conducted by third parties, in which case they would fall under Scope 3 emissions. These scenarios are framed to capture the uncertainty range attributed to jet fuel demand projections.

Table 4-2 Baseline GHG emissions

Emissions category	Emissions source	Activity	Scope 1 (Direct) (t CO_2-e)	Scope 2 (Indirect) (t CO_2-e)	Scope 3 (Indirect) (t CO_2-e)	Total (t CO_2-e)
Reference	Fuel use	Fuel consumption by trucks delivering the jet fuel	248,755	-	12,719	261,474
Low	Fuel use	Fuel consumption by trucks delivering the jet fuel	100,696	-	5,148	105,844
High	Fuel use	Fuel consumption by trucks delivering the jet fuel	468,279	-	23,943	492,222

5 Construction and operation emissions impact assessment

GHG emissions associated with the construction and operation of the Project are 45.3 kt CO_2-e with 5.7 kt CO_2-e associated with construction and 39.6 kt CO_2-e associated with operation of the Project. It was found Scope 2 emissions contributed about 56% to the Project footprint, whilst Scope 1 and Scope 3 contributed 29% and 15% respectively to the footprint. A summary of the total GHG emissions of the Project is presented in Table 5-1.

Table 5-1 Summary of total GHG emissions associated with the construction and operation of the Project

Emissions category	Emissions source	Activity	Scope 1 (Direct) (t CO_2-e)	Scope 2 (Indirect) (t CO_2-e)	Scope 3 (Indirect) (t CO_2-e)	Total (t CO_2-e)
Construction						
Stationary energy	Fuel use	Stationary construction equipment	325	-	17	342
Transport fuel	Fuel use	Mobile construction equipment, plant and site vehicles	2,174	-	111	2,285
Transport fuel	Fuel use	Delivery of pipe, concrete and other project components to the site	-	-	239	239
Waste	Waste	Spoil and waste removal	-	-	52	52
Stationary energy	Electricity consumption	Electricity used to power construction plant (lighting towers etc) and site offices	-	64	7	71
Land use changes	Vegetation removal / plantation	Clearance of vegetation because of the project (loss of carbon sink) or planting vegetation	-	-	-	-
Embodied emissions	Materials	Embodied energy of construction materials	-	-	2,752	2,752
Operation						
Stationary energy	Electricity consumption	Electricity used for pumping, lighting and maintenance	-	25,301	3,194	28,495
Transport fuel	Fuel use	Mobile construction equipment used for maintenance activities	10,575	-	540	11,115
Embodied emissions	Materials	Materials used for maintenance activities	-	-	-	-
Transport fuel	Fuel use	Fuel consumption by trucks delivering the jet fuel	-	-	-	-

Note: numbers may not add up exactly due to rounding.

A large portion of construction emissions are related to embodied emissions (Scope 3) followed by emissions associated with the diesel consumption of plant and equipment and the followed by the delivery of project components and materials from overseas. Most of the Project's operational emissions are likely to be associated with the electricity consumption of pumps (approx. 28.5 kt CO_2-e over the Project design life) and the fuel use for maintenance and monitoring patrols (approx. 11.1 kt CO_2-e over the Project design life). Vegetation clearance seems to be negligible as most vegetation removed will likely be re-introduced following construction. Similarly, the embodied emissions of materials used for maintenance activities is assumed to be negligible. Assuming the Project's estimated supply capacity is met, it is expected that jet fuel delivery via road transportation would no longer be required

Figure 5-1 compares the total GHG emissions of the Project against three baseline scenarios, over the design life of the Project. The Project would reduce the GHG emissions associated with jet fuel delivery by 83%, from 261 to 45.2 kt CO_2-e by 2065, compared to the baseline reference emission scenario.

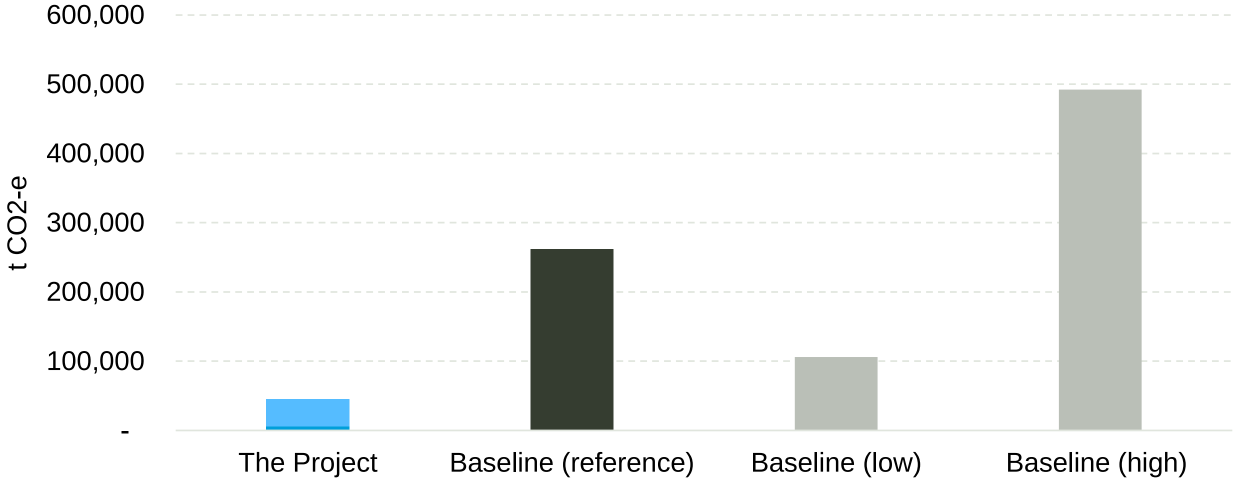


Figure 5-1 Comparison of the Project GHG emissions against the baseline emissions

Figure 5-2 compares the cumulative emissions of baseline (reference case is shown with a solid line while the low and high scenarios are shown in shades) and the Project overtime. The Project would offer emissions reduction against the baseline (reference) scenario after 6 years of operation. The reduction in GHG emissions increases throughout the Project design life.

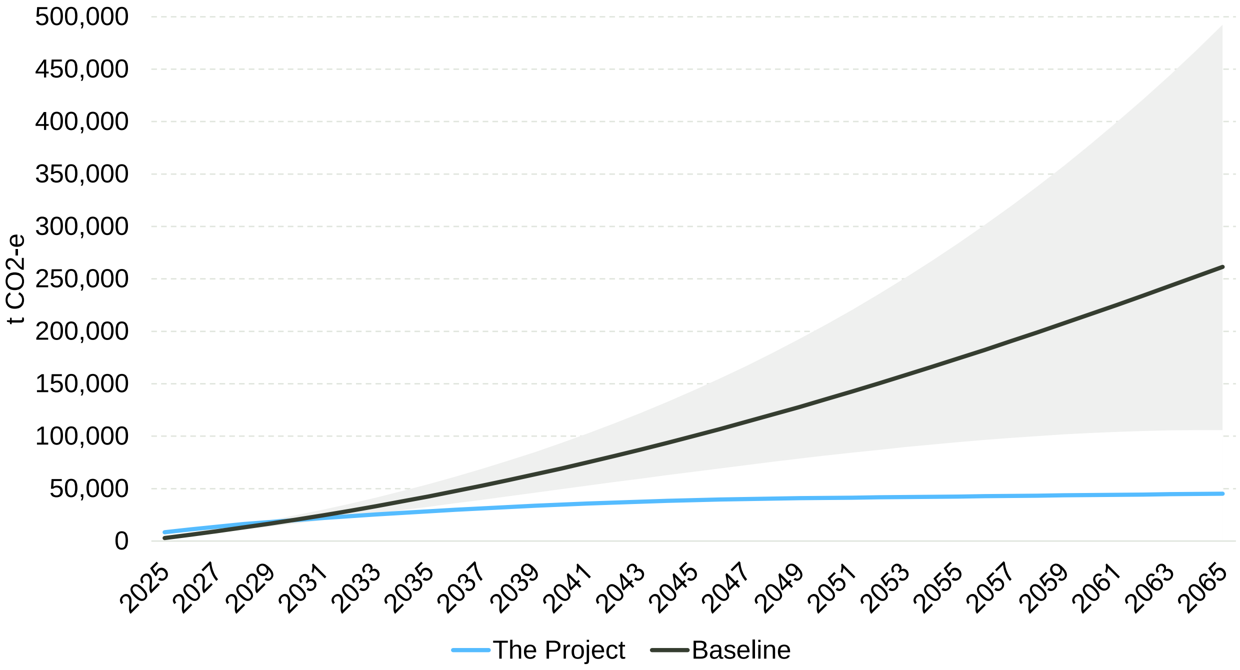


Figure 5-2 Comparison of the cumulative emissions of baseline and the Project over time

The Project's emissions can be further reduced by following a holistic environmental management framework that includes energy, resources and waste management plans. Some example measures are:

- Use of energy efficient and renewable energy technologies on site where possible, combined with purchasing of green power, can reduce GHG emissions associated with electricity use across the life of the Project.
- Use of zero emissions vehicles can reduce GHG emissions related to transportation.
- Operation of generators with bio diesel or a zero/low emission fuel source during construction can reduce diesel fuel usage and associated GHG emissions.
- Use of low carbon steel and concrete can reduce embodied materials GHG emissions.
- Offsetting residual GHG emissions by purchasing certified carbon offsets.

6 Qualitative climate change impact assessment

The following relevant events are expected to impact Melbourne due to climate change (Department of Environment, 2015; Clarke JM, 2019; Grose, 2015):

- Increase in temperature year round
- More hot days and warm spells
- More frequent and more intense downpours
- Harsher fire weather and longer fire seasons
- Rising sea level
- Less rainfall and more time in drought.

Jet fuel delivered via road transportation may face additional delays, disruptions and accidents as a result of changing climatic conditions. Climate change may increase the risks to fuel delivery due to increased intensity and frequency of flooding, increased severity of storms and increased extreme temperatures. Generally speaking, the underground pipeline offers a higher resilience and reliability of supply against the physical risks of climate change.

7 Potential GHG emissions reduction initiatives

Considering that the jet fuel needs to be delivered to the airport to support growing demand of the Melbourne airport (associated with both number of passengers and tonnes of freight) by 2065, the results of this assessment show that the Project can reduce the overall emissions related to the delivery of jet fuel.

The following potential initiatives can further reduce the Project’s GHG emissions impact during the construction and operation stages. Assessing the feasibility of these initiatives is outside the scope of this report.

1. **Minimise the use of electricity** by selecting energy efficient pumps, plant and equipment during planning and design phases, employing energy efficient operation strategies and incorporating energy management systems for the operation life of the Project.
2. **Maximise the use of green electricity** in operation (up to 10.9% further reduction compared to the baseline). This can be achieved by installing renewable energy sources on-site (e.g., solar panels on terminal sheds/buildings) and/or by purchasing renewable electricity.
3. **Maximise the use of low emission and energy efficient vehicles, plant and equipment** (e.g., hybrid excavators, hybrid site vehicles) to reduce fuel use during construction (up to 0. 9% further reduction compared to the baseline) and use of hybrid or electric vehicles during operation (up to 4.3% further reduction compared to the baseline).

References

Australian Government, 2008. National Greenhouse and Energy Reporting (Measurement) Determination 2008, s.l.: s.n.

Australian Government, 2008. National Greenhouse and Energy Reporting Regulations 2008, Australia: s.n.

Clarke JM, G. M. T. M. R. V. &. H. C., 2019. Greater Melbourne Climate Projections 2019, Melbourne Australia: CSIRO.

Department of Environment, L. W. &. P., 2015. Climate-ready Victoria: Greater Melbourne, Australia: Victoria State Government.

Department of Industry, Science, Energy and Resour, 2021. Australia's emissions projections 2021, Australia: Australian Government.

Department of Industry, Science, Energy and Resour, 2021. National Greenhouse Account Factors, Australia: Australian Government.

GHG Protocol, 2013. Technical Guidance for Calculating Scope 3 Emissions; Version 1.0, USA: World Resources Institute.

Graham, P. & Havas, L., 2021. Electric vehicle projections 2021, Australia: CSIRO.

Grose, M. e. a., 2015. Southern Slopes Cluster Report, Climate Change in Australia Projections for Australia’s Natural Resource Management Regions: Cluster Reports, Australia: eds. Ekström, M. et al., CSIRO and Bureau of Meteorology.

Infrastructure Victoria, 2019. Recycling and resource recovery infrastructure, Victoria: s.n.

Melbourne Airport, 2022. Master Plan 2022, Melbourne: s.n.

National Renewable Energy Laboratory, 2022. Decarbonizing Medium & Heavy-Duty On-Road Vehicles: Zero-Emission Vehicles Cost Analysis, United States: s.n.

Savvy, 2022. The State of Electric Trucks in Australia. [Online]
Available at: https://www.savvy.com.au/the-state-of-electric-trucks-in-australia/
[Accessed August 2022].

The British Standards Institution, 2019. Greenhouse gases - Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals (ISO 14064-1:2018), s.l.: s.n.

The British Standards Institution, 2019. Greenhouse gases - Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements (ISO 14064-2:2019), s.l.: s.n.

Appendix A - Calculation sheets

Document Control

Project Name	Melbourne Airport Jet Fuel Pipeline Project
Document Name	GHG emissions assessment

Version No	Date	Updated By (Name)	Comment / Key Changes
1	10/08/2022	Saeid Charani	Draft calculation sheet created
A	18/08/2022	Saeid Charani	Amended the spreadsheet based on Alison Dilger review
B	13/09/2022	Saeid Charani	Amended the spreadsheet based on Viva Energy's feedback
C	28/10/2022	Saeid Charani	Amended the spreadsheet based on Viva Energy's feedback
D	6/03/2023	Saeid Charani	Amended the spreadsheet based on changes to the construction method/time duration

Appendix A - Calculation sheets - Summary

Summary of total emissions of The Project and the baseline scenarios

	29%	56%	15%	
Total emissions	**Scope 1 (Direct) (t CO2-e)**	**Scope 2 (Indirect) (t CO2-e)**	**Scope 3 (Indirect) (t CO2-e)**	**Total (t CO2-e)**
The Project	13,074	25,365	6,912	**45,351**
Baseline (reference scenario)	248,755	-	12,719	**261,474**
			Reduction	**83%**

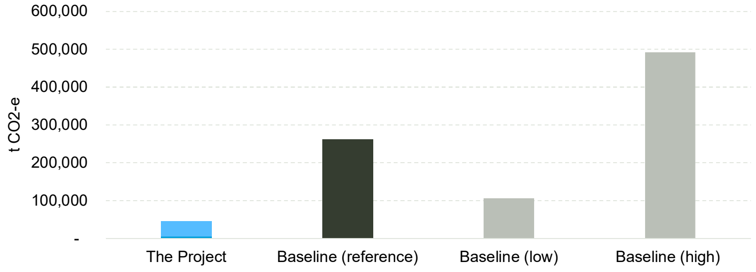
216,123

The Project								
Emissions category	**Emissions source**	**Activity**	**Scope 1 (t CO2-e)**	**Scope 2 (t CO2-e)**	**Scope 3 (t CO2-e)**	**Total (t CO2-e)**	**Notes**	
Construction								share of baseline
Stationary energy	Fuel use	Stationary construction equipment	325	-	17	**342**	Refer to the Equipment and Plant sheet	0.1%
Transport fuel	Fuel use	Mobile construction equipment, plant and site vehicles	2,174	-	111	**2,285**	Refer to the Materials and Transportation, and Waste and Spoli sheets	0.9%
Transport fuel	Fuel use	Delivery of pipe, concrete and other project components to the site	-	-	239	**239**	Refer to Materials and Transportation sheet	0.1%
Waste	Waste	Spoil and waste removal	-	-	52	**52**	Refer to Waste and Spoil sheet	0.0%
Stationary energy	Electricity consumption	Electricity used to power construction plant (lighting, etc) and site offices	-	64	7	**71**	Refer to the Construction site electricity sheet	0.0%
Land use changes	Vegetation removal / plantation	Clearance of vegetation because of the project (loss of carbon sink) or planting vegetation	-	-	-	**-**	Assumed negligible, refer to the report	0.0%
Embodied emissions	Materials	Embodied energy of construction materials	-	-	2,752	**2,752**	Refer to the Materials sheet	1.1%
Operation								
Stationary energy	Electricity consumption	Electricity used for pumping, lighting, control and maintenance	-	25,301	3,194	**28,495**	Refer to the Operation sheet	10.9%
Transport fuel	Fuel use	Mobile construction equipment used for maintenance activities	10,575	-	540	**11,115**	Refer to the Maintenance sheet	4.3%
Embodied emissions	Materials	Materials used for maintenance activities	-	-	-	**-**	Assumed negligible, refer to the report	0.0%
Transport fuel	Fuel use	Fuel consumption by trucks delivering the jet fuel	-	-	-	**-**	Assumed negligible, refer to the report	0.0%

Total emissions of the Project	**Scope 1 (Direct)**	**Scope 2 (Indirect)**	**Scope 3 (Indirect)**	**Total (t CO2-e)**
Construction	2,499	64	3,178	**5,741**
Operation	10,575	25,301	3,734	**39,610**

for the graph

	constructic	operation	total
The Project	5,741	39,610	
Baseline (reference)			261,474
Baseline (low)			105,844
Baseline (high)			492,222



Baseline							
Emissions category	**Emissions source**	**Activity**	**Scope 1 (Direct)**	**Scope 2 (Indirect)**	**Scope 3 (Indirect)**	**Total (t CO2-e)**	**Notes**
Reference (Following the expected growth)	Fuel use	Fuel consumption by trucks delivering the jet fuel	248,755	-	12,719	**261,474**	Refer to the report and the Baseline sheet
Low (20% reduction in expected growth)	Fuel use	Fuel consumption by trucks delivering the jet fuel	100,696	-	5,148	**105,844**	Refer to the report and the Baseline sheet
High (20% increase in expected growth)	Fuel use	Fuel consumption by trucks delivering the jet fuel	468,279	-	23,943	**492,222**	Refer to the report and the Baseline sheet

* Note: numbers may not add up exactly due to rounding.

5.11%
5.11%
5.11%

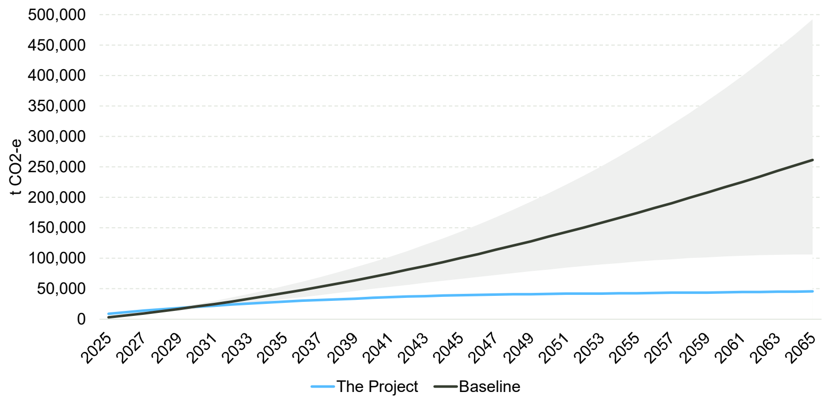
Appendix A - Calculation sheets - Emissions timeline

Cumulative emissions (t CO2e)

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
The Project	8560	11,300	13,884	16,311	18,307	20,224	22,059	23,812	25,482	27,070	28,576	29,999	31,340	32,599
Baseline	2,976	6,133	9,472	12,993	16,695	20,578	24,642	28,887	33,312	37,917	42,700	47,663	52,803	58,119
Baseline (low)	2,592	5,278	8,052	10,910	13,845	16,853	19,927	23,061	26,250	29,486	32,762	36,073	39,410	42,767
Baseline (high)	3,390	7,065	11,031	15,299	19,877	24,773	29,998	35,561	41,472	47,741	54,379	61,396	68,804	76,614

	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
The Project	33,776	34,870	35,882	36,812	37,659	38,424	39,107	39,707	40,225	40,661	41,014	41,285	41,556	41,827
Baseline	63,611	69,278	75,119	81,131	87,314	93,666	100,185	106,869	113,717	120,725	127,893	135,216	142,693	150,320
Baseline (low)	46,135	49,507	52,874	56,229	59,562	62,865	66,128	69,342	72,496	75,581	78,586	81,501	84,313	87,012
Baseline (high)	84,837	93,487	102,576	112,115	122,120	132,603	143,578	155,060	167,064	179,605	192,699	206,361	220,610	235,462

	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	Total emissions 2065
The Project	42,098	42,369	42,640	42,911	43,182	43,453	43,724	43,995	44,266	44,537	44,808	45,079	45,350
Baseline	158,095	166,014	174,073	182,270	190,599	199,058	207,641	216,344	225,161	234,089	243,120	252,250	261,473
Baseline (low)	89,586	92,022	94,309	96,432	98,378	100,134	101,685	103,018	104,115	104,963	105,545	105,844	105,844
Baseline (high)	250,934	267,045	283,814	301,260	319,403	338,263	357,862	378,221	399,362	421,309	444,085	467,714	492,222



Appendix A - Calculation sheets - Baseline emissions

Summary of baseline emissions

	reference	low	high
GHG emissions (Scope 1) [t CO2-e]	248,755	100,696	468,279
GHG emissions (Scope 3) [t CO2-e]	12,719	5,148	23,943
Total emissions [t CO2-e]	261,473	105,844	492,222

Key assumptions

	2019	2025	2042	2065	Notes	
Melbourne Airport Fuel Basis (BL p.a.)	2.20	2.5	3.8	6.7	According to RFI response, it is estimated the pipeline can deliver about 5.8 BL per annum by 2042	
Exisitng pipeline Volume (BL p.a.)	1.40	1.70	1.70	1.70	RFI response	
Melbourne Airport Fuel demand growth (p.a.)	0.02				RFI response by 2042. It is assumed the growth rate will continue until 2065	
Truck volume basis (kL)	52.10				B-Double from RFI	
Fuel density (kg/m3)	798				RFI response and double checked with the aviation data sheet https://www.ior.com.au/wp-content/uploads/2020/02/SDS-Jet-A1-20.02.2020.pdf	
Truck capacity (tonnes)	41.6				Calculated	
Truck fuel use (L/100km)	65				From trucks list on Fuel Burn Rate sheet	
	Distance (kms)	Drive Time (mins)				
Melbourne/JUHI return	55.40	65.00			RFI response	
Geelong/JUHI return	152.00	114.00			RFI response	
Mean distance traveled (50:50)	103.70				Calculated	

Baseline scenarios

Reference

Assumes the airport fuel demand growth rate would constantly increase by 2.45% per year. The fuel delivery through existing pipeline system would be utilised at its maximum capacity and the remaining jet fuel demand would be supplied by truck transportation from Melbourne and Geelong (50:50 split). 50% of jet fuel road transport would be by diesel trucks by the end of the Project design life.

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
fuel delivered to airport [BL p.a.]	2.20	Not relevant: before construction period as well as covid impact. The time horizon considered for the baseline period is from the operation year of pipeline to the end of its life spac, ie 2025-2065					2.5	2.6	2.7	2.7	2.8	2.9	2.9	3.0	3.1	3.2	3.2	3.3	3.4	3.5
pipeline capacity [BL p.a.]	1.40						1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
number of trucks	15,355						16,190	17,384	18,609	19,863	21,147	22,463	23,812	25,193	26,608	28,058	29,543	31,065	32,624	34,221
distance [km per trip]	103.7						103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7
transport fuel consumption [kL p.a.]	1035.0						1041.7	1105.2	1168.8	1232.3	1295.8	1359.3	1422.6	1485.9	1549.0	1611.9	1674.6	1737.0	1799.2	1861.0
fuel energy [GJ p.a.]	39951.4						40208.1	42661.5	45115.1	47568.1	50019.5	52468.4	54913.8	57354.6	59789.6	62217.8	64637.8	67048.5	69448.5	71836.4
emissions factor (Scope 1) [kg CO2-e/GJ]	70.4						70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4
emissions factor (Scope 3) [kg CO2-e/GJ]	3.6						3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
emissions (Scope 1) [t CO2-e p.a.]	2813.0						2831.1	3003.8	3176.6	3349.3	3521.9	3694.3	3866.5	4038.3	4209.8	4380.8	4551.1	4720.9	4889.9	5058.0
emissions (Scope 3) [t CO2-e p.a.]	143.8						144.7	153.6	162.4	171.2	180.1	188.9	197.7	206.5	215.2	224.0	232.7	241.4	250.0	258.6
total emissions [t CO2-e p.a.]	2956.8						2975.8	3157.4	3339.0	3520.5	3701.9	3883.2	4064.2	4244.8	4425.0	4604.7	4783.8	4962.3	5139.9	5316.6
cumulative sum							2975.8	6,133	9,472	12,993	16,695	20,578	24,642	28,887	33,312	37,917	42,700	47,663	52,803	58,119

	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
fuel delivered to airport [BL p.a.]	3.6	3.7	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.7	4.8	4.9
pipeline capacity [BL p.a.]	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
number of trucks	35,857	37,533	39,250	41,009	42,812	44,658	46,549	48,487	50,473	52,506	54,590	56,725	58,912	61,152
distance [km per trip]	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7
transport fuel consumption [kL p.a.]	1922.6	1983.7	2044.4	2104.6	2164.3	2223.4	2281.9	2339.8	2396.9	2453.3	2508.8	2563.5	2617.2	2669.9
fuel energy [GJ p.a.]	74210.8	76570.1	78912.7	81237.1	83541.4	85824.0	88082.9	90316.1	92521.7	94697.6	96841.5	98951.1	101024.1	103058.0
emissions factor (Scope 1) [kg CO2-e/GJ]	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4
emissions factor (Scope 3) [kg CO2-e/GJ]	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
emissions (Scope 1) [t CO2-e p.a.]	5225.2	5391.3	5556.2	5719.9	5882.2	6042.9	6201.9	6359.2	6514.5	6667.7	6818.6	6967.1	7113.1	7256.3
emissions (Scope 3) [t CO2-e p.a.]	267.2	275.7	284.1	292.5	300.7	309.0	317.1	325.1	333.1	340.9	348.6	356.2	363.7	371.0
total emissions [t CO2-e p.a.]	5492.3	5666.9	5840.3	6012.4	6182.9	6351.8	6519.0	6684.3	6847.5	7008.6	7167.2	7323.4	7476.8	7627.3
cumulative sum	63,611	69,278	75,119	81,131	87,314	93,666	100,185	106,869	113,717	120,725	127,893	135,216	142,693	150,320

	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	
fuel delivered to airport [BL p.a.]	5.0	5.1	5.3	5.4	5.5	5.6	5.8	5.9	6.1	6.2	6.4	6.5	6.7	
pipeline capacity [BL p.a.]	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	
number of trucks	63,447	65,798	68,207	70,675	73,204	75,794	78,447	81,166	83,951	86,804	89,727	92,722	95,790	
distance [km per trip]	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	
transport fuel consumption [kL p.a.]	2721.5	2772.0	2821.2	2869.1	2915.7	2960.8	3004.4	3046.3	3086.6	3125.0	3161.5	3196.0	3228.3	
fuel energy [GJ p.a.]	105050.1	106997.9	108898.6	110749.2	112546.7	114288.0	115969.8	117588.9	119141.6	120624.3	122033.3	123364.6	124614.2	
emissions factor (Scope 1) [kg CO2-e/GJ]	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	
emissions factor (Scope 3) [kg CO2-e/GJ]	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	
emissions (Scope 1) [t CO2-e p.a.]	7396.6	7533.7	7667.5	7797.8	7924.4	8047.0	8165.4	8279.4	8388.8	8493.2	8592.4	8686.1	8774.1	
emissions (Scope 3) [t CO2-e p.a.]	378.2	385.2	392.0	398.7	405.2	411.4	417.5	423.3	428.9	434.2	439.3	444.1	448.6	
total emissions [t CO2-e p.a.]	7774.8	7918.9	8059.6	8196.5	8329.6	8458.5	8582.9	8702.8	8817.7	8927.4	9031.7	9130.2	9222.7	261,473
cumulative sum	158,095	166,014	174,073	182,270	190,599	199,058	207,641	216,344	225,161	234,089	243,120	252,250	261,473	4,572,811

Low

Assumes the airport fuel demand growth rate would constantly increase by 1.96% per year (20% decrease compared to the reference case). The fuel delivery through existing pipeline system would be utilised at its maximum capacity and the remaining jet fuel demand would be supplied by truck transportation from Melbourne and Geelong (50:50 split). Zero per cent of jet fuel road transport would be by diesel trucks by the end of the Project design life.

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
fuel delivered to airport [BL p.a.]	2.20	Not relevant: before construction period as well as covid impact. The time horizon considered for the baseline period is from the operation year of pipeline to the end of its life span, ie 2025-2065					2.5	2.5	2.6	2.6	2.7	2.7	2.8	2.8	2.9	2.9	3.0	3.1	3.1	3.2
pipeline capacity [BL p.a.]	1.40						1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
number of trucks	15,355						14,807	15,736	16,682	17,648	18,632	19,636	20,659	21,703	22,766	23,851	24,957	26,084	27,234	28,406
distance [km per trip]	103.7						103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7
transport fuel consumption [kL p.a.]	1035.0						907.3	940.1	971.1	1000.3	1027.6	1052.8	1076.1	1097.2	1116.1	1132.7	1147.0	1158.8	1168.2	1174.9
fuel energy [GJ p.a.]	39951.4						35022.5	36288.8	37486.1	38612.1	39664.1	40639.5	41535.8	42350.1	43079.7	43721.7	44273.1	44730.8	45091.7	45352.6
emissions factor (Scope 1) [kg CO2-e/GJ]	70.4						70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4
emissions factor (Scope 3) [kg CO2-e/GJ]	3.6						3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
emissions (Scope 1) [t CO2-e p.a.]	2813.0						2465.9	2555.1	2639.4	2718.7	2792.7	2861.4	2924.5	2981.9	3033.2	3078.4	3117.3	3149.5	3174.9	3193.3
emissions (Scope 3) [t CO2-e p.a.]	143.8						126.1	130.6	135.0	139.0	142.8	146.3	149.5	152.5	155.1	157.4	159.4	161.0	162.3	163.3
total emissions [t CO2-e p.a.]	2956.8						2592.0	2685.7	2774.3	2857.7	2935.5	3007.7	3074.1	3134.3	3188.3	3235.8	3276.6	3310.5	3337.2	3356.5
cumulative sum							2592.0	5,278	8,052	10,910	13,845	16,853	19,927	23,061	26,250	29,486	32,762	36,073	39,410	42,767

	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
fuel delivered to airport [BL p.a.]	3.2	3.3	3.4	3.4	3.5	3.6	3.6	3.7	3.8	3.9	3.9	4.0	4.1	4.2
pipeline capacity [BL p.a.]	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
number of trucks	29,601	30,820	32,062	33,328	34,620	35,937	37,279	38,648	40,043	41,466	42,917	44,396	45,904	47,442
distance [km per trip]	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7
transport fuel consumption [kL p.a.]	1179.0	1180.3	1178.8	1174.3	1166.8	1156.1	1142.2	1124.9	1104.2	1079.9	1051.9	1020.2	984.5	944.8
fuel energy [GJ p.a.]	45510.2	45561.0	45501.6	45328.4	45037.6	44625.5	44088.1	43421.5	42621.6	41684.1	40604.7	39378.9	38002.1	36469.7
emissions factor (Scope 1) [kg CO2-e/GJ]	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4
emissions factor (Scope 3) [kg CO2-e/GJ]	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
emissions (Scope 1) [t CO2-e p.a.]	3204.4	3208.0	3203.8	3191.6	3171.1	3142.1	3104.2	3057.3	3001.0	2935.0	2859.0	2772.7	2675.7	2567.8
emissions (Scope 3) [t CO2-e p.a.]	163.8	164.0	163.8	163.2	162.1	160.7	158.7	156.3	153.4	150.1	146.2	141.8	136.8	131.3
total emissions [t CO2-e p.a.]	3368.2	3372.0	3367.6	3354.8	3333.2	3302.7	3263.0	3213.6	3154.4	3085.0	3005.2	2914.4	2812.5	2699.1
cumulative sum	46,135	49,507	52,874	56,229	59,562	62,865	66,128	69,342	72,496	75,581	78,586	81,501	84,313	87,012

	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	
fuel delivered to airport [BL p.a.]	4.3	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	
pipeline capacity [BL p.a.]	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	
number of trucks	49,010	50,608	52,238	53,899	55,594	57,321	59,082	60,878	62,709	64,575	66,478	68,419	70,397	
distance [km per trip]	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	
transport fuel consumption [kL p.a.]	901.0	852.8	800.2	743.1	681.3	614.7	543.1	466.3	384.3	296.8	203.7	104.8	0.0	
fuel energy [GJ p.a.]	34776.8	32918.4	30889.5	28684.9	26299.1	23726.7	20962.1	17999.3	14832.5	11455.5	7862.1	4045.8	0.0	
emissions factor (Scope 1) [kg CO2-e/GJ]	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	
emissions factor (Scope 3) [kg CO2-e/GJ]	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	
emissions (Scope 1) [t CO2-e p.a.]	2448.6	2317.8	2174.9	2019.7	1851.7	1670.6	1475.9	1267.3	1044.4	806.6	553.6	284.9	0.0	
emissions (Scope 3) [t CO2-e p.a.]	125.2	118.5	111.2	103.3	94.7	85.4	75.5	64.8	53.4	41.2	28.3	14.6	0.0	
total emissions [t CO2-e p.a.]	2573.8	2436.3	2286.1	2123.0	1946.4	1756.0	1551.4	1332.1	1097.8	847.8	581.9	299.4	0.0	105,844
cumulative sum	89,586	92,022	94,309	96,432	98,378	100,134	101,685	103,018	104,115	104,963	105,545	105,844	105,844	2,551,273

High

Assumes the airport fuel demand growth rate would constantly increase by 2.94% per year (20% increase compared to the reference case). The fuel delivery through existing pipeline system would be utilised at its maximum capacity and the remaining jet fuel demand would be supplied by truck transportation from Melbourne and Geelong (50:50 split). 100% of jet fuel road transport would be by diesel trucks by the end of the Project design life.

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
fuel delivered to airport [BL p.a.]	2.20	Not relevant: before construction period as well as covid impact. The time horizon considered for the baseline period is from the operation year of pipeline to the end of its life span, ie 2025-2065					2.6	2.7	2.8	2.9	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8
pipeline capacity [BL p.a.]	1.40						1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
number of trucks	15,355						17,606	19,081	20,600	22,163	23,773	25,429	27,134	28,889	30,696	32,556	34,470	36,441	38,469	40,558
distance [km per trip]	103.7						103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7
transport fuel consumption [kL p.a.]	1035.0						1186.7	1286.2	1388.5	1493.9	1602.4	1714.0	1829.0	1947.3	2069.1	2194.4	2323.5	2456.3	2593.0	2733.8
fuel energy [GJ p.a.]	39951.4						45807.9	49646.5	53597.9	57665.3	61852.2	66162.0	70598.5	75165.2	79866.0	84704.9	89685.9	94813.2	100091.1	105524.0
emissions factor (Scope 1) [kg CO2-e/GJ]	70.4						70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4
emissions factor (Scope 3) [kg CO2-e/GJ]	3.6						3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
emissions (Scope 1) [t CO2-e p.a.]	2813.0						3225.3	3495.6	3773.8	4060.2	4355.0	4658.5	4970.8	5292.4	5623.4	5964.1	6314.8	6675.8	7047.4	7429.9
emissions (Scope 3) [t CO2-e p.a.]	143.8						164.9	178.7	193.0	207.6	222.7	238.2	254.2	270.6	287.5	304.9	322.9	341.3	360.3	379.9
total emissions [t CO2-e p.a.]	2956.8						3390.2	3674.3	3966.8	4267.8	4577.7	4896.7	5225.0	5563.0	5910.9	6269.0	6637.7	7017.1	7407.7	7809.8
cumulative sum							3390.2	7,065	11,031	15,299	19,877	24,773	29,998	35,561	41,472	47,741	54,379	61,396	68,804	76,614
							2547.71	2469.321	2312.5383	2155.7561	1724.6048	1646.2137	1563.903	1481.5923	1399.2817	1316.971	1234.6603	1152.3496	1070.0389	987.72823

	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
fuel delivered to airport [BL p.a.]	3.9	4.0	4.2	4.3	4.4	4.5	4.7	4.8	4.9	5.1	5.2	5.4	5.6	5.7
pipeline capacity [BL p.a.]	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
number of trucks	42,707	44,920	47,197	49,541	51,955	54,439	56,996	59,628	62,338	65,127	67,998	70,953	73,995	77,127
distance [km per trip]	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7
transport fuel consumption [kL p.a.]	2878.7	3027.8	3181.3	3339.3	3502.0	3669.5	3841.8	4019.2	4201.9	4389.9	4583.4	4782.6	4987.6	5198.7
fuel energy [GJ p.a.]	111116.4	116873.1	122798.9	128898.7	135177.6	141640.9	148294.1	155142.6	162192.3	169449.0	176918.9	184608.1	192523.2	200670.7
emissions factor (Scope 1) [kg CO2-e/GJ]	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4
emissions factor (Scope 3) [kg CO2-e/GJ]	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
emissions (Scope 1) [t CO2-e p.a.]	7823.7	8229.0	8646.3	9075.8	9517.9	9972.9	10441.4	10923.6	11420.0	11930.9	12456.9	12998.3	13555.6	14129.2
emissions (Scope 3) [t CO2-e p.a.]	400.0	420.7	442.1	464.0	486.6	509.9	533.9	558.5	583.9	610.0	636.9	664.6	693.1	722.4
total emissions [t CO2-e p.a.]	8223.7	8649.8	9088.3	9539.8	10004.5	10482.8	10975.2	11482.1	12003.9	12540.9	13093.8	13662.8	14248.6	14851.6
cumulative sum	84,837	93,487	102,576	112,115	122,120	132,603	143,578	155,060	167,064	179,605	192,699	206,361	220,610	235,462
	905.41754	823.10686	740.79617	658.48548	576.174799	493.864114	411.553428	329.242742	246.932057	164.621371	82.3106856	0	0	0

	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	
fuel delivered to airport [BL p.a.]	5.9	6.1	6.2	6.4	6.6	6.8	7.0	7.2	7.4	7.6	7.9	8.1	8.3	
pipeline capacity [BL p.a.]	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	
number of trucks	80,350	83,668	87,084	90,600	94,219	97,944	101,779	105,726	109,790	113,972	118,278	122,710	127,272	
distance [km per trip]	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	103.7	
transport fuel consumption [kL p.a.]	5416.0	5639.7	5869.9	6106.9	6350.8	6601.9	6860.4	7126.5	7400.4	7682.3	7972.5	8271.3	8578.8	
fuel energy [GJ p.a.]	209057.5	217690.6	226577.2	235724.9	245141.2	254834.0	264811.5	275082.1	285654.2	296536.9	307739.2	319270.5	331140.4	
emissions factor (Scope 1) [kg CO2-e/GJ]	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	
emissions factor (Scope 3) [kg CO2-e/GJ]	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	
emissions (Scope 1) [t CO2-e p.a.]	14719.7	15327.6	15953.3	16597.4	17260.4	17942.9	18645.4	19368.5	20112.9	20879.2	21667.9	22479.8	23315.6	
emissions (Scope 3) [t CO2-e p.a.]	752.6	783.7	815.7	848.6	882.5	917.4	953.3	990.3	1028.4	1067.5	1107.9	1149.4	1192.1	
total emissions [t CO2-e p.a.]	15472.3	16111.3	16769.0	17446.0	18142.9	18860.3	19598.7	20358.8	21141.3	21946.7	22775.8	23629.2	24507.7	492,222
cumulative sum	250,934	267,045	283,814	301,260	319,403	338,263	357,862	378,221	399,362	421,309	444,085	467,714	492,222	7,367,074
	0	0	0	0	0	0	0	0	0	0	0	0	0	

Summary of construction site electricity emissions

GHG emissions (Scope 2) [t CO2-e]	**64**
GHG emissions (Scope 3) [t CO2-e]	**7**
Total emissions [t CO2-e]	**71**

Key assumptions

Common Parameter	**Value**	**Notes**
Internal Area (m2)	650	Assumed based on similar projects for offices at different sections of the construction site for about 105 workers and staff at peak
Baseline Energy Intensity (MJ/m2.a)	389	Baseline Energy Consumption and Greenhouse Gas Emissions in Commercial Buildings in Australia, November 2012 (Council of Australian Governments National Strategy of Energy Efficiency), weighted average intensity of standalone offices.
Construction duration (weeks)	52	from the construction plan. Assumes 38 per week, Monday to Friday based on consultation with the design team.
Total Electricity Consumption (MJ)	**252,850**	Calculation
Total Electricity Consumption site office (kWh)	**70,236**	Calculation
Average Monthly Electricity Consumption site office (kWh)	**5,853**	Calculation
total electicity per year (kWh)	**70,236**	Calculation

Appendix A - Calculation sheets - Materials and Transportation

Summary of embodied emissions

GHG emissions (Scope 3) [t CO2-e]	2,752
Total emissions [t CO2-e]	2,752

Summary of transportation emissions

GHG emissions (Scope 3) [t CO2-e]	239
Total emissions [t CO2-e]	239

Key assumptions

Embodied carbon used in pipeline construction

Component	Volume (m3)	Mass (tonnes)	Embodied emissions (kgCO2e/unit)	GHG emissions (Secope 3) (tCO2-e)	Notes
cocrete used for all components	250	600	442	110	Volume value received from the design team. Concrete global warming impact category from ISC material calculator. Density of concrete assumed 2.4 tonnes/m3 from ISC material calculator.
pipeline steel		700	2935	2,054	Mass value received from the design team. Steel pipe and tube imported global warming impact category from ISC material calculator
other components steel		200	2935	587	Mass value received from the design team. Steel pipe and tube imported global warming impact category from ISC material calculator
		900			
			total	2,752	

Transportation emissions

	number of vehicles	distance (km)	emission factor (kgCO2e/tkm)	GHG emissions (Secope 3) (tCO2-e)	Notes
Truck transport from the nearby supplier	36	2	0.128	6	Transported from Melbourne, 7m3 concrete agitator truck, ISC materials calculator used for emission factors
Sea transport from Europe	1	25000	0.009	156	Transported from Europe. Emission factor from ISC tool international shippng
Sea transport from Europe	1	25000	0.009	44	Transported from Europe. Emission factor from ISC tool international shippng
transport of steel from Port Melbourne to the construction site	26	20	0.072	33	Transported from Melbourne, articulated truck, ISC materials calculator used for emission factors
			total	239	

Appendix A - Calculation sheets - Operation

Summary of operational emissions

GHG emissions (Scope 2) [t CO2-e]	25,301
GHG emissions (Scope 3) [t CO2-e]	3,194
Total emissions [t CO2-e]	28,495

Key assumptions

	Value	Unit	Notes
control pannels demand	17520	kWh	one at each end of the pipeline with max demand of 5kW excluding the maintenance lights. Average used 1kW per location operating all year round from consultation with electrical team
lighting power demand	3942	kWh	at the ariport end assumed 6 x 150W LED lights on at night assumed 12 hours of operation
Current pump installed power	502	kW	From the technical sheet of the pump in email response
New pump installed power	947	kW	From the pump curve of the modified pump in email response (Required power divided by pump efficiency)
pumping power demand	3,898,094	kWh	Based on the difference in power demand for the current and new pump. Assumed pump is running at full capacity operation all year round to meet the increased fuel demand (160 m3/hour)
annual electricity demand	3.919.556	kWh	Calculation

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
emission factor (scope 2) [kg CO2-e/kWh]	0.91	0.68	0.60	0.57	0.58	0.56	0.54	0.50	0.39	0.37	0.35	0.33	0.31	0.30	0.28
emission factor (scope 3) [kg CO2-e/kWh]	0.10	0.07	0.06	0.06	0.07	0.07	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04
lighting and control electricity consumption [kWh]					21462	21462	21462	21462	21462	21462	21462	21462	21462	21462	21462
pumping electricity consumption [kWh]					3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094
total electricity consumption [kWh]					3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556
emissions (Scope 2) [t CO2-e]					2273	2195	2117	1960	1529	1450	1378	1305	1233	1160	1088
emissions (Scope 3) [t CO2-e]					274	274	196	196	196	196	186	176	167	157	147
total emissions [t CO2-e]					2548	2469	2313	2156	1725	1646	1564	1482	1399	1317	1235

	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
emission factor (scope 2) [kg CO2-e/kWh]	0.26	0.24	0.22	0.20	0.19	0.17	0.15	0.13	0.11	0.09	0.07	0.06	0.04	0.02	0.00
emission factor (scope 3) [kg CO2-e/kWh]	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00
lighting and control electricity consumption [kWh]	21462	21462	21462	21462	21462	21462	21462	21462	21462	21462	21462	21462	21462	21462	21462
pumping electricity consumption [kWh]	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094
total electricity consumption [kWh]	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556
emissions (Scope 2) [t CO2-e]	1015	943	870	798	725	653	580	508	435	363	290	218	145	73	0
emissions (Scope 3) [t CO2-e]	137	127	118	108	98	88	78	69	59	49	39	29	20	10	0
total emissions [t CO2-e]	1152	1070	988	905	823	741	658	576	494	412	329	247	165	82	0

	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	Total (MWh)	share
emission factor (scope 2) [kg CO2-e/kWh]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
emission factor (scope 3) [kg CO2-e/kWh]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
lighting and control electricity consumption [kWh]	21462	21462	21462	21462	21462	21462	21462	21462	21462	21462	21462	21462	21462	21462	21462	880	1%
pumping electricity consumption [kWh]	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	3898094	159,822	99%
total electricity consumption [kWh]	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	3919556	160,702	
emissions (Scope 2) [t CO2-e]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
emissions (Scope 3) [t CO2-e]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
total emissions [t CO2-e]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

Appendix A - Calculation sheets - Equipment and Plant

Summary of equipment and plant transportation emissions

GHG emissions (Scope 1) [t CO2-e]	2172.90
GHG emissions (Scope 3) [t CO2-e]	111.10
Total emissions [t CO2-e]	2283.99

Summary of stationary equipment emissions

GHG emissions (Scope 1) [t CO2-e]	324.65
GHG emissions (Scope 3) [t CO2-e]	16.60
Total emissions [t CO2-e]	341.25

Key assumptions

Mobile plant and equipment

Plant and equipment name	Equivalent plant assumed in the market	Number of Equipment	Fuel used	duration of use (weeks)	hous per week	operation hours (hours)	Fuel Burn Rate (L/hr)	fuel consumption (KL)	fuel energy (GJ)	emissions (Scope 1) (t CO2-e)	emissions (Scope 3) (t CO2-e)	total emissions (t CO2-e)	Notes
Excavator (35T)	CAT 330 - 30t	5	Diesel	22	38	836	31	130	5002	352	18	370	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Excavator (35T)	CAT 330 - 30t	2	Diesel	4	38	152	31	9	364	26	1	27	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Excavator (35T)	CAT 330 - 30t	1	Diesel	37	38	1406	31	44	1682	118	6	125	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Excavator (45T) with Hammer	CAT 349 - 45t	2	Diesel	15	38	570	61	69	2662	187	10	197	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Grader (14G)	CAT 140M - 17t	1	Diesel	4	38	152	26	4	151	11	1	11	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
D7 Dozer	CAT D8R	1	Diesel	4	38	152	54	8	318	22	1	24	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
D7 Dozer	CAT D8R	1	Diesel	36	38	1368	54	74	2862	202	10	212	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Rock chain trencher	CAT 320 - 21t	1	Diesel	15	38	570	27	15	583	41	2	43	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Vacuum truck	Water Cart 6 Wheel - 15kl (221kW)	2	Diesel	37	38	1406	17	49	1889	133	7	140	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
572 side boom	Boom Lift 18m (37kW)	3	Diesel	36	38	1368	2	10	390	27	1	29	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Prime movers (stringing trucks)	Medium Truck 3.5t≤GVM≤12t (L/hr)	1	Diesel	36	38	1368	22	31	1183	83	4	88	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Skid truck	Light Commercial ≤ 3.5t (L/hr)	2	Diesel	36	38	1368	10	27	1031	73	4	76	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Light Truck with Welding Machines	Light Commercial ≤ 3.5t (L/hr)	2	Diesel	36	38	1368	10	27	1031	73	4	76	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Tack rig	CAT 312 - 13t	1	Diesel	36	38	1368	15	21	803	57	3	59	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Loader	CAT 966M - 23t	2	Diesel	36	38	1368	21	57	2186	154	8	162	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
350 padding machine	CAT 312 - 13t	1	Diesel	36	38	1368	15	21	803	57	3	59	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Trucks to haul in bedding material	Tipper 25t (180)	3	Diesel	36	38	1368	29	119	4594	323	17	340	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Flocon truck	Medium Truck 3.5t≤GVM≤12t (L/hr)	1	Diesel	36	38	1368	22	31	1183	83	4	88	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Grader	CAT 140M - 17t	1	Diesel	36	38	1368	26	35	1362	96	5	101	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Grader (16G)	CAT 140M - 17t	1	Diesel	4	38	152	26	4	151	11	1	11	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
D7 Dozer - easemen and property rehab	CAT D8R	1	Diesel	4	38	152	54	8	318	22	1	24	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Tractor - reseeding	Medium Truck 3.5t≤GVM≤12t (L/hr)	1	Diesel	4	38	152	22	3	131	9	0	10	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Excavator (35T)	CAT 330 - 30t	1	Diesel	4	38	152	31	5	182	13	1	13	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.

Stationary plant and equipment

Generator (self bunded or within container)	Generator (80kW)	1	Diesel	1	38	38	25.54	1	37.47	2.64	0.13	3	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Generator	Generator (24kW)	1	Diesel	52	38	1976	7.20	14	549.17	38.67	1.98	41	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Fill pump	TF400/40 High Flow Pump	1	Diesel	8	38	304	30	9	352	25	1	26	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
750cfm compressor	Air Compressor 250 CFM (59kW)	1	Diesel	8	38	304	19	6	221	16	1	16	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
1200 cfm compressor for drying	Air Compressor 250 CFM (59kW)	1	Diesel	8	38	304	19	6	221	16	1	16	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Vacuum drying unit	Welder 400A (44kW) Diesel	1	Diesel	8	38	304	4	1	47	3	0	3	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Bending machine	Welder 400A (44kW) Diesel	1	Diesel	36	38	1368	4	5	211	15	1	16	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Light towers	4 Light (8kW)	11	Diesel	52	20	1040	2	23	883	62	3	65	Operation hour 5 days per week construction and 4 hours of lighting per day consultation with electrical team. 4 lights per construction section including portable LED and flood lighting. Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
Thrust boring activities (rotary auger and generator)		1	Diesel	1	38	38	32	1	47	3	0	3	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
High pressure squeeze pump	TF400/40 High Flow Pump	1	Diesel	8	38	304	30	9	352	25	1	26	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is taken from similar projects.
HDD rig		1	Diesel	36	38	1368	32	44	1690	119	6	125	Plant/equipment name and hours of operation are obtained from the design team. The fuel burn rate is assumed similar to thrust boring.

Summary of waste emissions

GHG emissions (Scope 3) [t CO2-e]	52
Total emissions [t CO2-e]	52

Summary of waste and spoil transportaion emissions

GHG emissions (Scope 1) [t CO2-e]	1
GHG emissions (Scope 3) [t CO2-e]	0
Total emissions [t CO2-e]	1

Key assumptions

	Value	Notes
Truck volume (kL)	14.84816	From trucks list, see Emission Factors sheet. Assuming soil density of 922 kg/m3 and 13.69 tonnes truck mass capacity
Truck fuel use (L/100km)	28	From trucks list, see Emission Factors sheet
Round trip distance to landfill (km)	20	Round trip estimated to the three nearest landfills
volume of contam soil (m3)	800	Consultation with the design team
number of trucks	53.9	Calculation
fuel used (kL)	0.3	Calculation
Scope 1 emissions (tCO2e)	0.82	Calculation
Scope 3 emissions (tCO2e)	0.04	Calculation
Total emissions (tCO2e)	0.86	Calculation

waste category	volume (m3)	density (t/m3)	Waste mass (tonnes)	emissions factor (tCO2e/t waste)	Scope 3 emissions (tCO2e)	Notes	
construction materials	18	1.2	22.0	0.2	4.4	Waste volume from consultation with the design team. waste volume to mass conversation factors from references in the link	https://www.dcceew.gov.au/sites/default/files/documents/hazardous-waste-unit-conversion-factors.pdf https://www.sustainabilityexchange.ac.uk/conversion_factors_for_calculation_of_weight_to_vo
waste from equipment and material deliver	18	0.7	12.8	1.3	16.7	Waste volume from consultation with the design team. waste volume to mass conversation factors from references in the link	
general waste from site office activities	18	1.05	19.3	1.6	30.8	Waste volume from consultation with the design team. waste volume to mass conversation factors from NABERS waste guidelines	
Total Scope 3 emissions (tCO2e)					51.9		

Appendix A - Calculation sheets - Maintenance

Summary of maintenance activities emissions

GHG emissions (Scope 1) [t CO2-e]	10575
GHG emissions (Scope 3) [t CO2-e]	541
Total emissions [t CO2-e]	11115

Key assumptions

	Value	Notes
number of vehicles	1	One Ute consultation with the design team
times per year	260	Daily patrol of the pipeline (5 days per week) based on Viva Energy's input
Round distance travelled per visit (km)	50	from Viva Energy office in Melbourne CBD
Ute consumption (L/100km)	7.3	Claimed fuel economy for 2015 Toyota Hilux 4x4 twin cab ute

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
times per year	260	260	260	260	260	260	260	260	260	260	260	260	260	260
number of Utes	1	1	1	1	1	1	1	1	1	1	1	1	1	1
distance [km]	50	50	50	50	50	50	50	50	50	50	50	50	50	50
fuel consumption [kL]	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90
fuel energy [GJ]	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14
emissions factor (Scope 1) [kg CO2-e/GJ]	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4
emissions factor (Scope 3) [kg CO2-e/GJ]	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
emissions (Scope 1) [t CO2-e]	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92
emissions (Scope 3) [t CO2-e]	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19
total emissions [t CO2-e]	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11

	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
times per year	260	260	260	260	260	260	260	260	260	260	260	260	260	260
number of Utes	1	1	1	1	1	1	1	1	1	1	1	1	1	1
distance [km]	50	50	50	50	50	50	50	50	50	50	50	50	50	50
fuel consumption [kL]	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90
fuel energy [GJ]	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14
emissions factor (Scope 1) [kg CO2-e/GJ]	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4
emissions factor (Scope 3) [kg CO2-e/GJ]	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
emissions (Scope 1) [t CO2-e]	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92
emissions (Scope 3) [t CO2-e]	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19
total emissions [t CO2-e]	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11

	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065
times per year	260	260	260	260	260	260	260	260	260	260	260	260	260
number of Utes	1	1	1	1	1	1	1	1	1	1	1	1	1
distance [km]	50	50	50	50	50	50	50	50	50	50	50	50	50
fuel consumption [kL]	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90	94.90
fuel energy [GJ]	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14	3663.14
emissions factor (Scope 1) [kg CO2-e/GJ]	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4	70.4
emissions factor (Scope 3) [kg CO2-e/GJ]	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
emissions (Scope 1) [t CO2-e]	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92	257.92
emissions (Scope 3) [t CO2-e]	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19	13.19
total emissions [t CO2-e]	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11	271.11

Appendix A - Calculation sheets - Fuel Burn Rates

Fuel Burn Rates

General note:
The burn rate has been from previous projets or available technical sheets.

Plant & Equipment Fuel Burn Rates

Plant Category	Plant Name	Power (kW)	Fuel Type	Fuel Burn Rate	Fuel Burn Units	Source	Notes
Elevated Work Platform	Boom Lift 18m (37kW)	37	Diesel	2.5	L/hr	https://auslift.com.au/collections/4wd-diesel-knuckle-boom-lifts-for-hire/products/jlg-60ft-diesel-knuckle-boom-lift	JLG Articulating Boom Lift 18.47m
Skid Steer	Skid Steer CAT 262D 3.8 (56kW)	56	Diesel	12.1	L/hr	Caterpillar Performance Handbook 49 (2019)	CAT 262D
Compacting Plate	Heavy Compacting Plate 500kg (7kW)	7	Diesel	1.9	L/hr	https://www.wackerneuson.com/en/au/products/compaction/vibratory-plates/reversible-vibratory-plates/model/dpu6555/type/TechnicalData/	
Compacting Plate	Light Compacting Plate 86kg (4kW)	4	Diesel	1.4	L/hr	https://www.hondashop.com.au/product/dowerin-show-specials/stationary-engine-gx160/	Uses the same engine in the Hoppt Compactor http://www.hoppt.com.au/box-plate-compactor
Roller	Roller - 380kg Ped.Duplex		Diesel	1.7	L/hr	Weber MT (2021) (https://www.webermt.com/DE/eng/rollers/duplex-roller-dvh-600/) Kohler Engines Workshop Manual (https://iservice.lombardini.it/documents/ProdCateg/1405/MO_Rev_00_KD_225_315_350_400_440_GB.pdf)	DVH 600 Roller uses 5.5HP Kohler Engine. Kohler KD350 has similar ratings with 0.260 kg/kWh fuel consumption. LPH = ((Fuel Consumption)x(Power Rating)x100% Load)/Specific Weight of Diesel (0.85)
Roller	CAT CS56 - 12t		Diesel	22.7	L/hr	Caterpillar Performance Handbook 49 (2019)	
Roller	CAT CS74 - 16t (130kW)	130	Diesel	26.5	L/hr	Caterpillar Performance Handbook 49 (2019)	Soil Compactor CS74
Roller	CAT CB24 - 2t (27kW)	27	Diesel	7.0	L/hr	Caterpillar Performance Handbook 49 (2019)	
Roller	CAT CS44 - 7t (75kW)	75	Diesel	15.7	L/hr	Caterpillar Performance Handbook 49 (2019)	
Roller	CAT 825K - 35t (302kW)	302	Diesel	69.7	L/hr	Caterpillar Performance Handbook 49 (2019)	
Concrete Pump	Conc. Pump with 36m Boom (300kW)	300	Diesel	81.4	L/hr	https://www.wpowerproducts.com/power-generation-resources/diesel-fuel-consumption-chart/	Assume equivalent to full load fuel consumption for 300 kW diesel engine (generator) from linked source. 21.5 gal = 81.4 L.
Compressor	Air Compressor 250 CFM (59kW)	59	Diesel	19	L/hr	Able Sales, Typical Diesel Generator Fuel Efficiency (https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html)	Assume equivalent fuel efficiency as 60 kW diesel generator
Crane	Crane 25t (200kW)	200	Diesel	64	L/hr	Able Sales, Typical Diesel Generator Fuel Efficiency (https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html)	Conversion of kW to fuel burn rate using average generator efficiencies
Crane	Crane 50t (250kW)	200	Diesel	64	L/hr	Able Sales, Typical Diesel Generator Fuel Efficiency (https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html)	Conversion of kW to fuel burn rate using average generator efficiencies
Crane	Crane 160t (400kW)	400	Diesel	128	L/hr	Able Sales, Typical Diesel Generator Fuel Efficiency (https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html)	Conversion of kW to fuel burn rate using average generator efficiencies
Crane	Crane 200t (400kW)	400	Diesel	128	L/hr	Able Sales, Typical Diesel Generator Fuel Efficiency (https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html)	Conversion of kW to fuel burn rate using average generator efficiencies
Crane	Crane 250t (425kW)	425	Diesel	136	L/hr	Able Sales, Typical Diesel Generator Fuel Efficiency (https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html)	Conversion of kW to fuel burn rate using average generator efficiencies
Crane	Crane 350t (450kW)	450	Diesel	144	L/hr	Able Sales, Typical Diesel Generator Fuel Efficiency (https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html)	Conversion of kW to fuel burn rate using average generator efficiencies
Crane	Crane 450t (505kW)	505	Diesel	161	L/hr	Able Sales, Typical Diesel Generator Fuel Efficiency (https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html)	Conversion of kW to fuel burn rate using average generator efficiencies
Articulated Dump Truck	CAT 740C2 - 38t		Diesel	45.2	L/hr	Caterpillar Performance Handbook 49 (2019)	
Dozer	CAT D8R		Diesel	54.2	L/hr	Caterpillar Performance Handbook 49 (2019)	Assume similar to CAT D8T
Excavator	CAT 312 - 13t		Diesel	15.2	L/hr	Caterpillar Performance Handbook 49 (2019)	Assuming it is HEX D SERIES 312 (STD)
Excavator	CAT 320 - 22t		Diesel	26.5	L/hr	Caterpillar Performance Handbook 49 (2019)	Assuming it is HEX D SERIES 320D (STD)
Excavator	CAT 320 - 21t		Diesel	26.5	L/hr	Caterpillar Performance Handbook 49 (2019)	Assuming it is HEX D SERIES 320D (STD)
Excavator	CAT 330 - 30t		Diesel	31.0	L/hr	Caterpillar Performance Handbook 49 (2019)	330F (STD) HEX F Series
Excavator	CAT 349 - 45t		Diesel	60.5	L/hr	Caterpillar Performance Handbook 49 (2019)	349E HEX E
Generator	Generator (80kW)	80	Diesel	25.5	L/hr	Able Sales, Typical Diesel Generator Fuel Efficiency (https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html)	Fuel burn rate estimated using average generator efficiency based on power rating.
Generator	Generator (24kW)	24	Diesel	7.2	L/hr	Able Sales, Typical Diesel Generator Fuel Efficiency (https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html)	
Grader	CAT 140M - 17t		Diesel	25.8	L/hr	Caterpillar Performance Handbook 49 (2019)	140M3
Loader	CAT 966M - 23t		Diesel	20.7	L/hr	Caterpillar Performance Handbook 49 (2019)	
Telehandler	Mani MT1135 - 9t (75kW)	75	Diesel	17.0	L/hr	Caterpillar Performance Handbook 49 (2019)	Assumed similar to TH350B
Lighting	4 Light (8kW)	8	Diesel	2.0	L/hr	Generator Source - Magnum Light Tower 3060 (https://www.generatorsource.com/specsheets/3000K.pdf)	
Pump	TF400/40 High Flow Pump		Diesel	30.0	L/hr	Caterpillar Performance Handbook 49 (2019)	Truflo Pumps (2019) which uses CAT C9.3 ACERT Engine (https://truflopumps.com.au/brochure/2019_TF_DATASHEET_WEB_TF400_40.pdf)
Pump	Pump with 6" Suction Pipe (17kW)	17	Diesel	4.8	L/hr	Able Sales, Typical Diesel Generator Fuel Efficiency (https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html)	Assume similar fuel consumption to a 16 kW generator at full load
Tipper	Tipper 15t (140)	140	Diesel	23.2	L/hr	Caterpillar Performance Handbook 49 (2019)	Estimated to be 80% of CAT 24t 730C2 truck (no smaller trucks available)
Tipper	Tipper 25t (180)	180	Diesel	29.0	L/hr	Caterpillar Performance Handbook 49 (2019)	Based on CAT 24t 730C2 truck
Truck	Flatbed HIAB Truck 20t (110kW)	110	Diesel	35.1	L/hr	Able Sales, Typical Diesel Generator Fuel Efficiency (https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html)	Fuel burn rate estimated using average generator efficiency based on power rating.
Truck	Flatbed HIAB Truck 24t (115kW)	115	Diesel	36.7	L/hr	Able Sales, Typical Diesel Generator Fuel Efficiency (https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html)	Fuel burn rate estimated using average generator efficiency based on power rating.
Water Cart	Water Cart 6 Wheel - 15kl (221kW)	221	Diesel	17.4	L/hr	Ezyquip hire water truck specifications (https://www.ezyquip.com.au/product/fvz-260-300-water-truck/)	Medium fuel burn rate is average of medium application.
Welder	Welder 400A (44kW) Diesel	44	Diesel	4.0	L/hr	https://www.scribd.com/doc/44059673/Standard-Fuel-Consumption-Model-2	Based on Miller 401DX 400A Welder
Minor Plant	Pressure Washer 3300PSI (5kW)	5	Diesel	5.7	L/hr	https://www.kewparts.com/uploads/3/4/0/2/34021509/kew_catalog.pdf	Similar to Neptune 7-66 2750PSI Washer at 1.5 gal/hr. Equivalent to 5.7 L/hr.
Minor Plant	Mulcher (16kW)	16	Diesel	3.0	L/hr	https://www.tpchipper.com/chippers/tp-175-mobile-stage-v/	17kW Chipper/Mulcher
Minor Plant	Stump Grinder (20kW)	20	Diesel	12.0	L/hr	Vermeer BC900XL	BC900XL Wood Chipper / Brush Chipper | Vermeer Australia Tree Care
Minor Plant	Grout Pump 10 Bag (5kW)	5	Diesel	2	L/hr	Able Sales, Typical Diesel Generator Fuel Efficiency (https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html)	Conversion of kW to fuel burn rate using average generator efficiencies
Minor Plant	Concrete Vibrator	3.5	Diesel	1.1	L/hr	Scintex - Concrete Vibrator Poker (https://www.scintex.com.au/products/concrete-vibrator-poker)	Assume 4.7 hp / 3.5 kW diesel vibrator. kW converted to fuel burn rate using average generator efficiency.
Pump	8kW Pump	8	Diesel	2.4	L/hr	https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html	Assume equivalent fuel consumption to the same size diesel engine (generator) operating at full load.
Sweeper	Street Sweeper		Diesel	4.0	L/hr	accounts@pmgalea.com.au	Supplier value
Light Vehicles	Light Commercial ≤ 3.5t (L/hr)		Diesel	9.760	L/hr	Transport Authorities Greenhouse Group (TAGG), (2013) Greenhouse Gas Assessment Workbook for Road Projects	L/km fuel burn rate converted to L/hr conservatively by multiplying by 80km in an hour.
Truck	Medium Truck 3.5t≤GVM≤12t (L/hr)		Diesel	22.400	L/hr	Transport Authorities Greenhouse Group (TAGG), (2013) Greenhouse Gas Assessment Workbook for Road Projects	L/km fuel burn rate converted to L/hr conservatively by multiplying by 80km in an hour.
Truck	Heavy Truck 12t≤GVM≤25t (L/hr)		Diesel	44.800	L/hr	Transport Authorities Greenhouse Group (TAGG), (2013) Greenhouse Gas Assessment Workbook for Road Projects	L/km fuel burn rate converted to L/hr conservatively by multiplying by 80km in an hour.
Light Vehicles	Twin Cab Ute		Diesel	7.3	L/100km	https://rac.com.au/car-motoring/info/car-reviews/four-wheel-drive-utes/toyota-hilux	Claimed fuel economy for 2015 Toyota Hilux 4x4 twin cab ute
Light Vehicles	Light Commercial ≤ 3.5t (L/km)		Diesel	0.122	L/km	Transport Authorities Greenhouse Group (TAGG), (2013) Greenhouse Gas Assessment Workbook for Road Projects	
Truck	Medium Truck 3.5t≤GVM≤12t (L/km)		Diesel	0.280	L/km	Transport Authorities Greenhouse Group (TAGG), (2013) Greenhouse Gas Assessment Workbook for Road Projects	
Truck	Heavy Truck 12t≤GVM≤25t (L/km)		Diesel	0.560	L/km	Transport Authorities Greenhouse Group (TAGG), (2013) Greenhouse Gas Assessment Workbook for Road Projects	
Trcuk B-double	B-double		Diesel	0.65	L/km	https://www.truck.net.au/system/files/industry-resources/TAPs%20-%20Truck%20Impact%20Chart%20March%202018.pdf	
Soil Nail Machine	Soil Nail Machine		Diesel	26.0	L/hr	Atlas Copco Technical Specification (https://ee-industry-equipment.com/deposit/3344_f2440.pdf, accessed 30th September 2021)	Equipment equivalent to Atlas Copco D9 per advice from project engineer. Fuel burn rate taken from equipment specification.

Typical Generator Diesel Fuel Efficiency

Assumed Power Factor	0.90	Based on past projects
Average Generator Fuel Use Efficiency (L/kWh)	0.32	Based on generator supplier data, refer table below

Generator Size	Power (kW)	¼ Load (litres/hr)	1/4 Load Fuel Efficiency (L/kWh)	½ Load (litres/hr)	1/2 Load Fuel Efficiency (L/kWh)	¾ Load (litres/hr)	3/4 Load Fuel Efficiency (L/kWh)	Full Load (litres/hr)	Full Load Fuel Efficiency (L/kWh)
8kW / 10kVA	8	0.8	0.40	1.3	0.33	1.8	0.30	2.4	0.30
10kW / 12kVA	10	0.9	0.36	1.6	0.32	2.2	0.29	2.9	0.29
12kW / 15kVA	12	1.1	0.37	1.9	0.32	2.7	0.30	3.6	0.30
16kW / 20kVA	16	1.5	0.38	2.5	0.31	3.6	0.30	4.8	0.30
20kW / 25kVA	20	1.8	0.36	3.1	0.31	4.5	0.30	6	0.30
24kW / 30kVA	24	2.2	0.37	3.7	0.31	5.4	0.30	7.2	0.30
32kW / 40kVA	32	2.9	0.36	5	0.31	7.2	0.30	9.6	0.30
40kW / 50kVA	40	3.6	0.36	6.2	0.31	9	0.30	12	0.30
60kW / 75kVA	60	5.4	0.36	9.4	0.31	13.5	0.30	18	0.30
80kW / 100kVA	80	7.2	0.36	12.5	0.31	18	0.30	24	0.30
120kW / 150kVA	120	10.8	0.36	18.8	0.31	27	0.30	36	0.30
160kW / 200kVA	160	14.4	0.36	25	0.31	36	0.30	48	0.30
200kW / 250kVA	200	18	0.36	31.2	0.31	45	0.30	60	0.30
280kW / 350kVA	280	25.2	0.36	43.7	0.31	63	0.30	84	0.30
400kW / 500kVA	400	36	0.36	62.4	0.31	90	0.30	120	0.30

Source: https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html

125 kVA				15.65	0.31			30	Calculated by interpolation in the above

Appendix A - Calculation sheets - Emission Factors

Emission Factors

2.1 Stationary Energy emissions (non-transport)

2.2 Transport fuel emissions (post-2004)

Fuel combusted	Energy content factor GJ/kL	Emission factor (kg CO2-e/GJ)						Source	Date Checked / Updated
		CO2	CH4	N2O	Scope 1	Scope 2	Scope 3		
Gasoline (other than for use as fuel in an aircraft)	34.20	67.40	0.02	0.20	67.62	0.00	3.60	NGAF- Tables 4 and 45	26/07/2022 SC
Diesel oil	38.60	69.90	0.01	0.50	70.41	0.00	3.60	NGAF- Tables 4 and 45	26/07/2022 SC
Liquefied petroleum gas	26.20	60.20	0.50	0.30	61.00	0.00	3.60	NGAF- Tables 4 and 45	26/07/2022 SC
Diesel oil - Euro iv or higher (Heavy vehicles conforming to Euro design stand	38.60	69.90	0.07	0.40	70.37	0.00	3.60	NGAF- Tables 4 and 45	26/07/2022 SC

2.3 Indirect emissions from electricity

State or Territory		Emission factor (kg CO2-e/kWh)						Source	Date Checked / Updated
		CO2	CH4	N2O	Scope 1	Scope 2	Scope 3		
Victoria		NA	NA	NA	0.00	0.91	0.10	NGAF- Table 46	26/07/2022 SC

Appendix 4 - Emissions from waste disposal to landfill and wastewater treatment

Waste type		Emission factor (t CO2-e/t waste)						Source	Date Checked / Updated
		CO2	CH4	N2O	Scope 1	Scope 2	Scope 3		
Municipal solid waste		NA	NA	NA	NA	NA	1.6	NGAF- Table 49	26/07/2022 SC
Commercial and industrial waste		NA	NA	NA	NA	NA	1.3	NGAF- Table 49	26/07/2022 SC
Construction and demolition waste		NA	NA	NA	NA	NA	0.2	NGAF- Table 49	26/07/2022 SC

Electricity grid emission factor projections

Emission factor	NGAF 2021 (Departme	Australia's emissions projection from (Department of Industry, Science, Energy and Resour, 2021)									Linear interpolation from 2030 to 2050																			
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Victoria's Scope 2 emisssions factors (kg CO2-e/kWh)	0.91	0.68	0.6	0.57	0.58	0.56	0.54	0.5	0.39	0.37	0.35	0.33	0.31	0.30	0.28	0.26	0.24	0.22	0.20	0.19	0.17	0.15	0.13	0.11	0.09	0.07	0.06	0.04	0.02	0
Victoria's Scope 2 and 3 combined emisssions factors (kg CO2-e/kWh)	1.01	0.75	0.66	0.63	0.65	0.63	0.59	0.55	0.44	0.42	0.40	0.38	0.36	0.34	0.32	0.29	0.27	0.25	0.23	0.21	0.19	0.17	0.15	0.13	0.11	0.08	0.06	0.04	0.02	0
Victoria's Scope 3 emisssions factors (kg CO2-e/kWh)	0.10	0.07	0.06	0.06	0.07	0.07	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00

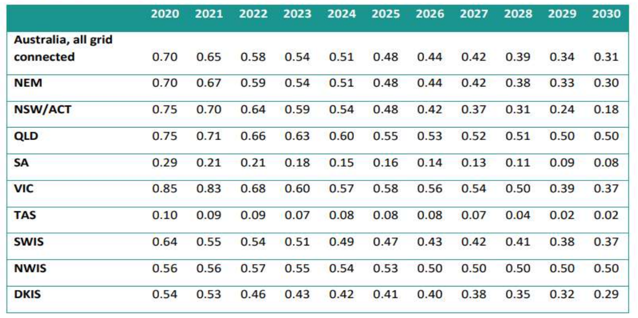
Diesel transport emission factor percentage change scenarios	Scenarios are framed considering CSIRO's Electric vehicle projections 2021																																												
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065
Reference	100%	99%	98%	97%	95%	94%	93%	92%	91%	90%	89%	88%	86%	85%	84%	83%	82%	81%	80%	78%	77%	76%	75%	74%	73%	72%	70%	69%	68%	67%	66%	65%	64%	63%	61%	60%	59%	58%	57%	56%	55%	53%	52%	51%	50%
Low	100%	98%	95%	93%	91%	89%	86%	84%	82%	80%	77%	75%	73%	70%	68%	66%	64%	61%	59%	57%	55%	52%	50%	48%	45%	43%	41%	39%	36%	34%	32%	30%	27%	25%	23%	20%	18%	16%	14%	11%	9%	7%	5%	2%	0%
High	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Sources:
National Greenhouse Account Factors (NGAF) - (Department of Industry, Science, Energy and Resources, 2021)
Australia's emissions projection from (Department of Industry, Science, Energy and Resources, 2021)

Table 37: Indirect Scope 2 and 3 combined emissions factors, tonnes CO_2-e per MWh

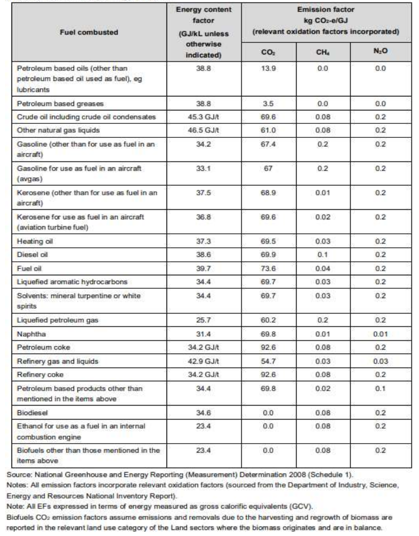
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Australia, all grid connected	0.77	0.72	0.65	0.60	0.56	0.53	0.49	0.47	0.43	0.37	0.34
NEM	0.79	0.75	0.66	0.61	0.57	0.54	0.50	0.47	0.43	0.37	0.34
NSW/ACT	0.82	0.76	0.70	0.64	0.59	0.53	0.46	0.40	0.34	0.27	0.19
QLD	0.86	0.81	0.75	0.73	0.69	0.64	0.61	0.60	0.59	0.58	0.57
SA	0.34	0.26	0.25	0.21	0.18	0.19	0.17	0.16	0.13	0.11	0.10
VIC	0.95	0.92	0.75	0.66	0.63	0.65	0.63	0.59	0.55	0.44	0.42
TAS	0.11	0.10	0.10	0.08	0.08	0.10	0.09	0.08	0.05	0.03	0.02
SWIS	0.69	0.59	0.58	0.55	0.53	0.50	0.46	0.45	0.43	0.40	0.39
NWIS	0.58	0.57	0.58	0.56	0.55	0.54	0.51	0.51	0.51	0.51	0.51
DKIS	0.59	0.59	0.50	0.47	0.46	0.45	0.43	0.41	0.39	0.35	0.32

Table 36: Indirect Scope 2 emissions factors, tonnes CO_2-e per MWh



	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Australia, all grid connected	0.70	0.65	0.58	0.54	0.51	0.48	0.44	0.42	0.39	0.34	0.31
NEM	0.70	0.67	0.59	0.54	0.51	0.48	0.44	0.42	0.38	0.33	0.30
NSW/ACT	0.75	0.70	0.64	0.59	0.54	0.48	0.42	0.37	0.31	0.24	0.18
QLD	0.75	0.71	0.66	0.63	0.60	0.55	0.53	0.52	0.51	0.50	0.50
SA	0.29	0.21	0.21	0.18	0.15	0.16	0.14	0.13	0.11	0.09	0.08
VIC	0.85	0.83	0.68	0.60	0.57	0.58	0.56	0.54	0.50	0.39	0.37
TAS	0.10	0.09	0.09	0.07	0.08	0.08	0.08	0.07	0.04	0.02	0.02
SWIS	0.64	0.55	0.54	0.51	0.49	0.47	0.43	0.42	0.41	0.38	0.37
NWIS	0.56	0.56	0.57	0.55	0.54	0.53	0.50	0.50	0.50	0.50	0.50
DKIS	0.54	0.53	0.46	0.43	0.42	0.41	0.40	0.38	0.35	0.32	0.29

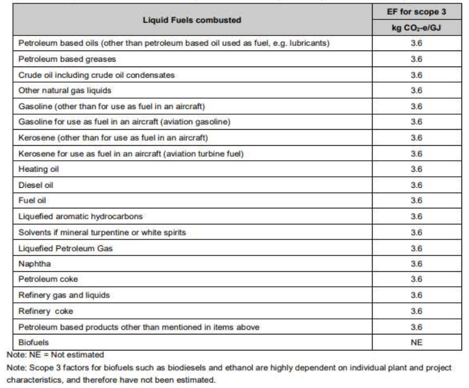
Table 3: Fuel combustion emission factors – liquid fuels including certain petroleum based products for stationary energy purposes



Fuel combusted	Energy content factor (GJ/kL unless otherwise indicated)	Emission factor kg CO_2-e/GJ (relevant oxidation factors incorporated)		
		CO_2	CH_4	N_2O
Petroleum based oils (other than petroleum based oil used as fuel), eg lubricants	38.8	13.9	0.0	0.0
Petroleum based greases	38.8	3.5	0.0	0.0
Crude oil including crude oil condensates	45.3 GJ/t	69.6	0.08	0.2
Other natural gas liquids	46.5 GJ/t	61.0	0.08	0.2
Gasoline (other than for use as fuel in an aircraft)	34.2	67.4	0.2	0.2
Gasoline for use as fuel in an aircraft (avgas)	33.1	67	0.2	0.2
Kerosene (other than for use as fuel in an aircraft)	37.5	68.9	0.01	0.2
Kerosene for use as fuel in an aircraft (aviation turbine fuel)	36.8	69.6	0.02	0.2
Heating oil	37.3	69.5	0.03	0.2
Diesel oil	38.6	69.9	0.1	0.2
Fuel oil	39.7	73.6	0.04	0.2
Liquefied aromatic hydrocarbons	34.4	69.7	0.03	0.2
Solvents: mineral turpentine or white spirits	34.4	69.7	0.03	0.2
Liquefied petroleum gas	25.7	60.2	0.2	0.2
Naphtha	31.4	69.8	0.01	0.01
Petroleum coke	34.2 GJ/t	92.6	0.08	0.2
Refinery gas and liquids	42.9 GJ/t	54.7	0.03	0.03
Refinery coke	34.2 GJ/t	92.6	0.08	0.2
Petroleum based products other than mentioned in the items above	34.4	69.8	0.02	0.1
Biodiesel	34.6	0.0	0.08	0.2
Ethanol for use as a fuel in an internal combustion engine	23.4	0.0	0.08	0.2
Biofuels other than those mentioned in the items above	23.4	0.0	0.08	0.2

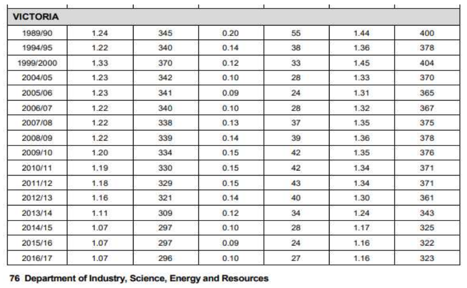
Source: National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Schedule 1).
Notes: All emission factors incorporate relevant oxidation factors (sourced from the Department of Industry, Science, Energy and Resources National Inventory Report).
Note: All EFs expressed in terms of energy measured as gross calorific equivalents (GCV).
Biofuels CO_2 emission factors assume emissions and removals due to the harvesting and regrowth of biomass are reported in the relevant land use category of the Land sectors where the biomass originates and are in balance.

Table 45: Scope 3 emission factors – liquid fuels including certain petroleum based products



Liquid Fuels combusted	EF for scope 3
	kg CO_2-e/GJ
Petroleum based oils (other than petroleum based oil used as fuel, e.g. lubricants)	3.6
Petroleum based greases	3.6
Crude oil including crude oil condensates	3.6
Other natural gas liquids	3.6
Gasoline (other than for use as fuel in an aircraft)	3.6
Gasoline for use as fuel in an aircraft (aviation gasoline)	3.6
Kerosene (other than for use as fuel in an aircraft)	3.6
Kerosene for use as fuel in an aircraft (aviation turbine fuel)	3.6
Heating oil	3.6
Diesel oil	3.6
Fuel oil	3.6
Liquefied aromatic hydrocarbons	3.6
Solvents if mineral turpentine or white spirits	3.6
Liquefied Petroleum Gas	3.6
Naphtha	3.6
Petroleum coke	3.6
Refinery gas and liquids	3.6
Refinery coke	3.6
Petroleum based products other than mentioned in items above	3.6
Biofuels	NE

Note: NE = Not estimated
Note: Scope 3 factors for biofuels such as biodiesels and ethanol are highly dependent on individual plant and project characteristics, and therefore have not been estimated.



VICTORIA						
1989/90	1.24	345	0.20	55	1.44	400
1994/95	1.22	340	0.14	38	1.36	378
1999/2000	1.33	370	0.12	33	1.45	404
2004/05	1.23	342	0.10	28	1.33	370
2005/06	1.23	341	0.09	24	1.31	365
2006/07	1.22	340	0.10	28	1.32	367
2007/08	1.22	338	0.13	37	1.35	375
2008/09	1.22	339	0.14	39	1.36	378
2009/10	1.20	334	0.15	42	1.35	376
2010/11	1.19	330	0.15	42	1.34	371
2011/12	1.18	329	0.15	43	1.34	371
2012/13	1.16	321	0.14	40	1.30	361
2013/14	1.11	309	0.12	34	1.24	343
2014/15	1.07	297	0.10	28	1.17	325
2015/16	1.07	297	0.09	24	1.16	322
2016/17	1.07	296	0.10	27	1.16	323

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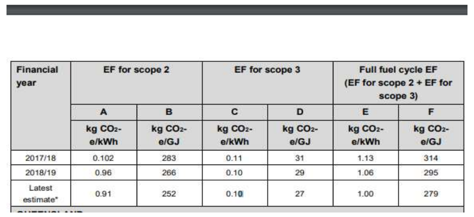
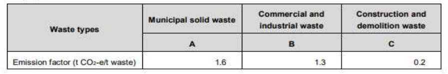


Financial year	EF for scope 2		EF for scope 3		Full fuel cycle EF (EF for scope 2 + EF for scope 3)	
	A	B	C	D	E	F
	kg CO_2-e/kWh	kg CO_2-e/GJ	kg CO_2-e/kWh	kg CO_2-e/GJ	kg CO_2-e/kWh	kg CO_2-e/GJ
2017/18	0.102	283	0.11	31	1.13	314
2018/19	0.96	266	0.10	29	1.06	295
Latest estimate*	0.91	252	0.10	27	1.00	279

Table 49: Waste emission factors for total waste disposed to landfill by broad waste stream category

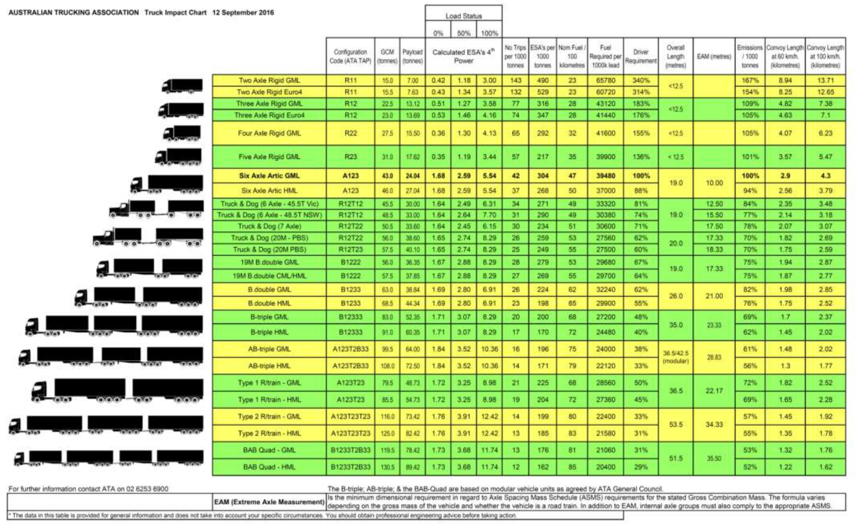


Waste types	Municipal solid waste	Commercial and industrial waste	Construction and demolition waste
	A	B	C
Emission factor (t CO_2-e/t waste)	1.6	1.3	0.2

https://www.truck.net.au/system/files/industry-resources/TAPs%20-%20Truck%20Impact%20Chart%20March%202018.pdf

Table 3: Truck impact chart

The Truck Impact Chart



AUSTRALIAN TRUCKING ASSOCIATION Truck Impact Chart 12 September 2016

	Configuration Code (ATA TAP)	GCM (tonnes)	Payload (tonnes)	Calculated ESA's 4th Power – Load Status 0%	50%	100%	No Trips per 1000 tonnes	ESA's per 1000 tonnes	Nom Fuel / 100 kilometres	Fuel Required per 1000k lead	Driver Requirement	Overall Length (metres)	EAM (metres)	Emissions / 1000 tonnes	Convoy Length at 60 km/h (kilometres)	Convoy Length at 100 km/h (kilometres)
Two Axle Rigid GML	R11	15.0	7.00	0.42	1.18	3.00	143	490	23	65780	340%	<12.5		167%	8.94	13.71
Two Axle Rigid Euro4	R11	15.5	7.63	0.43	1.34	3.57	132	529	23	60720	314%			154%	8.25	12.65
Three Axle Rigid GML	R12	22.5	13.12	0.51	1.27	3.58	77	316	28	43120	183%	<12.5		109%	4.82	7.38
Three Axle Rigid Euro4	R12	23.0	13.69	0.53	1.46	4.16	74	347	28	41440	176%			105%	4.63	7.1
Four Axle Rigid GML	R22	27.5	15.50	0.36	1.30	4.13	65	292	32	41600	155%	<12.5		105%	4.07	6.23
Five Axle Rigid GML	R23	31.0	17.62	0.35	1.19	3.44	57	217	35	39900	136%	< 12.5		101%	3.57	5.47
Six Axle Artic GML	**A123**	**43.0**	**24.04**	**1.68**	**2.59**	**5.54**	**42**	**304**	**47**	**39480**	**100%**	19.0	10.00	**100%**	**2.9**	**4.3**
Six Axle Artic HML	A123	46.0	27.04	1.68	2.59	5.54	37	268	50	37000	88%			94%	2.56	3.79
Truck & Dog (6 Axle - 45.5T Vic)	R12T12	45.5	30.00	1.64	2.49	6.31	34	271	49	33320	81%	19.0	12.50	84%	2.35	3.48
Truck & Dog (6 Axle - 48.5T NSW)	R12T12	48.5	33.00	1.64	2.64	7.70	31	290	49	30380	74%		15.50	77%	2.14	3.18
Truck & Dog (7 Axle)	R12T22	50.5	33.60	1.64	2.45	6.15	30	234	51	30600	71%		17.50	78%	2.07	3.07
Truck & Dog (20M - PBS)	R12T22	56.0	38.60	1.65	2.74	8.29	26	259	53	27560	62%	20.0	17.33	70%	1.82	2.69
Truck & Dog (20M PBS)	R12T23	57.5	40.10	1.65	2.74	8.29	25	249	55	27500	60%		18.33	70%	1.75	2.59
19M B.double GML	B1222	56.0	36.35	1.67	2.88	8.29	28	279	53	29680	67%	19.0	17.33	75%	1.94	2.87
19M B.double CML/HML	B1222	57.5	37.85	1.67	2.88	8.29	27	269	55	29700	64%			75%	1.87	2.77
B.double GML	B1233	63.0	38.84	1.69	2.80	6.91	26	224	62	32240	62%	26.0	21.00	82%	1.98	2.85
B.double HML	B1233	68.5	44.34	1.69	2.80	6.91	23	198	65	29900	55%			76%	1.75	2.52
B-triple GML	B12333	83.0	52.35	1.71	3.07	8.29	20	200	68	27200	48%	35.0	23.33	69%	1.7	2.37
B-triple HML	B12333	91.0	60.35	1.71	3.07	8.29	17	170	72	24480	40%			62%	1.45	2.02
AB-triple GML	A123T2B33	99.5	64.00	1.84	3.52	10.36	16	196	75	24000	38%	36.5/42.5 (modular)	28.83	61%	1.48	2.02
AB-triple HML	A123T2B33	108.0	72.50	1.84	3.52	10.36	14	171	79	22120	33%			56%	1.3	1.77
Type 1 R/train - GML	A123T23	79.5	48.73	1.72	3.25	8.98	21	225	68	28560	50%	36.5	22.17	72%	1.82	2.52
Type 1 R/train - HML	A123T23	85.5	54.73	1.72	3.25	8.98	19	204	72	27360	45%			69%	1.65	2.28
Type 2 R/train - GML	A123T23T23	116.0	73.42	1.76	3.91	12.42	14	199	80	22400	33%	53.5	34.33	57%	1.45	1.92
Type 2 R/train - HML	A123T23T23	125.0	82.42	1.76	3.91	12.42	13	185	83	21580	31%			55%	1.35	1.78
BAB Quad - GML	B1233T2B33	119.5	78.42	1.73	3.68	11.74	13	176	81	21060	31%	51.5	35.50	53%	1.32	1.76
BAB Quad - HML	B1233T2B33	130.5	89.42	1.73	3.68	11.74	12	162	85	20400	29%			52%	1.22	1.62

For further information contact ATA on 02 6253 6900

The B-triple; AB-triple; & the BAB-Quad are based on modular vehicle units as agreed by ATA General Council.

EAM (Extreme Axle Measurement) Is the minimum dimensional requirement in regard to Axle Spacing Mass Schedule (ASMS) requirements for the stated Gross Combination Mass. The formula varies depending on the gross mass of the vehicle and whether the vehicle is a road train. In addition to EAM, internal axle groups must also comply to the appropriate ASMS.

* The data in this table is provided for general information and does not take into account your specific circumstances. You should obtain professional engineering advice before taking action.

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