

Submission

HVO Open Cut Coal Continuation Project

25 September 2025

Introduction

Thank you for the opportunity to make a submission in relation to the HVO Continuation projects.

Our comments below relate to both of:

- SSD-11826621 – HVO South Open Cut Coal Continuation Project
- SSD-11826681 – HVO North Open Cut Coal Continuation Project

Geological and terrestrial carbon cycles

1. The carbon cycle can be described as flows of carbon among a series of reservoirs: the atmosphere, surface ocean, deep ocean, terrestrial biosphere and geosphere. Anthropogenic climate change arises from moving carbon from the geosphere (a very slow reservoir) directly to the atmosphere via fossil fuel extraction.
2. From the atmosphere, natural biological processes may remove carbon to the terrestrial biosphere and surface ocean, but these faster-moving carbon reservoirs are susceptible to the rapid return of that carbon to the atmosphere. That is, any addition of slow-moving geological carbon to faster carbon cycles in the atmosphere or biosphere will have long-term impacts on Earth's climate.
3. Current methods of carbon sequestration using (for example) land-based methods do not remove equivalent amounts of carbon compared to what has been added through anthropogenic processes. Geological sequestration is still an immature technology and is generally not cost-effective in the absence of either strict emission controls or a substantial price on carbon.

Fugitive emissions

4. Methane emissions are usually calculated by multiplying some activity by an emission factor. For example, if x tonnes of coal are mined and the emission factor is e tonnes of methane per tonne of coal then the total emissions are calculated as e times x . Uncertainties in emissions arise from uncertainties in e or x (or both).
5. Emission factors may vary from case to case so that the same quantum of activity in two locations may generate different emissions. For example, a major source of methane emissions from mining coal comes from methane trapped inside the coal seam. This methane is liberated when the coal is mined and crushed. The emissions hence depend on the amount of methane trapped in each tonne of coal, a quantity dependent on the type and depth of coal.

Precise determination of the quantity of trapped methane requires proper sampling of the variability of gas content which requires many samples if variability is large. Recent analysis of confidential core samples suggests this is indeed the case (Esterle et al., 2006); not only are gas parameters highly variable but also hard to predict. For future emissions we require a model of gas content for coal seams which cannot yet be sampled. The assumptions that underlie these models are similar to those that underlie current emissions estimates, so uncertainties revealed in current estimates will propagate to future emissions estimates.

6. Emissions enter the atmosphere where they increase the concentration of methane. This additional methane is dispersed by winds and turbulence in the atmosphere. The combination of emissions and dispersion produces structures of methane enhancement in the atmosphere in the vicinity of emissions.
7. The dispersion of methane in the atmosphere can be calculated either based on local measurements of atmospheric conditions or models of the atmosphere.
8. Such models are widely deployed in environmental assessment and air quality forecasting. For example, they form the basis of operational pollution forecasting.
9. The concentration of methane in the atmosphere can be measured. There are several technologies for doing this. Measurements at a single point using a gas analyser have been made since the early 1980s and are the basis for the global tracking of methane concentration.
10. Similar analysers can be mounted on conventional aircraft or drones to provide a spatial survey.
11. Finally, satellites can measure the amount of methane in a column through the atmosphere. Satellites can measure wherever there is sunlight and little or no cloud and have provided global coverage of increasing density and precision since 2005.
12. Measurement in the atmosphere near potential emissions can observe the structures arising from emissions and dispersion. Comparing the observed structures with those we expect provides a strong test of the purported emissions.
13. This technique is completely independent of the methods described above. Thus it provides an invaluable test of emissions inventories. It can capture emissions not included in the model as well as finding errors in that model.
14. There are uncertainties in satellite measurements of methane. For example, measuring the absolute amount of methane in the atmosphere requires precise calibration of the satellite. These uncertainties are far smaller when measuring the difference of methane concentration between two points, especially nearby points where general atmospheric conditions will be similar.

Thus the satellites are particularly well-suited to measure the structures that result from local emissions.

15. The technique of using atmospheric observations to quantify or locate methane emissions is well established. As summarised in Tibrewal et al. (2024) it has highlighted significant differences between the emission factor based methods and inferences from atmospheric observations. Even the much less capable previous generation of satellites was able to detect serious underestimates in regional emissions which were verified with local measurements (Frankenberg et al., 2016).
16. Similar approaches have also revealed emission estimates “close to the upper bound of bottom-up estimates” (Peng et al., 2023).
17. In their 2021 study, Sadavarte et al. (2021) calculated the mass of methane in a plume observed by the TROPOMI satellite and hence estimated the emissions. They estimated much larger emissions than expected from process-based estimates.
18. In their annual synthesis of methane emissions from different sectors and countries the International Energy Agency (IEA) has combined general evidence from atmospheric measurements with process-based estimates. They suggest that emissions from Australian coal mines may be 60% higher than the national inventory (International Energy Agency, 2024).
19. Uncertainties also exist among process-based methods. The ClimateTrace data set did not use atmospheric data over Australia but rather independent process-based methods. Its methane emission estimate for Australian fossil fuel extraction and processing was nearly 3 times the official inventory (ClimateTrace, 2023).
20. In 2024, The Superpower Institute (TSI) performed its own analysis of methane emissions from large emitters over Australia. The study calculated the so-called local enhancement of methane concentration, defined as the average concentration within 20km of an emission minus the concentration between 20 and 100 km away (Rayner & Grant, 2024). We compared this local enhancement as measured by the best available global satellite data set and the expected values from a high-resolution air quality model. The study noted that the model significantly underestimated the local enhancements with the underestimate growing with the emission strength as predicted by the inventory. The relationship between measured and modelled enhancements can be used to estimate the required multiple of emission strengths to bring the two data sets into agreement. While the small number of points allows considerable scatter, in this estimate the calculation yields a best value of twice the inventory emissions with a 50% chance that the emissions are larger than this and a 95% likelihood that the emissions are stronger than the official inventory.

21. The TSI analysis suggests a 95% probability that, on average, mine emissions are underestimated, with a 50% probability the emissions are at least double.
22. In conclusion, most independent data sets or attempts at atmospheric verification suggest the methods used for determining methane emissions from open-cut coal mines in NSW under-report these emissions. This is independent of whether the estimates use default emission factors or locally-derived estimates. These are the same methods that are used for emission projections from the mine. Thus there is a high risk that projected emissions are an underestimate.

Importance of accurate measurement and reporting of fugitive emissions

23. There are two significant risks and one opportunity arising from the errors noted above.
24. Climate risk: A key concept guiding climate policy in recent years is the carbon budget. This arises from the scientific finding that the peak warming is proportional to the total greenhouse gas emissions before reaching net zero (Allen et al., 2009). Under these circumstances, if the baseline emission rate is doubled then the cumulative emissions are doubled even if the ramp-down rate towards net zero is the same. Thus, the climate impact of the mine extension will be larger than accounted for in projections.
25. Risk to intermediate targets: The proposed extension date is prior to the target date for net zero. Thus, provided there are no residual emissions after mine closure (which may or may not be the case), the extension does not jeopardise the net zero target. Intermediate targets, however, must be met with a range of actions including emission reduction across many sectors and offsetting emissions where reductions are not feasible. Larger emissions from this source narrow the pathway to these intermediate targets, requiring other sectors to bear more of the burden.
26. Climate Opportunity: Larger-than-expected emissions from a facility also affords an opportunity for strong climate action. If these emissions can be prevented, the climate impact will be double the previous expectation.

International commitments and domestic targets

27. Given the high impact of methane emissions on global warming, Australia has entered into several international obligations to reduce net greenhouse gas emissions (the Paris Agreement) and gross methane emissions (the Global Methane Pledge). In particular, it is worth noting that the Global Methane Pledge

calls for a reduction of methane emissions without referring to offsets, meaning that an absolute reduction in emissions is required.

28. Mitigating methane emissions has also been identified by the UN Environment Program and the Climate and Clean Air Coalition as one of the most cost-effective methods to rapidly reduce the rate of global warming and to meet the 1.5°C goal of the Paris Agreement (United Nations Environment Program & Climate and Clean Air Coalition, 2021).

Global Methane Pledge

29. Australia is a signatory to the Global Methane Pledge, which requires participants to commit to collectively reduce global anthropogenic methane emissions by 30% below 2020 levels by 2030.
30. The Global Methane Pledge includes several other relevant commitments, including *inter alia*:
- a. '[Taking] comprehensive domestic actions ... focusing on standards to achieve all feasible reductions' to methane emissions, particularly in the energy and waste sectors
 - b. '[Moving] towards using the highest tier IPCC good practice inventory methodologies', with a particular focus on high emission sources.
 - c. 'Continuously [improving] the accuracy, transparency, consistency, comparability, and completeness of national greenhouse gas inventory reporting'.
31. Analysis by Ember further suggests that mitigating coal mine methane emissions could represent a reduction of 18% of Australia's methane emissions by 2030 (Assan, 2022). This would account for 60% of Australia's commitment to the Global Methane Pledge if considered on the basis of its share of current global methane emissions.
32. Furthermore, and noting that an expansion of fossil fuel infrastructure is itself contrary to the spirit of the Global Methane Pledge, underestimates of fugitive methane emissions would also put the achievement of the Global Methane Pledge at risk.

Paris Agreement

33. Article 2, paragraph 1(a) of the Paris Agreement identifies the aim of the Agreement to '[hold] the increase in the global average temperature to well below 2°C above pre-industrial levels and [pursue] efforts to limit the temperature increase to 1.5°C above pre-industrial levels'.

34. Article 4, paragraph 1 further specifies that to achieve this goal, Parties to the Agreement will 'aim to reach global peaking of greenhouse gas emissions as soon as possible ... and to undertake rapid reductions thereafter in accordance with best available science'.
35. Article 4, paragraph 2 requires Parties to 'prepare, communicate and maintain successive nationally determined contributions', and to 'pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions'. These are recorded in a public registry maintained by the UNFCCC Secretariat (Article 4, paragraph 12), and Parties are required to account for their nationally determined contributions by '[promoting] environmental integrity, transparency, accuracy, completeness, comparability and consistency, and [ensuring] the avoidance of double counting' (Article 4, paragraph 13).
36. In order to account for the nationally determined contributions described in Article 4, Article 13 requires Parties to engage in particular transparency arrangements, including a national inventory report of anthropogenic emissions and removals of greenhouse gases using 'good practice methodologies accepted by the Intergovernmental Panel on Climate Change' (paragraph 7(a)).
37. The Paris Agreement is ultimately aiming to limit the temperature increase from fossil fuels rather than directly limiting emissions themselves (outside of NDCs, as discussed below). As a result, the primary concern for the Paris Agreement arising from underestimated fugitive emissions is the risk that these uncounted emissions will increase global warming beyond the 1.5°C and 2°C goals of the Agreement.
38. Further, underestimated fugitive emissions reduce the accuracy and reliability of national inventory reports and other transparency processes under Articles 4 and 13 of the agreement.

Australia's legislated emissions reduction target

39. Australia has legislated two emissions reduction targets in line with its 2027 updated NDC:
 - a. Net zero emissions by 2050; and
 - b. A 62–70% reduction on 2005 levels by 2035, as both a point target and an emissions budget representing an indicative range of net greenhouse gas emissions between 1,248 and 1,395 mtCO₂-e for the period 2031–2035.
40. Similar to the discussion of the Global Methane Pledge above, an inaccurate baseline makes the accomplishment of the emissions reduction targets more challenging. Underestimating ongoing fugitive emissions also impacts the

accomplishment of these targets. There is also the policy risk that Australia's emissions will be found retrospectively to be higher than was reported, increasing pressure for more rapid reductions.

New South Wales' legislated emissions reduction target

41. New South Wales has legislated three emissions reduction targets:
 - a. Net zero emissions by 2050;
 - b. A 50% reduction on 2005 levels by 2030; and
 - c. A 70% reduction on 2005 levels by 2035.
42. In addition, the enabling legislation requires that interim targets be set for 2040 and 2045.
43. Similar arguments apply to both the national and the New South Wales emissions reduction targets.
44. Additionally, the NSW EPA has already noted the impact of large fugitive emissions on the NSW net zero pathway in its advice in relation to this project. In order to meet the requirement that offsets are sourced from within NSW, the project is likely to absorb a significant fraction of offset capability, increasing demand for offsets and hence cost for the net zero pathway overall. The under-reporting of current emissions noted in this submission will exacerbate this problem.

Further observations and considerations

45. IEA's Net Zero Emissions by 2050 Scenario calls for no new coal mines or coal mine lifetime extensions in order to meet the Paris Agreement target of net zero emissions, and further requires targeted action to reduce methane emissions from fossil fuel operations in order to reduce methane emissions sufficiently to limit warming to 1.5°C (IEA, 2023).

About The Superpower Institute

The Superpower Institute's (TSI's) mission is to help Australia seize the extraordinary economic opportunities of the post-carbon world.

A net zero Australian economy will reduce global emissions by just over 1 per cent. But if Australia successfully seizes the economic advantage in exporting zero emissions goods, this can create an opportunity for full employment with rising incomes for a

growing population sustained over more than a generation, and reduce global emissions by up to 10 per cent.

Renowned economist Ross Garnaut and economic public policy expert Rod Sims have joined forces through The Superpower Institute, to focus on practical research and policy to unlock this opportunity. The Institute specialises in the policy settings and market incentives needed to make Australia an economic superpower and provides practical knowledge to governments and industry to realise this opportunity.

TSI works across the building blocks of the superpower economy including: renewable energy, green hydrogen, land carbon and minerals processing; the potential zero carbon export products including green iron and green aluminium; and the enablers of this economy including economic and fiscal policy, trade policy and regional development.

Please contact TSI's Chief Scientist Professor Peter Rayner via info@superpowerinstitute.com.au for any further information.

<https://www.superpowerinstitute.com.au/>.

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