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Carbon capture delusion risks diverting South Australia from green iron and steel

- *The South Australian government is being led by gas interests towards technology that cannot fulfill its Green Iron and Steel Strategy.*
- *Contrary to a recent report from Infrastructure SA, carbon capture is not essential to decarbonise the iron and steel sector. The notion that CCUS is "tried and tested" ignores the technology's long track record of failure and significant underachievement.*
- *Santos suitor ADNOC operates the world's only commercial-scale CCUS facility for steelmaking. It captures only about 25% of the steel plant's emissions. In no way can the steel produced be considered "green".*
- *Locking into gas and CCUS will cost South Australia its emerging green iron and steel opportunity because you can't make green steel with gas.*

Introduction

A recent Infrastructure SA report suggests ccarbon capture and storage (CCS) at the Whyalla steel plant can be a foundational step towards a much larger carbon capture utilisation and storage (CCUS) system in South Australia.

The report, prepared by global engineering consultants AECOM, states that "there is a consensus that CCUS is required for 'hard-to-abate' industries to achieve the net-zero target of the Paris Agreement". For the iron and steel sector, this is not the case. Carbon capture technology has a long history of failure and underperformance across all sectors where it has been applied. For iron and steel, the track record of CCUS is poor, and the outlook is very unconvincing.

The South Australian government cannot fulfill its Green Iron and Steel Strategy using gas with CCUS. Infrastructure SA's report suggests that steel made using gas and CCUS is "green steel". This is incorrect; CCUS cannot capture enough emissions to sufficiently reduce iron and steelmaking emissions. Green iron is made using hydrogen produced from renewable energy (green hydrogen).

South Australia has a world-leading opportunity to process its high-grade iron ore reserves into iron via direct-reduced iron (DRI) technology for export and for further processing into steel at Whyalla. DRI can run on gas or hydrogen (or a mix of both).

If South Australia locks in permanent gas use, it risks failing to compete with the Middle East where DRI is already in use, gas is cheap and plans to export green iron to Asia are already in place. Adding expensive CCUS in a vain attempt to make iron and steel look green will only make it less competitive. Meanwhile, South Australia would fall behind other countries such as Canada and Brazil, which have truly green iron and steel opportunities based on clean power grids.

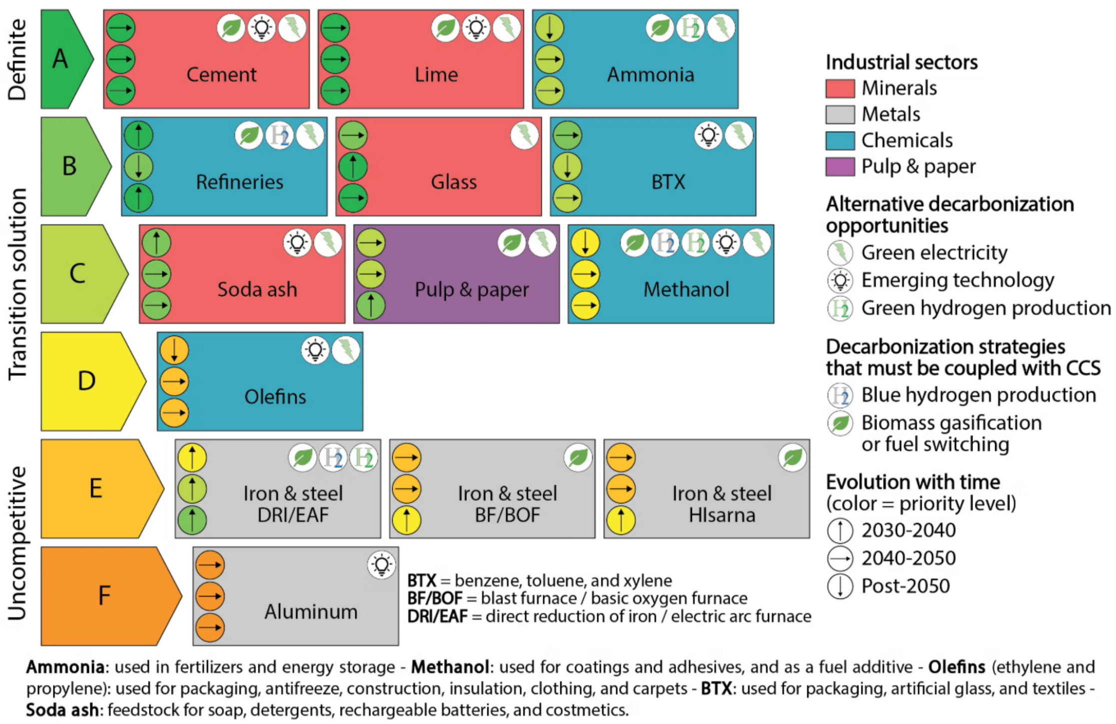
Low capture rates

Infrastructure SA states that, in the absence of green hydrogen for iron and steel production, “similar low-carbon outcomes can be achieved through the use of natural gas coupled with carbon capture”. This is not correct – carbon capture’s long track record of low capture rates means it cannot achieve the ~95% emissions reductions of green hydrogen-based steelmaking. You can’t make green steel with gas.

Across all the sectors where CCUS has been applied, it has consistently failed to achieve promised capture rates. In the iron and steel sector, there is only one commercial-scale CCUS plant in operation, the Al Reyadah project in the United Arab Emirates, which captures carbon emissions from Emirates Steel’s DRI-based steel plant. The Al Reyadah project is owned and operated by ADNOC, which is trying to acquire South Australian-based oil and gas major Santos.

The Al Reyadah CCUS project captures only about 25% of the steel plant’s Scope 1 and 2 emissions, according to IEEFA calculations. A separate study for the European Union estimated a similar figure. In no way can the iron and steel produced at this steel plant be considered “green”.

Figure 1: US carbon capture ladder for industrial decarbonisation



Source: Kleinman Center for Energy Policy

The carbon captured by Al Reyadah is used for enhanced oil recovery (EOR), enabling the release of more carbon emissions. It seems highly likely the project would never have been built if the captured carbon wasn't used for EOR. Since the project began operations nine years ago, no other commercial-scale CCUS project for iron and steel has become operational. This reflects the difficulty and expense of establishing CCUS for iron and steel where there are numerous sources of carbon emissions.

In October 2024, the Kleinman Center for Energy Policy at the University of Pennsylvania released its US industrial carbon capture ladder (Figure 1). It highlights that while carbon capture may have a role in decarbonising industries such as cement production, for iron and steelmaking via both blast furnace and DRI, it is "uncompetitive".

A long history of technical problems

Infrastructure SA maintains that CCUS is "tried and tested technology". However, in addition to an established history of low captures rates, CCUS has a long track record of technical issues that delayed or halted its implementation and increased its cost.

Even cases previously deemed successful demonstrate the risks of CCUS implementation, critically in geological storage. Here, each project faces a unique set of circumstances that limits the potential for technological learning and cost reductions. Late last year, oil and gas producer Equinor had to admit that faulty equipment meant it had been significantly overestimating the performance of its flagship Sleipner CCUS project for years. Sleipner had previously been considered one of the more successful CCUS projects to have been implemented.

Australian governments ought to be already familiar with the technical risks of CCUS due to the continued underperformance of the Gorgon carbon capture project off Western Australia. Gorgon is the world's largest CCS project but it has significantly underperformed due to persistent technical issues. It began storing carbon three years behind schedule, and since then has managed to capture only 44% of carbon against a target of 80%. More recently, its performance has deteriorated further; in FY2023-24, its capture rate was only 30%.

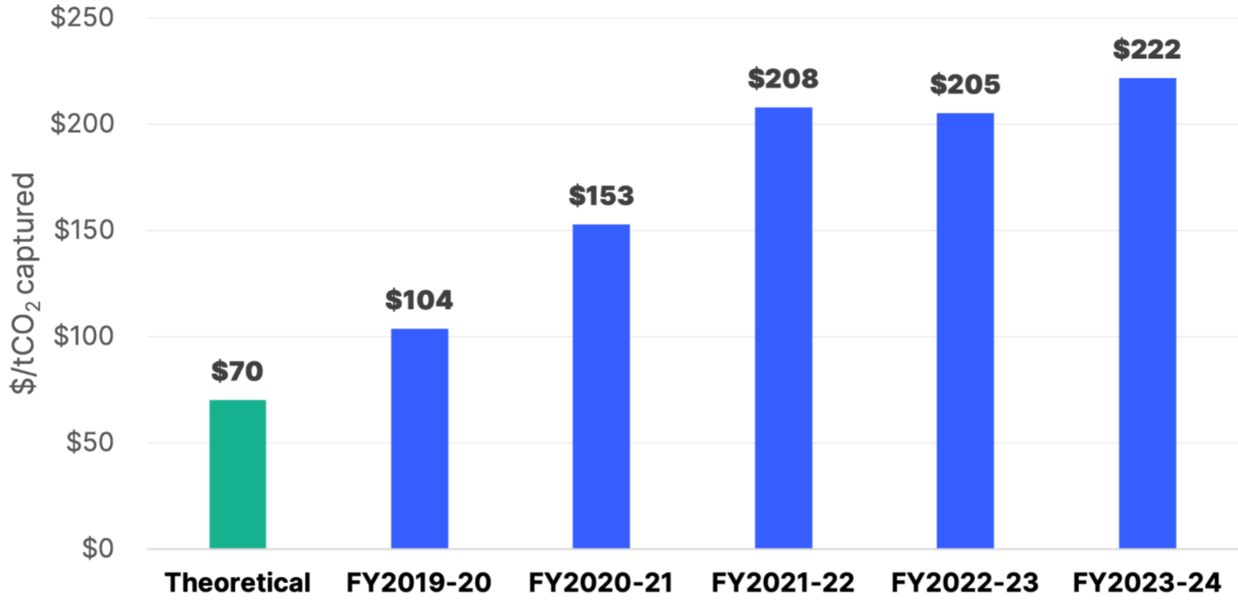
Infrastructure SA highlights Santos's Moomba CCS project as a key part of South Australia's carbon capture opportunity, including in the first phase - which would involve carbon capture at the Whyalla steelworks, a "proven operational CCS plant". Operational for less than a year, Moomba is far from proven. The long history of failure at CCS plants demonstrates it is often years before problems become apparent. The carbon captured so far at Moomba amounts to a barely perceptible fraction of Australia's total annual emissions, and its performance will need to be assessed over several years, not months.

Cost of CCUS

Infrastructure SA maintains that the value of carbon will exceed the cost of carbon capture for iron and steelmaking by 2031. This is based on Infrastructure Australia's 2024 carbon value – central scenario, which indicates a carbon value of AU$171 per tonne of CO_2 in 2031. However, this does not address the rate of carbon capture that will be achieved at that cost. Steel plants have multiple sources of carbon emissions, making it difficult and expensive to achieve high rates of capture. If the capture rate is similar to the Al Reyadah project (~25%), carbon capture may be economically feasible if it costs less than AU$171/t$CO_2$ in 2031 but the resulting iron and steel will only be partially decarbonised. Storing captured carbon at Moomba would also incur the significant extra cost of transporting the carbon hundreds of kilometres to Whyalla via either a dedicated pipeline or by road.

There is also significant doubt about the projected costs of CCUS. Technical challenges that have long plagued CCUS also drive up costs. At the Gorgon CCS project, costs have blown out from a theoretical AU$70/t$CO_2$ to AU$222/t$CO_2$ (Figure 2).

Figure 2: Theoretical vs actual costs for the Gorgon CCS project, AU$/t$CO_2$ captured



Source: Chevron, IEEFA analysis. Note: the theoretical cost is calculated based on initial project costs of AU$2.5 billion and annual capture rate of 4 million tonnes of CO_2.

Carbon capture technology has been in use for decades with little cost reduction achieved, partly due to the unique set of conditions for each project. As a result, it remains expensive. Despite there being a meaningful carbon price in the EU, steelmaker ArcelorMittal is considering shutting down its "flagship" carbon capture project in Belgium after only two years of operations as it is deemed financially unsustainable.

Woodside chief executive Meg O'Neill recently admitted carbon capture was too expensive for the company to make significant cuts to its emissions, citing costs of AU$200-AU$500/tCO_2.

A clear alternative

Infrastructure SA's CCUS report focuses on "hard-to-abate sectors", including steel, where "emissions are either unavoidable" or where "there is no clear alternative pathway to abatement". Neither of these applies to iron and steel. In Sweden, Stegra is constructing a commercial-scale steel plant that will produce iron and steel using 100% green hydrogen from day one. The plant will be operational next year. Stegra, formerly H2 Green Steel, has signed offtake agreements with customers with a 20-30% premium over the cost of standard, high-emissions steel.

In South Australia, gas may need to be used in the early years of new DRI-based iron and steel operations with green hydrogen use progressively ramped up as its cost declines. However, long-term reliance on gas for DRI in the state faces numerous risks, including limited supply and the cost of gas in the east coast market. In tight market conditions, demand for gas from DRI-based iron and steel operations would exacerbate the gas cost issue. In addition, South Australia risks permanent gas-DRI lock-in if it starts to support gas-based infrastructure such as CCUS.

The South Australian government insists it hasn't abandoned green hydrogen. Further support for domestic use of green hydrogen (which should be prioritised over exports) will be needed if the state is to become a pioneer in truly green iron and steel in the face of rising global competition. Hosting next year's UN climate change conference, COP31, in Adelaide would be an ideal opportunity to showcase the state's world-leading green iron and steel opportunity. As with other COPs, it can be expected that fossil fuel companies will be in attendance making the case for chronically underperforming technologies such as CCUS, which can't fulfill the state's Green Iron and Steel Strategy.

It's worth remembering that this year's COP30 will be hosted in Brazil, a nation that also has a major green iron and steel opportunity. Brazilian iron ore giant Vale is the world's largest supplier of direct reduction-grade (DR-grade) iron ore, and is examining opportunities to reduce it with green hydrogen. Vale has stated that two final investment decisions related to new DRI-based ironmaking projects can be expected this year. Announcements timed to coincide with COP30 seem likely.

Amid growing global competition, getting locked into gas and CCUS will cost South Australia its emerging green iron and steel opportunity.

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