ENVIRONMENTAL JUSTICE AUSTRALIA

Submission to

The Senate Inquiry on Glencore's proposed CTSCo carbon capture and storage project in the Great Artesian Basin

prepared by

Environmental Justice Australia

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About Environmental Justice Australia

Environmental Justice Australia (formerly the Environment Defenders Office, Victoria) is a not-for-profit public interest legal practice. Our legal team combines technical expertise and a practical understanding of the legal system to protect our environment.

We act as advisers and legal representatives to community-based environment groups, regional and state environmental organisations, and larger environmental NGOs, representing them in court when needed. We also provide strategic and legal support to their campaigns to address climate change, protect nature and defend the rights of communities to a healthy environment.

1 Summary

1. This submission addresses the environmental implications of Glencore's proposed carbon capture and storage (**CCS**) project (the **Project**) by its subsidiary, Carbon Transport and Storage Corporation (**CTSCo**), in the Great Artesian Basin. This submission will focus primarily on paragraphs (g) and (h) of the Senate Inquiry terms of reference, namely, "the role of CCS technology in Australia's broader climate change mitigation strategy, including an evaluation of its efficacy, risks and alternatives" and "any other related matters."

2. In summary, Glencore's proposed Project exemplifies the fallacy of CCS as a climate solution. The Project is pitched as a CCS pilot that will demonstrate effective greenhouse gas (**GHG**) mitigation by sequestering around 330,000 tonnes of carbon dioxide (**CO_2**) emissions, and thereby supposedly help Australia to progress the clean energy transition. In fact, this is a proposal to construct a post-combustion CCS facility attaching to Millmerran, an existing coal-fired power station. The Project intends to capture CO_2 extracted from flue gas from the coal-fired power station as its only GHG stream source. Based on Glencore's own data, the net CO_2 captured amounts to only 0.4% of Millmerran coal-fired power station's Scope 1 annual emissions, and the capture process will terminate after three years. The Millmerran coal-fired power station could be easily replaced by cheaper renewable energy sources, which would make CCS unnecessary.

3. This submission has three parts. First, we submit that CCS does not have a viable role in Australia's climate change mitigation strategy. Drawing on our research from CCS operations around the world, we show how the vast majority of projects have fallen far short of their targeted carbon capture rates. While delivering low rates of carbon removal and high costs, CCS has also shown to be energy intensive. Although Glencore proposes to sequester over 300,000 tonnes of CO_2, due to the 'energy penalty', the net reduction in carbon emissions is less than 20% of that amount.

4. Further, CCS projects such as this one are targeted at fossil fuel stations that should be retired. The Project presents a potential justification for delaying retirement and enabling the continuation of fossil fuel production, while diverting resources from the transition to clean energy.

5. The second part of the submission briefly addresses some other risks and impacts from CCS deployment (excluding water pollution), such as:

    a. Risks associated with CO_2 pipelines, including risks of ruptures and corrosion, and the impacts of construction of large-scale infrastructure;

    b. Risks of leaks at other stages, including from the processes of capture, transportation, and storage; and

    c. Air pollution risks.

6. Despite these significant risks to communities and the environment, this Project was not subjected to federal environmental review under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (**EPBC Act**). A related CCS project, proposed by Esso Australia Resource (**Esso**) in Victoria, which involves constructing a new underground CO_2 pipeline and repurposing a 20-year-old hydrocarbon pipeline for CO_2 transport, is now before the federal Environment Minister for determination as to

whether it is a controlled action under the EPBC Act. The Esso project underlines the need for scrutiny and stronger regulations particularly on managing pipeline risks.

7. Finally, we conclude with a summary of proposed regulatory changes, prior to permitting, which are needed to manage risks across the lifecycle of CCS projects and ensure long-term liabilities remain with the operator.

In summary, our key points are:

1. **CCS is not a viable technology and has no viable role in Australia's climate change mitigation strategy;**
2. **CCS technology is inherently risky. It poses risk of significant environmental and human health impacts as a result of potential pipeline failing, leaks, and air pollution;**
3. **The Project was not subjected to federal environmental review under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth). As further CCS projects continue to emerge, (such as the recent Esso project in Gippsland, Victoria), there is a real need for scrutiny and stronger regulations, particularly on managing pipeline risks; and**
4. **Any CCS buildout requires strong and comprehensive regulation prior to permitting to manage risks across the lifecycle and ensure long-term liabilities remain with the operator.**

2 Background to the Project

8. Glencore proposes to injection test up to 330,000 tonnes of CO_2 into a water aquifer at depths of 2.3 kilometres in the Surat Basin, within the Great Artesian Basin, over a three-year period.[1] The target reservoir is the Precipice Sandstone aquifer.[2] The GHG stream for the Project is to be sourced from a Post-Combustion Capture (**PCC**) station to be constructed adjacent to the Millmerran coal-fired power station.[3]

9. According to Glencore's final Environmental Impact Statement (**EIS**), the Project is designed to test "the viability of geological storage of CO_2 in Queensland."[4] The stated aims of the Project are to "evaluate the feasibility of GHG stream storage by GHG storage injection testing of the captured CO_2" and thereby "assist in determining the long-term feasibility to safely capture and store GHG streams from multiple industrial sources, and examine development of a commercial CO_2 supply chain, ultimately reducing CO_2 discharge to atmosphere."[5]

10. The Project EIS is lacking in key details to fully understand the Project. For example, before capturing CO_2, it is essential to remove impurities – such as sulfur dioxide,

[1] CTSCo, 'Chapter 02: Proposed Project Description', *Surat Basin Carbon Capture and Storage Project Environmental Impact Statement* (March 2024), p. 44.
[2] CTSCo, 'Chapter 01: Introduction', *Surat Basin Carbon Capture and Storage Project Environmental Impact Statement* (March 2024), p. 5.
[3] CTSCo, 'Chapter 02: Proposed Project Description', *Surat Basin Carbon Capture and Storage Project Environmental Impact Statement* (March 2024), p. 9.
[4] CTSCo, 'Chapter 01: Introduction', *Surat Basin Carbon Capture and Storage Project Environmental Impact Statement* (March 2024), p. 5.
[5] Ibid.

oxides of nitrogen, and particulates – from flue gas.[6] However, there is insufficient information in the EIS to understand how the proposed facility will remove these pollutants from the GHG stream from the coal-fired power station; for example, it is unclear whether it includes flue gas desulfurisation.

3 CCS does not have a viable role in Australia's climate change mitigation strategy

11. Glencore, the world's largest coal trader,[7] promotes the Project as a climate solution that will help "achieve the goals of the Paris Agreement."[8] Glencore's core justification for the Project is to demonstrate that CCS is a viable option in the pathway to decarbonisation. The Project purports to be "a first step toward large-scale CCS, with the potential for emissions from multiple industrial emission sources being captured and safely stored."[9] In the EIS and promotional materials on the Project, Glencore touts the emission mitigation potential of CCS, claiming it is "an important and proven technology which can mitigate carbon emissions from hard to abate industries and is a potential enabler of future energy projects in Australia."[10]

12. However, for the following reasons, Glencore's proposed CCS buildout is perversely more likely to prolong dependence on fossil fuels and lock in substantial GHG emissions, exacerbating climate change and related harms to frontline communities. For the foreseeable future, CCS does not have a viable role in climate change mitigation and the transition to a net-zero future in Australia.

False promises: CCS has failed to deliver on climate mitigation and is not a feasible, scalable option for meeting rapid reduction targets

13. Claims by Glencore and the fossil fuel industry that CCS is an effective solution to the climate crisis do not reflect the history of CCS projects across the world that have overwhelmingly failed to meet their GHG mitigation targets.

14. As a 2021 report by the Center for International Environmental Law states:

> The unproven scalability of CCS technologies and their prohibitive costs mean they cannot play any significant role in the rapid reduction of global emissions necessary to limit warming to 1.5°C. Despite the existence of the technology for decades and billions of dollars in government subsidies to date, deployment of CCS at scale still faces insurmountable challenges of feasibility, effectiveness, and expense.[11]

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[6] Ben Finzel, 'Capturing Carbon at Industrial Facilities Leads to Billions of Dollars in Annual US Health Benefits' (Blog Post, 7 August 2023). See also Toby Lockwood, *A Technology Roadmap for High Efficiency Low Emissions Coal Power Plant, CCC/309* (2 March 2021).
[7] Javier Blas, 'Glencore Envisions a Super-Sized King of Coal', *Bloomberg* (13 April 2023).
[8] Glencore, 'Carbon Capture' (Web Page, 2024). Note that Glencore has been criticised for failing to align its own company strategy and emission reduction targets with the Paris Agreement: see Australasian Centre for Corporate Responsibility, *Analysis of Glencore's forward coal emissions profile* (February 2023). See also Australasian Centre for Corporate Responsibility, 'New research raises doubts about Paris-alignment of mining giant Glencore - increasing pressure as the company faces a shareholder resolution on thermal coal' (Media Release, 22 February 2023).
[9] Glencore, 'Carbon Capture' (Web Page, 2024).
[10] Glencore, 'Glencore's CTSCo Carbon Capture and Storage (CCS) Project' (Fact sheet, March 2023), p. 1.
[11] Center for International Environmental Law, Confronting the myth of carbon-free fossil fuels: why carbon capture is not a climate solution (July 2021), p. 2.

15. In the few real-world examples of large-scale operational CCS to date, CCS has proven to be a costly and ineffective diversion from the clean energy transition. Multiple pilot projects have been run to demonstrate that the technology is viable; however, few of the planned large-scale projects have materialised. Of those that have been built, the vast majority have failed dramatically to meet their CO_2 reduction targets. Ten of 13 flagship projects around the world, including Australia's Gorgon CCS, have failed to deliver.[12] At the same time, CCS has been used to justify new and expanded production of fossil fuels and hydrogen, while diverting investment from cheaper and cleaner energy alternatives that are available to displace fossil fuels across Australia.

16. Glencore's own figures show how inefficient the Project will be at mitigating carbon emissions. Whereas 330,000 tonnes of carbon dioxide equivalent (**tCO_2-e**) are proposed to be injected for geological storage, after subtracting the total Scope 1, 2 and 3 GHG emissions from the Project, the net reduction in GHG emissions is only 57,032 tCO_2-e for the life of the Project (roughly 19,011 tCO_2-e per year over 3 years). To put this into context, in 2022-23, the Millmerran coal-fired power station released at least 5,009,858 tCO_2-e (Scope 1 emissions only) into the atmosphere.[13] Thus Glencore's Project proposes to reduce Millmerran's Scope 1 GHG emissions by only 0.4% per year—and will cease entirely after three years.

17. The CCS project that Glencore chooses as the closest analogy is in fact a well-known failure in terms of carbon mitigation. Glencore cites SaskPower's Boundary Dam Project in Canada as an "internationally analogous CCS project."[14] Boundary Dam is one of the only operating power generation CCS facilities in the world. It introduced the first commercial-scale post-combustion capture station, and injected CO_2 into saline sandstone aquifers 3.2km underground. Since it began operating in 2015, Boundary Dam's daily average CO_2 capture rate has been around 50% of SaskPower's own pre-specified goals, not the targeted 90%.[15] Even its more recent annual figures fall short by around 50%, despite upgrades to reflect improvements in technology in the last decade. The levelised costs of capturing CO_2 have also swelled accordingly, compared to SaskPower's estimations.[16]

18. The Boundary Dam example is not an anomaly. Whether for 'easy' or 'hard' to abate sectors, existing CCS technologies do not capture all carbon emissions from the facility to which they are attached and projected capture rates are often never realised. Also, CCS projects only capture emissions at one point of the lifecycle, so they are likely to fail to capture upstream and/or downstream emissions. Studies and surveys of CCS facilities around the world show that rates of CO_2 removal range from as low as 8% to no more than 65%.[17]

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[12] Institute for Energy Economics and Financial Analysis (**IEEFA**), *The carbon capture crux: Lessons learned* (1 September 2022), p. 71.
[13] Australian Government, Clean Energy Regulator, *Electricity sector emissions and generation data 2022–23: Designated generation facility data 2022-23* (4 April 2024).
[14] CTSCo, 'Executive Summary', *Surat Basin Carbon Capture and Storage Project Environmental Impact Statement* (March 2024), p. 14.
[15] David Schlissel, IEEFA, *Boundary Dam 3 Coal Plant Achieves Goal of Capturing 4 Million Metric Tons of CO2 But Reaches the Goal Two Years Late* (April 2021), pp. 2-3.
[16] IEEFA, *The carbon capture crux: Lessons learned* (1 September 2022), pp. 42-44.
[17] See Andrea Bacilieri et al., *Assessing the relative costs of high-CCS and low-CCS pathways to 1.5 degrees* (4 December 2023), p. 17; Mark Z. Jacobson, 'The health and climate impacts of carbon capture and direct air capture' (2019) 12 *Energy & Environmental Science* 3567, pp. 3568-69; Daniel Mercer, 'World's biggest carbon capture plant running at one third capacity, Chevron Australia reveals', *ABC News Australia* (17 May 2023).

19. Below is a selection of CCS projects that, similar to Boundary Dam, have failed to meet capture rates and/or have been discontinued due to cost blowouts:

    a. The Gorgon CCS Project (part of gas processing, not post-combustion), operated by Chevron in Western Australia, has failed to meet projected rates of CO_2 sequestration. The Institute for Energy Economics and Financial Analysis (**IEEFA**) notes that, calculated on a five-year rolling average commencing in July 2016, Chevron committed to ensure that at least 80% of reservoir CO_2 – that would otherwise be vented to the atmosphere – would be removed during processing and injected underground.[18] However, environmental performance reports indicate that the project failed to meet its target for the first five-year period by about 50%, and it also failed to reach its five-year rolling average target ending July 2022.[19] Chevron confirmed in July 2022 that it had bought and surrendered 5.23 million tonnes of CO_2 offsets to compensate for the failure to meet its 2021 target, but only 200,000 tonnes of those were available on the Australian market.[20] At the same time, Chevron increased LNG production and remains Australia's biggest industrial carbon polluter.[21]

    b. The Petra Nova carbon capture project, a post-combustion retrofit to one of the four units at the W.A. Parish coal-fired power station in Texas, was designed to capture approximately 90% of CO_2 from the unit.[22] After spending US$1 billion on construction, and receiving a taxpayer subsidy of US$195 million, the project was paused in 2020 after less than four years of operation.[23] It remains out of service. Analysis indicates that it missed its capture targets by 17-25%,[24] and ultimately captured less than 7% of total CO_2 emissions emitted by the power station.[25]

    c. In early May 2024, Capital Power announced it was discontinuing development of the Genesee CCS project as "it is not economically feasible", despite already receiving a CA$5 million subsidy from the government of Alberta.[26]

    d. The Archer Daniels Midland CCS facility at an ethanol station in the U.S. state of Illinois has captured at most 10-12% of the station's emissions each year over the past decade. This is despite receiving US$281 million from taxpayer funds and being described by the U.S. Department of Energy's National Energy Technology Laboratory as "the largest demonstration of its kind in the United States."[27]

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[18] IEEFA, *The carbon capture crux: Lessons learned* (1 September 2022), p. 29.
[19] Ibid, pp. 30-31.
[20] G. Readfearn, 'Gas giant Chevron falls further behind on carbon capture targets for Gorgon gasfield', *The Guardian* (16 July 2022).
[21] P. Milne, 'Chevron's Gorgon hits record gas exports at the expense of emissions', *WA Today* (12 April 2023).
[22] U.S. Department of Energy, Office of Fossil Energy and Carbon Management, *Petra Nova – W.A. Parish Project*.
[23] Energy and Policy Institute, *Petra Nova carbon capture project stalls with cheap oil* (6 August 2020).
[24] "Emissions data for Parish Unit 8 reported to the EPA suggests the actual CO2 capture rate was substantially lower than 90%, perhaps as low as 65% to 70%": Suzanne Mattei and David Schlissel, IEEFA, 'The ill-fated Petra Nova CCS project: NRG Energy throws in the towel' (Web Page, 5 October 2022). See also Nichola Groom, 'Problems plagued U.S. CO2 capture project before shutdown: document', *Reuters* (7 August 2020).
[25] Energy and Policy Institute, *Petra Nova carbon capture project stalls with cheap oil* (6 August 2020).
[26] S. Polczer, 'Edmonton's Capital Power cancels $2.4 billion carbon capture project at Genesee', *Western Standard* (2 May 2024); Environmental Defence, *Statement in response to another failed carbon capture project* (1 May 2024).
[27] B. Gibbons, 'In Illinois, a massive taxpayer-funded carbon capture project fails to capture about 90 percent of plant's emissions', *Oil & Gas Watch* (25 April 2024).

20. The Australian government should take the lead from other jurisdictions which allow for remedial measures or penalties to be imposed by permitting authorities, in cases where projected CO_2 capture rates are not met. The state of Victoria, for example, provides for improvement notices and potentially penalties if an operator contravenes the state GHG sequestration legislation or a condition imposed by the state authority, or fails to comply with a monitoring and verification plan.[28] Some Canadian and U.S. jurisdictions impose civil penalties or sanctions for failure to comply with requirements, which may include carbon capture targets.[29] Since the justification for these projects hinges on their capacity to mitigate carbon emissions, there must be consequences for failure to meet projected rates, especially given the track record for CCS projects worldwide.

CCS is energy intensive and contributes to the climate crisis that it purports to address

21. Any review of CCS projects needs to account for the substantial emissions resulting from the total project lifecycle. Carbon capture systems can be highly energy intensive, requiring high temperatures and pressures. Significant energy is required to run the capture unit, compress the CO_2, transport it through pipelines, and inject it into the sequestration medium, as well as control additional pollution from CCS processes.[30] Emissions from these processes are usually not captured by the carbon capture technologies.[31]

22. For post-combustion systems on power stations, the IPCC notes that this "energy penalty" (that is, the increased fuel requirement) ranges from 13-44%.[32] In retrofitting existing power stations, as is proposed in the Project, new and separate generators are built on site to power the carbon capture equipment specifically, but emissions from those generators are not captured.[33] For new power facilities designed with carbon capture, the increased energy needs still result in both additional air emissions and water consumption.

23. In addition, energy engineer Dr. Ranajit Sahu[34] notes in relation to coal-fired power stations, the CCS process imposes a significant energy penalty of as much as 8-10% on thermal efficiency. He finds that "a state-of-the-art HELE [high-efficiency low-emissions] station with a cycle efficiency of, say, 47%, could achieve [carbon capture]

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[28] See *Greenhouse Gas Geological Sequestration Act 2008* (VIC), Part 15 (Enforcement), especially ss 270-275.
[29] See, e.g., *Oil and Gas Conservation Act,* Revised Statutes of Alberta 2000, Chapter O-6 Section 100(1) Control, completion and operation costs (Canada); *West Virginia Code Ann* § 22-11-22(a) (US). The European Union, by comparison, manages underperforming CCS projects through emissions trading schemes: see Ian Havercroft and Richard Macrory, 'Legal Liability and Carbon Capture and Storage: A Comparative Perspective' (2014) *Global CCS Institute & UCL Laws* 35.
[30] Concerned Health Professionals of New York & Physicians for Social Responsibility, *Compendium of scientific, medical, and media findings demonstrating risks and harms of fracking and associated gas and oil infrastructure* (8th ed.) (April 2022), p. 80 ("[E]xtra energy is needed to run the carbon-capturing machinery. CCS requires 10 to 20 percent of a power plant's energy output, for example.").
[31] Concerned Health Professionals of New York & Physicians for Social Responsibility, *Compendium of scientific, medical, and media findings demonstrating risks and harms of fracking and associated gas and oil infrastructure* (8th ed.) (April 2022), p. 80 ("[T]he CCS equipment is itself a source of greenhouse gas emissions, which are unaccounted for in most assessments of CCS climate impacts.").
[32] Leon Clarke and Yi-Ming Wei, Energy Systems. In *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (2022), section 6.4.2.5 (p. 642).
[33] Greg Kennedy, *W.A. Parish Post-Combustion CO_2 Capture and Sequestration Demonstration Project (Final Technical Report)* (31 March 2020).
[34] Dr. Ranajit Sahu is a consulting engineer with more than 30 years' experience in environmental, mechanical, and chemical engineering, including the design and specifications of power stations and pollution control equipment. 'Expert Affidavit – Dr. Ranajit Sahu', filed in *African Climate Alliance & Ors v. The Minister of Mineral Resources and Energy & Ors* (in the High Court of South Africa, Gauteng Division, Pretoria), 22 July 2022.

but with the efficiency reduced to 37-39%, setting aside costs. This means, that with [carbon capture], most of the thermal efficiency benefit associated with HELE is lost."[35]

24. It is essential to remove sulfur dioxide, oxides of nitrogen, and particulates from flue gas before capturing CO_2. Even pro-CCS studies assert that conventional pollutants should be controlled for amine-based CCS.[36] In the case of the Project, it appears that the EIS omits basic information on how the proposed facility will remove impurities from the GHG stream: there is no mention of flue gas desulfurisation. Retrofitting coal-fired power stations with pollution control technologies is not only necessary for removing contaminants from the CO_2 stream to facilitate CCS, but it further increases the energy penalty. The World Bank/IFC guidelines note that operating wet flue gas desulfurisation (the most effective technology for removing sulfur dioxide ($\mathbf{SO_2}$)) will increase electricity use of a station by 1.5%; operating selective catalytic reduction technology for reduction of nitrogen oxides will increase electricity use by 0.5%; and a fabric filter for PM removal will increase electricity use up to 3%.[37] These recommended pollution control devices can add a further 5% to the energy penalty at coal-fired power stations where they were not previously in place.

CCS delays fossil fuel-station retirements and enables the continuation of fossil fuel production

25. Glencore's Project would be only the third project operating in the coal power sector worldwide, after Boundary Dam in Canada and Petra Nova in Texas.[38] Whereas Glencore has positioned the Project as a demonstration that will enable CCS to mitigate emissions from "hard to abate" industry sources (such as cement and steel), the Project could in fact extend the life of coal power generation in Queensland.

26. The Project involves retrofitting an existing coal-fired power station which is over 20 years old, potentially delaying its retirement. The description of the Project in the EIS understates that the *only* GHG stream to be used is sourced from the Millmerran power station, an 880MW coal-fired power station, which is technically due to retire in 2051—last in line among all coal-fired power stations in Australia.[39] Glencore will have to invest considerable sums in constructing a PCC station on the Millmerran site, and use the GHG stream from the coal-fired power station to "test" carbon storage in the nearby aquifer over a three-year period. It seems unlikely that these plans will be cost-effective unless the PCC is used for a much longer period.

27. Glencore asserts that the Project will demonstrate that CCS is a "safe and viable option to avoid emissions of GHGs to the atmosphere with direct capture and storage of a GHG stream from industrial sources to assist in *meeting global, Commonwealth and*

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[35] Dr. Ranajit Sahu, *Comments on potential impacts of proposed new coal generation under the South Africa 2019 Integrated Resource Plan* (July 2021), p. 18.
[36] Ben Finzel, 'Capturing Carbon at Industrial Facilities Leads to Billions of Dollars in Annual US Health Benefits' (Blog Post, 7 August 2023). See also Toby Lockwood, *A Technology Roadmap for High Efficiency Low Emissions Coal Power Plant, CCC/309* (2 March 2021).
[37] International Finance Corporation, World Bank Group, *Environmental, Health, and Safety Guidelines for Thermal Power Plants* (19 December 2008), pp. 4-6.
[38] Note that Petra Nova restarted in 2023 due to high oil prices, as its injected carbon is used to recover oil. See Institute for Energy Economics and Financial Analysis, *The carbon capture crux: Lessons learned* (1 September 2022), p. 77; Power Engineering, 'Groundbreaking Petra Nova CCS project back up and running, owner says' (14 September 2023).
[39] Australian Energy Council, *Australia's Energy Future: 55 by 35* (July 2022), p. 5. A proposed coal mine expansion could extend Millmerran's lifespan further until 2056: Queensland Conservation Council, 'Millmerran Power proposes coal mine expansion, extending station lifespan' (Web Page, 19 August 2022).

Queensland GHG emission targets."[40] However, in supporting an existing coal-fired power station, the Project is in fact inconsistent with national and state objectives to expedite coal-fired power station retirement.

28. In September 2022, the Queensland government announced its plan to transition to 80% renewable energy in the state electricity system by 2035, and to end Queensland's reliance on coal-fired power generation by 2035.[41] The government committed to converting "all publicly owned coal-fired power stations into clean energy hubs by 2035."[42] It has projected that coal power will be entirely eliminated from the generation mix by 2037.[43]

29. The Millmerran power station, as a privately run facility, is not explicitly covered in the Queensland government's plans for early retirement and conversion of coal-fired power stations into clean energy hubs. However, the Millmerran station will still be required to close early (well before 2051), if the government is to achieve its goal to end reliance on coal power by 2035 and completely phase out coal from the generation mix by 2037.

30. National authorities have set similar targets for the power sector. Under the roadmap for Australia's National Electricity Market, set out in the draft 2024 Integrated System Plan published by the Australian Energy Market Operator (**AEMO**), "about 90% of the NEM's coal fleet is forecast to retire before 2035 in AEMO's most likely future scenario, and the entire fleet before 2040."[44]

31. None of these goals will be achievable if CCS projects are used to justify extending the life of existing coal-fired power stations and building new fossil fuel developments.

CCS is an expensive and ineffective diversion from the clean energy transition

32. Finally, in assessing the role of CCS in Australia's broader climate mitigation strategy, this Committee should consider the risks that CCS will delay, rather than hasten, the clean energy transition. There is no logic to investing in CCS projects for sectors where there are already cheaper, more effective, and cleaner alternatives available for mitigating emissions.

33. Glencore's Project produces a relatively small net reduction in GHG emissions from an existing coal-fired power station (less than 60,000 tCO_2). The International Energy Agency estimates that the levelised cost of carbon capture in the power sector could be up to US$100 per tonne of CO_2-e.[45] In the comparable case of Boundary Dam, the *lowest* cost of carbon capture was estimated at US$100-120 per tonne. However, this was calculated on an assumption that the CCS facility would operate at 85% capacity at a minimum;[46] as above, the Boundary Dam station in fact achieved only a 50% capture rate on average, driving up the per-unit costs significantly. The Boundary Dam project ultimately cost US$1.5 billion and received CA$240 million in public subsidies.[47]

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[40] https://www.qld.gov.au/__data/assets/pdf_file/0025/253357/surat-basin-carbon-capture-storage-ias.pdf
[41] Queensland Government, *Queensland Energy and Jobs Plan* (September 2022). See also Mark Ludlow, 'Queensland to cut off coal power by 2035', *Australian Financial Review* (28 September 2022).
[42] Queensland Government, *Queensland Energy and Jobs Plan* (September 2022), 44.
[43] Ibid, 12.
[44] Australian Energy Market Operator, *Draft 2024 Integrated System Plan: For the National Electricity Market* (15 December 2023), p. 6.
[45] A. Baylin-Stern and N. Berghout, International Energy Agency, *Is carbon capture too expensive?* (17 February 2021).
[46] IEEFA, *The carbon capture crux: Lessons learned* (1 September 2022), p. 44.
[47] Ibid, p. 42.

34. Attaching CCS to fossil fuel stations is not justified, considering the increasing evidence that many renewables are already cheaper and more reliable than coal and gas power. This is even reflected in data from some pro-CCS industry and government sources. A report from a leading Australian CCS research institute, CO2CRC, shows that the levelised cost of electricity from black coal with CCS, as in Glencore's proposal, is higher than from nearly all forms of solar or wind power.[48] The same report notes that solar thermal with storage and hydroelectric power are "more favourable" than coal with CCS in terms of flexibility in "increase[ing] or decreas[ing] output to meet changes in demand, to respond to changing output from other stations, and to respond to changing grid conditions."[49]

35. Glencore's justification for this Project rests on vague and unverifiable aspirations that the demonstration will support future CCS buildouts that will mitigate emissions from "hard to abate" industry sources. However, there is no guarantee of this future. Achieving it will require significant investment and carry further risks; for example, potentially hazardous CO_2 pipelines will be required for transport to the aquifer, and additional CCS facilities will need to be constructed and attached to the relevant polluting facilities.

36. In any case, Glencore has failed to explain why it has not designed this demonstration project to capture carbon emissions from a hard-to-abate industry source, and why the proposed PCC station only captures carbon from a coal-fired power station that can and should be retired in the near-term.

37. The most cost-effective alternative for reducing emissions from this coal power source is simply to convert the station into a clean energy hub, as the Queensland government plans to do with all publicly owned coal-fired power stations by 2035. Approving a PCC station that appears unlikely to be used after 3 years, and allowing public funding to be spent on retrofitting a coal-fired power station, potentially only temporarily, is a misuse of resources, and the opportunity cost means delaying the transition to a clean economy.

4 CCS entails potential risks of significant environmental and health impacts

38. In addition to the above obstacles to using CCS to progress decarbonisation, CCS comes with its own environmental and health concerns. Some examples are provided below.

Risks of CO_2 pipelines

39. The proposed Project, as a CCS demonstration attaching to an existing coal-fired power station, will involve a relatively short flowline to transport the CO_2. However, this Committee should consider the wider consequences if this Project supports the expansion of CCS in the Great Artesian Basin. Glencore's vision is for this Project to

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[48] Even some scenarios of solar thermal with storage are the same or less expensive than the least expensive scenarios of coal with CCS. See CO2CRC et al., *Australian Power Generation Technology Report* (November 2015), p. v. See also Tania Constable (CO2CRC) and Geoffrey Bongers (Gamma Energy Technologies), 'Australian Power Generation Technology APGT' (2017) 114 *Energy Procedia* 6377, p. 6382.
[49] CO2CRC et al., *Australian Power Generation Technology Report* (2016), p. 22. See also Australia Institute, *Money for Nothing* (May 2017), p. 27.

enable capture and storage of GHG streams from "multiple industrial sources", as noted above. If, for example, the aquifer was to capture emissions from other facilities in the future (such as coal, gas, hydrogen, and petrochemical stations), then in most cases longer CO_2 pipelines would need to be built, which raises a larger set of potentially lethal harms to surrounding communities and the environment. Even in the case of CCS to capture emissions from "hard to abate" industries, these potential risks could outweigh the mitigation benefits.

40. CO_2 pipelines come with risks of failures, leaks, and ruptures. Since CO_2 in high concentrations can be hazardous to human health,[50] these risks are significant particularly for pipelines that travel through communities. Whereas this Project involves a relatively short flowline since the targeted coal-fired power station is situated near the aquifer, transport of CO_2 from additional facilities in future is likely to require a greater distance, which will accordingly increase the risk of pipeline failures.[51] The awareness of pipeline failure risks was heightened in 2020 with the CO_2 pipeline explosion disaster in Satartia, Mississippi, when a rupture released a giant plume which travelled over 30 kms, injuring over 40 people and causing environmental destruction in its path.[52]

    a. **Risks of pipeline ruptures**: As CO_2 is heavier than air, it can displace oxygen and cause suffocation and even death to humans or animals. Pipeline CO_2 is also likely to contain potentially hazardous contaminants.[53] Leaked CO_2 gas can move quickly and collect in low lying areas and therefore could have a devastating impact on fauna, flora, and ecological communities in its path. For these reasons the impact area of a CO_2 pipeline should be measured in kilometres, not metres.[54] It is colourless, odourless gas that is difficult to detect without specialised instruments.

    b. **Risks of pipeline corrosion**: CO_2 forms an acid (carbonic acid, H_2CO_3) with any exposure to water, which is strongly corrosive to carbon steel.[55] Common acid-forming impurities such as SO_2 and nitrogen dioxide (**NO_2**) in CO_2 streams also contribute to a much greater corrosion potential than natural gas.[56] Because of the limitations of capture technologies, CO_2 transported through pipelines will unavoidably contain impurities, threatening pipeline integrity.[57]

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[50] Center for International Environmental Law, 'Carbon Capture and Storage (CCS): Frequently Asked Questions' (Web Page, 2024). See also Congressional Research Service, *Carbon Dioxide Pipelines: Safety Issues* (2022).
[51] A. Brown et al, 'IMPACTS: Framework for Risk Assessment of CO2 Transport and Storage Infrastructure' (2017) 114 *Energy Procedia* 6501, p. 6503. See also, Steven Jansto, *Risks and Potential Impacts from Carbon Steel Pipelines in Louisiana Transporting and Processing Variable Produced Gases such as Carbon Dioxide (CO2), Hydrogen (H2), Methane (CH4)* (9 October 2022).
[52] See U.S Department of Transportation, Pipeline and Hazardous Materials Safety Administration, *Failure Investigation Report – Denbury Gulf Coast Pipelines LLC Pipeline Rupture/Natural Force Damage* (26 May 2022). See also 'Federal order reached after Mississippi pipeline rupture', *AP News* (7 April 2023).
[53] V. E. Onyebuchi et al., 'A systematic review of key challenges of CO2 transport via pipelines', 81, *Renew. Sustain. Energy Rev.,* 2563–2583 (2018).
[54] Richard B. Kuprewicz, 'Accufacts' perspective on the state of federal carbon dioxide transmission safety regulations as it relates to carbon capture, utilisation and sequestration within the US' (Report for Pipeline Safety Trust, March 2022), pp. 9-10.
[55] Gregory Cooney et al., 'Evaluating the Climate Benefits of CO2-Enhanced Oil Recovery Using Life Cycle Analysis' 49, *Environ. Sci. Technol.*, 7491–7500 (2015).
[56] Steven Jansto, 'Risks and Potential Impacts from Carbon Steel Pipelines in Louisiana Transporting and Processing Variable Produced Gases such as Carbon Dioxide (CO2), Hydrogen (H2), Methane (CH4)' (Report, 9 October 2022).
[57] V. E. Onyebuchi et al., 'A systematic review of key challenges of CO2 transport via pipelines', 81, *Renew. Sustain. Energy Rev.,* 2563–2583 (2018).

c. **Risks from the large-scale infrastructure buildout**: Large-scale implementation of CCS would require a massive buildout of pipelines and associated infrastructure, which brings additional environmental impacts and potential harms to nearby communities.[58]

41. These issues are currently in contention in relation to Esso Australia Resource's proposed CCS project in Victoria, which is currently before the federal Environment Minister for determination as to whether it is a controlled action.[59] Esso not only proposes to construct a new underground CO_2 pipeline, but also to repurpose a 20-year-old hydrocarbon pipeline for CO_2 transport that presents increasing risks as it ages, while passing under the Gippsland Lakes Ramsar wetlands site and out to sea. There are concerns that the age of the repurposed pipeline will increase the risk for pipeline rupture. Esso noted in its EPBC referral that it had studied the suitability for repurposing the pipeline yet has not provided the study for public comment or made it available to the Minister assessing the likelihood of significant impacts.[60] Esso's position in its referral is that the project is not a controlled action. This CCS project is a related matter which the Committee should consider in the present inquiry, as it showcases the wider range of risks that CCS projects herald.

Risks of leaks at other stages of CCS

42. CO_2 can leak slowly during the processes of capture, transportation and/or storage, for example: due to pipeline corrosion from gas impurities; mischaracterisation of an injection well's structural characteristics; inadequate sealing; migration of CO_2 through underground passages;[61] damage to well seals by groundwater acidified by the injected CO_2; and/or seismic activity (including seismic activity caused by the CO_2 injection itself) leading to compromised wells.[62]

43. Chevron's Gorgon CCS project has been plagued by technical issues including leaks; for example, inspectors found leaking corroded valves and excess water in the pipeline between the LNG station and the injection wells, which can lead to corrosion.[63] IEEFA has noted that Gorgon's frequent inefficiencies (including problems that led to underperformance in capturing carbon and re-injecting it) are "typical of the technical risks involved in CCS projects."[64]

44. As other submissions to this Inquiry have highlighted, Glencore's Project has higher risks since it involves injection testing in an underground aquifer. Injection and storage in reservoirs create risks of reservoir failure and potential for water contamination.[65]

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[58] Center for International Environmental Law, 'Carbon Capture and Storage (CCS): Frequently Asked Questions' (Web Page, 2024). See also Congressional Research Service, *Carbon Dioxide Pipelines: Safety Issues* (2022).
[59] EPBC Act Public Portal, 'Referral summary · EPBC Act Public Portal (awe.gov.au)', (Web Page, 2024)
[60] Esso Australia, Victorian Referral, "Attachment 09 – Proposed Action Details" at p. 2
[61] Richard B. Kuprewicz, 'Accufacts' perspective on the state of federal carbon dioxide transmission safety regulations as it relates to carbon capture, utilisation and sequestration within the US' (Report for Pipeline Safety Trust, March 2022), p. 9.
[62] Joshua A. White and William Foxall, 'Assessing induced seismicity risk at CO2 storage projects: Recent progress and remaining challenges' (2016) *International Journal of Greenhouse Gas Control* 49.
[63] Peter Milne, 'Carbon hiccup for Chevron with 5 million-tonne greenhouse gas problem at Gorgon LNG plant', *The West Australian* (19 December 2017).
[64] Bruce Robertson and Milad Mousavian, IEEFA, *Gorgon Carbon Capture and Storage: The Sting in the Tail* (29 April 2022), p. 5.
[65] "The overlying geological strata should be effectively impermeable to CO2 to prevent it rising through the subsurface and either flowing into potable aquifers or returning to the surface": The Royal Society, *Locked Away: Geological Carbon Storage Policy Briefing* (2022) p. 12. See also Minh Hà Dương and David W Keith, 'Carbon

GHG leaks can lead to contamination of important aquifers as CO_2 migrates through fractured or ineffective caprock, along fault lines, or through porous geological strata.[66]

45. There are other risks that we do not cover in detail here, including the severe adverse impacts of CCS on water resources, as they are addressed in other submissions to this Inquiry. In brief, post-combustion CCS can be highly water-intensive and risks water pollution. Power stations often use large quantities of low-temperature water for cooling,[67] and the addition of CCS technology will only increase the quantity of water consumed.[68] Capture processes require additional water for chemical and physical processes.[69] Where amine scrubbers and chemical solvents are used, they are highly water intensive due to the additional cooling water requirements.[70]

Air pollution risks

46. While prolonging the life of fossil fuel stations, CCS technology does not eliminate all non-carbon emissions from these polluting facilities.[71] For example, Millmerran power station has the distinction of being the coal-fired power station with the highest airborne mercury pollution rates in Queensland, and the third highest Australia-wide.[72] It is unclear how the Project will impact mercury emissions from Millmerran.

47. Whether by attaching CCS technology to existing facilities or building out a new CCS complex, the added infrastructure contributes to existing local air pollution, especially in areas where industry is already concentrated. In fact, the European Environment Agency modelled that ammonia emissions could significantly increase with use of amine-based CCS.[73] Moreover, CCS capture at a facility does not account for the air pollution from the upstream and downstream processes of facilities with CCS. The industrial processes which produce CO_2 for capture from only some of their stacks can also release conventional pollutants from other stacks, continuing to impact public health.[74]

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storage: The economic efficiency of storing CO2 in leaky reservoirs' (2003) 5 *Clean Technologies and Environmental Policy* 181, p. 182.

[66] Jinfeng Ma et al., 'Carbon Capture and Storage: History and the Road Ahead' (2022) 14 *Engineering* 33, 39; see IPCC, *Carbon Dioxide Capture and Storage* (2005).

[67] Michelle van Vliet et al., 'Vulnerability of US and European electricity supply to climate change' (2012) 2 *Nature Climate Change* 676, 1.

[68] Lorenzo Rosa et al., 'The water footprint of carbon capture and storage technologies' (2021) 138 *Renewable and Sustainable Energy News* 110511.

[69] Rachel Newmark et al., 'Water Challenges for Geologic Carbon Capture and Sequestration' (2010) 45 *Environmental Management* 651.

[70] Ibid, 651, 653-654.

[71] Concerned Health Professionals of New York & Physicians for Social Responsibility, *Compendium of scientific, medical, and media findings demonstrating risks and harms of fracking and associated gas and oil infrastructure* (8th ed., April 2022), p. 80.

[72] Department of Climate Change, Energy, the Environment and Water, National Pollutant Inventory, 'http://www.npi.gov.au/npidata/action/load/emission-by-facility-result?exportCsv=true' (Webpage, 2024)

[73] European Environment Agency, *Air Pollution Impacts from Carbon Capture and Storage* (2011), Figure ES 1, p. 6.

[74] See, e.g., Terry L. Jones, 'LNG Export Terminals Pose a Growing and Invisible Threat: Air Pollution', *Louisiana Illuminator* (6 February 2023).

5 Any CCS buildout requires strong and comprehensive regulation prior to permitting to manage risks across the lifecycle and ensure long-term liabilities remain with the operator

48. As described throughout this submission, CCS entails a wide range of significant risks across the lifecycle of the process, including air and water pollution, pipeline rupture, and failure to meet capture rates. Further, CO_2 leaks at any point in the process can nullify the very purpose of CCS. As such, any CCS deployment requires strong and comprehensive regulation to mitigate all potential risks and avoid CO_2 leakages. The following paragraphs outline some examples of regulatory issues that must be addressed, leaving aside the important issues of air and water pollution, and pipeline rupture. Regulatory changes to address the failure to meet capture rates were discussed above at paragraph 20.

Leak prevention and integrity demonstration and testing

49. Because any CO_2 leakage will undermine carbon mitigation, regulation must require any proponent proposing to capture, transport, and store CO_2 to demonstrate the integrity of the entire process, including of the injection process and sequestration site, prior to any CCS proposal being approved.

Lifecycle leak detection monitoring

50. Regulation must require regular and reliable monitoring throughout the capture, transport, and sequestration processes to promptly detect leaks.[75] It must also require rapid remediation of leaks and empower the appropriate regulator to issue remedial directions. In relation to the sequestration process specifically, monitoring must ensure there is no CO_2 leakage or subsurface movement of CO_2 post-injection:[76]

> Successful implementation of CO_2 storage will require monitoring the CO_2 migration in the subsurface, understanding the processes controlling the subsurface distribution of the CO_2, and to provide assurance that the CO_2 is safe and not leaking upwards through the geological strata. Such assurance is vital to assess the risk of leakage of CO_2 from the reservoir…[77]

51. California provides an example of regulation requiring long-term monitoring: all CCS projects must "monitor and report seismic activity related to geologic sequestration of [CO_2], and monitoring of sequestered [CO_2], including movement within the geologic storage complex, for a period of time that is sufficiently long enough to demonstrate that the risk of [CO_2] leakage poses no material threat to public health, safety, and the environment and to the achievement of net zero greenhouse gas emissions in California and that terminates no earlier than 100 years after the last date of injection."[78]

Long-term liabilities to remain with operator

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[75] Ivar-Kristian Waarum et al., 'CCS leak detection technology – Industry needs, government regulations, and senor performance' (2017) 114 *Energy Procedia* 3613-3627.
[76] Ibid.
[77] The Royal Society, *Locked away – geological carbon storage policy briefing* (2022), p. 31.
[78] California Health and Safety Code, § 39741.1(a)(3)(D).

52. Because a proponent should be able to demonstrate the integrity of the capture and transport processes and the sequestration site, it is reasonable and essential that regulation require the operator to retain near- and long-term liabilities for monitoring, remediation, site closure and post-closure responsibilities, and decommissioning, to ensure the state and taxpayer are not forced to assume liability. For example, in Victoria, in both onshore and offshore greenhouse gas storage legislation, all liabilities remain with the operator.[79] However, in contrast, the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth) (**OPGGS Act**) requires the Commonwealth to indemnify the operator against liability that meets specified conditions after the "closure assurance period" (which is at least 15 years after the issuance of a site closing certificate).[80] The consequence of this provision is that, a mere 15 years after a site closing certificate is issued, Australian taxpayers bear the liability burden while the operator is able to retain its profits.

53. It is vital that any regulatory regime ensures that governments can achieve their climate goals and the public is protected from liability. Further, government, industry, and the public rightfully expect that carbon sequestration projects will operate over the long-term. Accordingly, we recommend that any regulatory regime require the operator to maintain liability in perpetuity, as occurs in other jurisdictions.[81]

Financial assurances and trailing liability for closure and post-closure liabilities

54. In addition, regulation must require strong financial assurances to cover the period of liability and the costs of near- and long-term monitoring and remediation, site closure and post-closure responsibilities, and appropriate and safe decommissioning. Estimates of security must be reviewed regularly by an independent third-party to ensure their adequacy to cover near- and long-term liabilities.

55. Regulatory regimes must also include a trailing liability scheme to ensure closure and post-closure liabilities cannot be avoided (e.g., through bankruptcy or sale of assets to an impecunious entity). For example, specific trailing liability provisions were inserted into the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth) in early 2022 to permit the offshore gas regulator, NOPSEMA, to direct former registered holders of GHG titles and related body corporates to take certain necessary remedial actions.[82]

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[79] *Greenhouse Gas Geological Sequestration Act 2008* (VIC), s 14; *Offshore Petroleum and Greenhouse Gas Storage Act 2010* (VIC), s 65(2).
[80] *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth), ss 399, 400.
[81] See for example, the United Kingdom's Department for Business, Energy & Industrial Strategy Guidance Note which states that operators must outline how they will manage liability in perpetuity for any remaining structures post decommissioning programme, 'DECC Document Template - Standard Numbering (publishing.service.gov.uk)' p 23
[82] *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth), s 594A.