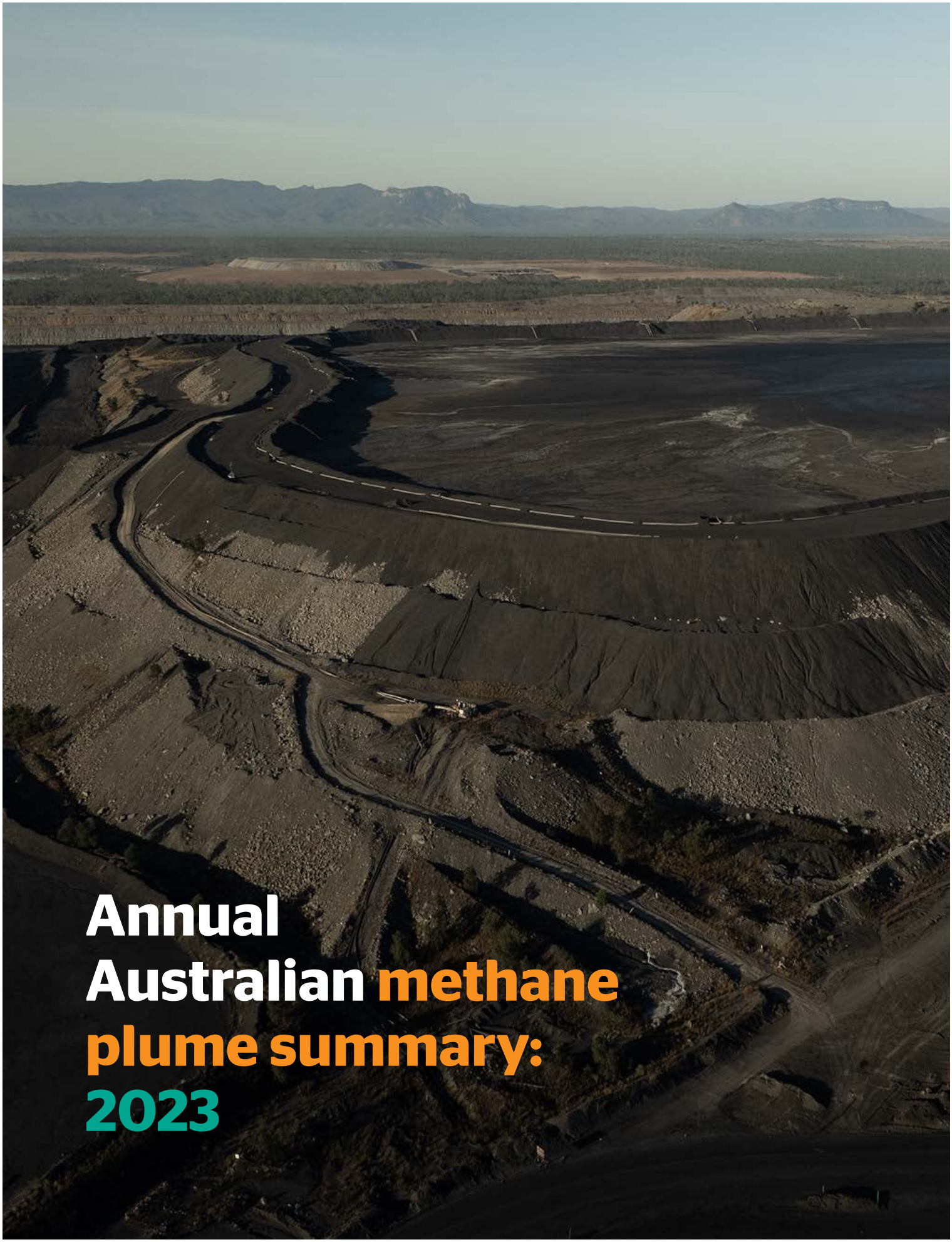


Annual Australian methane plume summary: 2023

AUSTRALIAN CONSERVATION FOUNDATION

Nature needs us, now

We acknowledge the Traditional Owners of Country and their continuing connection to land, waters and community. **We pay respect to their Elders past and present** and to the pivotal role that First Nations Peoples continue to play in **caring for Country across Australia.**

Cover. Hail Creek Mine *Photo.* Supplied
Right. APA compressor station *Photo.* CATF

Contents

Introduction

Methane is a super-polluting greenhouse gas that is 86 times more potent than carbon dioxide over a 20-year period and is accelerating destructive climate change.

Methane is responsible for around 30% of the rise in global temperatures since the industrial revolution and is making climate-fuelled disasters like bushfires, floods and extreme heat even worse.

Methane pollution in Australia is severely under-reported, with the International Energy Agency estimating that Australia is under-reporting methane emissions from coal and gas by at least 64%.

The fossil fuel industry is one of the largest sources of this dangerous pollution. Huge volumes of methane leak into our atmosphere from operating and disused coal mines and gas projects. Leaks occur in the transportation, production and use of these fossil fuels. Avoiding the worst of climate change means dramatic reductions in methane emissions from fossil fuels this decade.

New technology and publicly available data is making it possible to see just how big our methane problem is in Australia. This report reveals a number of significant pollution events from operating and retired coal mines that might otherwise have gone unchecked. Over recent years, a range of satellite missions have been launched that allow a never-before-seen insight into methane plumes - concentrations of dangerous methane gas big enough to be detected from space. Normally invisible to the naked eye, methane has a distinct infrared signature which these satellites can detect and measure.

Even the smallest detectable plume should be concerning - a methane leak at a rate of 1 tonne per hour is as bad for the climate as about 100,000 cars driving for that hour. The biggest single plume identified in 2023 was measured to be *80* times that much. Shockingly, four plumes were identified over the Glencore's Hail Creek coal mine in 2023, suggesting that an extended super-emitting event occurred in the middle of the year. The coal mine emitted 8,640 tonnes of methane in this period – more methane than their official government report said they previously released over a full year.

Many of the observations detailed in this report were made over or very near open cut coal mines, which, under Australia's current emissions measurement and reporting requirements, are assumed to release less methane than underground mines. **There is currently no obligation for most fossil fuel producers in Australia to directly measure the methane emissions**, nor is there any need for them to reconcile their emissions estimates that they report with blow-outs observed by third parties.

This report underscores a gaping hole in the system of calculating and reporting methane emissions in the energy industry. A fundamental flaw that undermines Australia's best efforts on emissions reduction and our chance to prevent the worst of climate destruction.

Right. Appin colliery VAM vents *Photo*. CATF

Key findings - by the numbers

- A review of publicly available data sources found that in 2023, 61 methane plumes were observed over Australia using different quantification techniques.
- **Almost all of these plumes occurred in regions with significant coal and gas infrastructure,** with 41 plumes located over regions that exclusively produce coal, 16 over regions that produce both coal and gas, and 1 over a region that exclusively produces gas.
- **Hail Creek open cut coal mine in Queensland continued its previously-identified pattern of unusual emitting behaviour** in 2023, with four significant methane plumes identified within one sixteen day period.
  - If the four plumes observed over Hail Creek were part of a single extended super-emitting event, then **that mine will have emitted at least 8,640 tonnes of methane in this period – more methane than their official government report said they previously released in an entire year.**
  - This has significant financial implications. In the first year of operation of the reformed safeguard mechanism, **Glencore will receive up to 150,000 undeserved safeguard mechanism credits for Hail Creek – with a value of several million dollars** – due to nothing more than the federal government's faulty emissions reporting.
- **Another site of concern is EDL's German Creek coal mine waste gas power station**, located at the site of the now closed Grasstree mine. This operation – which should be capturing and combusting methane from Anglo American's * underground coal mining operations nearby – was observed venting significant qualities of methane on three separate occasions over 2023.
  - To date this financial year, **the EDL facility has been issued with 124,000 Australian Carbon Credit Units** for its methane capture and combustion activity. One of the three plumes (28/11/2023) occurred within this period.
- Across the 61 plumes detected, the average plume was polluting at a rate of over 20,000 kg CH_4/hr. This is the same rate of methane emissions as around two million cows would produce over the same period.
- The biggest single event was located 3 kilometres from the Wambo coal mining complex in the Newcastle coal field. It had an emissions rate of 80,000 kg CH_4/hr. To use the same analogy as above, that's the methane emissions rate of eight million cows.
- 32 plumes were found in Qld with an average rate of 14,727 kg CH_4/hr and 29 plumes were found in NSW with an average rate of 26,800 kg CH_4/hr.

Key recommendations

1. **Mandate all existing Australian coal, oil and gas facilities to accurately measure and publicly report their emissions** by urgently reforming the National Greenhouse and Energy Reporting (NGER) scheme, including:

   a. Immediately increase the transparency of NGER CO_2e data by mandating the publication of emissions estimation methods, time-series data, and segmented greenhouse gases data for all facilities above 5,000 t;

   b. In Q2 of 2024, fund and establish a panel of relevant Australian and international subject matter experts to develop higher order emissions measurement methodologies for Australian open cut coal mines, utilising findings from the United Nations Environment Programme (UNEP). The panel should also assess the availability of the technology needed to implement direct source and site emissions measurement required for higher order methodologies. The panel should aim to report their findings by Q2 of 2025, with an intent to incorporate these findings into the 2025 NGER update;

   c. Urgently phase out methods 1, 2 and 3 emissions estimation methodologies once higher order methods have been established;

   d. In Q2 of 2024, fund and establish a panel of relevant Australian and international subject matter experts to develop independent verification standards for methane emissions from coal, oil and gas facilities. This panel should develop guidelines for verification activities, determine the process for resolving inconsistencies between reported emissions estimates and independent verification, and assess the availability of verification technology. The panel should aim to report their findings by Q1 of 2025, with an intent to incorporate these findings into the 2025 NGER update.

   e. Urgently phase out the use of Predictive Emission Monitoring systems (PEMS) at underground coal mines and mandate the use of Continuous Emission Monitoring systems (CEMS).

   f. Implement the United Nations Environment Programme's (UNEP) Oil and Gas Methane Partnership 2.0 reporting framework for all Australian oil and gas facilities in the 2025 NGER update.

2. **Urgently fund a national scale background observing network to monitor methane** and carbon dioxide, utilising a network of 12 ground-based towers at sites across the country. The location of these sites should be determined using an independent network design study undertaken by subject matter experts, with priority given to sites in Queensland and New South Wales where there is a high concentration of coal and gas operators;

3. **Stop approving new coal, oil and gas projects.** Due to the severity of fossil methane under-reporting in Australia and the substantial uncertainty about the true emissions contributions of coal and gas facilities, any additional projects pose an unjustifiable risk to Australia's state, national and international climate commitments.

Overview

Over recent years, a range of satellite missions have been launched that allow a never-before-seen insight into the climate impact of human activities. Of particular note for this report is the 2017 launch of the European Space Agency's Sentinel-5P satellite with its on-board TROPOMI instrument and NASA Jet Propulsion Laboratory's EMIT spectrometer aboard the International Space Station which has been in operation since mid-2022. However, there are tools improving our ability to hold large emitters to account, including the privately owned GHGSat network and the recently launched MethaneSAT, jointly funded by the Environmental Defense Fund and the New Zealand Government.

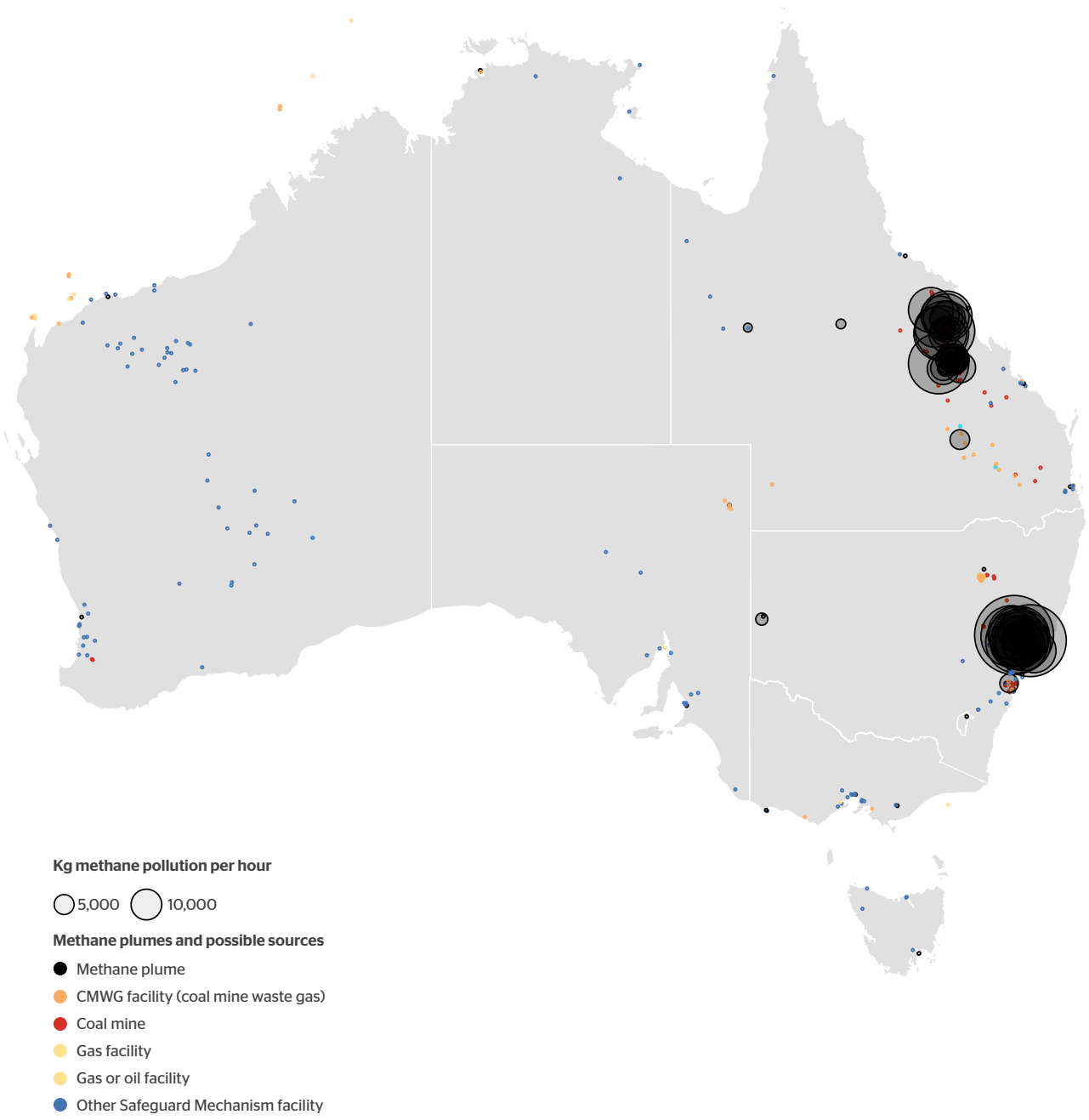
This report seeks to pool publicly available information from publicly available sources that have analysed data from the TROPOMI and EMIT missions in order to provide a synthesis of those plumes seen over Australia in the 2023 calendar year. Three primary sources were synthesised to provide this data with the providers being the Netherlands Institute for Space Research (SRON),[1] Kayrros,[2] and Carbon Mapper.[3] These results were cross-checked against data provided by the UNEP's International Methane Emissions Observatory.[4]

After removing duplicates, a total of 61 unique plumes were observed over Australia in 2023. The overwhelming majority of these plumes occur over or near Australian fossil fuel infrastructure, particularly coal mines. Just three plumes were identified in regions that produce neither coal nor gas. All plumes identified over Australia, were over Queensland and New South Wales. A summary of all the detections is available in an appendix at the end of this report.

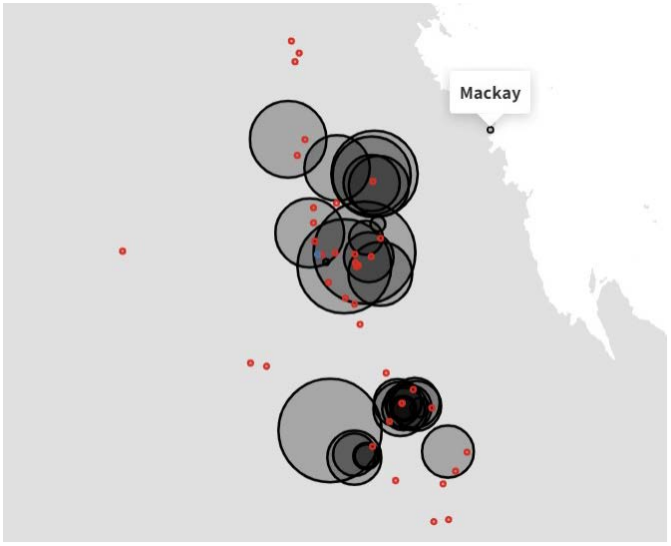
2023 methane plumes

Source: ACF Date: Kayross, MARS, SRON, TROPOMI

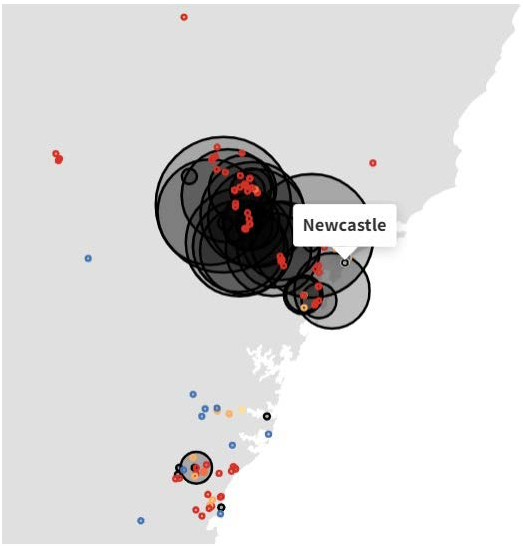
2023 methane super-emitters



Bowen Basin

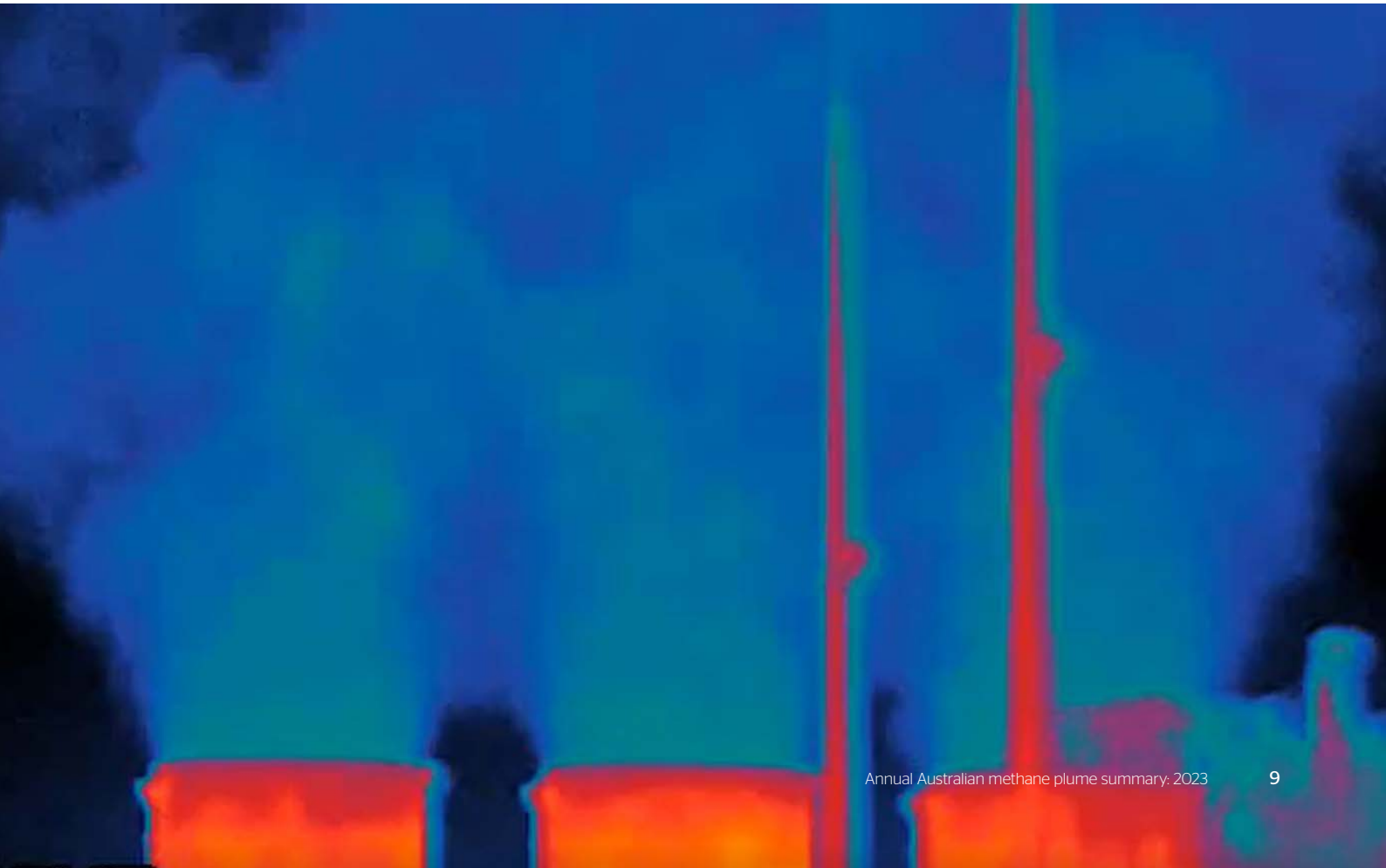


Newcastle Basin



Source: Kayross, SRON, MARS, TROPOMI

Below. Appin colliery VAM vents *Photo.* CATF



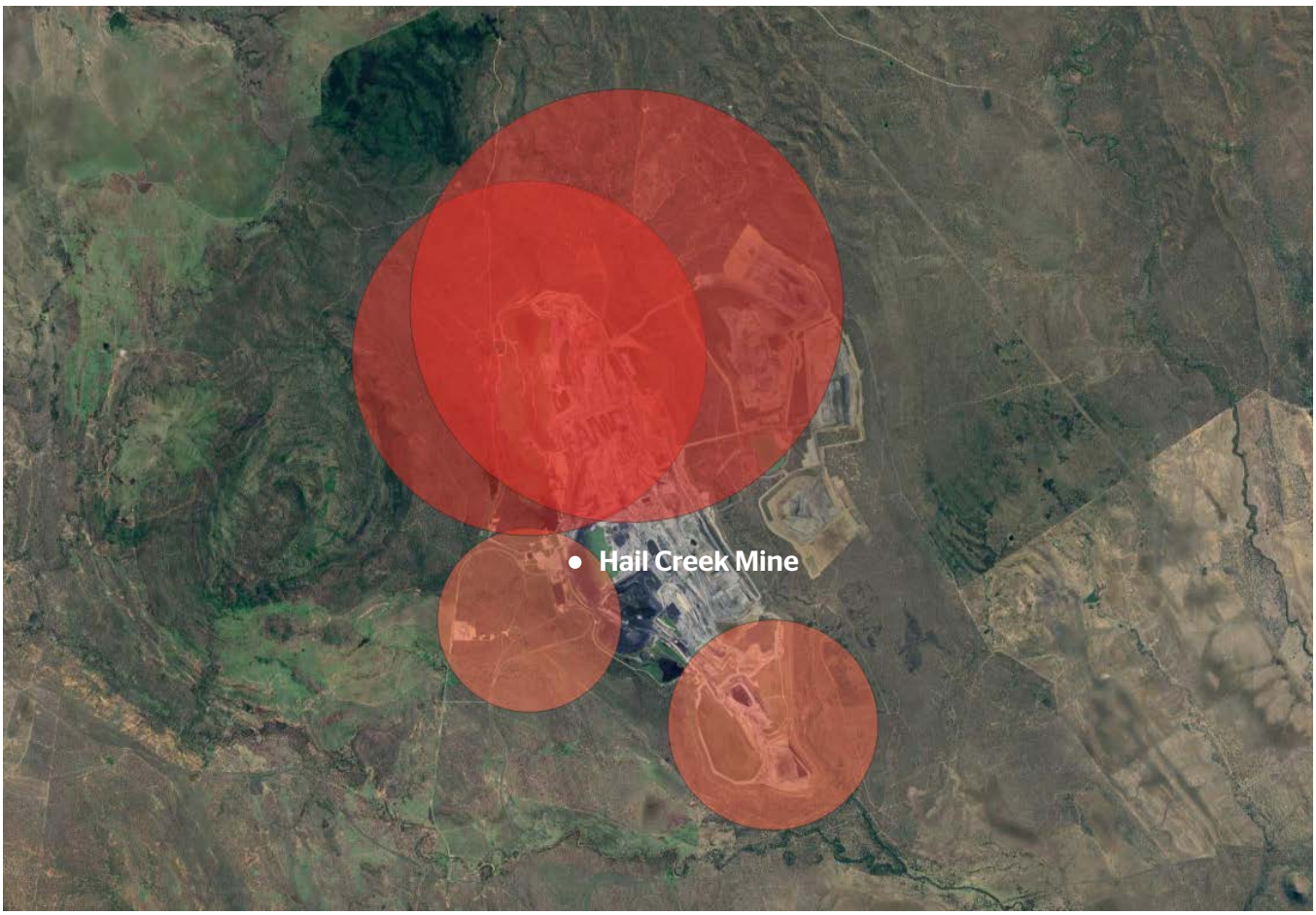
The average plume detected in this study was polluting at a rate of over 20,000 kg CH_4/hr. On average, one cow will produce 90 kilograms of methane per year. Therefore, the average plume is roughly equivalent to what two million cows would produce in a year. The biggest single event was located three kilometres from the Wambo coal mining complex in the Newcastle coal field. It had a rate of 80,000 kg CH_4/hr. To use the same analogy as above, that's the same emissions rate of eight million cows a year.

The data indicates a number of interesting trends. For example, while there are fewer observations in New South Wales, that state contains seven of the ten largest plumes. There are also some truly unexpected outcomes. For example, all of the plumes identified over New South Wales coal regions are in the Newcastle Basin, and none are over the Southern Basin. Similarly, most plumes occur over or very near open cut mines, which are commonly assumed to emit less methane and which certainly emit methane across a more diffuse area. This should mean that releases from underground mines would be easier to detect via satellite imagery and so should be disproportionately apparent in the data. This does not appear to be the case.

Two sites were particularly interesting and the remainder of the report will focus on discussing what can be known from the plume data about them. These are Glencore's Hail Creek open cut mine and the EDL Grasstree coal mine waste gas facility.

Below. Shell QCG high point vent continuous operational venting *Photo.* CATF

Hail Creek



Methane plume

Hail Creek coal mine in Queensland's Bowen Basin is majority owned and operated by Glencore, with the Japanese firms Marubeni and Sumitomo respectively holding 12% and 3.33% shares while Glencore holds the remaining interest.[5] The mine is open-cut, and produces around two-thirds metallurgical coal and one-third thermal coal.[6] It has been operational since 2003 and is a designated large facility under the safeguard mechanism, meaning that it is required to report facility-level emissions estimations in accordance with the rules set out in the *National Greenhouse and Energy Reporting (Measurement) Determination 2008*.

Coal mines are a significant source of methane. The greenhouse gas is ordinarily bound to the coal seam via a mechanism known as adsorption while the seam is underground. In accessing the coal, the pressure that is holding the methane in place is necessarily removed which liberates it from the coal, ordinarily allowing it to access the atmosphere. According to Australia's national accounts, around 1 million tonnes of raw methane are emitted in this way each year.[7] However, third-party assessments routinely find that the true figure should be far higher.[8–10] A recent International Energy Agency estimate found that Australia under-reported its fossil methane emissions in 2023 by at least 64%.[11]

Peer-reviewed research conducted using TROPOMI satellite data from 2018 and 2019 indicated that Hail Creek's officially reported emissions were just a fraction of its true impact.[12] This study was conducted by SRON and quantified the emissions flow rate from above Hail Creek using satellite observations over the mine in 2018 and 2019. It estimated that Hail Creek's methane emissions were about 35 times higher than has been estimated using official methods. This extraordinary quantity of methane means that this one mine released more than 15% more methane than was officially reported as coming from all open cut mines in Queensland, Australia's largest coal producing state and its most significant source of coal mine methane.

The TROPOMI instrument used in this study has global coverage and is capable of taking a snapshot of methane concentrations in the atmosphere above each point on the globe roughly once per day. That said, due to local conditions – including cloud cover and aerosol concentrations – not every pass of the satellite overhead is capable of being used to identify plumes. In the original study, the research team was able to quantify emissions flow rates from 32 observations over the Hail Creek mine over a period of more than 18 months, with the vast majority of these being between June and December. During this period when weather conditions were best, human-led quantification was possible in around one out of every ten days.

Like all Australian open cut coal mines, the operators at Hail Creek have a choice of how to estimate the amount of methane that is released from their operations each year. They can either apply a simple state-based emissions factor, known as method 1, or undertake a process of sampling and modelling, with the two subtly different ways of doing this known as methods 2 and 3.[13] Operators have free choice over which method to use under the scheme, with the likely outcome that operators will choose whichever estimation method is likely to result in the lower figure (see discussion below). Despite the fact that it is well documented that the methane emissions intensity of coal mines varies greatly from site to site, there is no obligation under either method 1 or methods 2 and 3 for the final emissions estimate to be cross-checked, independently verified or reconciled with any external data. This includes known plumes identified by satellites, aerial flyovers, and other means as well as peer-reviewed third-party estimates like the one provided by SRON.

Over the five most recent years, Hail Creek has reported average annual scope 1 emissions of 528,000 tonnes of carbon dioxide equivalent greenhouse gas (t CO_2e) per year.[14] Reported scope 1 emissions from the mine have been relatively steady over this period, with inter-annual variation mostly staying within 5%.

Breaking down emissions beyond the total scope 1 figure is difficult. A recent review of the *National Greenhouse and Energy Reporting Act* found that there are significant data transparency issues with Australia's emissions reporting scheme, with little information available beyond the total scope 1 emissions figure.[15] The hidden data includes both the breakdown of emissions by greenhouse gas and by source (e.g. fugitive methane emissions versus emissions from the use of diesel and other distillate fuels on-site) and the method used to estimate fugitive emissions. As part of the safeguard mechanism reforms made last year, the Clean Energy Regulator will in future be required to release emissions data broken down by greenhouse gas, and this information could easily be used to assume fugitive methane at a mine, but the first tranche of this data won't be available until early 2025.[14]

However, the same review that highlighted these transparency issues provided two important insights. The first of these is that 72% of fugitive methane emissions in Queensland are reported using the state-based emissions factor, implying that the majority of mines in that state use method 1. The second is that 41% of scope 1 emissions from open cut mines in Australia are attributable to their fossil methane. Consequently, it is possible to estimate the share of Hail Creek's total scope 1 emissions that come from its fugitive methane via two means.

The first of these simply assumes that Hail Creek's reported emissions are close to the national average for open cut mines, with 41% of scope 1 emissions being fossil methane. The second assumes that, like the majority of Queensland mines, Hail Creek uses the simple state-based emissions factor to estimate its total fossil methane emissions. This approach sets an effective ceiling on the estimates of Hail Creek's emissions.

As noted above, the operator of Hail Creek has a free choice of whether to use the state-based emissions factor or a process of sampling and modelling to estimate its annual emissions. In the past, the incentive to switch between methods was weak. So long as facilities stayed under their baseline, there was no additional benefit to selecting an even lower estimate. However, significant reforms to the safeguard mechanism commenced in 2023 introduced declining baselines, and the issue of tradable emissions credits equal to the proportion of unused emissions allowances in a given year (safeguard mechanism credits). These two changes create a greater incentive to game the methodology selection to minimise the potential costs and increase potential benefits under the reformed scheme.

Above. Hail Creek Mine *Photo.* Supplied

After adjusting for a recent increase in the state-based emissions factor,[16] Hail Creek's average total scope 1 emissions intensity over the five most recent years that have been reported to the Clean Energy Regulator was 0.0625 t CO_2e/t ROM.[6,14] If Hail Creek is using the new state-based emissions factor of 0.031 t CO_2e/t ROM to determine its fossil methane emissions, then that means that 50% of the mine's total scope 1 emissions are attributable to fossil methane.

Coal production for the full 2023 calendar year at Hail Creek is not yet available. However, in the 2022–23 financial year 10.1 million tonnes of run-of-mine coal was produced from the mine.[6] This is comparable with recent years. For example, in the financial years 2020-21 and 2021-22, the total run-of-mine coal produced at Hail creek was 10.6 and 10.8 million tonnes respectively. As such, it can be assumed that reported emissions will likewise be similar for the year.

Due to reporting delays, Hail Creek's reported methane emissions for the 2023 calendar year will not be able to be interpolated until April 2025. However, it can be estimated that the facility's reported annual methane emissions will be 7,730 tonnes of raw methane for the year, with an effective ceiling of around 9,430 tonnes.

Since publishing the initial study in 2021, SRON has expanded upon their methods, including by using a machine learning algorithm to identify plumes at a global rather than an individual basin scale.[17] While every plume identified by the algorithm is still verified with human intervention, the shift from a human-led to a machine-led process has necessarily required inserting additional layers of conservatism. For a simple demonstration of the impact of these additional steps, in 2019, the human-led method quantified the flow rate of 85 plumes over the Bowen Basin, while in 2023, the machine-led approach quantified just 32 plumes over the entire Australian continent. While it is certainly possible that there may have been some real change in the number of plumes in 2023 compared to 2018 and 2019, and it is also possible that some stochastic change in weather conditions contributed to our ability to detect those plumes, it seems likely that the machine-led method is more cautious when detecting super-emission events.

Among other steps, it is notable that the publicly available data provided by SRON only includes plumes that have an emission rate of more than 5 tonnes of methane per hour (t CH_4/hr). This threshold is quite high, and certainly higher than the normal rate of methane released from even the most emissions-intensive open cut mines.

Nonetheless, even with this additional conservatism embedded in their automated global method, SRON's publicly available data shows that Hail Creek's concerning emitting behaviour has continued well beyond the period of their original study.[1]

In 2023, SRON observed four significant methane plumes above the Hail Creek mine that were in excess of 5 t CH_4/hr. These four observations all occurred in one 16 day period between 22 June and 8 July. This rate of clear sky observations – one every fifth day – far exceeds the rate of one-in-ten day rate seen in the original study and so it is likely that these were the only days in that period where an observation was possible at the mine.

The clustering of these observations, with several occurring in a short space of time, but none observed through the remainder of the year, raises the possibility that what was detected by the SRON team was not in fact four discrete plumes, but rather one sustained venting of methane from the coal seam that lasted for a period of several weeks.

The mean flow rate of the plumes identified by the SRON team in that period was 22.5 t CH_4/hr, with a range of 14–33 t CH_4/hr. Presuming that this was sustained over the 16 day period, and no longer, then around 8,640 tonnes would have been vented from the mine during this period.

Unfortunately, it is impossible to use these observations to paint a complete picture of the emissions from the mine over 2023, but what is shown is sufficient to raise concerns. **Recalling that previous work found Hail Creek's annual methane emissions were dozens of times higher than officially reported in 2018 and 2019, this new data has found the mine may have released a year's worth of methane in this one 16-day period.**

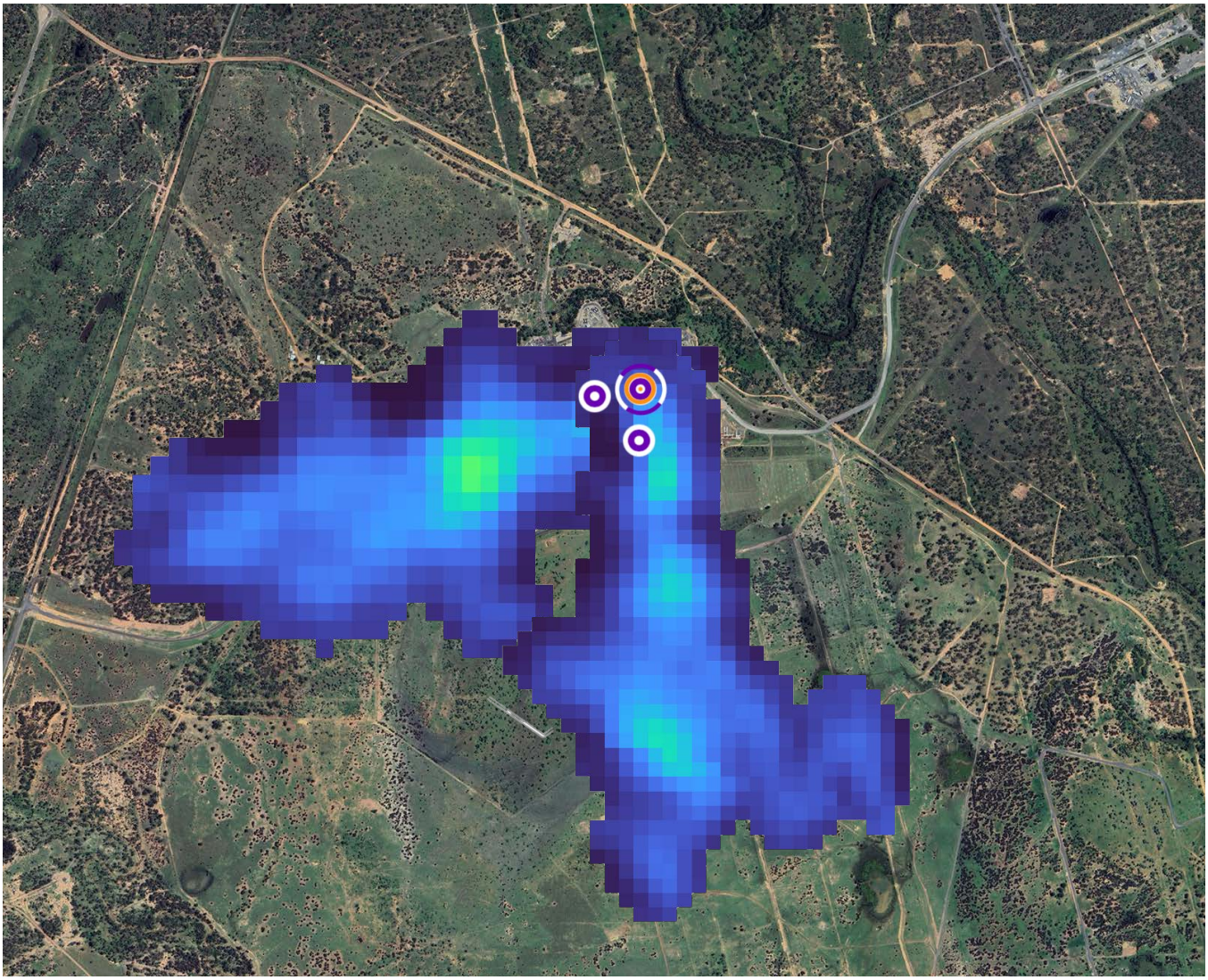
If the identified plumes represent a single event, then the estimated 8,640 tonnes of methane released between the 22nd of June and the 8th of July is comparable to the 7,730–9,430 tonnes that Hail Creek reports on its emissions in any given year.

It is also worth emphasising that Hail Creek will, of course, have continually emitted outside the narrow period between late June and early July. The fact that estimates made with publicly available information from the current generation of satellites are unable to provide greater insight into the mine's methane emissions should not be taken to mean that greater insight is impossible. There are a range of technologies, and a number of options available to significantly improve measurement reporting and verification of methane from open cut coal mines.[15,18,19] It is past time to make use of 21st century technologies and significantly improve upon Australia's methane emissions reporting standards, including by requiring source-site reconciled emissions reporting for these mines.

The discrepancy between officially reported methane emissions estimates and true emissions is one that has significant financial implications. **In the first year of operation of the reformed safeguard mechanism – based on its reported emissions intensity – Glencore will receive up to 150,000 safeguard mechanism credits for Hail Creek,[20] with a total value of several million dollars.** Hail Creek will receive this windfall of credits despite compelling third-party evidence that the mine way well be one of the largest single sources of coal mine methane in Australia. In the absence of actual emissions reductions, these credits will be created for no other reason than the fact that the federal government's emissions reporting scheme is broken. If the satellite estimates prove correct, then the tradable units gifted to Glencore are entirely undeserved, and the company would instead be hit with a significant debt if accurate measurement, reporting and verification of methane emissions was required.

Left. Talinga 32 gas well controller *Photo.* CATF

EDL German Creek



Above: methane plumes detected by Carbon Mapper in 2023 directly above the EDL German Creek facility. Image: ACF. This work is adapted from the work of Carbon Mapper Inc. with funding from Bloomberg Philanthropies, used under a Modified Creative Commons Attribution ShareAlike 4.0 International Public License. Satellite imagery: ©2024 Airbus, CNES / Airbus, Maxar Technologies. Map data: ©2024 Google.

The German Creek coal mine waste gas facility is a power station located in the Bowen Basin, near Middlemount in Queensland.[21] The power station is operated by EDL, a wholly-owned subsidiary of British-owned CK Williams Australia. The Australian parent company of EDL also owns a controlling interest in United Energy (a Victorian electricity distribution network covering the east and southeast of Melbourne) and Australian Gas Infrastructure Group (one of Australia's largest gas transmission and distribution pipeline operators).

The power station burns methane from coal mining operations at Anglo American's Capcoal coal mining complex. The facility has been in operation since 2006, and consists of 20 gas-powered electricity generators with a combined capacity of 45.2 MW. In 2023, it ran at an average capacity of 26.3%, which is significantly below its long term average capacity of around 70%.[22] It is unclear what drove this change, though it is possible that a change in operations could have disrupted the flow of methane to the generator. The EDL facility is located on the site of Grasstree mine, which closed in 2022.[23] At the same time the Grasstree closed, underground mining operations commenced at the linked Aquila mine.[23]

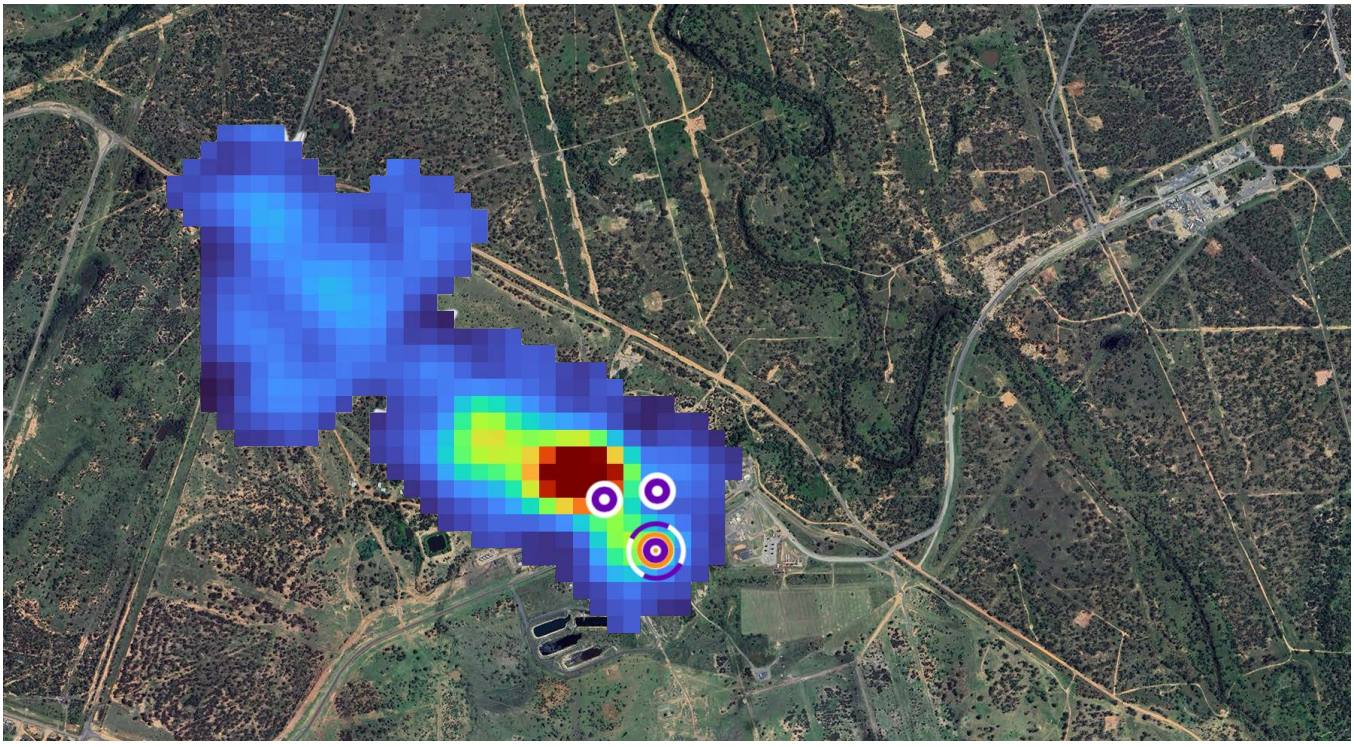
The EDL facility has been registered under the coal mine waste gas method to generate Australian Carbon Credit Units (ACCU) under the Federal government's scheme since 2021.[24] The abatement methodology document that the facility is registered under provides tradable credits to new or expanded projects that capture and destroy methane from Australian coal mines via a number of means.[25]

The German Creek facility is deemed under the ACCU scheme to be a "transitioning displacement electricity production project". This classification was created in 2021 – the same year that EDL registered the project – and is designed to provide a continued source of revenue to projects that had formerly been able to generate credits under the Renewable Energy Target (RET) until they became ineligible in 2020. The classification applies to projects that are located on mines subject to an existing legal requirement to capture and destroy methane and only credits these projects for the displacement of higher emitting electricity sources on the grid. The logic behind issuing credits to these projects is that the government is providing a financial incentive for these facilities to take the additional step of generating electricity with the methane that they are required to capture and combust, lowering the emissions of meeting electricity demand. This means these facilities receive at least two income streams – the price of electricity supplied to the grid and the sale price of the ACCUs credited – in order to do something that is to some extent legally required under either the mine's state or federal environmental approvals or other legislation.

The temporary inclusion of these projects under the RET was itself controversial given that these projects are not renewable by definition.[26] Like several other coal mine waste gas projects, the EDL facility was originally registered under the New South Wales Greenhouse Gas Reduction Scheme (GGAS).[27] This state program was the world's first emissions trading scheme,[28] and placed a mandatory requirement on that state's electricity retailers to purchase offsets from greenhouse gas reduction projects located around the country. GGAS closed in 2012, with the commencement of the federal carbon price.[28] A policy choice was made at the federal level to maintain support for these projects through the federal RET until 2020 to soften the impact of the early closure of the state scheme.[26]

At the end of this explicitly temporary transitional period, the federal government chose to provide these projects with a third round of government support by allowing them to register under the ACCU scheme for a further five years. In total, the EDL project has been receiving some form of additional support – either from the NSW or federal government – for most of its 17 years of operation. It received credits under the New South Wales scheme from 2006 until 2012,[27] was eligible to generate credits under the RET from 2012 until 2020,[26] and received its first credits under the ACCU scheme in the 2024 financial year,[24] with several more years of eligibility for these valuable units. **So far this financial year, the project has been issued with 123,734 ACCUs, with a total value of around $4 million.**

In 2023, five methane plumes were identified within 5 kilometres of the German Creek facility, with most of these occurring in the first half of the year. One occurred in January (8 t CH_4/hr, Carbon Mapper), one in April (13 t CH_4/hr, SRON), two in May (3 t CH_4/hr, Carbon Mapper; and 9 t CH_4/hr, SRON), and one in November (2 t CH_4/hr, Carbon Mapper). While there is a considerable amount of fossil fuel infrastructure in the region – between the closed Grasstree mine, the recently opened Aquila mine, and dozens of unconventional gas wellheads – the three plumes identified by Carbon Mapper were all detected with high-resolution EMIT images directly above the EDL facility. One of these is shown below.



Above: methane plumes detected by Carbon Mapper in 2023 directly above the EDL German Creek facility. Image: ACF. This work is adapted from the work of Carbon Mapper Inc. with funding from Bloomberg Philanthropies, used under a Modified Creative Commons Attribution ShareAlike 4.0 International Public License. Satellite imagery: ©2024 Airbus, CNES / Airbus, Maxar Technologies. Map data: ©2024 Google.

It is important to note that while the two plumes identified by the SRON team were tagged in that data as being respectively 2 and 4 kilometres away from the EDL site, due to the TROPOMI instrument's more coarse resolution of 7 km x 5 km per pixel, it is plausible that these were equivalently direct observations of vented emissions from that site. That said, given the concentration of other fossil fuel infrastructure it is not possible to confirm the source of those plumes.

A further five plumes, all identified by the SRON team, are located within 12 kilometres of the site. It is plausible that these plumes could have originated at the site but given the concentration of fossil fuel infrastructure in the area, attributing these to the EDL site would be tenuous at best.

While the EDL facility is not receiving its ACCUs in exchange for the capture and combustion of methane, it is nonetheless remarkable that the site – which has received fifteen years worth of government support in the form of valuable emissions units in order to do something that the mine operator is largely required to do by law – is linked to at least three methane plumes significant enough to have been detected from space.

Open-source methane MRV in 2024 and beyond

This report used only publicly available information from publicly available sources, and can be repeated every year, helping to see trends in methane super-emission events in Australia. The ability to detect and attribute methane plumes is improving rapidly.

Painting an accurate, actionable, picture of methane emissions is the mission of several evolving networks that harness datasets from different sources, including satellite sensors (e.g. MethaneSAT), modelling technologies (e.g. Kayrros), drone flux mappers (e.g. Explicit), aerial flyovers (e.g. Airborne Research Australia), ground-based infrared detectors (e.g. FLIR OGI cameras), early warning systems (e.g. MARS), and open data platforms designed to improve the transparency and actionability of methane measurement data (e.g. Open Methane).

In this section an overview will be given of three new technologies that will be added to this ecosystem in 2024.

MethaneSAT

The world's most advanced methane-detecting satellite launched on 4 March 2024 local time (5 March Australian time), using advanced sensing technology to detect methane emissions across the globe with unprecedented resolution and precision.

MethaneSAT orbits the earth fifteen times a day at 590 km altitude, about 300 km closer than Sentinel 5P, in 200 km swaths. MethaneSAT's sensor has a resolution 40 times higher than Sentinel 5P's, enabling MethaneSAT to have a lower detection threshold and to visualise individual point sources within large methane plumes.

Data from MethaneSAT will allow national and subnational regulators, as well as companies, to compare emissions across different areas, monitor how emissions change and deploy solutions that achieve maximum reductions. MethaneSAT data will enable bad actors to be held accountable while also allowing stakeholders to document improvements. Some MethaneSAT data will be online for free, adding momentum to the revolution of climate transparency and accountability.

Open Methane

Also coming in 2024, Open Methane is an open platform for understanding Australia's methane emissions. This free, open source platform for detecting, measuring and locating Australia's methane emissions employs satellite observations and environmental modelling to produce an up-to-date, continent-scale picture of Australia's methane emissions.

Open Methane incorporates wind speed and direction as well as atmospheric conditions to predict methane movement through the air, allowing more precise modelling of methane emissions. By offering a more precise representation of the country's emissions, Open Methane aims to enhance research-based understanding of methane in Australia, support industry initiatives for reducing and mitigating emissions, and contribute to informed policy discussions on meeting Australia's obligations under the Global Methane Pledge.

Open Methane is currently in its public beta phase. The full version of the platform is set to launch in 2024 and will include:

- An interactive map displaying Australia's methane emissions
- Daily alerts for unexpected, significant methane spikes
- Customisable location views and methane events
- Open, accessible, and auditable data for public use

ACF's FLIR OGI camera

Optical Gas Imaging (OGI) cameras are the industry standard for methane leak detection and repair (LDAR) programs.

By filming methane plumes on ground, OGI cameras can also be used as a tool to corroborate remote-sensor methane detection and quantification. One of the obstacles for the current resolution of remote-sensing satellite data is that in the Australian landscape, especially in places like the Bowen Basin, potential sources of fugitive methane are clustered together in close quarters, making attribution to particular point sources difficult. By deploying an OGI camera to investigate a plume detected by satellite, it is theoretically possible to narrow down an area of several square kilometers to an individual facility, and from there down to an individual vent or other piece of equipment at that facility.

OGI can help close the MRV gap in two crucial ways: most importantly, it allows (and encourages) action to be taken as soon as possible to respond to a methane super-emission event, for example by plugging the leak or fixing whatever process is causing fugitive emissions. Secondly, it prevents responsible companies from denying that the fugitive methane emissions occurred and/or are attributable to them, thereby improving transparency and accountability.

ACF recently acquired a state-of-the-art OGI camera. When appropriate, ACF will deploy investigators to sites at which methane plumes are detected by satellite sensors and identified by platforms such as MARS, MethaneSAT and Open Methane.

Conclusion

Methane is a toxic and potent greenhouse gas with a warming potential 86 times greater than carbon dioxide over a twenty year period. This dangerous gas is a major driver of climate change and is responsible for a third of the global temperature rise that has occurred to date. This polluting gas makes extreme heat, floods, bushfires, and biodiversity and ecosystem collapse even worse.

Australia is one of the world's largest producers of fossil fuels, and is therefore a massive and disproportionate contributor of global methane emissions. The action Australia does – or does not – take to rapidly reduce fossil methane emissions between now and 2030 will have a substantial impact on the effects of climate change across the world.

The IEA estimates that Australia is under-reporting its fossil methane emissions by at least 64%. This report contributes to the rapidly growing body of evidence that many coal and gas facilities in Australia are spewing out substantially higher volumes of methane than they report due to Australia's flawed methane measurement and reporting regulations. Glencore's Hail Creek coal mine in the Bowen Basin, which stands to receive several million dollars in tradable safeguard mechanism credits despite compelling evidence of severe methane under-reporting, is an example of the unacceptable consequences of Australia's archaic emissions measurement methodologies.

Over the next 12-24 months, the technological ability for third-parties to measure and scrutinise methane from Australian fossil fuel facilities will rapidly expand, deepen and mature. The findings of this report should serve as a wake up call for Australian regulators to urgently fix Australia's emissions accounting by improving methane measurement, reporting and verification, or risk drastically undermining the integrity of Australia's state, federal and international climate commitments.

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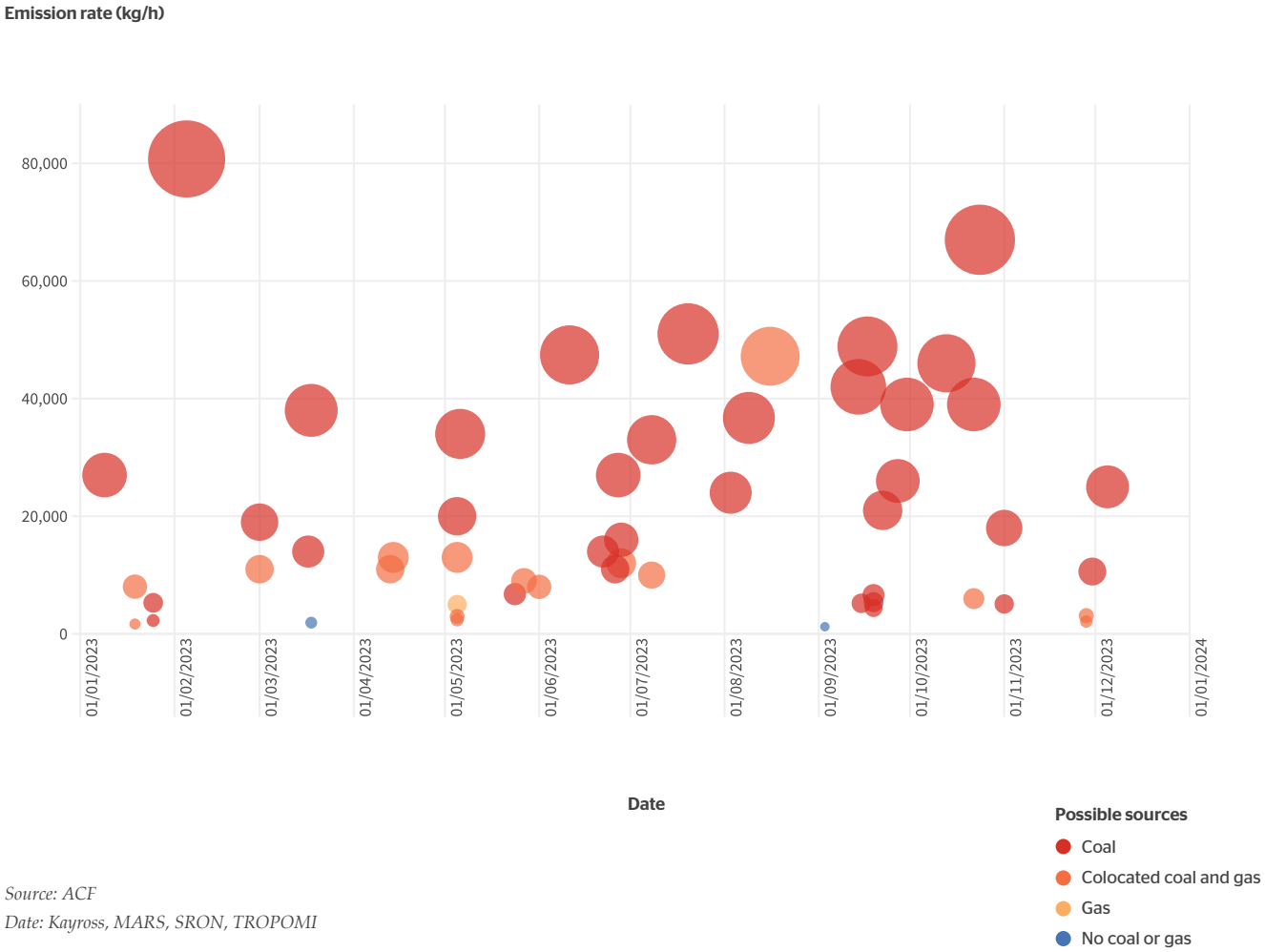
Note: Some satellite data used in this report was compiled by Ember.

Below. Shell QCG high point vent continuous operational venting
Photo. CATF

Appendix

Breakdown of plumes observed over time



Source: ACF
Date: Kayross, MARS, SRON, TROPOMI

Breakdown of plumes observed by source

	Total observed plumes (Region)	NSW (Region)	QLD (Region)
SRON (TROPOMI)	32 (22 coal, 9 co-located coal and gas, 1 gas)	11 (11 coal)	21 (11 coal, 9 co-located coal and gas, 1 gas)
Kayrros (TROPOMI and EMIT)	16 (11 coal, 2 co-located coal and gas, 3 unknown)	10* (9 coal, 1 unknown)	6* (2 coal, 2 co-located coal and gas, 2 unknown)
Carbon Mapper (EMIT)	12 (7 coal, 5 co-located coal and gas)	7* (7 coal)	5 (5 co-located coal and gas)
UNEP MARS (Synthesises other third-party sources	1 (1 coal)	1 (1 coal)	0*
Total	61 (43 coal, 16 co-located coal and gas, 1 gas, 3 unknown)	29 (28 coal, 1 unknown)	32 (13 coal, 16 co-located coal and gas, 1 gas, 2 unknown)

* A number of methane plumes were identified by multiple sources by providers who were processing the same satellite data. In each instance, the quantification with the lowest absolute uncertainty was preferred. Two plumes were identified in both the SRON and Kayrros data: one near Bulga mine in NSW and one near Millennium mine in Queensland. SRON was preferred for both. Two plumes were shown in both Kayrros and Carbon Mapper's data over the Ashton and Bulga open cut coal mines in NSW. In the case of Bulga, only Kayrros had quantified the emissions rate, so it was preferred. In the case of Ashton, Carbon Mapper's quantification had lower uncertainty, so that quantification was preferred. Another two plumes over EDL's Grasstree coal mine waste gas facility were quantified in Kayrros, Carbon Mapper data and MARS data. Carbon Mapper's quantification was preferred in each instance due to lower uncertainty.

Left and Below. Jemena Hexham receiving station *Photo.* CATF

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Australian Conservation Foundation
Wurundjeri Country, Level 1, 60 Leicester Street, Carlton VIC 3053 ABN 22 007 498 482

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