CLIMATE COUNCIL

DANGEROUSLY OVERLOOKED:

WHY WE NEED TO TALK ABOUT METHANE

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The Climate Council acknowledges the Traditional Owners of the lands on which we live, meet and work. We wish to pay our respects to Elders, past and present, and recognise the continuous connection of Aboriginal and Torres Strait Islander peoples to land, sea and sky. We acknowledge the ongoing leadership of First Nations people here and worldwide in protecting Country, and securing a safe and liveable climate for us all.

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Key findings

1 Methane is the second largest contributor to global warming after carbon dioxide – and it's fuelling the unnatural disasters we're experiencing.

- Like carbon dioxide, methane is a greenhouse gas that's worsening extreme weather like heatwaves and devastating events like bushfires and floods. While carbon dioxide is more prevalent and longer lasting in the atmosphere, methane is more effective at trapping heat.
- Over a 20-year period, methane traps 85 times more heat than the equivalent amount of carbon dioxide – turbocharging global warming.
- Over a 100-year period, methane traps about 28 times more heat than the equivalent amount of carbon dioxide.
- Methane is estimated to be responsible for 25 to 30 percent of global warming since pre-industrial times.

2 Humans are turbocharging methane pollution – and it's rising at a record rate.

- Human activities, such as fossil fuel mining and agriculture, are estimated to contribute roughly half of the methane emissions going into the atmosphere, with the other half coming from natural sources such as wetlands.
- The concentration of methane in the atmosphere is increasing at record rates. Annual increases in methane pollution measured in 2020 and 2021 were the largest since reliable records began.
- The concentration of methane in our atmosphere is now more than 1900 parts per billion, the highest level for at least 800,000 years.
- The recent rapid rise in methane pollution is estimated to have come almost entirely from human activities.

3 Australia produces an outsized share of global methane pollution, due to our large fossil fuel mining and agriculture industries – and our coal and gas corporations may be significantly under-reporting the methane they are releasing.

- Australia is the world's 12th largest methane polluter, higher than many larger developed economies including France, Germany, the UK and Canada. Given that Australia has just over 0.3 percent of the world's population, this means we are producing about four to five times as much methane as would be expected based on our population alone.
- In the year to December 2023, Australia produced nearly four million tonnes of methane, with the main sources including agriculture (52 percent) fossil fuel mining (25 percent), and household/business waste (11 percent).
- The International Energy Agency estimates that Australian coal and gas corporations could be under-reporting methane pollution by as much as 60 percent.

4 We need to urgently slash methane pollution alongside carbon dioxide to hold climate change in check – that starts with setting clear national targets backed by action.

- There is growing recognition around the world that we must rapidly cut *both* methane and carbon dioxide to avoid worsening climate extremes.
- Without concerted action, global methane pollution from human activities is expected to rise 15 percent this decade.
- Along with over 150 other countries, Australia has signed the Global Methane Pledge to cut global methane pollution by at least 30 percent by 2030. But to date, the Australian Government has no published plan to help meet this objective, and there are no national or state methane reduction targets.

5 The Australian Government needs to hold fossil fuel corporations accountable for accurately monitoring, reporting and slashing methane pollution – and take other practical steps to tackle this greenhouse gas by:

- Mandating that all coal and gas corporations directly measure and report their methane pollution, rather than relying on flawed indirect estimates – in line with international best practice;
- Ending the approval of new coal and gas projects, and requiring the highest polluting mines to cut methane pollution as a condition of continued approval to operate; and
- Requiring underground coal mines to capture and destroy methane that is currently vented into the atmosphere, and banning all non-emergency flaring and venting of gas.
- We must also tackle other major sources of this gas by scaling up emerging solutions for cutting methane pollution from agriculture, and collecting and processing waste in ways that reduce methane from landfills.

1. Introduction

Most people understand that carbon dioxide is the number one culprit when it comes to climate change. But there's another harmful gas permeating our atmosphere and warming up our planet: methane. It's the second most dangerous climate pollutant and it's fuelling the unnatural disasters we're experiencing now and into the next few decades.

There is growing recognition around the world that methane pollution is a huge contributor to warming the climate, especially in the near term. That's because methane is highly effective at trapping heat. It breaks down in the atmosphere much more quickly than carbon dioxide, hanging around for only about a decade. But over a 20-year period it causes around 85 times the climate damage of carbon dioxide. And even when methane does break down, it adds to the amount of carbon dioxide in the atmosphere. That's why slashing methane pollution now is critical to limiting the build up of harmful greenhouse gases that are fuelling global warming.

The Albanese Government has signed up to the Global Methane Pledge to slash global methane emissions 30 percent by 2030. But a promise is not a plan; currently, we have no dedicated national strategies or policies to deal with this harmful gas. Part of the problem is that we don't know the true extent of our methane pollution. Official estimates rely heavily on self-reporting from the coal and gas industry, often using outdated and indirect methods. The good news is that there are many practical steps the Australian Government can take right now to cut methane pollution at the source. This starts with setting clear national targets for cutting methane pollution and holding coal and gas corporations accountable for accurately reporting and driving down methane pollution.

Right now, Australia is broadly on track to meet our national target of reducing climate pollution by 43 percent this decade (DCCEEW 2023a). But to avoid the worst impacts of climate change and ensure a safer future for our kids, we need to slash pollution further and faster. Taking action on methane, alongside carbon dioxide, is an important way to double down on cutting climate pollution today, so we can ensure a safer tomorrow.

Figure 1: NASA has developed 3D visualisations showing the emission and transport of atmospheric methane around the globe.
Source: NASA Scientific Visualisation Studio.

2. What is methane and where does it come from?

Methane is a colourless, odourless and highly flammable gas and it's the main component of the gas we use today in our homes and businesses. Methane is also a greenhouse gas, meaning it affects the earth's temperature and climate system when released into our atmosphere, by trapping heat reflected from the Earth's surface. A molecule of methane has one carbon atom attached to four hydrogen atoms, giving it the chemical symbol CH_4.

Methane found deep below ground and under the ocean is formed by geological processes after fossil organic matter is broken down by the heat and pressure of the Earth's crust. In many countries, including Australia, this 'fossil' methane is extracted and processed into liquefied gas for export and domestic use in cooking, heating and manufacturing. Alongside its use as a fuel, methane is also an ingredient in a range of commonly-used industrial products like ammonia.

Gas and coal mining and processing results in large amounts of methane being leaked or deliberately vented into the atmosphere. These methane emissions are known as 'fugitive emissions', and are an additional source of climate pollution to the carbon dioxide that is produced when these fossil fuels are burned.

Methane is also produced through a range of biological processes such as animal digestion and decomposition of organic matter. Some of this pollution would occur without humans, but a significant amount is produced by the farming of sheep and cows and the production of rice. Overall, in the period 2008-2017, roughly half of global methane pollution is estimated to come from human activities, with the rest coming from natural sources such as wetlands and oceans (Figure 2).

Agriculture and fossil fuels are the main sources of methane from human activities.

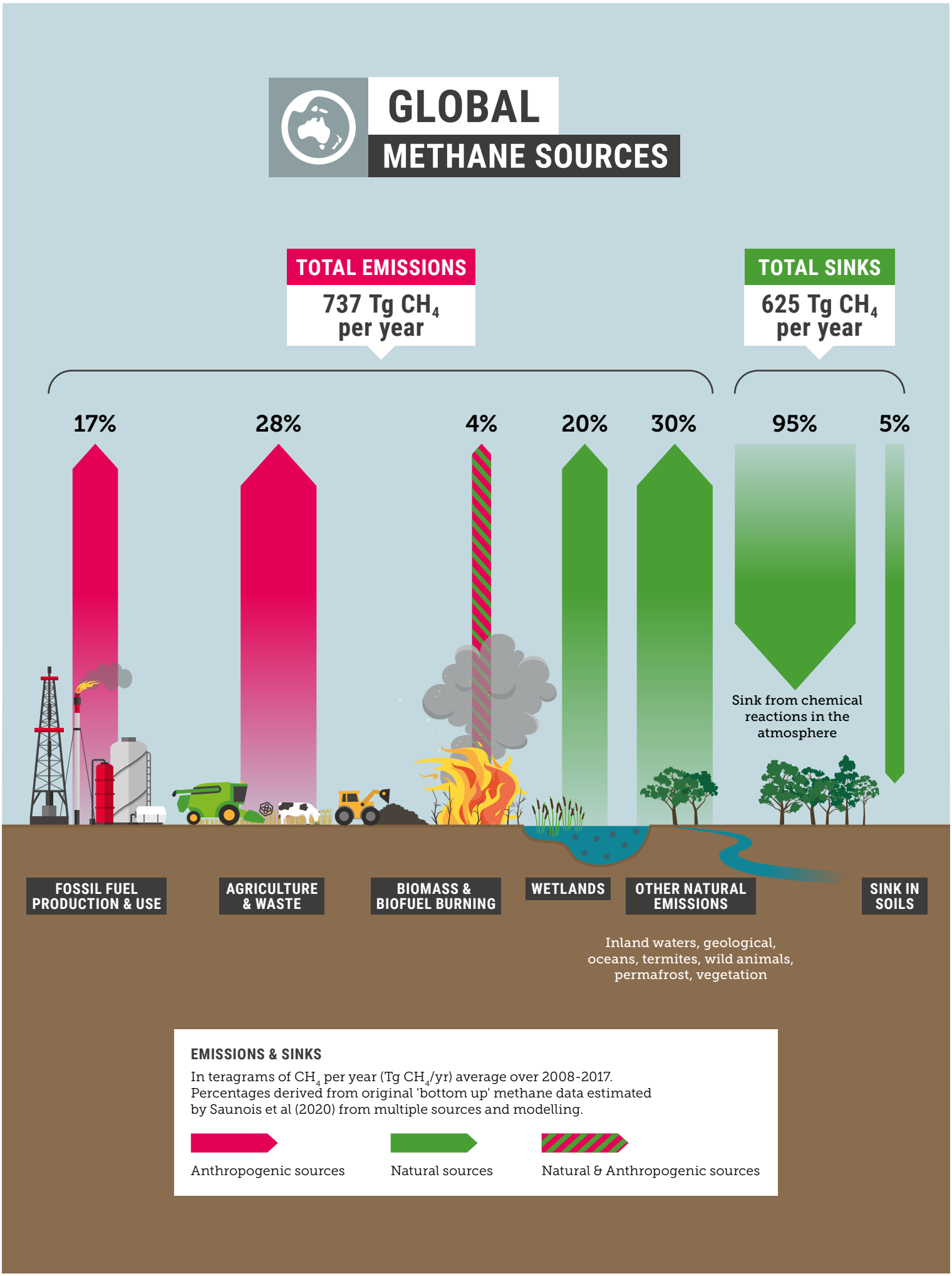


Figure 2: Agriculture and fossil fuels dominate the global sorces of methane from human activities.
Source: Saunois et al. 2020. The best available data on methane sources globally covers the period 2008-2017. It is expected that current trends are broadly comparable as there has been only limited and recent global action to reduce methane pollution.

METHANE POLLUTION IS FUELLING CLIMATE CHANGE

Carbon dioxide (CO_2) is the most dangerous climate pollutant in our atmosphere – but methane is hot on its heels. While carbon dioxide can hang around in our atmosphere for thousands of years, methane has an average lifespan of about 12 years. It is known as a 'live fast, die young gas' – officially called a Short-Lived Climate Pollutant.

But what methane lacks in prevalence and staying power, it makes up in heat trapping action. Over a 20-year period, methane will trap 85 times more heat in our atmosphere than the equivalent amount of carbon dioxide (Box 1). This extra heat turbocharges the global warming we are experiencing now and into the next few decades.

Over a 20-year period, methane traps 85 times more heat than the equivalent amount of carbon dioxide – turbocharging global warming.

BOX 1: SOME IMPORTANT DEFINITIONS

Global Warming Potential (GWP) is a measure of how much heat one tonne of a greenhouse gas will trap over a given period of time, relative to one tonne of carbon dioxide. Over a 20-year period, methane is about *85 times* more effective at trapping heat compared to carbon dioxide. Over 100 years, methane is still about *28 times* as effective as carbon dioxide in trapping heat. While GWP 100 has been the global standard of conversion to express the impact of methane relative to carbon dioxide,[1] there are growing calls to use GWP 20 to better recognise and account for the impacts of methane on near- to medium-term warming. This is because the goal of the Paris Climate Agreement to limit warming to 1.5°C requires us to focus on action that makes a difference now, not in a century.

Carbon dioxide equivalent (sometimes written as 'CO_2-eq' or 'CO_2e') is a way of referring to all greenhouse gases (like carbon dioxide, methane and nitrous oxide) in common terms by reducing them to a single metric. If methane is expressed as CO_2-e, and assuming GWP 100, the figure can simply be divided by 28 to convert it back to an amount of methane, usually expressed as millions of tonnes. Expressing methane as a separate gas, instead of within a common metric, provides a more transparent way for scientists and policy-makers to compare and understand the impact of different types of climate pollution.

Parts per billion (ppb): The concentration of methane in the atmosphere is generally expressed as ppb. A concentration of 1 ppb means that there is one unit of methane per billion units, by volume of atmosphere. In April 2024, the concentration of methane in the atmosphere was 1932 ppb. By contrast, carbon dioxide makes up a far greater proportion of the gases in the atmosphere and its concentration is expressed as parts per million (ppm).

1 Unless otherwise stated, GWP100 is used by international bodies such as the International Energy Agency (IEA) and the Intergovernmental Panel on Climate Change (IPCC) for reporting methane emissions.

Another problem is that methane contributes to the formation of ground-level ozone (O_3), in itself a greenhouse gas and a dangerous air pollutant (UNEP 2021). Ozone amplifies the warming impact from methane by about 38 percent. Ozone from human-caused methane is estimated to cause about half a million avoidable respiratory-related deaths every year, as well as harming ecosystems and crops by suppressing plant growth (UNEP & CCAC 2021).

When the direct impact of methane on the climate is added to the indirect impact from ozone on human health and the environment, a tonne of methane pollution is estimated to be between 7 and 32 times worse for us than the same amount of carbon dioxide (Azar et al. 2023).

The United Nations Environmental Program (UNEP) estimates that methane is now responsible for around 25 percent of the global temperature increase since pre-industrial times (UNEP 2022). The International Energy Agency's Global Methane Tracker puts this figure higher at up to 30 percent (IEA 2024). Whatever the estimation method used, scientists agree that methane is a significant problem – and it's growing.

METHANE POLLUTION IS RISING AT A RECORD RATE

In the period 2010-2019, methane accounted for 18 percent of global greenhouse gas emissions released into the atmosphere (IPCC 2022). Like other greenhouse gases, the concentration of methane is increasing at record rates (UNEP 2022). Annual increases in methane pollution measured in 2020 and 2021 were the largest since reliable records began in 1983 (WMO 2023). By April 2024, methane levels had reached over 1,932 parts per billion (Lan et al. 2024), an increase of more than 260 percent from pre-industrial levels. The concentration of methane in our atmosphere is now at its highest level for at least 800,000 years (IPCC 2021).

Concerningly, there has been a particularly rapid rise in methane levels since 2007. This additional methane is estimated to have come almost entirely from human activities – both directly through agriculture and fossil fuels (Jackson et al. 2020) and indirectly through what may be the beginnings of climate feedback loops, in which warming causes changes that in turn lead to more warming (NOAA, 2024a). As the world continues to warm, the increased release of methane from thawing permafrost, wetlands and coastal ecosystems will continue to add to the global methane problem (Al-Haj & Fulweiler 2020, UNEP & CCAC 2021, IPCC 2022).

This rapid increase in methane pollution is consistent with the highest of the IPCC's global warming scenarios which leads to warming of 4.3°C by the end of the century (IPCC 2021), taking us ever closer to catastrophic tipping points in the Earth's climate system.

The concentration of methane in our atmosphere is now more than 1900 parts per billion, the highest level for at least 800,000 years.

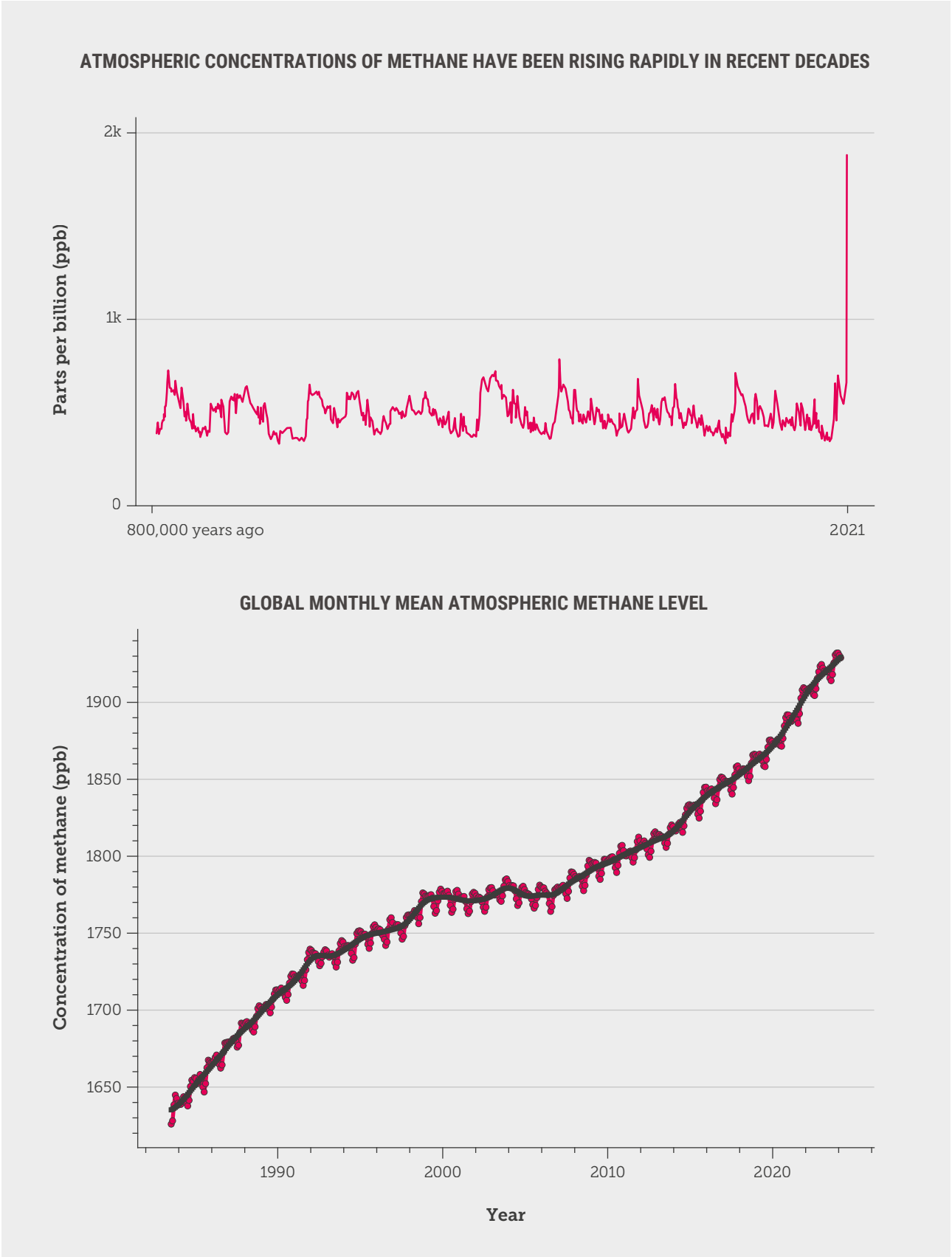


Figure 3: The concentration of methane in our atmosphere has been rising rapidly – particularly since 2007 – and is now significantly higher than the long-run historic trend. **Sources:** U.S. Environmental Protection Agency; National Oceanic & Atmospheric Administration; Bloomberg (2023); NOAA (2024b).

3. Australia's methane problem

Australia produces an outsized share of global methane pollution, due to our large fossil fuel mining and agriculture industries. We are the world's 12th largest methane polluter, higher than many larger developed economies including France, Germany, the United Kingdom and Canada (IEA 2024).

Given Australia has just over 0.3 percent of the world's population, this means we are producing about four to five times as much methane as would be expected based on our population.

According to the Australian Government, Australia's fossil fuel, agriculture and waste sectors produced 3.9 million tonnes of methane in the year to December 2023 (approx 109 million tonnes CO_2-e) (DCCEEW 2024). Over this period, the extracting, processing and use of fossil fuels released around 1.2 million tonnes of methane. Agriculture was responsible for a further 2.3 million tonnes and waste from our homes and businesses for 0.5 million tonnes (Figure 4). These are the key sectors where targeted policies and focused action can drive down methane pollution now.

Australia produces four to five times as much methane pollution as the rest of the world on a per person basis.

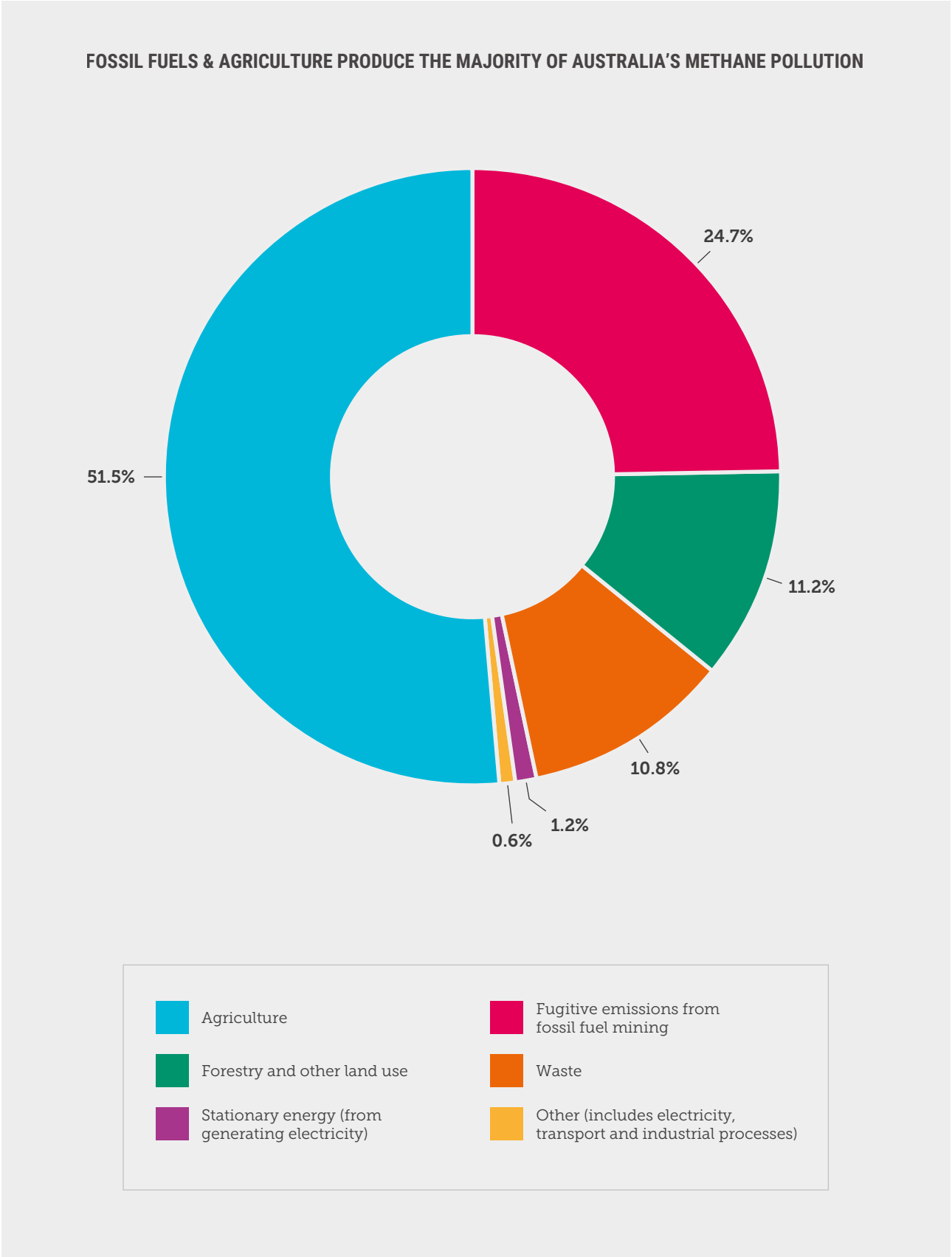


Figure 4: Fossil fuels and agriculture produce the majority of Australia's methane pollution.
Source: National Greenhouse Gas Inventory Quarterly Update: December 2023 (DCCEEW, 2024).

WE MAY BE SIGNIFICANTLY UNDERCOUNTING METHANE POLLUTION

There is a growing awareness that countries around the world may be significantly undercounting methane pollution. The International Energy Agency (IEA) has noted that in many countries, there are significant differences between methane levels measured by scientific studies at specific locations, and those reported by governments to the United Nations Framework Convention on Climate Change (UNFCCC), the international body supporting the global response to climate change (IEA 2022). Globally, the IEA has estimated that annual methane pollution from coal and gas mining could be as much as 70 percent higher than the total reported to the UNFCCC (IEA 2023a). These estimates are supported by scientific studies on methane pollution from individual coal mines. For example, methane pollution from coal mining in the US has been estimated to be 60 percent higher than reported (Alvarez et al. 2018) and in Canada at least 50 percent higher (Chan et al. 2020).

Australia appears to be no exception to this problem. The International Energy Agency estimates that Australian coal and gas corporations could be under-reporting methane pollution by as much as 60 percent (IEA 2023a). That's equivalent to the combined methane pollution from fossil fuel mining in France, Germany and the UK (ERI 2023). This conclusion has been informed by satellite measurements quantifying methane pollution from six coal mines in Queensland's Bowen Basin. The methane pollution measured from these mines via satellite was estimated to be around half of the reported national total from all coal mining in Australia, yet the mines produce only about 7 percent of Australia's coal – pointing to significant under-reporting. Methane pollution measured from one 'super polluter' mine, at Hail Creek, was estimated from satellite measurements to be 20 percent of the reported national total from coal mining, even though this mine produces only 1 percent of Australia's coal (Sadavarte et al. 2021). While these conclusions have been both disputed (Sturgiss 2024) and defended (Sadavarte et al. 2024) this points to a critical need for improved and transparent measurement of methane pollution from fossil fuel mining.

The likely reason for under-reporting is that methane levels are generally estimated indirectly. Information such as the tonnes of coal extracted from a mine, or number of cows in a region, is multiplied by a standardised emission factor to arrive at a figure for the total amount of methane produced. In many cases, these emission factors have been derived from outdated research and lack credibility (CCA 2023a).

The International Energy Agency estimates that Australian coal and gas corporations could be under-reporting methane pollution by as much as 60 percent.

Figure 5: Despite producing only 1 percent of Australia's coal, satellite measurement at Glencore's Hail Creek open cut coal mine in Queensland's Bowen Basin indicates that it produced 55 percent of Australia's reported methane emissions in 2018-19, pointing to significant under-reporting.
Source: Sadvarte et al, 2021.

WE HAVE NEW METHODS TO TRACK METHANE POLLUTION

More recently, methods have been developed to directly measure plumes of methane near the Earth's surface, using remote sensing from aircraft or satellites (IEA 2022; Jacob et al. 2022). The remote sensing data is then used to trace back a specific plume of methane to a source – like a coal mine. Satellite measurements have the advantage of providing global coverage and continuous monitoring in near-real time (Palmer et al. 2021; Jacob et al. 2022).

In March 2024, a dedicated satellite called MethaneSAT was launched by a collaboration between the US Environmental Defense Fund, the New Zealand Space Agency and the Bezos Earth Fund (EDF 2024). This satellite will circle the Earth 15 times a day and provide highly detailed data on methane pollution globally. All the data will be publicly available, providing a new way to detect methane pollution that may have previously gone uncounted.

Researchers from the University of Melbourne, in collaboration with the Superpower Institute, have also developed a web-based platform called OpenMethane for detecting, measuring and locating Australia's methane pollution. This open access platform will enable far greater public awareness about, and scrutiny of, methane reporting (Box 2).

Satellite technology like MethaneSAT and tools such as OpenMethane are sorely needed to better understand how much methane pollution is being pumped into our atmosphere by coal and gas mining, the farming sector and waste facilities. We must also raise the bar on industry self-reporting of methane pollution in countries which are major fossil fuel and agriculture producers like Australia. Only by understanding the real scale of the problem that we're facing, can we take the right action to fix it.

Under-reporting methane emissions has major implications for Australia's climate policies – particularly the Safeguard Mechanism. This national framework sets climate pollution caps on approximately 200 of Australia's largest industrial facilities. The caps progressively reduce each year, forcing these facilities to cut their climate pollution at its source or buy offsets. If methane emissions have been significantly under-reported, the Safeguard Mechanism pollution caps would need to increase significantly. IEFFA has estimated the annual rate of pollution reduction would need to almost double to address this under-reporting so that Australia can meet our climate targets (IEFFA 2023a).

New satellite data and analysis methods will greatly increase the transparency of methane reporting, globally and in Australia.

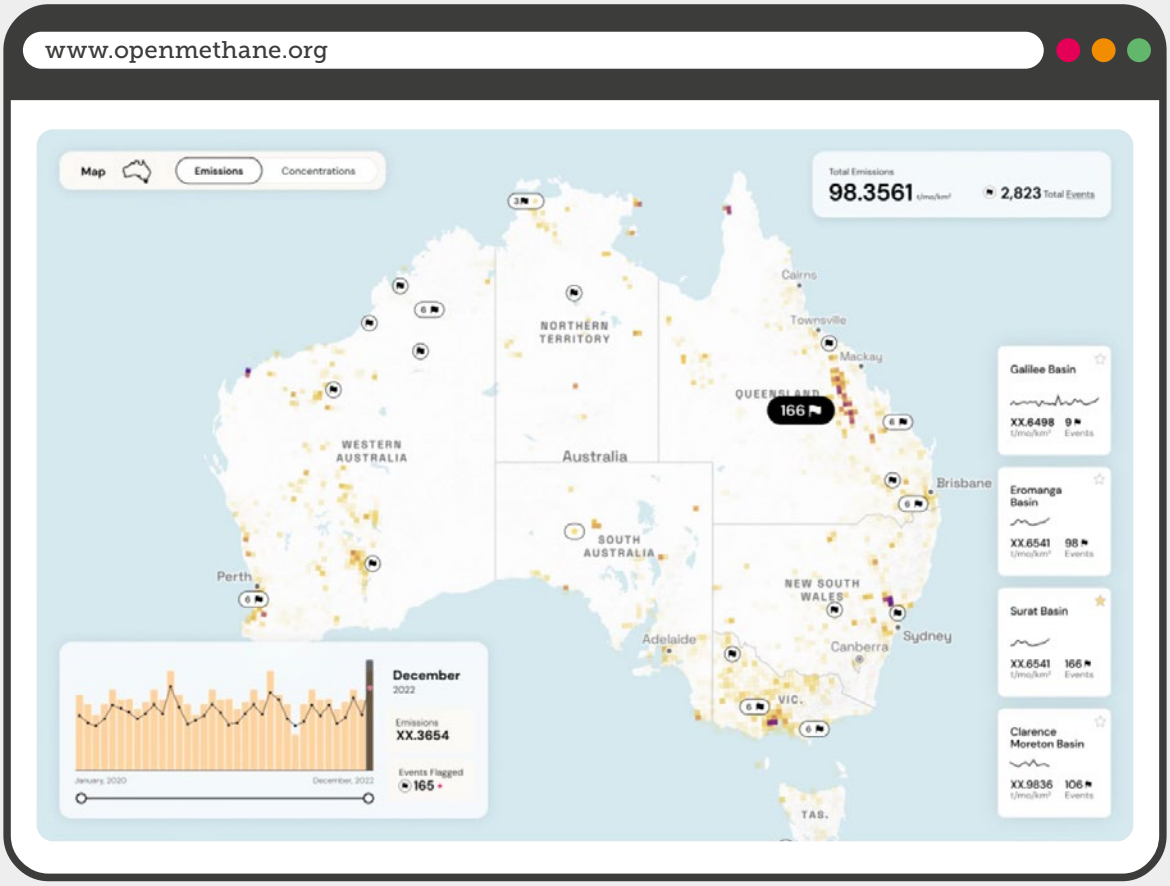
BOX 2: OPENMETHANE TOOL

OpenMethane combines data from the Australian Government's National Methane Inventory with land use, atmospheric and meteorological data. By employing a Weather Forecast Model (WRF) and an Atmospheric Pollution Model (CMAQ), the researchers have developed a predictive model of methane movement in the atmosphere above Australia. A map is produced indicating expected methane concentration in every cubic metre (m^3) of air across the continent.

The 'predicted methane' from this model is then compared to actual methane pollution measured by the TROPOMI satellite. Discrepancies between the predicted and actual methane measurements appear as 'methane events', accessible via the OpenMethane Map and Data Tool.

Once fully functional towards the end of 2024, this will be the first tool capable of providing continuous methane observations at the continent, state and regional level in Australia, with a real time pollution quantification and alert system for methane 'events'. This will allow independent verification of methane emissions reported by coal and gas corporations and other industries.

Source: openmethane.org



4. Slashing methane pollution is essential for holding global warming in check

There is growing recognition around the world that we must rapidly deal with both methane *and* carbon dioxide to avoid worsening climate extremes. Deeply cutting methane pollution is essential for holding global warming as close as possible to 1.5°C, in line with the Paris Agreement (Collins et al. 2018; van Vuuren et al. 2018, IPCC 2021). The United Nations Environmental Program estimates that reducing methane pollution by 30 percent this decade could directly avoid nearly 0.25°C of global warming (UNEP 2021). This will require a 75 percent reduction in methane pollution from fossil fuel industries.

Right now, countries including Australia are not doing enough to slash this dangerous climate pollutant. Global methane pollution from human activities in 2023 has been estimated to cause more warming over the next 20 years than the carbon dioxide from all passenger vehicles and coal-fired power stations in that same year (EDF 2023). Under current global commitments, methane from human activities is expected to rise 15 percent during the 2020s compared with 2010 levels, reaching nearly 380 million tonnes a year by 2030 (Högland-Isaksson et al. 2020). Despite signing the Global Methane Pledge to cut methane emissions by 30 percent this decade, Australia's methane pollution is also expected to keep rising (DCCEEW 2022).

The bottom line is that cutting methane pollution can reduce the amount of climate warming we experience in the near term. We need to tackle *both* carbon dioxide and methane urgently this decade, through tailored actions that deal with this pollution from all sources.

"Methane reductions are the single most effective strategy to reduce global warming in the near term and keep a 1.5°C future within reach."

— Former United States Special Presidential Envoy for Climate, John Kerry

5. Focused action on methane now can cut climate pollution from major Australian industries

Australia is broadly on track to achieve our national target of cutting climate pollution 43 percent below 2005 levels by 2030 (DCCEEW 2023a). This is important progress but to do our fair share in tackling dangerous climate change, Australia should be working harder and faster to slash climate pollution by 75 percent this decade and reach net zero by 2035 (Climate Council 2024).

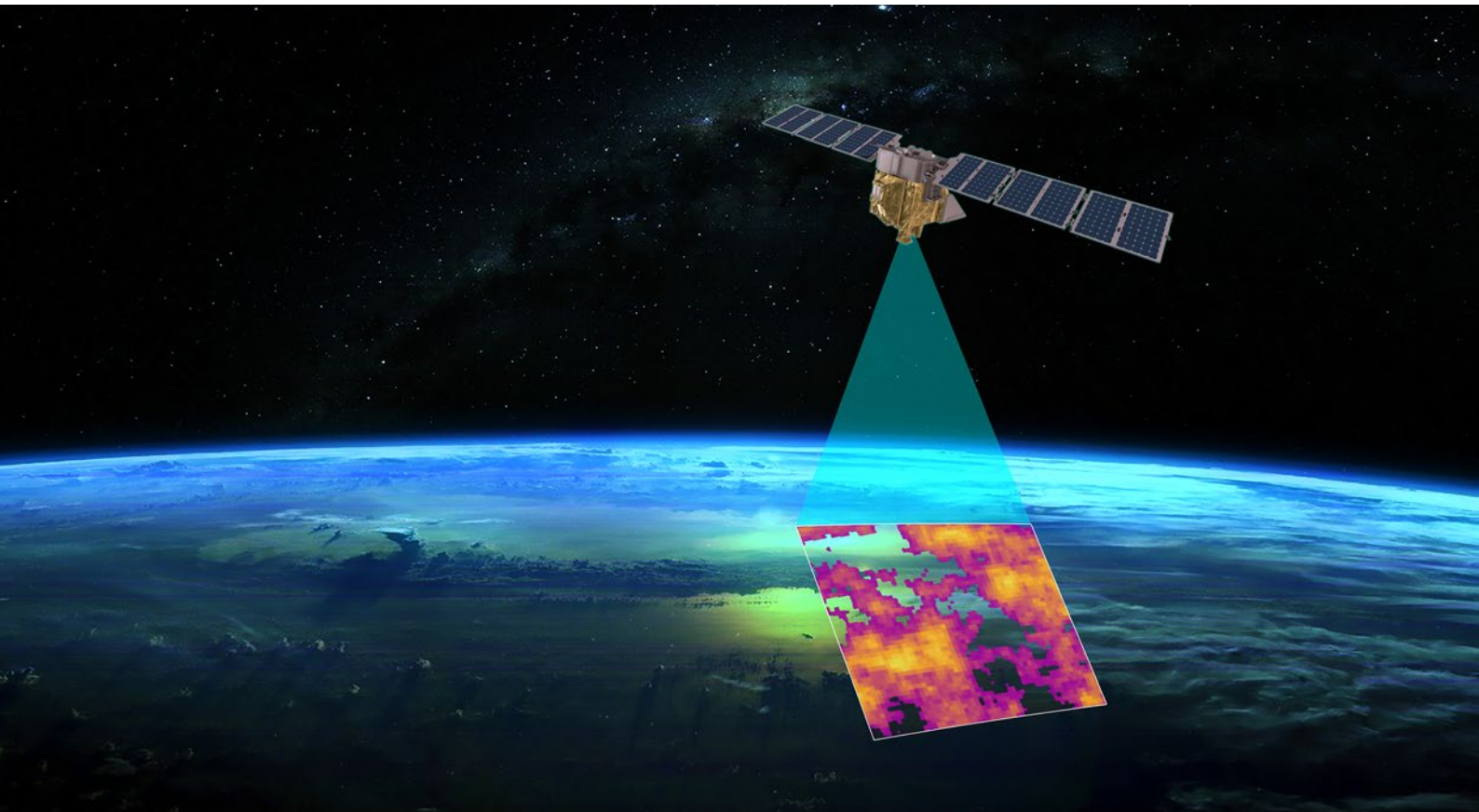
Slashing methane pollution can help us get there, alongside continuing to drive down carbon dioxide. While Australia has signed on to the Global Methane Pledge to cut methane pollution by 30 per cent this decade, there is no published plan to get there and no national or sector-specific targets. This is a gaping hole in Australia's roadmap to net zero.

We must take direct action to slash methane pollution because there is currently no way to draw it down directly from the atmosphere (Jackson et al. 2019). Carbon dioxide can be absorbed by plants and our land system over time through photosynthesis, although this is not a viable and permanent solution for the carbon dioxide generated from burning fossil fuels. Methane, on the other hand, needs to break down to carbon dioxide before it can be absorbed in this way (Lowe 2023). But by the time this occurs, methane has already had a very strong warming impact. The best solution is to genuinely and permanently slash the amount of methane released in the first place.

The good news is that there are readily available technologies and policies that can cut methane pollution, while simultaneously reducing ground-level ozone for safer, healthier air. Practical actions we can take now could reduce global methane pollution 30 percent by 2030 (UNEP & CCAC (2021). This could help avoid about 0.25°C of warming by mid-century, and more than 0.5°C by 2100 (Ocko et al. 2021). Importantly, any new policies to reduce methane *must be additional* to those already in place or being developed to cut carbon dioxide. Dealing with methane is not a substitute for reducing carbon dioxide – both are critical for tackling the climate crisis.

We need to urgently slash methane pollution alongside carbon dioxide – both are critical for tackling the climate crisis.

Figure 6: New technology like MethaneSAT – pictured here in an animated rendering – will enable more accurate measurement of methane pollution globally.



OPPORTUNITY #1

Proper monitoring, reporting and verification of methane pollution

We can't cut what we can't measure. The first step in dealing with Australia's methane problem is to properly measure it. This will help to build a shared understanding among government, industry and communities of what we're up against.

The *National Greenhouse and Energy Reporting (NGER) Act 2007* provides the framework for monitoring and reporting greenhouse gas emissions across all sectors of the Australian economy. This Act requires facilities that produce greenhouse gases to report their annual total to the Clean Energy Regulator if these are over certain thresholds.

There are four methods available for calculating and reporting methane pollution (summarised in Box 3). These vary significantly in their level of rigour, ranging from Method 1, which relies on standardised information to roughly estimate pollution levels, through to Method 4, which uses direct measurement of pollution onsite. Companies that need to report methane emissions under these rules generally have a choice of methods, but not all methods are available for all types of facilities. For example, emissions from underground coal mines must be estimated using Method 4, whereas open cut coal mining can use Methods 1-3.

At the moment, more than half of Australia's total 'fugitive emissions' reported from coal, oil and gas facilities use Method 1 (CCA 2023a). This means most fossil fuel producers are relying on the least sophisticated and most outdated method for estimating their methane pollution. As a top priority, we can fix this by aligning Australian methane reporting requirements with international best practice. This focuses on measuring methane emissions *directly* at the actual sites of mines or processing facilities – rather than relying on indirect estimations using standard emissions factors – and then reconciling measurement data from multiple sources to check its accuracy.

BOX 3: CURRENT METHODS FOR REPORTING METHANE EMISSIONS IN AUSTRALIA (AS SPECIFIED BY THE NATIONAL GREENHOUSE AND ENERGY REPORTING MEASUREMENT DETERMINATION 2008)

Method 1	Method 2
The simplest method, also referred to as the default method. It uses emissions factors i.e extrapolating estimates from standardised information.	Requires facility-specific sampling of coal-seam methane before mine development and applies Australian or international standards, or their equivalent, to the analysis.

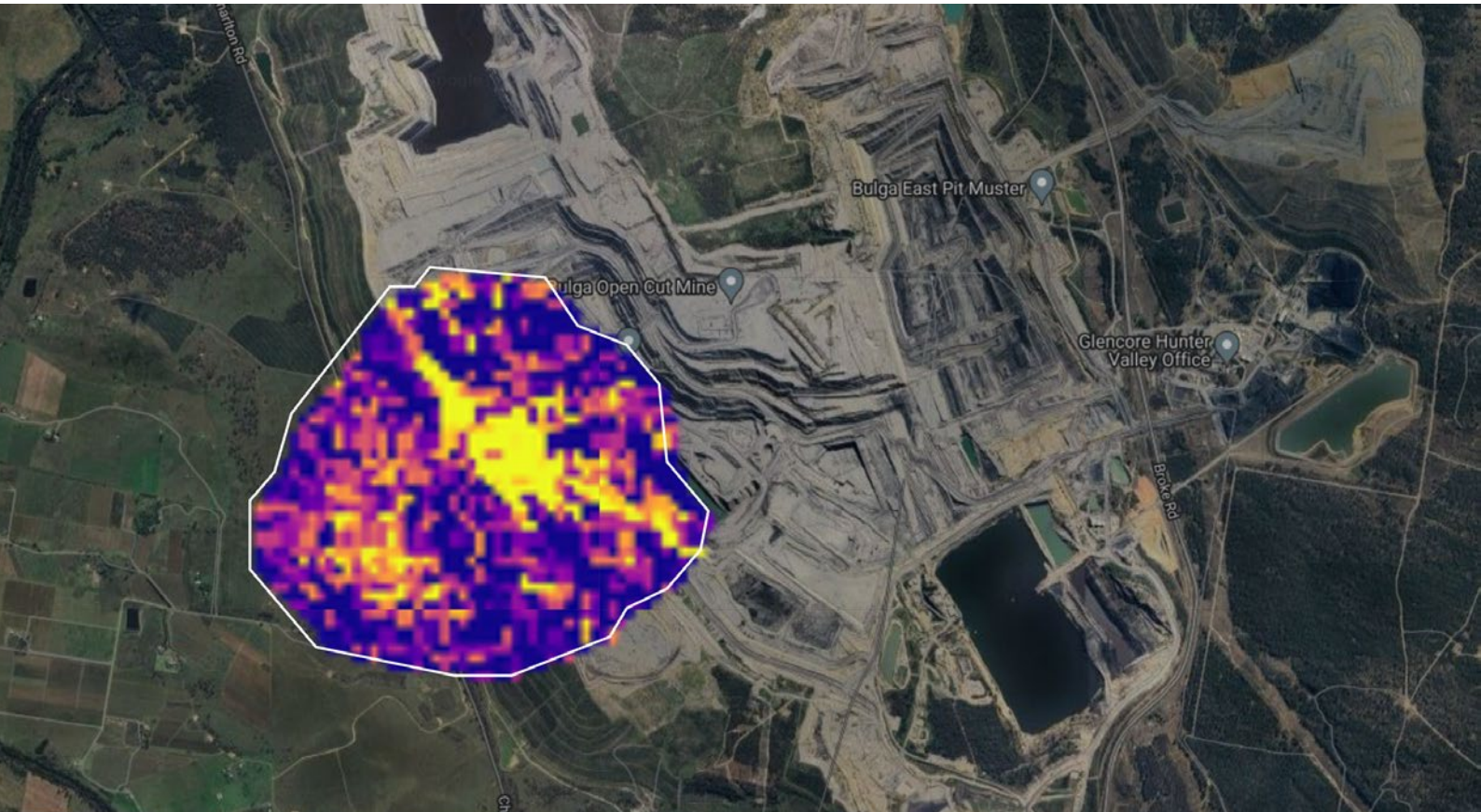
Method 3	Method 4
Very similar to Method 2, except that it requires Australian or international standards to be applied to *both* sampling and analysis.	Typically requires direct monitoring or measuring of emissions on a periodic or continual basis.

Source: 2023 Review of the National Greenhouse and Energy Reporting Legislation, December 2023 (CCA 2023a).

In partnership with industry, the United Nations Environment Program (UNEP) has been working on high quality frameworks for the monitoring, reporting and verification of methane from different industry sources. The *Oil and Gas Methane Partnership 2.0* was launched in 2020 and more than 100 companies have already joined. This framework provides robust and detailed reporting guidelines, and companies are required to share their methane monitoring data with the International Methane Emissions Observatory, which houses a public dataset of methane pollution levels and sources. The *Steel Methane Partnership* is still under development, but when finalised, will provide similar guidelines for measuring and reporting methane emissions from coal mines.

Accurate monitoring, reporting and verification (MRV) of methane pollution is vital for Australia to take the necessary action to reduce it. The Australian Government should align our national reporting requirements with these international best practice frameworks to increase the transparency and reliability of our methane pollution data. In particular, this means ending the use of methods which are not consistent with international best practice today. The Climate Change Authority's 2023 review of the National Greenhouse and Energy Reporting Act highlighted the serious risk of methane under-reporting and called for a shift to direct measurement methods to be mandated for all fossil fuel facilities (CCA 2023a). The Australian Government should implement these and other recommendations from the Authority as soon as possible.

Figure 7: Methane emissions observed by satellite near Glencore's Hunter Valley Coal Mine in January 2023.



There are two other practical improvements we can make now to tracking and reporting methane pollution, which will give us better insights into the effectiveness of policies to cut climate pollution:

- When releasing annual data under the National Greenhouse and Energy Reporting scheme, Australia's Clean Energy Regulator reports the main greenhouse gases together, using the carbon dioxide equivalent (CO_2-e) metric. Providing public reporting separately on the three main greenhouse gases – carbon dioxide, methane and nitrous oxide – would allow more transparent monitoring of each gas, so we can see where policies and actions are working, and where more effort is needed. Following reforms to the Safeguard Mechanism in 2023, facilities covered by that framework will be required to report their climate pollution by individual gas. This is a positive step that should be extended to all reporting under the National Greenhouse and Energy Reporting scheme.

- When methane is converted to carbon dioxide equivalent (CO_2-e), the Clean Energy Regulator also uses a standard conversion approach for reflecting the Global Warming Potential of methane, which is GWP100 (see Box 1, p.5). This means that the warming impact of methane in the near term is dramatically understated in official government reporting. The Clean Energy Regulator should update this approach to include pollution data based on GWP20 (energy absorbed by a gas over 20 years) *and* GWP100 (energy absorbed by a gas over 100 years), to provide a more transparent picture of the near-term impacts of methane pollution on global warming.

In Australia, industrial and other single facilities that produce 25,000 tonnes or more a year of carbon dioxide equivalent (CO_2-e) climate pollution must report this to the Clean Energy Regulator. Similarly, large Australian corporations that produce 50,000 tonnes or more of CO_2-e climate pollution must publish information about this each year. But agricultural businesses are generally not required to report their climate pollution at all – including methane. It has been estimated that an agricultural business with approximately 15,000 head of grazing cattle or 11,000 head in feedlots would also cross the threshold for reporting to the Clean Energy Regulator. There are at least ten large agricultural companies – running herds of 100,000 to 450,000 cattle – that would meet or exceed the same threshold (CCA 2023a).

Tackling Australia's methane emissions means that large sources of agricultural methane should also be measured directly. A study at two locations in QLD's Surat Basin, for example, found that 50 percent of the methane pollution in the region came from grazing cattle, and 25 percent from feedlots (Luhar et al. 2020). Australia needs to put in place far stronger requirements for reporting of methane pollution in agriculture, so that this sector starts to pull its weight in cutting harmful pollution.

The Australian Government needs to implement far stronger requirements for reporting of methane pollution from fossil fuel facilities and agriculture.

Together, these changes could comprehensively transform how methane is reported and tracked in Australia by industry and government alike. By making clear the real scale of the methane problem, we will be far better equipped to deal with it effectively.

Once we have a clearer picture of how much methane pollution is produced in Australia, we can take more targeted and effective action to cut it. Most of these opportunities will be found in three major sectors of the Australian economy: fossil fuels, agriculture and waste.

PRIORITY STEPS TO IMPROVE MEASURING AND REPORTING OF METHANE POLLUTION IN AUSTRALIA

- Mandate that all coal, oil and gas facilities report their methane emissions using direct measurement under the *National Greenhouse and Energy Reporting (NGER) Act 2007,* in every instance where this is possible. As part of the reporting process, source-level measurements should be verified against onsite measurements to ensure accuracy. Measurement practices should reflect the Oil and Gas Methane Partnership 2.0 framework's highest standards (for oil and gas), the Steel Methane Partnership (for coal), and be kept up to date with international best practice. Reforms for oil and gas should be implemented by mid-2025, and for coal by mid-2026.
- Improve transparency of emissions data by separating out carbon dioxide, methane and other major greenhouse gases in all public reporting by the Clean Energy Regulator – not just that related to Safeguard Mechanism facilities.
- Where the carbon dioxide equivalent metric is used, the Clean Energy Regulator should report both GWP20 (energy absorbed by a gas over 20 years) and GWP100 (energy absorbed by a gas over 100 years), to provide a more transparent picture of the near-term impacts of methane pollution.
- Update the National Greenhouse and Energy Reporting (NGER) Act to require agriculture businesses that exceed the publication thresholds to report their climate pollution – including methane – in the same way as big polluters in the energy and industry sectors. As an initial step towards this, the government can support agricultural producers in the development of an official standard or framework for farm level greenhouse gas accounting, to ensure integrity and transparency.

Within this framework, different greenhouse gases, including methane, should be reported separately, and in absolute terms (i.e. millions of tonnes) rather than carbon dioxide equivalent.

OPPORTUNITY #2

Ensure fossil fuel companies cut methane pollution while we phase out production

The faster we can move away from burning fossil fuels, the faster we can move towards a stable climate for future generations. This is true when it comes to preventing long-term pollution from carbon dioxide *and* methane. Every coal mine and gas plant produces methane pollution during the mining and processing of these fossil fuels. Scaling down and phasing out the production of fossil fuels is the only way to permanently deal with this share of methane pollution.

Australia should stop approving new coal and gas projects as a first important step towards a full phase out of fossil fuel production (Climate Council 2024). But while we work towards the phase-out of fossil fuel mining, there are also practical actions to take now that can slash methane pollution in the meantime. These actions are essential to drive down harmful pollution this decade, during the make-or-break years for preventing the worst of dangerous warming. It has been estimated that 65 percent of Australia's methane pollution from coal, oil and gas could be cut using existing technology costing less than $30 per tonne of carbon dioxide equivalent pollution, while up to 50 percent of this could actually be captured for a profit (Rystad Energy 2023). The International Energy Agency estimates that about US$170 billion will be needed to deliver all possible methane reduction measures across the fossil fuel industry globally (IEA 2024). This represents less than five percent of income from fossil fuels in 2023, highlighting the industry's capacity to take responsibility for this problem.

CUTTING METHANE FROM COAL MINING

In 2020-21, Australia was the world's largest exporter of metallurgical (coking) coal used in steelmaking, and the second largest exporter of thermal coal after Indonesia, with these rankings expected to continue until 2029 (DISR 2024). Methane trapped in coal seams escapes during mining and processing. In surface, open pit and open cut mines, methane is released as the coal seams are broken up.

In underground mines, methane is often drained and vented directly into the atmosphere prior to mining because it is highly explosive and poses a safety hazard. The US Environmental Protection Agency estimates this type of methane represents around 75 percent of pollution from underground mining, and is the largest contributor to coal mine methane (EPA 2023). Even after production ends at these coal mines, methane continues to escape from disused shafts for decades, although good data on the extent of this problem is lacking (Ember 2022).

Unlike other coal producing countries, Australia mostly mines coal using open cut mining methods. In NSW open cut mines now make up 80 percent of production. It's a similar situation in Queensland, with the top 10 producing mines being open-cut facilities. Australia's biggest coal mines are also getting larger and increasing their production (IEEFA 2023b).

"Methane abatement in the fossil fuel industry is one of the most pragmatic and lowest cost options to reduce greenhouse gas emissions."

— (IEA 2024)

In Australia, methane accounts for approximately 95 percent of direct (Scope 1)[2] pollution from underground mines and about 40 percent from open pits (CCA 2023a). Open cut mines are responsible for approximately 75 percent of Australian coal production (IEFFA 2023b). We are the world's sixth-largest coal mine methane polluter and look set to rapidly rise up the ranks. This is because Australia has the most coal mines under development globally, aside from China and Russia. The development of all these mines would send Australia's methane pollution skyrocketing even further (Ember 2022).

Beyond phasing down and then ending coal production, a key avenue for cutting this pollution is to drain and capture methane from coal mines before production. Methane is vented from underground coal mines (called 'ventilation air methane') for safety reasons but the gas is not captured. Technology is now available for destroying methane that is currently vented from underground coal mines using regenerative thermal oxidation (producing carbon dioxide and water). This technique is already being used at mines around the world but has had limited uptake in Australia. If this technology was used in all of Australia's underground mines, it could almost halve fossil fuel methane pollution nationally (Ember 2022). This would be a good start, but the coal methane problem won't be fully solved until coal mining is phased out completely.

Given the inevitable demise of coal mining as renewables increasingly replace fossil fuels, it is not only active mines that need attention. In the future, emissions from closed or abandoned mines are expected to increase faster than from active mines (Kholod et al. 2020). There are more than 50,000 abandoned mine sites (including coal and gas) in Australia but there is no national database tracking their status or pollution levels (Salmi 2022). Understanding the scale of the problem with abandoned mines is critical, so we can put in place the right actions to deal with methane from these sources as well. Options for preventing methane leaks from inactive coal mines include sealing and putting drainage systems in place to capture emerging gas (IEA 2023d). Mines can also be flooded, although this practice may pose long-term contamination risks and can have very high water requirements (IEEFA 2024). All mining companies should be required to comprehensively plan for emissions control beyond the end of operations. This includes ensuring all environmental approvals are obtained, all community consultation has occurred, all necessary water and other licences have been acquired and sufficient funds are set aside from today.

As outlined in the previous section, the first step towards reducing methane from fossil fuel mining and processing in Australia is to increase the accuracy of measurement and transparency of reporting. Aligning Australian Government reporting requirements with international best practice can ensure our open cut and underground coal mines all report accurately on their climate pollution (Ember 2024). Together, improving transparency and requiring coal companies to take practical, affordable steps to cut their methane pollution can help reduce the climate-wrecking impact of this mining while we move towards phasing out coal altogether.

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2 Scope 1 emissions are those produced by a particular company or other entity (e.g emissions released from a company's smokestacks). Scope 2 emissions are indirect emissions produced to generate the power used by a company. Scope 3 emissions are indirect emissions produced in the consumption or use of a company's goods or services (such as those produced by burning coal exported overseas).

CUTTING METHANE FROM GAS PRODUCTION

Australia's gas industry is directly responsible for at least 7 percent of climate pollution nationally, about the same as the pollution of all trucks, trains, planes and ships combined. Two-thirds of this pollution comes from methane leaks and the burning of methane during the process of liquefying gas for export (DCCEEW 2023).

Proponents of the gas industry frequently hold up this energy source as being 'cleaner than coal' and an 'important part of the clean energy transition'. But leakage of fugitive methane emissions from a gas mine or processing facility of as little as 4.2 percent is enough to make gas just as bad as coal in its climate-warming impact (Gordon et al. 2023).

Methane pollution from the gas industry occurs in two main ways: unintentional leaks from wells and pipelines along the production and distribution process, and the direct venting and flaring of gas. Both can be addressed through relatively simple facility upgrades and new regulations for handling gas.

The International Energy Agency has estimated that upgrading ageing equipment and detecting leaks could slash methane pollution from oil and gas production by 75 percent, with no technological breakthroughs needed (IEA 2023a). Recommendations include replacement of pressurised gas pumps and controllers with electric or air systems; replacement of gas-powered pneumatic devices with electric motors; early replacement of devices with versions which have lower methane release rates; regular replacement of compressor seals and rods; and the capping of unused wells (UNEP & CACC 2021). For the gas sector, reducing methane pollution is cost-effective because the cost of abatement measures is very often less than the market value of the additional gas that is captured (IEA 2023a).

Figure 8: Projects like the Kenya coal seam gas project in Queensland involve digging multiple wells across large tracts of land. Each individual well can be a source of methane leaks.

While detecting and eliminating leaks from infrastructure makes obvious sense, oil and gas companies must also stop engaging in the wasteful practices of flaring and venting. Flaring is the combustion of fugitive emissions which converts most of the methane into carbon dioxide. Venting is the intentional release of the gas to the atmosphere. Both flaring and venting can also release contaminants such as heavy metals, black soot and sulphur dioxide which are damaging to our health. As noted earlier, methane emissions also lead to the formation of ground-level ozone, which has widespread impacts on human health, agriculture and natural environments. From 2005 to 2022, venting and flaring emissions from oil and gas activities in Australia increased by 124 percent (CCA 2023b).

Banning venting and flaring is an important way to prevent the release of many different pollutants into the air we breathe. The IEA has noted that stopping all non-emergency flaring and venting would be the single most effective measure to reduce methane pollution from the oil and gas sector. Gas that would otherwise be vented can be recovered with technology like vapour recovery units and well plungers (UNEP & CACC 2021).

PRIORITY STEPS TO CUT METHANE POLLUTION FROM COAL MINING OPERATIONS

- End the approval of new and expanded coal mines, and require the highest emitting mines to cut their methane pollution as a condition of continued approval to operate.
- Require underground coal mines to capture and destroy methane that is currently vented into the atmosphere.
- Develop a comprehensive database of all inactive and abandoned coal mines and their pollution levels.
- Require all mining companies to comprehensively plan for methane mitigation beyond the end of operations. This includes ensuring all environmental approvals are obtained, all community consultation has occurred, all necessary water and other licences have been acquired and sufficient funds are set aside from today.

PRIORITY STEPS TO CUT METHANE POLLUTION FROM OIL AND AND GAS OPERATIONS

- End the approval of new oil and gas extraction and processing facilities.
- Require that facility operators monitor and repair infrastructure leaks and institute substantial penalties for major leaks that are not quickly fixed.
- Ban all non-emergency flaring and venting of gas.

The Australian Government should prioritise these measures in the sector pathways under development for the energy and resources sectors, to help drive deeper and faster cuts to climate pollution this decade beyond current national plans.

OPPORTUNITY #3

Scale up emerging solutions for cutting methane pollution from agriculture

Methane pollution from fossil fuels is the most straightforward source to deal with, and focused action this decade can slash the amount of this harmful greenhouse gas in our atmosphere – with rapid benefits for near-term warming.

But as we deal with fossil fuel methane, we must also tackle other major sources of this gas. The agricultural sector is responsible for nearly half of global methane pollution, mostly from ruminant animals such as cows and sheep (Ivanovich et al. 2023). This means that the way in which we produce and consume our food is also a high priority for action.

In many developed countries, including Australia, there is growing interest in plant-based diets because of the benefits for both our health and the climate. But around the world, meat consumption continues to rise. Global meat consumption is expected to increase 14 percent by 2032, driven by ongoing population growth and rising incomes in a range of less developed countries (OECD-FAO 2023). As people become wealthier, they tend to eat more meat and dairy.

This projected increase in the consumption of meat and dairy has huge implications for global warming. Climate pollution from animal-based foods is twice that of plant-based foods (Xu et al. 2021). A recent study has projected that global food consumption could contribute almost 1°C above current warming by 2100 (Ivanovich et al. 2023). This increase alone would push us far beyond the Paris Agreement target of holding global temperature rise as close as possible to 1.5°C. Methane pollution would be responsible for nearly 60 percent of this estimated increase in warming, demonstrating the outsized role it plays in climate pollution from agriculture.

Breaking down this projected additional warming further, dairy and meat consumption account for about half of the expected warming increase, followed by rice at 19 percent. Vegetables, grains, seafood, eggs and other foods are expected to contribute 5 percent each or less (Ivanovich et al. 2023). These estimates assume no change in consumption patterns, but given that global consumption of meat and dairy is growing, as noted above, the contribution of these products to future warming is likely underestimated.

Agriculture was responsible for over half of Australia's methane emissions in 2022-23, the largest share of any single sector (DCCEEW 2024). Cutting climate pollution from agriculture – including methane – is generally assumed to be a bigger challenge than from fossil fuels because there are currently fewer proven, scalable and affordable solutions. But we need to drive down climate pollution from all sources further and faster this decade, so we cannot ignore this important sector. Where pollution from energy production has been falling in Australia, it has been rising in agriculture in recent years (CCA 2023b). This is mainly due to a bounceback in the number of animals being raised and increased crop production as large parts of Australia have moved out of long-running drought (DCCEEW 2024).

In 2022-23, nearly 65 percent of the climate pollution from Australian agriculture came from methane burped out by cattle (CCA 2023b). Most of these animals are raised for meat or dairy that is sold overseas; for example, we export around two-thirds of all beef produced in Australia. There is significant research and investment underway to find solutions to methane pollution from the Australian meat industry. In 2017, the peak industry body, Meat and Livestock Australia, set a goal of being carbon neutral by 2030 (MLA 2020). The industry body claims to have spent more than $180 million on projects to reduce methane and other types of climate pollution, in collaboration with government and commercial partners (MLA 2023a). Meat and Livestock Australia is also an investor in the $167 million Zero Emissions Agriculture Collaborative Research Centre, recently established between 74 partners from industry, universities and governments. The Centre aims to drive action to achieve net zero pollution from agriculture from 2040, and below net zero emissions by 2050 – although this would be achieved with a significant reliance on carbon offsets.

Seeing this part of the agricultural industry embrace the urgency of cutting methane and other greenhouse gases is a welcome step. Now we need to accelerate these efforts to drive down climate pollution from every possible part of our food system. The top priorities are to deal with methane pollution from cattle, sheep and rice, while also scaling up the production and promotion of good alternatives to meat and dairy so we are all better informed about choices of food that pollute less.

We cannot ignore the fact that agriculture in Australia is currently responsible for around 50% of estimated methane emissions.

CUTTING METHANE FROM MEAT AND DAIRY PRODUCTION

Cows, sheep and goats produce methane as a byproduct of digesting and metabolising food – a process called enteric fermentation. About 95 percent of this methane is burped out to the air; a dairy cow can produce more than 400 litres of methane each day (Henry & Eckard 2009).

Just as methane emissions from fossil fuels appear to have been substantially under-estimated, both globally and in Australia, new Australian research indicates that the same may be true for the livestock sector. Information on cattle numbers is generally obtained from surveys of cattle businesses, not direct counts of cattle being raised. This leads to an estimate of around 25 million cattle in the national herd, with some fluctuation during droughts (Mayberry et al. 2018). However, new estimates indicate there may be about 10 million more cattle in Australia, with the national herd actually averaging about 35 million (Fordyce et al. 2023). If correct, this means the amount of methane produced from animal agriculture may be up to a third higher than previously thought.

Emerging solutions to cut methane from cattle are primarily focused on feed supplements. For example, supplements derived from the red seaweed *Asparagopsis* and the chemical 3-NOP (3-Nitroxypropanol) have already been piloted and are starting to be scaled up for delivery across some agricultural businesses. Early, relatively short-term studies suggest supplements like these can significantly reduce the amount of methane animals burp out, by up to 90 percent for *Asparagopsis* and 40 percent for 3-NOP (Black et al. 2021). Selected farmers have been trialling *Asparagopsis*-based feed supplements for four years with no negative impacts on the animals so far (S. Elsom pers. comm).

Figure 9: Red seaweed *Asparagopsis* under commercial production at Sea Forest, based in Tasmania. Sea Forest is poised to become one of the largest suppliers of *Asparagopsis*-based supplements (marketed as SeaFeed™) in the world and could produce enough feed for five million cattle.

While feed supplements are an exciting innovation for their potential to cut methane pollution, there are still a number of practical obstacles to overcome before these solutions can be used widely. These include the scale of production needed for inputs like *Asparagopsis*, and the fact that animals need to eat supplements daily for them to be effective. This is technically possible for dairy and feedlot cattle, but is less practical for most of Australia's cattle and sheep, the vast majority of which graze on rangelands (Ridoutt 2023).

Other solutions for animal methane are still being researched such as:

- vaccines which target methane-producing organisms living in the animal gut;
- the use of water sources and salt licks to deliver feed supplements;
- selective breeding for genetic variants of cattle which naturally produce less of this pollution;
- increasing productivity per animal;
- using certain species of pasture legumes as food.

All of these approaches show promise, but need ongoing research and development. The contribution of different solutions to climate pollution from agriculture is also complicated by the fact that some solutions to reduce methane may be associated with an increase in other greenhouse gases through production of new foods, feed additives or animal waste (Beauchemin et al. 2022).

As emerging options to cut climate pollution from agriculture are further developed, regulatory solutions will likely be required to ensure they are taken up. As outlined above, the Australian Government can set a clear direction for the sector by bringing large agricultural producers into the Safeguard Mechanism from a set future date such as 2030. This would give the industry time to identify the most feasible and affordable solutions, while providing strong signals about their upcoming necessity.

In parallel, methane reduction activities can also be recognised by the Australian Government's Emissions Reduction Fund framework, so that farming businesses can generate Australian Carbon Credit Units (ACCUs) by deploying them. At present, farmers using feed supplements to reduce methane production in cattle and sheep must absorb the additional cost – a strong disincentive to widespread uptake. Developing a robust and effective ACCU method in close collaboration with the livestock sector would give agricultural producers better financial incentives to cut methane pollution from their animals.

CUTTING METHANE BY SCALING UP AND PROMOTING ALTERNATIVES TO MEAT

In addition to researching ways to reduce the climate impacts of meat production, there are also opportunities to meet our needs with other food options that have a smaller environmental and climate impact.

Livestock agriculture has been estimated to take up 83 percent of the world's farmland and produce 60 percent of agricultural climate pollution (Poore & Nemecek 2018). A detailed study comparing the climate pollution and land use requirements of the 40 food types that collectively make up 90 percent of human diets found that even the lowest impact meat and dairy products cause far more environmental damage than the cereals and vegetables which have the highest impact (Poore & Nemecek 2018). One glass of dairy milk, for example, produces three times the climate pollution of any plant-based milk, and consumes nine times more land. Poore and Nemecek (2018) estimated that if we were to stop producing meat and dairy from animals, global land use for agriculture could be reduced by more than 75 percent and still feed the world.

Other studies have reached similar conclusions. Reducing meat and dairy consumption globally could decrease anticipated warming due to food consumption by more than 21 percent, while delivering positive health benefits (Ivanovich et al. 2023). A study of diets in the UK found that even reducing consumption of meat and dairy by one-third in that country would cut methane pollution by around six million tonnes a year (Green et al. 2015).

Australians are big meat eaters. In 2020, Australia was estimated to have the third highest per person consumption of meat in the world at 145 kilograms per person per year, just behind the United States and Portugal (Our World in Data 2020). But things are gradually changing. In 2019, a survey by the Roy Morgan company found that about 12 percent of Australians (nearly 2.5 million people) had diets that were fully or mostly vegetarian (Roy Morgan 2019).

It's possible that we are on the cusp of the most disruptive and rapid change to how we produce protein for food since animals were first domesticated 10,000 years ago (Rethinkxx 2019). In the past decade, research has focused on using genetically modified yeast and other microbes in a process known as *precision fermentation* to produce what cows, sheep, chickens and other animals have traditionally provided. Essentially, these microbes are engineered to become tiny production factories, in a similar way to how insulin is made for diabetes sufferers, and rennet for cheese is produced. The products in development, and already being marketed, include all forms of meat plus eggs, milk, cheese and whey protein. Some of the companies investing in the technology are traditional livestock producers, including the New Zealand dairy giant Fonterra, which clearly recognise the potential disruption to their industries and are getting ahead of the game (AFN 2024). Australian startup company Eden Brew has attracted more than $25 million in investment and could have animal-free milk in our supermarkets by 2025 (ABC 2023).

At present, the main limitation for precision fermentation technology is yield – scaling up the process to produce commercial quantities of food is expensive. But CSIRO's 2022 Protein Roadmap projects that the industry could be worth between $750 million and $2.2 billion in Australia by 2030 (CSIRO 2022). Scaling up affordable, healthy and appealing protein alternatives to animal meat could be an important opportunity to slash methane pollution while ensuring we all still have diverse food choices.

At the same time, more Australians may choose to eat less meat and dairy products – or go vegetarian or vegan altogether – if they were more aware of the significant climate and environmental impacts of food production and the available alternatives. Consumer education campaigns and point of sale information about the health, environment benefits and impacts of different types of food can help people to make informed choices that suit their needs and preferences. Tools like the ecoSwitch app produced by The George Institute for Global Health are already helping consumers to better understand the climate impact of their food choices.

CUTTING METHANE FROM RICE PRODUCTION

Beyond burping cows and sheep, the production of rice creates around 8 to 11 percent of global methane pollution from human activities (Saunois et al. 2020, UNEP 2021). As with meat, rice plays a huge role in our diets, feeding up to a third of the global population. Rice is generally grown in flooded paddy fields, where water stops oxygen from penetrating the soil. This creates the ideal conditions for methane-producing bacteria.

In 2023, around 70,000 hectares of Australian land was used for growing rice, across approximately 1,500 agricultural businesses (ABARES 2023). Most rice is grown in the Murrumbidgee Valley, NSW and the Murray Valley of NSW and Victoria. Smaller pockets of rice farming are also based in the NSW Northern Rivers region, and the tropical zones of Far North Queensland (AgriFutures Australia 2018).

One of the few studies aimed at testing methods to reduce methane emissions from rice growing in Australia found that drill sowing and delaying the flooding of rice fields can reduce emissions by more than 50 percent without affecting emissions of nitrous oxide – another greenhouse gas (AgriFutures Australia 2018). Drill sowing also has the advantage of reducing water use without affecting yields, a win-win. Around 60 to 70 percent of rice farmers in Australia now use this sowing method, and many delay flooding their fields with water until late in the year, reducing anaerobic decomposition and therefore methane (N. Bull, pers. comm). There are also alternative dryland rice production methods in some regions that may result in a significant reduction in methane compared with traditional paddy field methods.

More research is needed to understand the best opportunities to cut methane pollution from rice production – in Australia and across Asia, where the majority of the world's rice is grown. More collaborative research between the rice industry, governments and universities can help identify solutions which can see Australia lead the way on dealing with our own methane pollution, and then help other countries in our region to do the same.

Cutting methane pollution from agriculture will call for a more diverse mix of solutions than in the fossil fuel sector, some of which are still under development. But as we cut all forms of climate pollution further and faster this decade by rolling out clean energy solutions, this pollution from agriculture will become a larger share of what's left. This means producers, governments and communities need to make a focused effort now to identify the right solutions, so we can get on with delivering them in the years ahead. No plan for cutting climate pollution is complete without a plan to cut methane – and other – pollution in agriculture, no matter how hard to abate some sources seem today.

PRIORITY STEPS TO CUT METHANE POLLUTION FROM FOOD PRODUCTION

- Support multi-year, large-scale livestock trials under a range of Australian environmental conditions to better quantify methane reduction and productivity impacts of feed supplements and other emerging solutions. In particular, research on options to reduce methane from rangeland grazing systems, such as slow-release supplements and pasture legumes, is critical.
- Set a clear direction and effective market incentives for animal producers by identifying a future date when large agricultural producers will be brought into the Safeguard Mechanism.
- Incentivise farmers to cut methane pollution from their animals by enabling them to generate Australian Carbon Credit Units (ACCUs).
- Invest in further research to assist rice growers to minimise methane, and understand impacts of different management practices on the interaction between soil carbon sequestration, methane and other types of climate pollution.
- Enable the scale-up of production of safe and healthy protein alternatives to animal meat and dairy, including by providing clear regulatory pathways for securing review and approval of new food products where this is needed.
- Support consumer education campaigns and point of sale information on the environmental and climate impact of different types of food, to support informed consumer choices.

The Australian Government's net zero pathway for agriculture should prioritise implementation of the practical measures farmers can take now, together with more research and collaborative development of solutions which are still being tested.

OPPORTUNITY #4

Collect and process waste better to avoid more methane from landfills

About 11 percent of Australia's methane pollution comes from waste, including landfills, wastewater treatment, waste incineration and the biological treatment of solid waste (DCCEEW 2024). Around 97 percent of landfill pollution consists of methane (Blue Environment 2022), produced as organic matter decays under anaerobic conditions. Fortunately, there are ways to both capture and use this gas to make energy, and to stop it being produced in the first place.

Keeping organic waste out of landfill is the best way to stop methane pollution being produced as it breaks down. About 92 percent of Australia's food waste ends up in landfill (Clean Up Australia 2024). Less than 40 percent of local governments provide a dedicated collection service for food organic and garden organic (FOGO) waste which allows residents to separate these out from other waste for kerbside collection (DCCEEW 2023c). Rolling out FOGO services across the country will generate a separate waste stream that can be recycled in dedicated facilities, rather than becoming more waste in landfills where it produces methane pollution. Composting FOGO waste has been shown to significantly cut climate pollution compared with landfilling.

Methane pollution from waste that is already in Australia's landfills can also be captured and used to generate energy (CCA 2023b). Methane released from the decomposition of natural materials, like sewage, food and agricultural waste, is sometimes referred to as 'biomethane', 'biogas' or 'renewable natural gas'. If this methane is captured, it can be used for energy production. By being burned, it does eventually get converted to carbon dioxide, which is released to the atmosphere. However, if this carbon dioxide is fully absorbed by plants during photosynthesis, there is no net increase of carbon dioxide in the atmosphere. This is why biomethane is sometimes referred to as 'green'. Biomethane is chemically identical to fossil gas, and can be transported in the same pipelines – for example to be used for industrial purposes.

Biomethane is not expected to be a major alternative fuel replacing fossil gas. For example, analysis by the Grattan Institute indicates that this fuel could provide about a third of the energy currently produced from fossil gas in Australia – at most – and only if significant economic, technical and logistical issues in its production could be overcome (Wood et al. 2023). Chief amongst the problems is that biomethane is currently more expensive than fossil gas, and will likely remain so. The feedstocks to make it are also unevenly distributed around Australia, leading to significant transport costs. The bottom line is that biomethane is no substitute for wide-scale electrification and uptake of renewable energy, decarbonising industry and transport systems, and using energy more efficiently. But there are some limited and near-term uses for biomethane from existing landfills, and increasing how much methane is captured for this purpose represents another positive way to stop this pollution being released into our atmosphere.

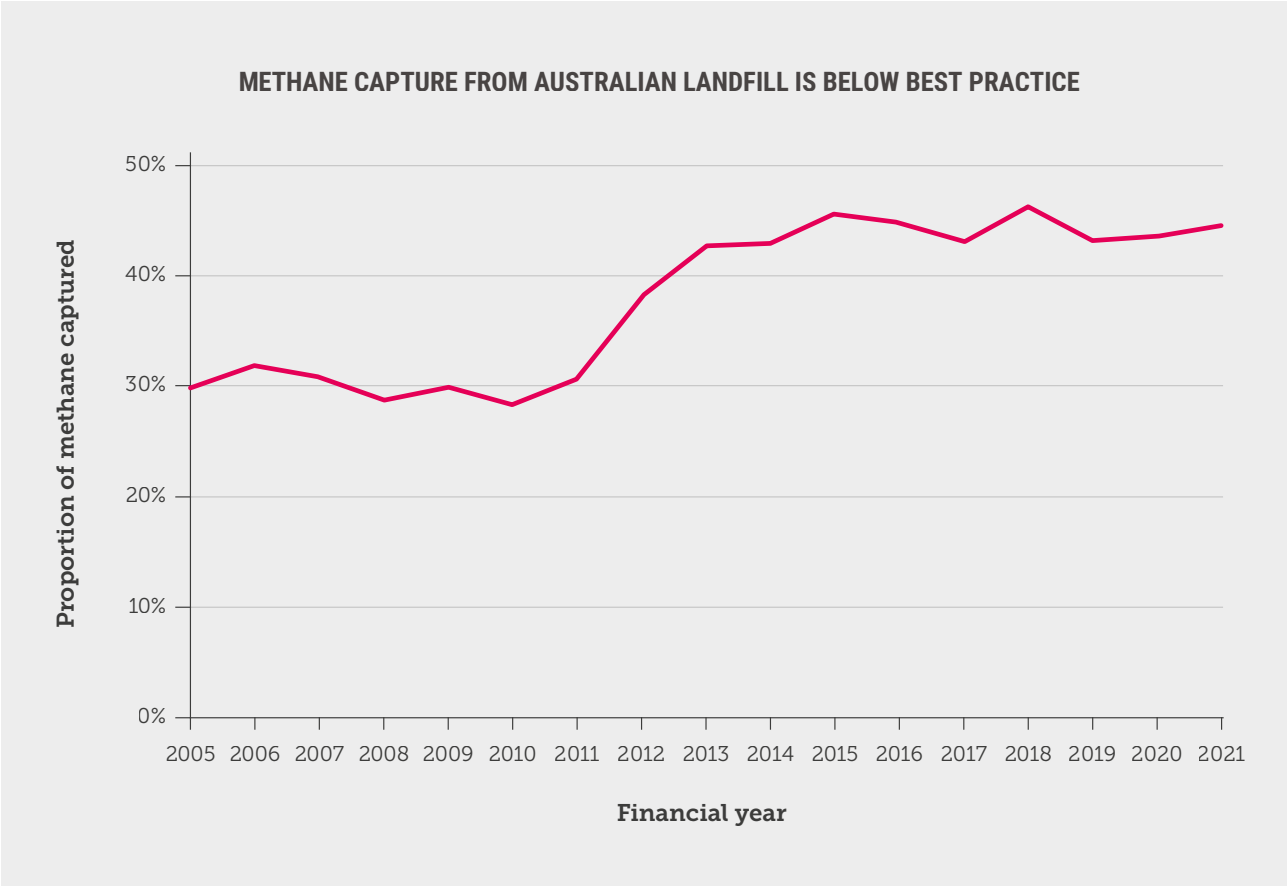

Figure 10: Rates of methane capture from Australian landfill sites have been rising over the past decade, but are still significantly below international best practice.
Source: DCCEEW (2023d)

At the moment, less than half of the methane from landfill is captured and used for energy (Figure 10). This is well below rates in other countries like the UK and USA where rates of capture up to 80 percent have been achieved in well-designed landfill sites (CCA 2023b). Using environmental and pollution laws to tighten requirements for methane capture from landfills would be a direct way for federal and state governments to ensure more of this resource gets used, and cut its environmental harm.

In relation to methane from wastewater processing, a recent analysis by Jazbec et al. (2023) found that by modifying existing facilities, these could also be employed to process organic waste. These facilities already use anaerobic digesters to process sewage and generally have excess capacity that could, with the right incentives, produce valuable compost for fertiliser and divert landfill waste.

As UN Secretary General Antonio Guterres once memorably put it, we need to do "everything, everywhere, all at once" to slash climate pollution this decade and prevent the worst impacts of dangerous climate change. Dealing with methane from waste is a straightforward step we can take, with technologies and business models already in place today, to see this sector play its part in driving down climate pollution right across the Australian economy.

PRIORITY STEPS TO CUT METHANE FROM WASTE

- Increase investment to roll out food organic and garden organic (FOGO) collection services across every local government in Australia and divert waste from landfill.
- Tighten federal and state requirements on landfill operators to capture gas at all landfill sites where there is significant methane pollution, and require capping of sites where this is more limited.
- Increase research and investment support to modify wastewater treatment plants to process household food and other organic waste.

Plans for cutting climate pollution from waste will be dealt with in the Australian Government's industry net zero plan. Incorporating these actions into that plan will help drive down another important source of harmful methane.

OPPORTUNITY #5

Set clear targets for cutting methane pollution to get Australia on the right track

This report highlights the practical steps that are possible now to cut methane pollution and help deal with its climate heating impacts. Across fossil fuels, agriculture and waste, Australia needs direct action on methane that builds on existing plans to cut climate pollution. This can help us cut harmful pollution further and faster this decade, in line with what the science tells us is necessary to avoid the worst impacts of climate change.

The Australian Government has already committed to cutting methane pollution by signing the Global Methane Pledge aimed at reducing global methane emissions 30 percent – compared to 2020 levels – by 2030. More than 150 countries have also signed, accounting for around 55 percent of global energy sector methane emissions in 2023. The signatories to this pledge include three of Australia's largest importers of Australian coal and gas – Japan, South Korea and Vietnam – which collectively account for nearly 50 percent of Australia's fossil fuel exports (ERI 2023).

The government now needs to back up this commitment to action by establishing clear national targets. State and territory government plans for cutting climate pollution can also be updated to track progress on cutting the main greenhouse gases separately, and include new actions directly targeting methane. Many other governments around the world are moving decisively in this direction, providing evidence that cutting methane pollution is not just necessary but achievable (Appendix A).

Figure 11: The Global Methane Pledge Ministerial meeting during the United Nations Climate Change Conference held at Expo City in Dubai, United Arab Emirates on December 4, 2023.

During 2024, the Australian Government is leading a detailed national policy conversation to develop an updated Net Zero Plan, with sectoral pathways for cutting climate pollution in six key areas of our economy, and Australia's next Nationally Determined Contribution (NDC) under the Paris Agreement. There is thus a timely opportunity to incorporate stronger targets and actions on methane to accelerate Australia's efforts to cut this type of climate pollution.

Greenhouse gases are not created equal. Methane does far more harm in the near term than other types of climate pollution. Focused action to cut methane pollution at its source now is essential, alongside action to phase out fossil fuels and deal with longer-lasting carbon pollution.

To slash methane pollution, Australia must set clear national targets backed by action.

PRIORITY STEPS FOR GOVERNMENT LEADERSHIP ON CUTTING METHANE POLLUTION

Government policy, regulation and investment will be essential to seize the opportunities for cutting methane pollution identified throughout this report. The following improvements to Australia's current federal, state and territory climate frameworks can underpin this important work:

- Establish a national methane reduction target, consistent with Australia's commitment to the Global Methane Pledge and with the 1.5°C ambition of the Paris Climate Agreement, and include this target in our next Nationally Determined Contribution due in 2025 – Australian Government.
- Incorporate specific plans for dealing with methane into Australia's Net Zero Plan under development, and include specific targets and actions driving rapid cuts to methane pollution in the Energy and Electricity, Resources, Agriculture and Industry and Waste sectoral plans which will feed into the Net Zero Plan – Australian Government.
- Update climate pollution reduction plans and targets to specifically address methane, and update policies and regulation as needed to deliver these – state and territory governments.

6. Conclusion

We are in a climate crisis. 2023 was the hottest year on record and already – for certain months – the world is exceeding 1.5°C of global warming. We need to pull out all the stops to ensure a safer climate for our kids.

Focused action to slash methane pollution is a vital part of tackling our climate pollution problem. The short lifespan, enormous warming potential, and accelerating concentration of methane in the atmosphere means that we can make a huge difference to how much warming we will experience if we deal with it now.

As one of the world's largest exporters of fossil fuels, and a significant supplier of agricultural products, Australia is also a significant contributor to the global methane problem. We can, and must, change this.

That means phasing out the mining, burning and exporting of fossil fuels as quickly as possible. It calls for measuring methane accurately, reporting it transparently, and holding large methane emitters accountable. It means we must support the agricultural industry and the waste sector to develop and apply new solutions to methane pollution. And it means giving Australians more choice and information about the impacts of our food system.

Australia is a signatory to the Global Methane Pledge, aiming to cut methane pollution 30 percent by 2030. Right now, this is just a promise, not a plan. We can't take our foot off the pedal to cut carbon dioxide emissions, but at the same time, we need to focus on the next wave of federal and state policy and action to cut methane pollution further and faster this decade, and all the way to net zero by 2035.

Australia's next Nationally Determined Contribution for 2035 and the new Net Zero Plan are important opportunities to embed action on methane in the national climate action agenda. Let's make this the moment Australia ramps up effort on carbon dioxide and methane together, because this is what it will take to ensure a safer climate and future for our kids.

"Mitigation of methane is very likely the strategy with the greatest potential to decrease warming over the next 20 years."

— UNEP & CACC 2021

Appendix A: International action on methane

Since the ratification of the Paris Climate Agreement, international focus on the role of methane in the climate change crisis has been growing. Of the 174 signatories to the Paris Climate Agreement in 2015, only nine originally set a separate target for methane emissions. By COP 28 in Dubai in 2023, a host of new pledges to accelerate action on methane were announced.

The International Energy Agency estimates that if all the current pledges and policies are implemented and achieved in full, methane emissions from fossil fuels could be cut 50 percent by 2030 (IEA 2024).

Apart from the Global Methane Pledge, methane-focused international initiatives and organisations include: the World Bank's Global Flaring and Methane Reduction Partnership; the Global Methane Hub; the Oil & Gas Decarbonisation Charter; the Methane Alert and Response System; the Oil and Gas Climate Initiative; and the Joint Statement on Accelerating Methane Mitigation from the LNG Value Chain.

There are also a number of organisations providing free tools and resources for methane abatement, including the Global Methane Initiative; the Methane Guiding Principles; the Country Methane Abatement Tool (COMAT) and the Methane Roadmap Action Programme (M-RAP).

Examples of how other countries are acting to reduce methane emissions are shown in Table 1.

Table 1: Examples of international commitments and practices for reducing methane. Note this is not an exhaustive list.

Country/Jurisdiction	Plans & Policies
 **European Union**	The EU is the world's largest importer of natural gas. By 2030, importers of fossil fuels into the EU will face financial penalties if they buy from foreign suppliers that don't comply with strict methane intensity regulations. There will also be new requirements for the oil, gas and coal sectors to measure, report and verify methane emissions from both active and closed wells and mines, and to regularly check for and fix methane leaks in their operations. Routine flaring and venting will be banned from drainage stations by 2025, and from ventilation shafts from 2027 (European Commission 2023).
 **Canada**	The Canadian Government published its 'Proposed Regulatory Framework for Reducing Oil and Gas Methane Emissions to achieve 2030 target' in 2022, aiming to achieve at least a 75 percent reduction relative to 2012. British Columbia and Alberta have also set strong emissions standards via legislated regulations. These are similar to Australia's Safeguard Mechanism but with methane-specific requirements. (Government of Canada 2022).
 **United Kingdom**	Methane emissions from the energy sector have reduced 84 percent in 2020 compared to 1990, mainly due to general decline in fossil fuel use. The 'UK Methane memorandum, 2022' will track methane reduction progress plans for future reductions (UK Government 2022). The memorandum aims to achieve zero routine flaring and venting by 2030 or sooner (Rennie Advisory 2023).
 **China**	China is the world's largest emitter of methane, producing nearly 16 percent of the global total (IEA 2023a). China published its National Methane Action Plan in 2023, focused on extraction and use of coal mine methane, and applying targets and restrictions on venting and flaring (IEA 2023c, China Dialogue 2023). Since the plan was published, China and the US have issued the Sunnylands Statement, which indicated that methane reduction actions will be included in their 2035 NDCs.
 **Japan**	In 2022, Japan joined a US-led declaration to specifically cut methane emissions from trade (ERI 2023). In July 2023, Japan's JERA and South Korea's Kogas initiated a program to reduce methane in the LNG supply chain (Hanson 2023).
 **USA**	The US is the largest methane emitter from the oil and gas sector (closely followed by Russia). The US EPA launched its Natural Gas STAR program in 1993 to provide a framework for companies with US oil and gas operations to implement methane reducing technologies and practices and document their voluntary emission reduction activities. In 2016, the EPA established an additional voluntary program, called the Methane Challenge, to encourage oil and natural gas companies to adopt cost-effective technologies and practices that improve operational efficiency and reduce methane emissions. The Inflation Reduction Act (2022) specifically addresses methane emissions (Rennie Advisory 2023). A charge of USD$900/ton on methane pollution in 2024 will rise to US$1500 in 2026 and thereafter will apply to most oil and gas companies. The Biden administration is aiming for an 87 percent reduction in methane emissions below 2005 levels by 2030 (EDF 2023).
 **Norway**	Norway introduced a methane tax on vented and fugitive methane emissions from offshore oil and gas installations in 2022 (IEA 2023b).
 **Uruguay**	Uruguay has set separate targets in its Paris Agreement Nationally Determined Contribution for methane, carbon dioxide and nitrous oxide. It aims to achieve 57 percent reduction in methane emissions intensity per gross domestic product by 2025 in the energy, waste, agriculture and industry sectors (Pekkarinen 2020).
 **New Zealand**	New Zealand has set a target in 2019 to reduce biogenic methane emissions 10 percent below 2017 levels by 2030, and 24 to 47 percent by 2050 (NZ Government 2023).

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The Climate Council acknowledges the Traditional Owners of the lands on which we live, meet and work. We wish to pay our respects to Elders, past and present, and recognise the continuous connection of Aboriginal and Torres Strait Islander peoples to land, sea and sky. We acknowledge the ongoing leadership of First Nations people here and worldwide in protecting Country, and securing a safe and liveable climate for us all.

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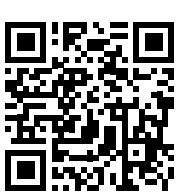

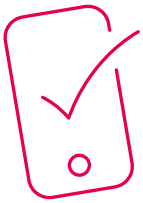

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