



Carbon Capture and Storage Is About Reputation, Not Economics

Supermajors Saving Face More Than Reducing Emissions

Executive Summary

The Australian Government proposes to broaden the scope of its Climate Solutions Fund¹ to include the ability to invest in carbon capture, use and storage (CCS or CCUS) projects.

This expansion of scope is essential if CCS projects are to be undertaken as CCS projects:

- are prohibitively expensive compared to other greenhouse gas emissions mitigation options, such as renewable energy and energy storage technologies;
- offer no financial return for investors; and
- have a dubious track-record. Even the Global CCS Institute - a booster organisation for CCS - acknowledges in its 2019 *Global Status of CCS* report that CCS is at best a minor contributor to decarbonisation, addressing up to 9% of greenhouse gas (GHG) emissions by 2050.²

There isn't one example of a CCS project anywhere in the world that offers a financial justification for investing in CCS.

In the absence of a carbon price, CCS will never provide a return on investment.

European oil companies—in particular, Equinor, Shell and Total—are investing in CCS, notwithstanding the lack of return, because it is an important part of their decarbonisation narrative and supports their aims to be seen as “responsible” energy companies.

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The Australian Labor Party's recent statement that it remains “open to CCS” but insists that CCS must *not* be funded by the Clean Energy Finance Corporation (CEFC) nor the Australian Renewable Energy Agency (ARENA), makes sense. These bodies

¹ Australian Government. Clean Energy Regulator. [Climate Solutions Fund](#).

² Global CCS Institute. [Global Status of CCS 2019](#).

are intended to facilitate the increased flow of finance into the commercialisation and deployment of Australian based renewable energy, energy efficiency and low carbon technologies.”³ With CCS, there is no flow of finance into the CCS sector because there is no business case. With a carbon price, this might change: the market could then decide how much to invest in CCS projects.

Despite the Minerals Council of Australia’s recent hollow statement about the Paris Agreement in its “Climate Action Plan”⁴, decarbonisation of electricity, electrification of mining, and the use of green hydrogen in minerals processing will be the contributions its’ members make to combating increasing emissions, rather than the limited benefits afforded by CCS.

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CCS, Carbon Sinks and a Carbon Price

Oil majors Total and Shell have both emphasised the role that CCS, carbon sinks and a carbon price play in their ability to meet their long-term net-zero objectives.

Figure 1 shows directionally how Shell could meet its goal. Although this is not intended to be a precise chart, it is noteworthy the proportion of the reduction attributed to “natural sinks” (i.e., planting trees) and CCS.

Patrick Pouyanné, Chairman and CEO of Total, has stated, “We have the technology to capture and reinject carbon. The real question is how to do it in a way that is economically sustainable. That brings us back to the issue of carbon pricing.”⁵ In relation to CCS for coal-fired power generation, Pouyanné has said, “... I know that people advocate... for clean coal, but frankly, clean coal means a lot of CCS, and I would like to see where the CCS technologies are.”⁶

³ CEFC. [CEFC Investment Policies](#).

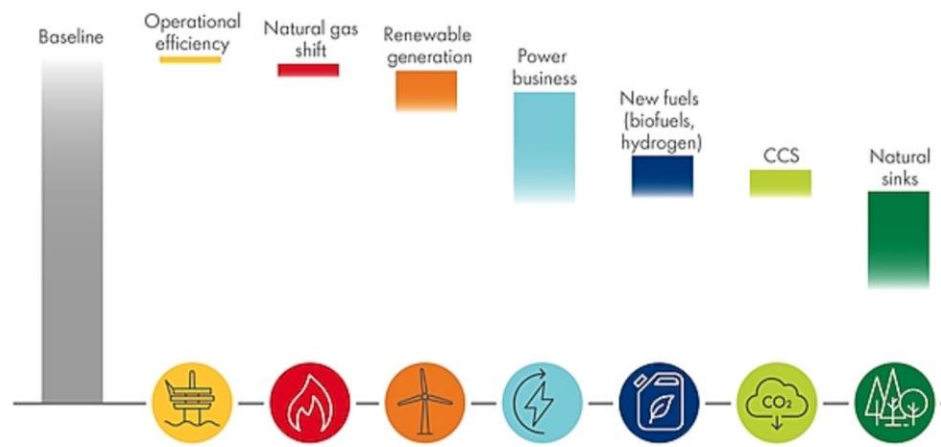
⁴ Minerals Council of Australia, [Climate Action Plan](#), 2020.

⁵ CNBC. [Total gives itself 15 years to make its products 15 percent less carbon intensive](#). 20 October 2018.

⁶ CSIS. [A Conversation with Patrick Pouyanné, Chairman and CEO of Total S.A.](#) 17 May 2018.

Figure 1: Shell's Path to Decarbonisation

MEETING THE AMBITION: HOW SHELL COULD CHANGE



An infographic showing how Shell could change in the future

Source: Shell.

IEEFA supports the idea that a carbon price is essential to achievement of large-scale carbon emission reductions. However, the fact that both companies' CEOs refer to this almost as a precondition to their climate goals invites scepticism about their commitment to unilateral action on CCS. Each company currently spends an immaterial percentage of annual capital expenditure on CCS⁷, so it is arguable that CCS is little more than a helpful marketing message to support their boarder decarbonisation ambitions.

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What is Carbon, Capture and Storage?

Carbon capture, use and storage (CCS or CCUS) encompasses an integrated suite of technologies that can prevent large quantities of carbon dioxide (CO₂) from being released into the atmosphere as a consequence of using fossil fuels.

This technology has been applied in a wide range of industries since 1972 when several natural-gas processing plants in the Val Verde area of Texas began

⁷ None of their investments are quantified in annual reports.

employing carbon capture to supply CO₂ for enhanced oil recovery (EOR) operations. Since then, more than 200 million tonnes of CO₂ have been captured and injected deep underground.

The net emissions impact of CCS must include emissions from the energy used in the process (up to 20% more than an operation without CCS) and the emissions from any oil extracted using EOR.

CCS Involves Three Major Steps:

1. **Capture:** The separation of CO₂ from other gases produced at large industrial process facilities such as coal and natural-gas-fired power plants, steel mills, cement plants and refineries.
2. **Transport:** Once separated, the CO₂ is compressed and transported via pipelines, trucks, ships or other methods to a suitable site for geological storage.
3. **Storage:** CO₂ is injected into deep underground rock formations, usually at depths of one kilometre or more, depleted oil or gas fields, deep saline aquifer formations or other forms of underground caverns, though it could apply to any form of storage.

The 'usage' component includes applications of the carbon in industrial processes such as the manufacture of synthetic diesel, biofuels, solvents and polymers.

A Good Idea but...

CCS is an excellent idea: if greenhouse gasses can be prevented from entering the atmosphere, we can continue traditional fossil fuel activities without worrying about the devastating effects of the changing climate.

The Global CCS Institute report quotes Lord Nicholas Stern, Bill Gates and other experts in the fields of climate, engineering and finance all emphasising the crucial role CCS has to play in addressing rising emissions.

There Are Some Key Problems However:

- Storage solutions can and do leak methane;
- The energy cost involved in the process materially reduces its net benefit; and,
- It doesn't make any economic sense, absent a whole-of-economy price on carbon emissions, supported by carbon border taxes (as proposed by the European Union).

What Can Go Wrong... and Does

Transportation and storage are two key areas of concern.

'Captured' carbon must be separated, transformed and, in most cases, transported to the sequestration site. The energy used in this process and the leakages that can occur during transportation and handling can materially reduce the net impact of the CCS process.⁸

Further, the underground storage into which the carbon is injected is not always secure. Wells have weaknesses and gaps. Fracking causes long-term subterranean instability, and seismic activity could dislodge even the most carefully stored carbon. Leaks in the Aliso Canyon natural gas storage facility in 2015 "released 97,100 metric tons of methane to the atmosphere,"⁹ doubling the methane emission rate of the entire Los Angeles basin.

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According to geologists, leaks should not be a practical concern for carbon dioxide (CO₂) storage if the CCS process is carefully implemented. However, further research concludes that the consequences of a minor leakage could reduce the benefit of CCS by up to 35%.¹⁰

The fossil gas industry has failed to systematically cap, sterilise and monitor abandoned gas wells over the last few decades, so methane leakage is massively underreported and largely ignored (thanks to regulatory capture and constant defunding of EPA departments). Further, the industry resists accepting liability for leakages.

The Economics of CCS Are Wrong

Whilst the technical issues of CCS can probably be addressed with engineering solutions over time, the more significant problem is a financial one.

CCS is an expensive process that generates very little revenue. Aside from limited pricing signals from emissions trading systems, there is no financial reason to invest in CCS. Consequently, there are no commercially viable examples of CCS anywhere in the world.

⁸ IEEFA. [Volkswagen lied about emissions from their vehicles, and the gas industry is also lying about their emissions](#). March 2020.

⁹ Science. [Methane emissions from the 2015 Aliso Canyon blowout in Los Angeles, CA](#). 18 March 2016.

¹⁰ Frontiers in Energy Research. [Bearing the Cost of Stored Carbon Leakage](#). 15 May 2018.

The traditional financial justification for doing CCS is for enhanced oil recovery (EOR). With oil prices currently well below breakeven for oils sands extraction, this does not begin to cover the costs of CCS.

With costs in the order of US\$4,200 per kilowatt¹¹ for a power plant equipped with CCS, even if it works, CCS is a poor investment, multiples of the cost of new renewable energy even when the addition cost of firming is included.

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It is no surprise that the few operating CCS plants globally are government subsidised.

Playing With Someone Else's Money

Shell

Royal Dutch Shell promotes CCS as a key factor in its new, bold emission reductions strategy: to bring down its net carbon footprint of products by 50% by 2050. As a then new CEO in 2014, Ben van Beurden told the audience in a keynote speech at Columbia University that CCS could remove up to 90% of emissions from power generation. In 2015, Shell promised investment in CCS, coinciding with the opening of the Quest CCS facility in Canada. At every AGM since, van Beurden has returned to CCS as a key part of the solution.

To date, Shell has two CCS projects: Quest in Alberta, Canada, funded by the Albertan and Canadian governments and operated by Shell; and Gorgon in Western Australia, a project in which the project principals (Shell and Chevron) are financially motivated *not* to operate the CCS plant. The Gorgon plant has failed to meet its targets every year, notwithstanding a \$60 million subsidy from the Western Australian government.

Shell's actual outlay in CCS over the years remains to be seen. Its overall investment in renewables is well behind its stated targets.¹² Any progress Shell demonstrates in removing carbon from the atmosphere using CCS (1m tonnes per annum at Quest and up to 4m tonnes at Gorgon) should be seen in light of Shell's total emissions of 656 million tonnes per annum (80Mt scope 1 and 2; 576Mt scope 3).¹³

Total SA

Total SA has also promised massive investment in CCS to remove up to 5 million tonnes of CO₂ per annum (8% of Total's scope 1 and 2 GHG emissions and 1% of

¹¹ EIA. [PetroNova is one of two carbon capture and sequestration power plants in the world](#). 31 October 2017.

¹² NS Energy. ["Royal Dutch Shell could be set to miss out on its green energy targets"](#). 3 January 2020.

¹³ Shell. [Shell Sustainability Report 2019](#).

scope 1/2/3 emissions).¹⁴

Total SA is an investor in Equinor's Sleipner CO₂ storage as well as, with Shell and Equinor, the larger Nordic project under development, Northern Lights.¹⁵

Equinor

Equinor, the Norwegian state oil and gas producer, has been investing in CCS since 1996, mainly because Norway has had a carbon price since 1991. Its Sleipner CO₂ storage and Snøhvit CO₂ storage facilities have cumulatively captured and stored around 22 million tonnes of CO₂. Compared to the rest of the fossil fuel industry, this is considerable achievement but this pales into insignificance when one considers that Equinor is responsible for over 330m tonnes of CO₂-e emissions every year (scope 1, 2 and 3). With the carbon price, there is a modest economic return on its CCS operations but the impact on emissions is immaterial in the scheme of Equinor's contribution to global warming. By way of comparison, Equinor's scope 3 emissions increased by 26 million tonnes per annum from 2014 to 2018.¹⁶

Capturing Carbon at Power Stations Proves Fraught

CCS is more problematic in relation to power stations.

Boundary Dam in Saskatchewan, Canada and Petro Nova in Texas are the only power stations to implement a CCS retrofit that were completed in North America this past decade.

Boundary Dam, owned by the Saskatchewan utility, SaskPower, cost C\$1.3bn to the retrofit, was years behind schedule, and operated at less than 50% capacity when it finally commenced.¹⁷ Only one power unit has been retrofitted and SaskPower made a decision not to apply the technology to the other units.

Kemper was to be the shining example of 'clean' coal. The cost blew out to US\$7.5bn, and the project was abandoned.

Petro Nova cost US\$1bn, at approximately \$4,200/KW, and captures 33% of emissions from one unit (654MW).¹⁸ The carbon was intended to be supplied for enhanced oil recovery (EOR) but the price has fallen dramatically since the initial modelling was done and the project is a financial failure. It receives a \$50/t subsidy

¹⁴ Total. [Integrating Climate into our Strategy](#). 2019.

¹⁵ Northern Lights. [About the Project](#).

¹⁶ Equinor. [Six ways our oil and gas expertise is energising renewables](#).

¹⁷ Renew Economy. [The Fallout from SaskPower's Boundary Dam debacle](#). 12 November 2015.

¹⁸ EIA. [Petron ova is one of two carbon capture and sequestration power plants in the world](#). 31 October 2017.

from the U.S. Government—effectively a carbon price—to keep it running at this minimal level.

Kemper was to be the shining example of ‘clean’ coal. A massive new coal-fired power station in Mississippi—possibly the largest project ever in the state—promised jobs and cheap, clean electricity. The \$2.4bn estimated cost (\$4,100/KW) blew out to US\$7.5bn and the project was abandoned.¹⁹

There is no business case for gas CCS other than as a corporate social responsibility initiative, and there is no business case for coal CCS at all.

Conclusion

The IEA identifies CCS as mitigating up to 9% of GHG emissions by 2050 but notes:

“With only two large-scale CCUS power projects in operation at the end of 2018 and a combined capture capacity of 2.4 million tonnes of CO₂ (MtCO₂) per year, CCUS in power remains well off track to reach the 2030 Sustainable Development Scenario (SDS) level of 350 MtCO₂ per year.

As CCUS applied to power is at an early stage of commercialisation, securing investments will require complementary and targeted policy measures such as tax credits or grant funding. Support for innovation needs to target cost reductions and broaden the portfolio of CCUS technologies.”²⁰

Figure 2 highlights the IEA’s assessment of the huge gap between aspiration and reality in relation to power CCS.

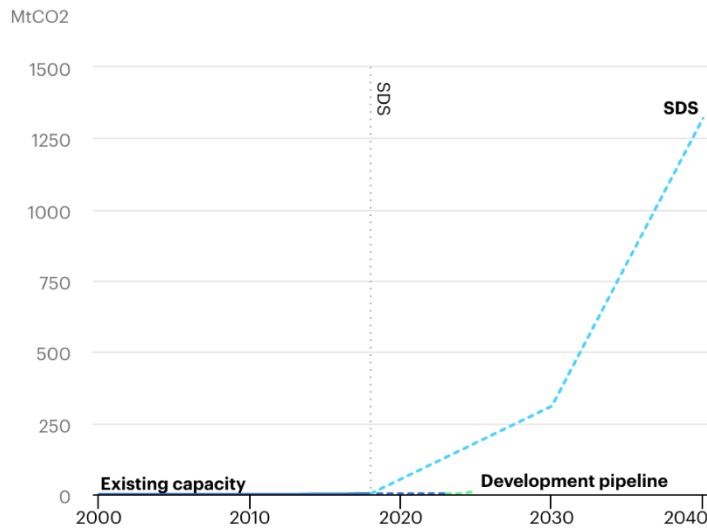
¹⁹ EIA. [Petron ova is one of two carbon capture and sequestration power plants in the world](#). 31 October 2017.

²⁰ IEA. [Tracking Power 2019](#).

Figure 2: IEA Highlights the Gap Between CCS Ambition and Reality

Large-scale CO₂ capture projects in power generation in the Sustainable Development Scenario, 2000-2040

Open 



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● SDS ● Existing capacity ● Development pipeline

Source: IEA.

If the Australian Government wishes to encourage the development of CCS in Australia, in both gas and power, a carbon price would be a much better policy than the subsidisation of uneconomic CCS project proposals.

About IEEFA

The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

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