Responsible Investing

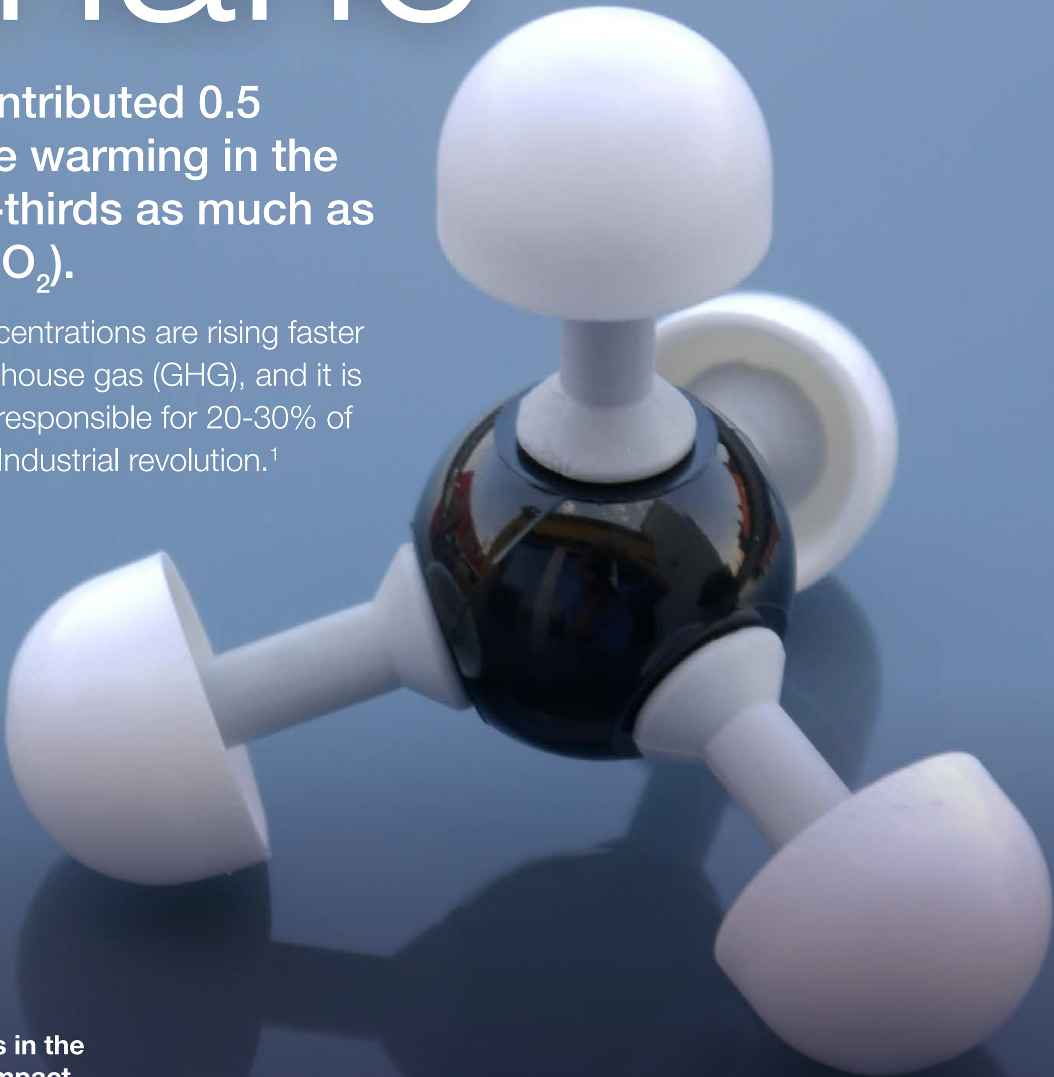
JULY 2025

PLATYPUS
ASSET MANAGEMENT

Methane

Methane (CH_4) contributed 0.5 degrees of climate warming in the 2010s, about two-thirds as much as carbon dioxide (CO_2).

Atmospheric methane concentrations are rising faster than any other major greenhouse gas (GHG), and it is estimated that methane is responsible for 20-30% of climate warming since the Industrial revolution.[1]



Reducing methane emissions in the short term will have a large impact on reducing global temperatures.

Over 100 years, methane has a global warming potential (GWP) of 28, which means that compared to CO_2, methane has 28 times more impact on globval warming than CO_2. Over 20 years, this increases to 84 times, because the atmospheric lifetime of methane is between 7-12 years, highlighting the importance of focusing on reducing methane emissions in order to reach near-term emission targets.

Methane is ~18.9% of total CO_2-e GHG emissions (using 100 years GWP).

In terms of total global methane emissions, about two-thirds result from human activities. The three largest sources are agriculture (46.1%), fuel (32%), and waste (18.3%). Methane emissions can be estimated using top-down and bottom-up approaches, and then compared to total measured atmospheric concentrations.

Coal mines contribute about ~10.5% of global anthropogenic methane emissions.

Methane, trapped within coal seams, is released when coal is mined. For safety, methane is drained prior to mining. However, not all gas is removed and the remainder enters the atmosphere as fugitive emissions.

[1] For all data quoted on the first two pages, please see Bibliography on page 26 for sources.

Methods for estimating methane emissions from open-cut coal mines are likely underestimating methane emissions.

At present, for open-cut mines the regulator requires mine owners to estimate methane using modelling. Empirical measurements point to these methods underestimating actual methane emissions: independent results estimate that fugitive methane emissions are underreported by ~3.6-8x (Borchardt et al., 2025, Vigil et al., 2025).

Improved measurement will have an impact on the Safeguard Mechanism and Australian Carbon Credit Unit (ACCU) demand.

We estimate the ACCU liability of BHP, Whitehaven, New Hope Group and Yancoal. We use independent results to define methane emission bounds and compare liabilities to underlying EBITDA. If fugitive methane was measured differently, this could lead to demand pressure in the ACCU market towards 2030.

Fugitive methane emissions could impact how Australia meets its Paris Agreement commitments.

The government has committed to reduce 2005 emissions by 43% by 2030, which means total emissions of 347Mt by 2030. We estimate that accurate measurement of fugitive methane emissions from open-cut coal mines could increase total Australian emissions by between 3.3% and 11.5% putting pressure on 2030 government emission targets.

Contents

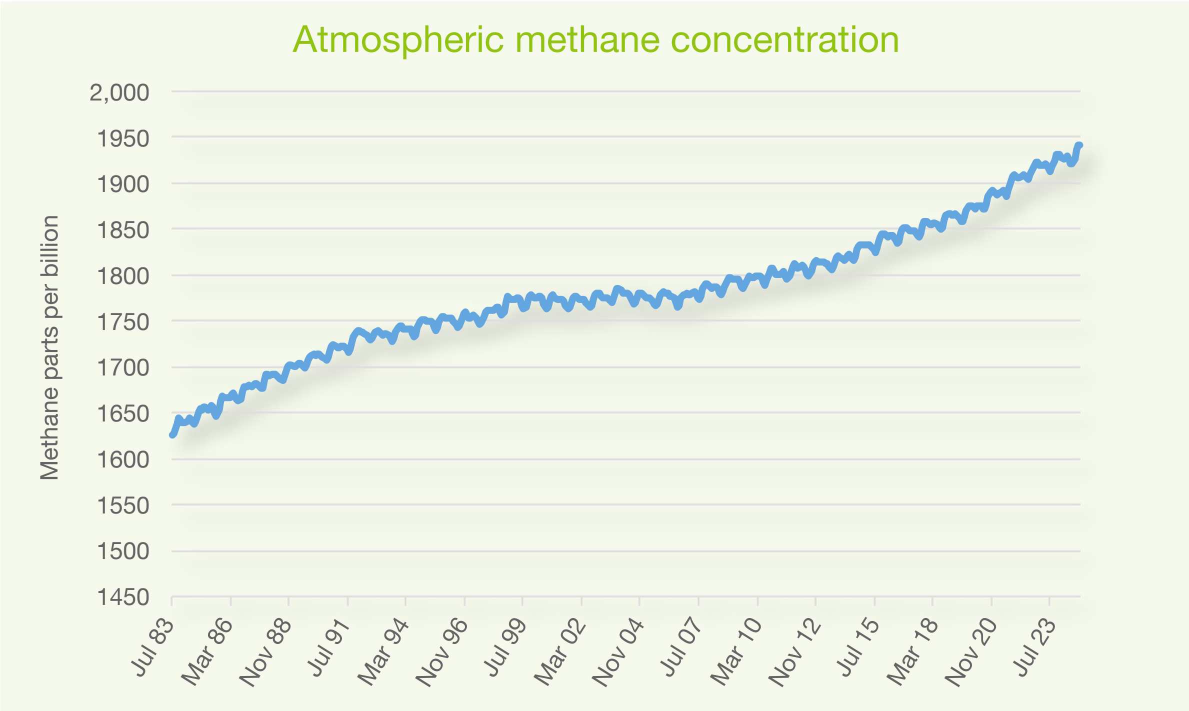
Global emissions & methane

Importance of methane

Methane is the second most abundant greenhouse gas (GHG) after carbon dioxide. In the Sixth Assessment Report, the Intergovernmental Panel on Climate Change (IPCC) estimated that methane has contributed 0.5 degrees of warming in the 2010s, two-thirds as much as carbon dioxide.

Methane concentrations are rising faster in relative terms than any other major GHG (Jackson, 2024), and NASA cite research claiming that methane is responsible for 20-30% of climate warming since the Industrial Revolution.

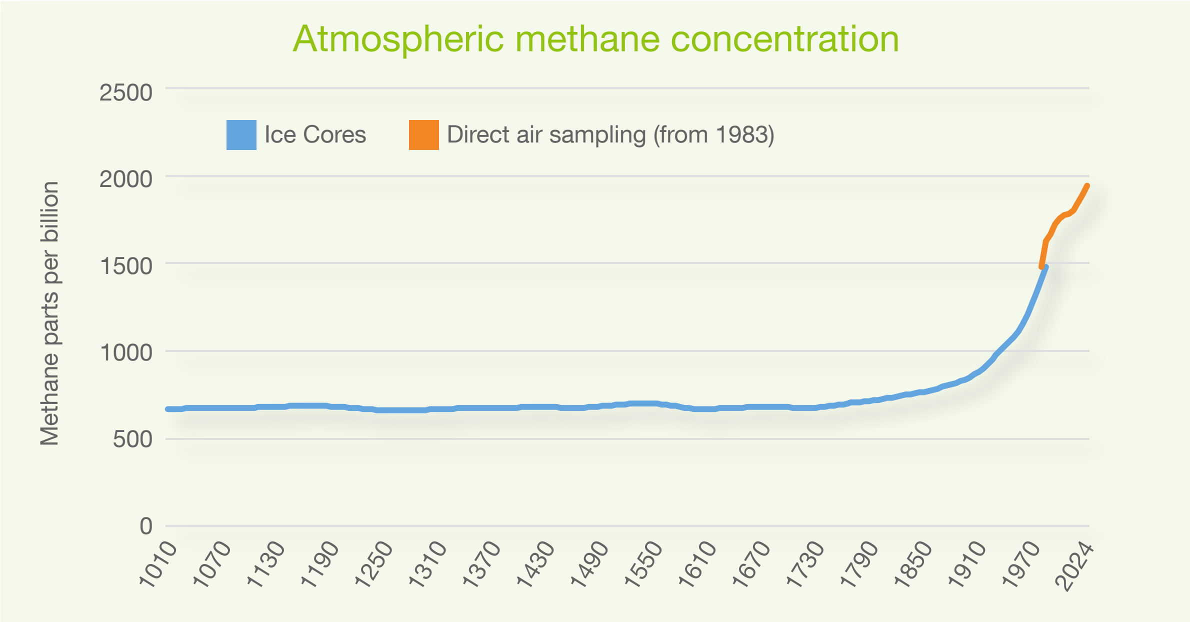
Exhibit 1: Atmospheric methane concentration using direct measurement



Source: NASA, Platypus

Since 1983, atmospheric methane concentration has increased from 1625 parts per billion (ppb) to 1941 ppb (Exhibit 1). For context, using data from ice cores, in the year 1010 concentrations were 667 ppb and did not rise above 1000 until 1930.

Exhibit 2: Atmospheric methane concentration using ice cores and direct measurement



Source: ESS-DIVE, Platypus

Proportion of global emissions attributed to methane

Using the Emissions Database for Global Atmospheric Research (EDGAR) data from the European Commission, total global GHG emissions in 2023 were 52,963Mt. Of this amount, 46% was emitted by three countries (Exhibit 3). In this dataset, Australia contributes 1% to global emissions or about 572Mt.

Exhibit 3: Highest emitting geographies

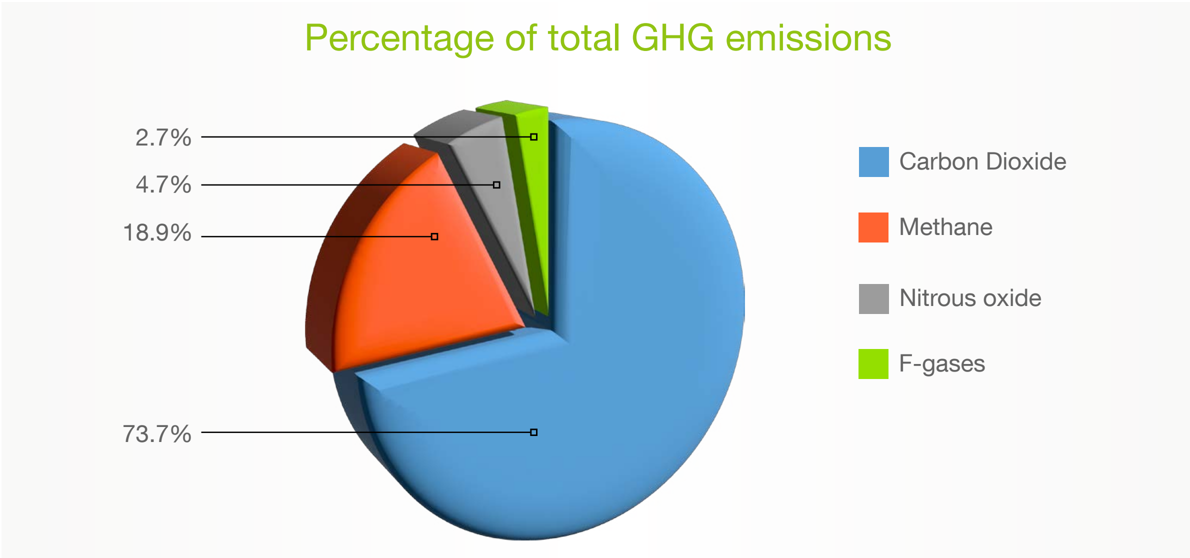
Country	Percentage of global emissions	Million Tonnes
China	28.2%	15,944
United States	10.5%	5,961
India	7.3%	4,134
EU27	5.7%	3,222
Russia	4.7%	2,672
Brazil	2.3%	1,300
Indonesia	2.1%	1,200
Japan	1.8%	1,041

Source: Emissions Database for Global Atmospheric Research (EDGAR), Platypus

The GHG emissions include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorinated greenhouse gases (F-gases). They are aggregated within the Emissions Database for Global Atmospheric Research (EDGAR) team using global warming potential values from the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (called AR5).

Global warming potentials (GWPs) are a way to compare the impact of different gases on the amount of heat a GHG traps in the atmosphere. Different gases have different atmospheric lifetimes and absorption properties and GWPs allow comparison over specific time periods.

Exhibit 4: Percentage of total global emissions of 52,963Mt



Source: *Emissions Database for Global Atmospheric Research (EDGAR), Platypus*

The GWP of carbon dioxide is calibrated to 1 for all time periods. In the AR5, using a 100 year time period, methane has a GWP of 28, meaning one kg of methane is 28 times more impactful to global warming than one kg of carbon dioxide. Nitrous oxide has a GWP of 265 and F-gases have GWPs that range from as low as 4 to as high as 23,500.

Impact of methane over different time periods

Methane has an atmospheric lifetime of between 7-12 years, while carbon dioxide can persist in the atmosphere for centuries. This impacts the GWP over different time periods.

Exhibit 5: GWP of methane and nitrous oxide

	20 Years		100 Years	
IPCC report	AR5	AR6	AR5	AR6
Carbon dioxide	1	1	1	1
Methane	84	81.2	28	27.9
Nitrous oxide	264	273	265	273

Source: IPCC Sixth Assessment Report, Platypus

GWPs are updated in light of the evolving science: IPCC report AR5 was released in 2014 and AR6 in 2023. These numbers are important, because they are used to estimate emissions across multiple sectors, including both private and public institutions. Most analysis uses AR5, including the Australian Government.

For AR5, the GWP of methane is 3 times more potent over 20 years as compared to 100 years. Most emissions calculations use 100 years, however, in the short term this differing GWP highlights the importance of addressing methane emissions when focusing on reducing global temperatures to 2050.

The methane data in Exhibit 4 can be translated to 20 years using the GWP in Exhibit 5. We assume the GWP of fluorinated greenhouse gases (F-gases) remains the same: the composition of different GWPs within F-gases is not easily disaggregated from the EDGAR data, making estimation difficult. Given the size of F-gas emissions compared to carbon dioxide and methane, we estimate this to have a small impact.

Exhibit 6: CO_2-e GHG emissions over 20 and 100 years, compared using relative GWPs of methane and nitrous oxide

	100 years CO_2-e (Mt)	20 years CO_2-e (Mt)
Carbon Dioxide	39,024	39,024
Methane	10,001	30,003
Nitrous oxide	2,487	2,478
F-gases	1,451	1,451
Total	**52,963**	**72,956**

Source: *EDGAR, IPCC Sixth Assessment Report, Platypus*

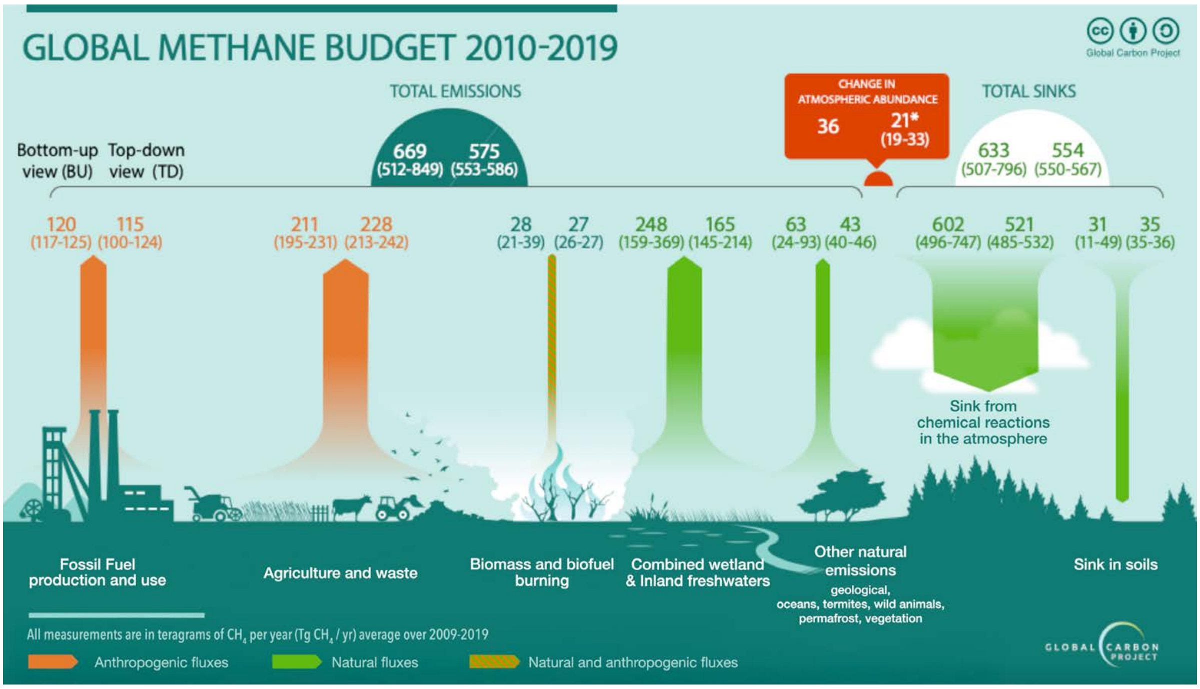
Over 100 years, methane is 18.9% of global CO_2-e emissions, while carbon dioxide is 73.7%. Over 20 years, this becomes 41.1% for methane and 53.5% for carbon dioxide. All else being equal, comparative near term impact is higher for methane emission reduction than for carbon dioxide. In our view, reaching 2050 targets requires an increased focus on methane.

Sources of methane

Methane comes from both natural sources and human activities. Jackson et al. (2024) estimate that approximately two-thirds of current global methane emissions are the result of human activities.

Methane emissions can be estimated using both a top-down and a bottom-up approach. These calculations can then be cross-checked using measured atmospheric concentrations.

Exhibit 7: Global methane budget 2020 in Mt



Source: *Global Carbon Project*

Exhibit 7 shows the methane lifecycle for both natural and anthropogenic sources and natural sinks from both a top-down and bottom-up perspective. For top-down estimates of methane, inversion models are used, which work backwards from atmospheric concentrations to numerically estimate the methane source. Saunois et al. (2024) detail a number of these methods and some of these are employed by Jackson et al. (2024).

Exhibit 8: Contribution of different types of methane to global emissions using a top-down approach

Sources	2020 average (Mt)	[min-max]
Wetlands	175	[151-229]
Other natural sources	44	[40-47]
Agriculture and waste (anthropogenic)	245	[232-259]
Fossil fuels (anthropogenic)	122	[101-133]
Biomass and biofuel burning (anthropogenic)	26	[22-27]
Total sources	**608**	**[581-627]**
Sinks		
Chemical loss in the atmosphere	538	[503-554]
Soil uptake	36	[35-36]
Total sinks	**575**	**[566-589]**
Imbalance		
Sources-sinks (top-down estimate)	32	[15-38]
Measured atmospheric growth	41.8	[40.7-42.9]

Source: *Jackson et al. (2024)*

In Exhibit 8, ‘Other natural sources’ include termites, oceanic sources, and geological sources. Interestingly, from a bottom up perspective, termites are ~3% of global methane emissions, resulting from the way they digest wood and plant material. The last two rows show the difference between the top-down calculation and the measured growth in atmospheric methane. The three anthropogenic sources sum to 393Mt, which when multiplied by 28, equals 11Gt of CO_2-e emissions. The EDGAR data for 2020 has CO_2-e methane emissions at 9.49Gt, which is within the [min-max] bounds.

For coal mining, using bottom-up methods, methane emissions for 2020 were calculated as 41Mt [38-43], or ~10.5% of global methane emissions. This is relevant for Australian investors because there are a number of coal mining assets within the Safeguard Mechanism, a climate policy introduced in Australia to limit emissions from large industrial facilities that emit more than 100,000t of CO_2-e per annum.

Using EDGAR data, fuel exploitation, defined as the production, transformation and refining of fuels, contribute ~32% of methane emissions (Exhibit 9). Taken together, these two datasets imply that methane emissions from coal are approximately one-third of all fuel exploitation methane emissions. Fugitive emissions from oil and gas make up the majority of the remainder.

Exhibit 9: Contribution of different types of methane to global emissions

	Global % using 100 years GWP
Agriculture	46.1%
Fuel Exploitation	32.0%
Waste	18.3%
Buildings	2.8%
Transport	0.3%
Industrial Combustion	0.2%
Power Industry	0.2%
Industrial Processes	0.1%

Source: *EDGAR, Platypus*

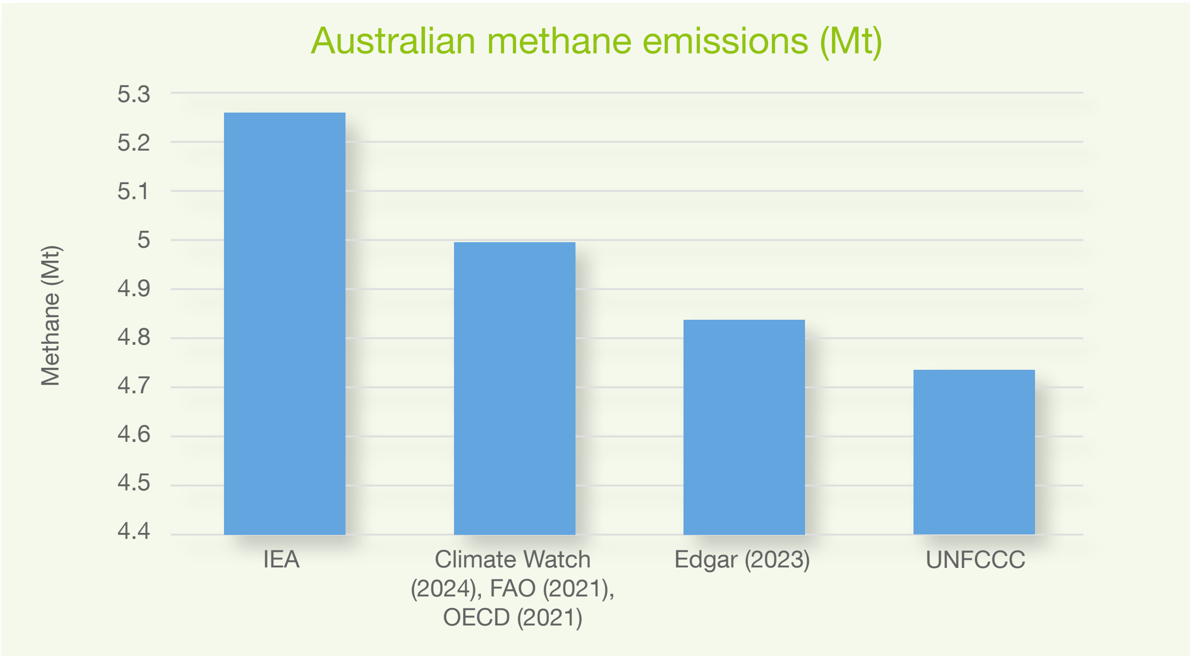
Australian methane emissions

The Department of Climate Change, Energy, the Environment and Water (DCCEEW) publish Australia's National Greenhouse Accounts. For 2023, total emissions for Australia using the United Nations Framework Convention on Climate Change (UNFCCC) framework were calculated as 453.4Mt. Of this amount, 132.8Mt (29.3%) resulted from methane emissions. Under the UNFCCC, methane is 28 times more potent than CO_2, which means 4.7Mt of methane was emitted.

We use a different source to help build our understanding. The IEA estimate that in Australia, 45% of methane emissions come from agriculture, 41% from energy (oil, natural gas, and coal), 11% from waste, and the remainder from other sources.

Specifically, the IEA estimates that in 2024, Australia emitted 5.26Mt of methane. This was split into energy (2.146Mt), agriculture (2.38Mt), waste (0.588Mt), and other sources (0.144Mt).

Exhibit 10: Methane emissions in Australia. Multiply by 28 to get CO_2-e.



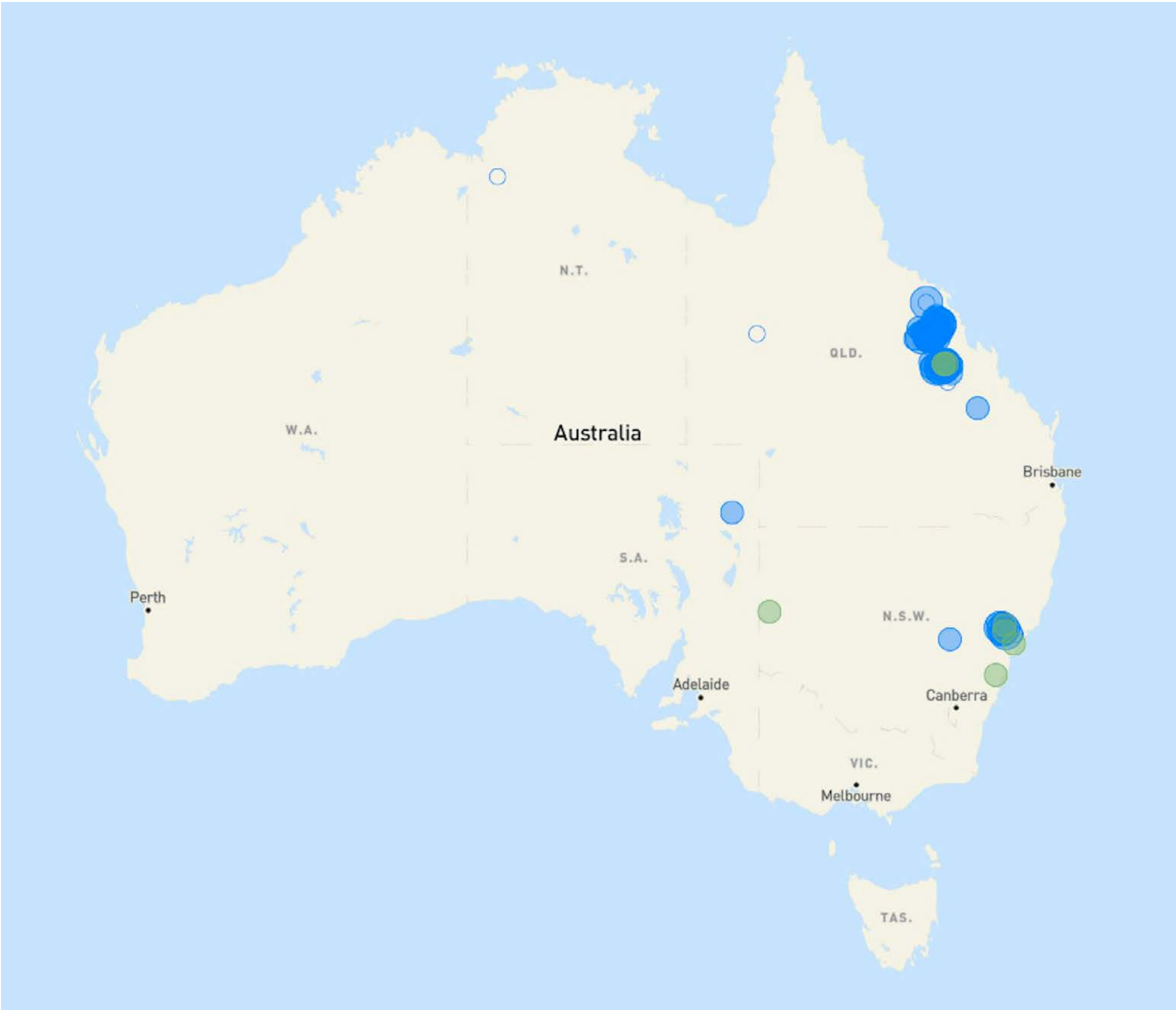
Source: IEA, DCCEEW, Platypus

Of energy, 368kt came from oil and gas, 867kt from metallurgical coal (used in the steel making process) and 785kt from thermal coal (used to produce electricity). These can be compared to other estimates, all of which point to underestimation of Australia's methane emissions.

If the IEA estimates are correct, Australia's could be underreporting total CO_2-e emissions by ~3%. This has implications for meeting the 2030 target of 43% CO_2-e below 2005 levels.

Satellites can track methane hotspots in real time. CSIRO have published data from Kayrros showing methane hotspots in Australia. These are generally concentrated around mining activity.

Exhibit 11: Methane hotspots in Australia



Source: CSIRO, Kayrros

Coal and methane

Coal is found in seams, which are layers of coal embedded in rock underground or near the surface. Coal seams are formed through the decay and subsequent transformation of plant material. Called coalification, a by-product of this process are various gases, one of which is methane. The gases become trapped within the coal seams, and are held in place by the pressure of the groundwater within the coal seam. Specifically, due to pores and fractures within its structure, coal has a large internal surface area, meaning the amount of gas stored within a coal seam can be up to seven times larger than a conventional gas reservoir of equal rock volume. When coal is mined, some of these gases are released into the atmosphere.

With respect to the Safeguard Mechanism (SGM), the emission measurement and subsequent reduction requirements relate to emissions from the site only. For coal mines, fugitive emissions from methane released when the coal is mined are counted under the SGM, but emissions from burning the coal offsite are not. These emissions are the responsibility of the company that is using the coal to either generate electricity or as part of a steel making process.

Safety

For coal mining, gas management is a safety requirement. For methane, inhaling high concentrations is a health risk. Methane displaces oxygen, causing asphyxiation, which in severe cases leads to loss of consciousness and death. At standard temperatures and pressure, methane is colourless and odourless, making it hard to detect. Traditionally, canaries were used by underground miners as a warning system: when a canary stopped singing or started shaking their cages, this signalled the presence of gas. Canaries were used up until as late as 1996, when the British government introduced legislation requiring the use electronic detectors.

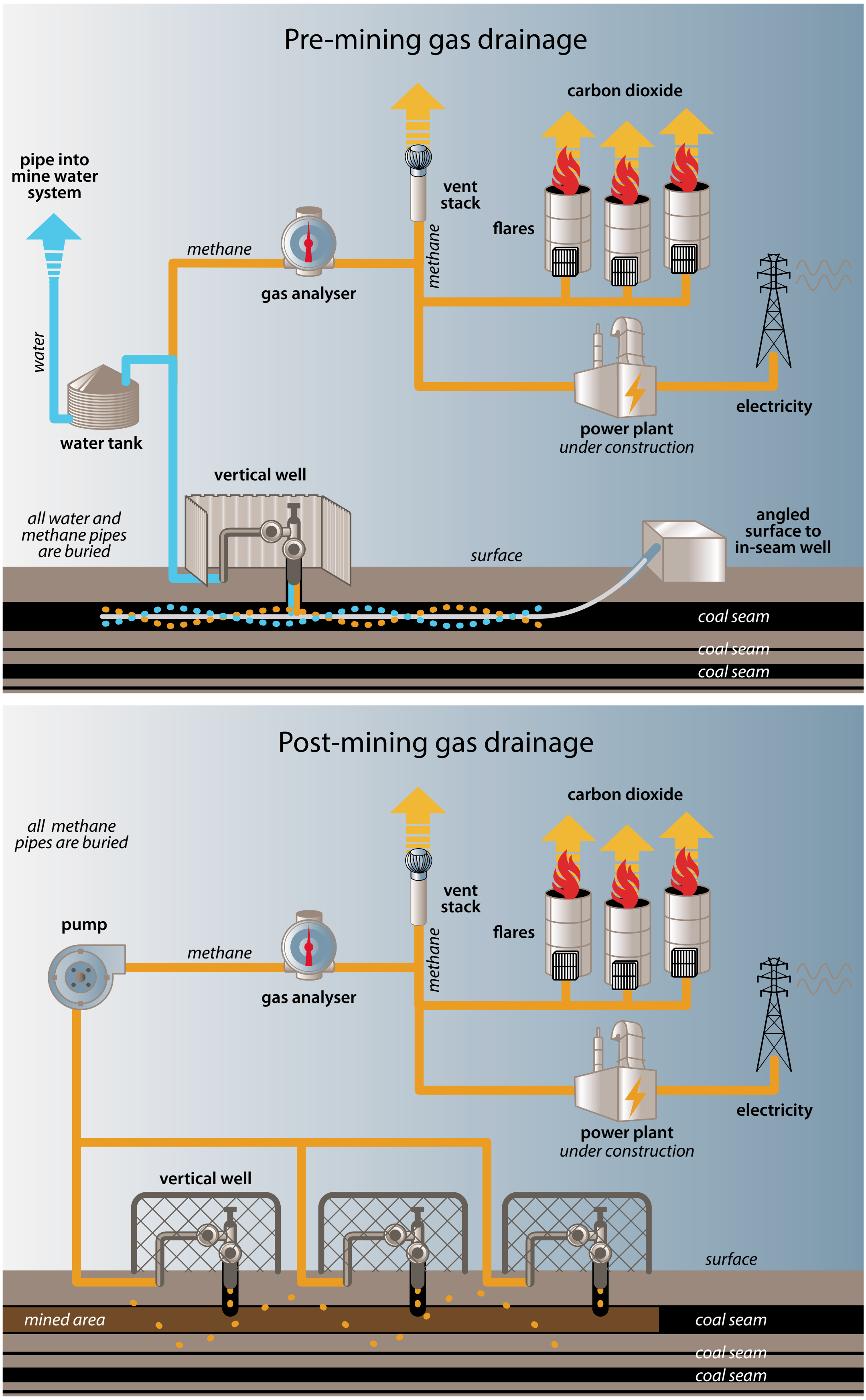
Specifically for underground mines, if methane concentration reaches 2.5% or higher, mine workers are required to be evacuated. At methane concentrations of between 5-15%, equivalent to 50,000 to 150,000 parts per million (ppm), there is a risk of combustion.

Gas drainage

In order to remove methane (and other toxic gases) from coal seams, mines are drained. This involves two stages: pre and post drainage.

> ***Pre-drainage:*** Horizontal holes are drilled into the coal seam, and gas flows under natural pressure into a collection system. While it is possible to use this gas to generate electricity, in most cases the gas is flared, releasing CO_2. Using GWPs detailed in Exhibit 5, for methane this is 84 times less harmful than CO_2 over 20 years or 28 times less harmful over 100 years.
>
> ***Post-drainage:*** vertical and horizontal holes are drilled into the mined area, and the gas is removed under suction.

Exhibit 12: Pre- and post-drainage



Source: Glencore

Measuring methane

The Clean Energy Regulator has published a guide for estimating emissions and energy from coal mining. Whether pre- or post-drainage, drained gas may be flared, captured for on-site use or off-site transfer. This reduces the emission profile of the coal mine, which can assist in the site meeting its emissions baseline number[2] under the Safeguard mechanism and qualify for Australian Carbon Credit Unit (ACCU) generation.

Under the National Greenhouse and Energy Reporting Scheme, the measurement determination provides the methods and criteria for calculating GHG emissions from fugitive methane. These are relevant for understanding SGM liabilities of coal mines.

Exhibit 13: Summary of different methods to measure methane

Method	Approach	Description
Method 1	State-based emission factors	Run-of-mine coal (total unprocessed mined material) multiplied by emission factor
Method 2	Site-specific emission factors	Requires development of a geological model of the coal reserve and a gas assignment model
Method 3	Site-specific emission factors	Additionally to Method 2, requires appropriate standards for gas sampling
Method 4	Direct emissions monitoring	Measurement at source

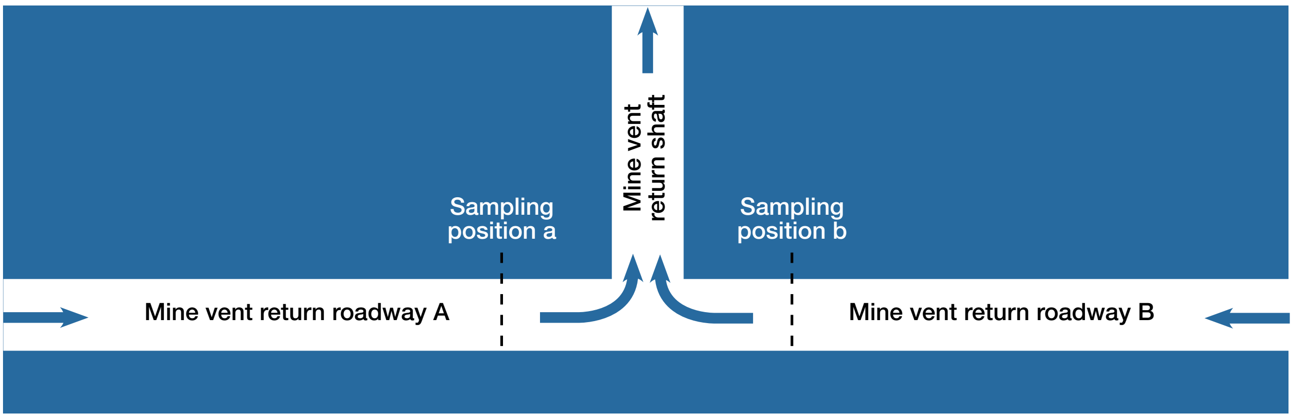
Source: *Department of Climate Change, Energy, the Environment and Water*

The accuracy of the method increases as the number increases from one to four.

Underground coal mines

For underground coal mines, methane emissions are monitored directly. Called Method 4 by the Clean Energy Regulator, this direct emission monitoring process requires detection at source and there are specific requirements for sampling positions, flow rate sampling, gas concentration, and the performance characteristics of the equipment. Method 4 is the most accurate because it measures the methane at source.

Exhibit 14: Example sampling positions for Method 4 methane, carbon dioxide, and nitrous oxide

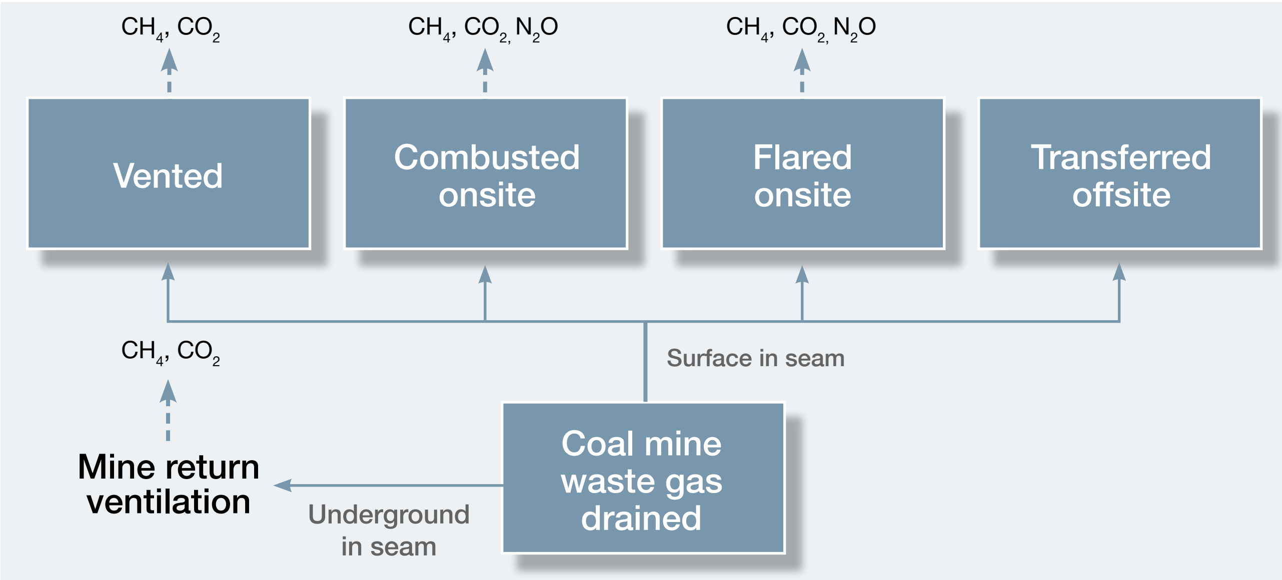


Source: *Clean Energy Regulator*

[2] Reported emissions need to be less than the baseline to avoid an ACCU liability.

A schematic for gas drainage for underground coal mines is shown in Exhibit 15. Surface in seam refers to wells that are drilled into the coal seam from the surface, with gas drainage occurring directly to the surface. Underground in seam refers to wells drilled into the coal seam from the underground roadways, with the gas drained into the underground area. This gas is then vented through the current mine ventilation. Gas content is measured at each point, providing an accurate measure of emissions.

Exhibit 15: Example underground coal mine gas drainage emission sources

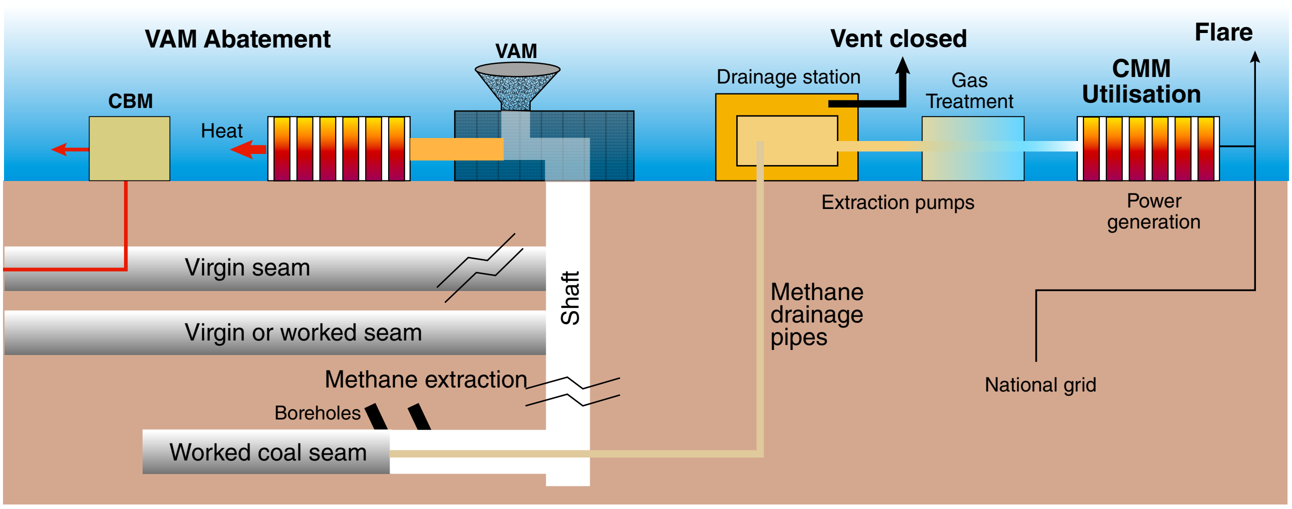


Source: *Clean Energy Regulator, Platypus*

Ventilation Air Methane (VAM)

Exhibit 16 shows the various pathways for extracting underground methane. In this example, methane is emitted from gas drained before the seam is mined (labelled CBM, or Coalbed Methane), from worked areas of the mine (labelled CMM, or Coal Mine Methane) and from mine ventilation air (labelled VAM, or Ventilation Air Methane). Typical methane concentrations for VAM are 0.1-1%, for CBM are 60-95%, and for CMM 30-95% (Su et al, 2005). To generate power, methane concentrations need to high enough to generate sufficient energy (> 30%).

Exhibit 16: Methane extraction from underground coal mines. CBM refers to Coalbed Methane, CMM refers to Coal Mine Methane, and VAM to Ventilation Air Methane.



Source: *UNECE*

Given the low concentrations, VAM abatement is difficult. United Nations Economic Commission for Europe (UNECE) estimates that around 70% of global methane emissions from underground coal is due to VAM. For Australian coal mines, this number is around 60%. For context, typical ventilation shafts can emit 1 million cubic meters per hour. If the methane concentration in the emitted gas is 0.8%, this corresponds to 50,000 metric tonnes of methane, or 1.4Mt CO_2-e per year from a single source. Domestically, VAM emissions account for about 15% of total Australian methane emissions.

Removing methane from ventilation air can achieved via Regenerative Thermal Oxidation (RTO). Prior to applying this technology to VAM in the 1990s, it had been used since the 1970s across the chemical, petrochemical, and pharmaceutical industries.

Technology RTO technology works by moving the ventilation air over a bed of ceramic media, typically pre-heated to 850-900°C, which is the temperature at which methane converts to CO_2 and water. Generally, a methane concentration of between 0.2% and 1% is required for the RTO technology to be effective. Note that the average life of a mine ventilation shaft is 5-15 years.

Costs According to the UNECE, capex for a VAM processing plant of 0.5 million cubic metres per hour is between USD $12-16 million and is expected to last about 20 years. VAM opex is USD $9 per tonne of CO_2-e when measured over a 100-year lifetime.

VAM installations are generally only economical when there is a carbon price penalty for fugitive emissions – safety requirements have already been achieved for the mine to be operational.

Safety The VAM installation is operating at a temperature at which low concentrations of methane will ignite. At first glance, this is particularly risky for mine sites where there is a risk of fugitive methane emissions. However, given the long history of using RTO technology, the UNECE argue that experienced RTO suppliers are well equipped to handle the risks of mine site installation.

CSIRO is developing technology that can remove methane at concentrations of between 0.15-0.4%, operating at a temperature of between 450-600°C. This reduces costs and improves safety risks.

Open-cut coal mines

Historically, measuring methane from open-cut coal mines within the Safeguard Mechanism has been performed using Method 1. The calculation is straightforward: methane emissions equal the emissions factor multiplied by the total amount of material extracted. Using an emission factor, while a necessary first step, does not take account of local specifics of resource geology. For open-cut mines, direct emissions are primarily from methane (Vigil et al., 2025), making accurate measurement important for abatement strategies.

From July 2025, the Clean Energy Regulator is phasing out Method 1 for open-cut coal mines.

Exhibit 17: CO_2-e emission factors for Method 1 for each state

State	Emission factor (tonnes CO_2-e/tonne raw coal)
NSW	0.061
Queensland	0.023
Tasmania	0.019
Victoria	0.0003
South Australia	0.0003
Western Australia	0.023

***Source:** National Greenhouse and Energy Reporting (Measurement) Determination*

Within the Safeguard Mechanism, facilities have a baseline, which is the maximum allowable level for direct emissions. Standard baselines are calculated by multiplying production quantities, emissions intensity values, and decline rates (4.9% per annum until 2030).

Independent estimates

Method 1 comes from broad averages

The data in Exhibit 17 comes from the United Nations Framework Convention on Climate Change (UNFCCC), which derive their numbers from various sources, including the Intergovernmental Panel on Climate Change (IPCC).

As techniques are developed, there is scope for these to become more accurate. Moving to Method 2 with the Safeguard Mechanism will have a positive effect on the accuracy of the emissions factor detailed in Exhibit 14.

There are 51 open-cut coal mines under the Safeguard Mechanism, 22 of which use Method 1 for fugitive methane emissions (Vigil et al., 2025). Method 2 has two primary steps (Climate Transition Action Plan, BHP, 2024):

1. Core samples and the geological characteristics of the site are analysed to develop a model that accounts for the distribution and composition of gas content at the mine.
2. On an annual basis, at the mine the location and quantity of the coal extracted as well as its gas content is compared against the model from the first step.

Given Method 1 focuses on broad averages, using Method 2 can either increase or reduce fugitive methane emission estimates.

Underestimation risk

Two scientific results suggest that Method 1 and Method 2 underestimate fugitive methane emissions.

Using results from reservoir models, Vigil et al. (2025) simulated methane emissions using initial gas volumes, less the volumes emitted from the mine face, gas produced from wells, and gas prevented from migrating to the face from deeper areas of the coal seam. The authors estimate that fugitive methane emissions under the Safeguard Mechanism are underestimated by ~3.6-4.2 times. These are computer simulations and do not rely on atmospheric measurement.

A second investigation by Borchardt et al. (2025) used estimations from two aircraft based platforms. The authors estimated emission rates ~3-8x higher than reported by the mine. Atmospheric emissions have uncertainties and the analysis does its best to account for these. For example, the approach relies on data acquired downwind of the mine, as the mean wind speed and direction are hard to define within the open pit. The authors took measurements on two different days to verify their results. At present, some open-cut mine owners have disputed atmospheric results as inaccurate, primarily because they are point in time, rather than flow based.

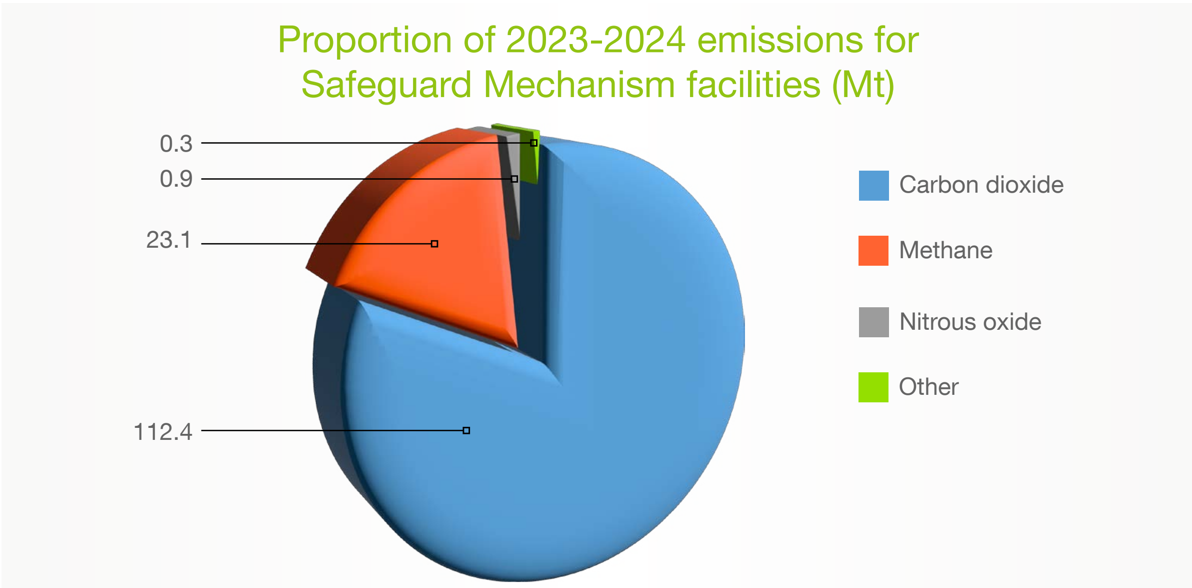
However, in our view, because the numerical modelling and the aircraft based results provide similar bounds to methane underestimation, and the two approaches are independent, we remain cautious of arguments defending the accuracy of Method 2.

Safeguard Mechanism

The Safeguard Mechanism is a climate policy introduced in Australia to limit emissions from large industrial facilities that emit more than 100,000t of CO_2-e per annum. While there are idiosyncrasies within the policy, generally each facility has to reduce emissions from a baseline number by 4.9% per annum. If this is not achieved, the owner of the facility has to purchase Australian Carbon Credit Units (ACCUs) to offset the carbon emissions not reduced by that amount. These are then submitted to the Clean Energy Regulator and subsequently cancelled.

For 2023-2024, the Clean Energy Regulator has published the CO_2-e for carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and other gases for Safeguard Mechanism (SGM) facilities.

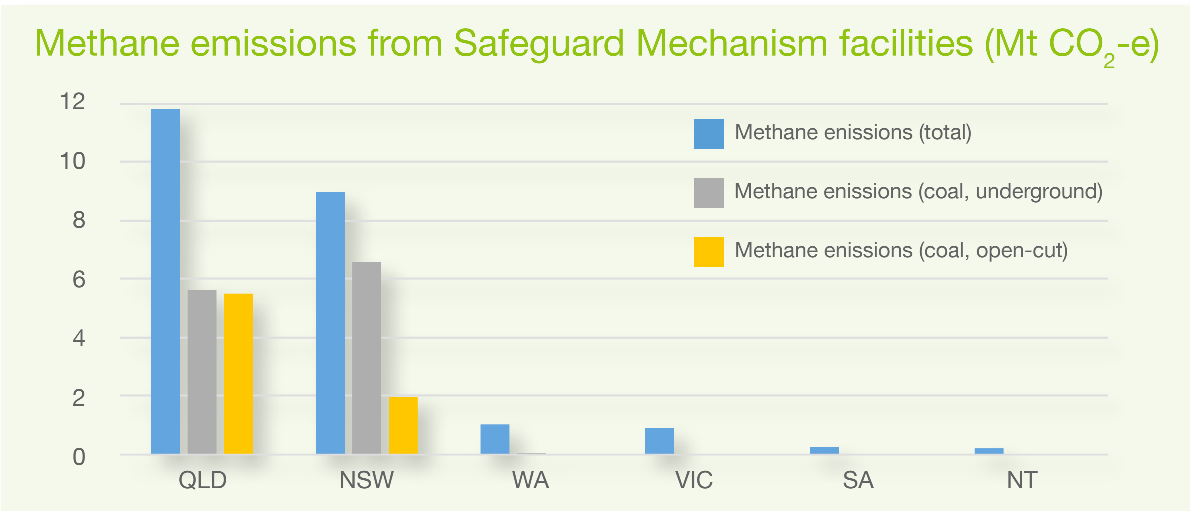
Exhibit 18: Sources of emissions for Safeguard Mechanism facilities (CO_2-e)



Source: *Platypus, CER*

Methane accounts for 16.9% of total emissions while carbon dioxide accounts for 82%. Total methane emissions are 23.09Mt CO_2-e within the SGM. Of that, 19.6Mt CO_2-e is from coal mining.

Exhibit 19: Australian methane emissions, estimated from different sources



Source: Platypus, CER

Methane emissions from coal are concentrated in QLD and NSW, with QLD more evenly split between open-cut and underground than NSW. These regions broadly correspond to the hotspots shown in Exhibit 11.

We can use these numbers to make some high level observations:

- Methane emissions from open-cut mines in the Safeguard Mechanism are 7.43Mt CO_2-e,
- If Method 2 underestimates methane emissions between 3-8 times, it would imply that these emissions are between 22.3Mt and 59.4Mt,
- The total 136.7Mt of covered emissions within the SGM would then be between 151.6Mt and 188.7Mt,
- This would increase Australian emissions (using 2023 numbers, calculated using UNFCCC) of 453.44Mt to between 468.3Mt and 505.47Mt, an increase of between 3.3% and 11.5%.

These estimates highlight the importance of accurately measuring open-cut coal mine fugitive methane emissions to Australia's nationally determined contribution under the Paris Agreement. The lower bound of these estimates is in line with the IEA, detailed on page 9.

Companies

We calculate the range of ACCU liability outcomes for four listed companies if Method 2 underestimates methane emissions from open-cut mines by 3-8 times. To be clear: we are not suggesting that any company is underestimating methane emissions deliberately. We expect companies to follow the CER methods required under the Safeguard Mechanism to calculate fugitive methane emissions from open-cut mines.

We are interested in the range of outcomes that could eventuate for companies if Method 2 is redefined. We do not see this as low risk, especially in light of independent evidence that Method 2 underestimates fugitive methane emissions.

Under the Safeguard Mechanism, there is a price on carbon which enables this risk to be quantified. We focus on the next five years to 2030, and use a capped ACCU price that has been established in the legislation to estimate maximum liability. We emphasise that this is not a prediction of the ACCU price.

Exhibit 20: ACCU price used to stress test liability for different methane emission possibilities. We have used a maximum to quantify worst case cost scenarios.

	FY25	FY26	FY27	FY28	FY29	FY30
ACCU price (indexed at inflation[3] plus 2% after FY26)	$ 35.0	$ 45.0	$ 78.4	$ 81.9	$ 85.2	$ 88.6

Source: Platypus

For the estimates, we weight liability according to mine ownership and vary methane estimates only for open-cut mines.

Exhibit 21: Open-cut coal mine example in the Hunter Valley, NSW.

Source: Image used under license from Shutterstock.com

[3] Measured using CPI.

BHP BHP has full or part ownership of six coal mines, five in QLD and one in NSW. The QLD mines are owned by BHP Mitsubishi Alliance, a 50:50 joint venture between BHP and Mitsubishi Development, itself a wholly owned subsidiary of Mitsubishi Corporation.

The QLD mines are located throughout the Bowen Basin, and all produce metallurgical coal while the NSW mine is in the Hunter Valley and produces thermal coal. The QLD mines produced 44.6Mt of coal in 2024, while the NSW mine produced 15.4Mt. BHP uses Method 2 to calculate fugitive methane emissions.

Exhibit 22: BHP coal mines

Name	BHP ownership	Location	Type
Broadmeadow	50%	Bowen Basin, QLD	Underground
Caval Ridge	50%	Bowen Basin, QLD	Open-cut
Goonyella Riverside	50%	Bowen Basin, QLD	Open-cut
Mount Arthur	100%	Hunter Valley, NSW	Open-cut
Peak Downs	50%	Bowen Basin, QLD	Open-cut
Saraji	50%	Bowen Basin, QLD	Open-cut

Source: *Platypus, BHP*

We assume 1% per annum production growth to 2030 (Platypus internal estimates) and an emissions reduction of 4.9% per annum as required by the Safeguard Mechanism (SGM). Within the SGM, Goonyella Riverside and Broadmeadow are reported as one entity. We have ignored the Norwich Park mine, closed in 2012, given it only emits 1,551 tonnes of methane.

Exhibit 23: BHP Safeguard Mechanism reported data for 2023-2024. Emissions are in tonnes of CO_2-e

Name	Baseline emissions	Covered emissions	ACCUs surrendered	CO_2	NH_4	N_2O	GHG Other
Caval Ridge	254,032	324,232	70,200	319,134	4,174	910	14
Goonyella Broad-meadow	1,015,171	1,257,022	241,851	498,368	757,040	1,437	177
Mount Arthur	581,285	594,767	13,482	553,414	39,762	1,584	7
Peak Downs	371,336	434,812	63,476	418,160	15,450	1,192	10
Saraji	311,441	353,611	42,170	324,806	27,833	932	40

Source: *Platypus, CER*

The SGM data separates emissions into carbon dioxide, methane, nitrous oxide and other GHGs. We can estimate the ACCU liability given the risk of underestimating methane from open-cut coal mines. In BHP's 2024 ESG Standards Databook, the company mentioned that methane emissions from Goonyella Riverside, including Broadmeadow, were elevated due to open-cut mining. For this reason, we include all of the methane emissions from Goonyella Broadmeadow in our estimates of upside exposure to methane.

We use the lower and upper bounds of the range from Vigil et al. (2025) and Borchardt et al. (2025). Note we are focused on cost to the company and so are calculating an amount above which we think it unlikely BHP will have any liability. We do not take into account any operational decarbonisation that BHP could undertake with methane abatement from its open-cut coal mines.

Exhibit 24: BHP ACCU liability given methane measurement

Year	Liability under Method 2 ($m)	3x increase in methane ($m)	8x increase in methane ($m)	ACCUs (m) required (3x)	ACCUs (m) required (8x)
2025	7.78	15.87	33.31	0.45	0.95
2026	13.57	21.50	41.32	0.48	0.92
2027	29.68	43.62	78.49	0.56	1.00
2028	37.15	51.87	88.67	0.63	1.08
2029	44.84	60.30	98.95	0.71	1.16
2030	52.91	69.15	109.75	0.78	1.24

Source: *Platypus, CER*

While the ACCU liability has more than doubled under the 8 times scenario, relative to revenues, this amount is immaterial. However, all else being equal, this will add demand pressure to the ACCU market.

Yancoal (YAL) Yancoal has five coal mines relevant to the Safeguard Mechanism, four of which are open-cut.

Exhibit 25: YAL coal mining assets

Name	YAL ownership	Location	Type
Ashton	100%	Hunter Valley, NSW	Underground
Moolarben	100%	Mudgee, NSW	Open-cut and underground
Premier	100%	Collie, WA	Open-cut
Warkworth	84.47%	Hunter Valley, NSW	Open-cut
Yarrabee	100%	Bowen Basin, QLD	Open-cut

Source: *Platypus, CER*

In terms of total emissions, 92.8% of YAL's Scope 1 emissions are from these mines. Yancoal had a liability within the SGM of 420,842t, which is the sum of ACCUs surrendered in Exhibit 27. Yancoal do not disclose the price they paid for these ACCUs, but at $40, this amounts to $16.8 million, the sum of ACCUs surrendered in Exhibit 27. For our modelling, we assume that Yancoal's ACCU liability is proportional to is ownership.

Exhibit 26: YAL Safeguard Mechanism reported data for 2023-2024. Emissions are in tonnes of CO_2-e.

Name	Baseline emissions	Covered emissions	ACCUs surrendered	CO_2	NH_4	N_2O	GHG Other
Ashton	158,653	350,750	192,097	9,420	341,315	11	4
Moolar-ben	238,272	233,663	-	212,128	21,008	523	4
Premier	100,000	110,291	10,291	109,820	156	312	3
Wark-worth	795,576	966,843	171,267	353,927	611,940	967	9
Yarra-bee	136,622	183,809	47,187	113,339	70,142	328	-

Source: *Platypus, YAL*

Exhibit 27: WHC ACCU liability given methane measurement

Year	Liability under Method 2 ($m)	3x increase in methane ($m)	8x increase in methane ($m)	ACCUs (m) required (3x)	ACCUs (m) required (8x)
2025	15.77	71.85	165.61	1.8	4.1
2026	20.62	84.54	191.08	1.9	4.2
2027	41.13	153.58	341.00	2.0	4.4
2028	48.29	166.98	364.79	2.0	4.5
2029	55.60	180.27	388.05	2.1	4.6
2030	63.28	194.23	412.48	2.2	4.7

Source: *Platypus, CER*

Yancoal's operating EBITDA for FY2024 was $2.6 billion, so at 8 times increase in methane, ACCU liability becomes 6.3% of operating EBITDA.

Whitehaven Coal (WHC)

Whitehaven's total revenue is split: 64% from metallurgical coal and 36% from thermal coal. In the first half of FY2025, run-of-mine coal production was 19.4Mt, with 9.4Mt from NSW and the remainder from QLD. Underground operations produced 3Mt, and the rest came from open-cut mines.

Whitehaven has eight coal mines that produce coal. Of these, four are covered by the Safeguard Mechanism.

Exhibit 28: WHC coal mines

Name	WHC ownership	Location	Type
Blackwater	70%	Bowen Basin, QLD	Open-cut
Daunia	100%	Bowen Basin, QLD	Open-cut
Maules Creek	75%	Narrabri, NSW	Open-cut
Narrabri	77.5%	Narrabri, NSW	Underground

Source: *Platypus, WHC*

We use the same assumptions as for BHP above and assume that WHC's other coal mines remain below the SGM threshold of 100,000t CO_2-e until 2030. We have assigned all emissions and surrendered ACCUs from Daunia and Blackwater to Whitehaven, even though the purchase from BHP was finalised in April 2024. This means that WHC did not pay the full amount for the ACCUs surrendered over 2023-2024 for Blackwater and Daunia.

Exhibit 29: WHC Safeguard Mechanism reported data for 2023-2024. Emissions are in tonnes of CO_2-e.

Name	Baseline emissions	Covered emissions	ACCUs surrendered	CO_2	NH_4	N_2O	GHG Other
Blackwater	641,861	722,053	80,192	329,329	391,728	955	41
Daunia	234,840	215,551	-	168,633	46,418	480	20
Maules Creek	383,633	555,048	171,415	199,690	355,312	30	16
Narrabri	275,001	286,028	11,027	283,525	1,710	789	4

Source: *Platypus, WHC*

Exhibit 30: WHC ACCU liability given methane measurement

Year	Liability under Method 2 ($m)	3x increase in methane ($m)	8x increase in methane ($m)	ACCUs (m) required (3x)	ACCUs (m) required (8x)
2025	8.85	43.27	131.24	1.1	3.3
2026	12.61	52.24	152.20	1.2	3.4
2027	26.70	97.03	272.87	1.2	3.5
2028	33.34	107.58	293.16	1.3	3.6
2029	40.18	118.15	313.09	1.4	3.7
2030	47.36	129.26	334.02	1.5	3.8

Source: *Platypus, CER*

For H1 FY2025, WHC made $960 million underlying EBITDA. If methane measurements were altered away from Method 2 and led to an 8 times increase, this would result in an ACCU liability of ~6.8% of EBITDA. While we think this is an unlikely outcome, it points to the importance of measurement accuracy within the Safeguard Mechanism.

New Hope Group (NHC)

The New Hope Group has one coal mine under the SGM. It is 80% owned by NHC and 20% by Taipower. The mine has approval to extract 15Mt run-of-mine per annum. It is an open-cut mine located in Muswellbrook, NSW.

Exhibit 31: NHC Safeguard Mechanism reported data for 2023-2024. Emissions are in tonnes of CO_2-e.

Name	Baseline emissions	Covered emissions	ACCUs surrendered	CO_2	NH_4	N_2O	GHG Other
Bengalla	519,270	626,511	107,241	213,856	412,057	581	17

Source: *Platypus, CER*

While there is only one mine, due to the methane emissions, if these increase due to a change in measurement methodology, it could have a meaningful impact. Underlying EBITDA for H1 FY 2025 was $517 million, making the ACCU liability ~11.5% of underlying EBITDA.

Exhibit 32: NHC ACCU liability given methane measurement

Year	Liability under Method 2 ($m)	3x increase in methane ($m)	8x increase in methane ($m)	ACCUs (m) required (3x)	ACCUs (m) required (8x)
2025	4.29	37.25	119.67	0.93	2.99
2026	6.03	43.49	137.13	0.97	3.05
2027	12.54	78.43	243.15	1.00	3.10
2028	15.18	84.72	258.58	1.03	3.16
2029	17.88	90.93	273.55	1.07	3.21
2030	20.72	97.45	289.27	1.10	3.27

Source: *Platypus, CER*

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