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Santos 2022 Climate Change Report – A Reality Check

The Scorecard Shows Emissions Climbed Steeply, and Understates the True Position

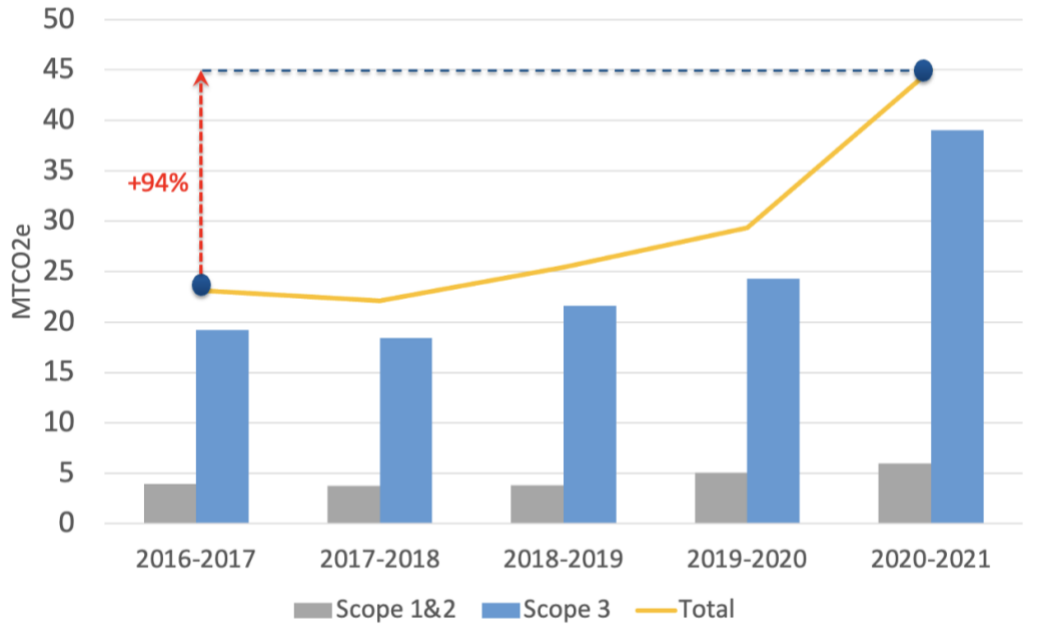
Executive Summary

Santos's 2022 Climate Change Report makes many claims about reducing emissions, yet its emissions rose by 53% in 2020-21.

A person reading the Climate Change Report would have trouble finding this number as it's buried in a table on page 54 of the report. Santos does not disclose its emissions up front in its Chair's message or its Chief Executive Officer's introduction, a somewhat glaring omission for an annual climate report.

The longer-term record is even worse. Over the past five years, Santos's total emissions have risen by 94%, again a figure that is not readily ascertainable from the report.

Santos's Emissions Over the Past Five Years*



** Santos completed the Oil Search merger in December 2021 which is outside of the period covered by Santos' 2022 Climate Change Report. However, the company has included the equity share of Oil Search emissions for 2020-21. In the report on page 16 the company stated "In December 2021, a merger between Santos Limited and Oil Search Limited was completed. The information in this section (Emissions calculation and reporting) provides an overview of emission sources for both the Santos and Oil Search assets and disclosure of greenhouse gas emissions for*

the 2020-21 financial year includes the Oil Search assets." For consistency we have adopted Santos's reporting framework.

Some of Santos's emission increases came with acquisitions or mergers in recent years. Acquisitions are a conscious decision of the board and management to allocate more capital to emissions intensive gas and liquefied natural gas (LNG). Every dollar spent on acquiring a competitor is a dollar *not* spent on low-emissions energy.

There is systemic under-reporting of emissions globally and Santos is no exception. At least some of the numbers within Santos's 2022 Climate Change Report are simply *not* a reliable indication of the true position.

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Santos:

- holds the largest number of offshore exploration permits as an operator.
- operates the largest offshore area under exploration of any company.
- is the operator of exploration projects worth A$1.3 billion collectively; representing 25% of the total exploration expenditure in Australian waters to be spent until 2027 by all companies.

New development projects are *not* consistent with net-zero emissions by 2050 targets as outlined by both the United Nations Production Gap report and the International Energy Agency.

New gas fields are generally speaking higher emitting than older gas fields. The cheap, close to shore, low carbon dioxide (CO_2) fields have already been developed. New fields that are further from shore generally have higher CO_2 content and therefore are far more emissions intensive.

Santos justifies its expansion projects by stating it will reduce emissions with carbon capture technologies. Carbon capture has proven to be technically difficult to implement, saving only fractions of the emissions initially promised.

Santos promises a bright future with blue hydrogen (produced from natural gas using carbon capture and storage), neglecting to mention that at current gas prices blue hydrogen is wholly uneconomic and its production results in higher emissions than just burning the gas.

According to Santos, the other path to offsetting emissions is via purchasing carbon credits for residual carbon emissions that can't otherwise be abated. Australia's Emission Reduction Fund has allowed the creation of Australian Carbon Credit Units (ACCUs) that have highly questionable efficacy. Offshore carbon credit schemes have similar low-quality attributes. Purchasing its way out of emissions reduction is not a completely credible way forward for Santos.

The practical example of Santos's latest largescale development project shows how the company will expand emissions. Its Barossa gas project is the highest CO_2 offshore gas field to be developed in Australia. Production is slated to begin well before any carbon capture project is implemented. Barossa is emblematic of the problems Santos faces. Even with carbon capture and storage (CCS), the high emitting project will increase the company's emissions and is entirely inconsistent with its 2022 Climate Change Report's stated aim of reducing emissions.

Investors in Santos should judge the company by its actions, not its aspirations. Barossa shows clearly that it pays little heed to emissions reduction. Any possible abatement CCS is not contemplated until years after operations start. The proposed CCS project at Bayu-Undan is 800km from the gas field. Compression emissions will probably offset any carbon captured at Bayu-Undan.

Investors in Santos should judge the company by its actions, not its aspirations.

Investors in, and bankers extending finance to, Santos need to re-examine their stance on this rapidly expanding gas company. Producing more emissions is not emissions reduction.

Santos has historically grown its emissions at a rapid rate. Its expansion plans will ensure that this continues into the future. Reliance on carbon capture, a technology with high failure rates despite its long history, is a fig leaf to disguise rising emissions.

Contents

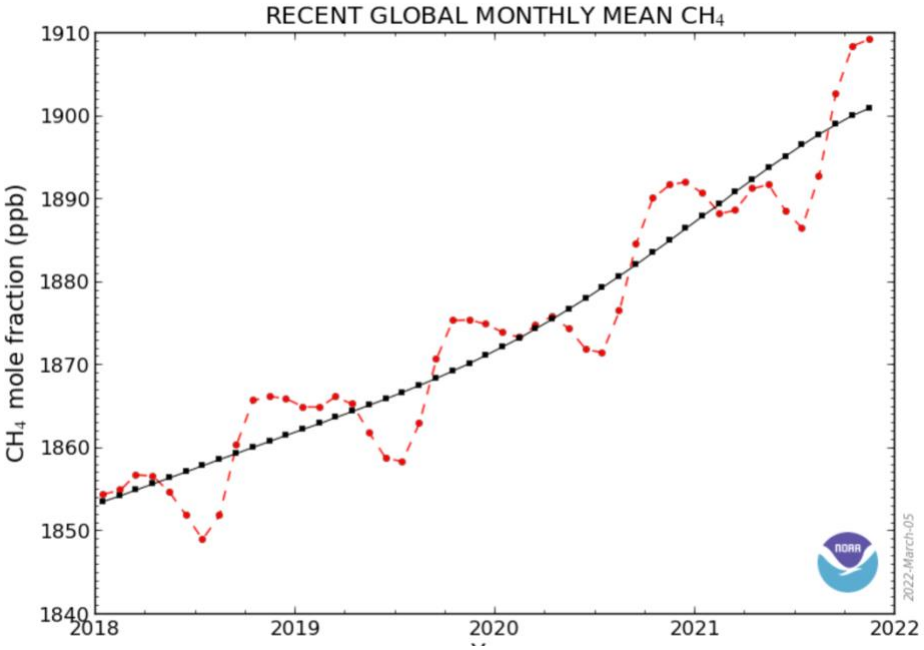
Dimensioning The Problem

Methane is the primary constituent of natural gas. Its emission reduction is vital to curbing the worst effects of climate change. It makes up at least one-quarter[1] of all greenhouse gases.

The importance of methane in global warming has been emphasised globally by the separate pledge on methane emissions organised by the United Nations (UN) environment program. The goal of a joint agreement signed in November 2021 by the European Union (EU) and the United States (US) to cut global methane emissions by 30% by 2030 marked a crucial step in tackling climate change.[2] Australia did not sign the methane reduction pledge.

Globally, methane emissions are rising strongly. The gas industry is driving this expansion in emissions through increased production. In 2020, despite the COVID-19-induced recession, methane emissions grew at the fastest rate since records began in 1983.[3]

Figure 1: Global Monthly Mean Methane (CH4) Levels



Source: NOAA. Global Monitoring Laboratory.

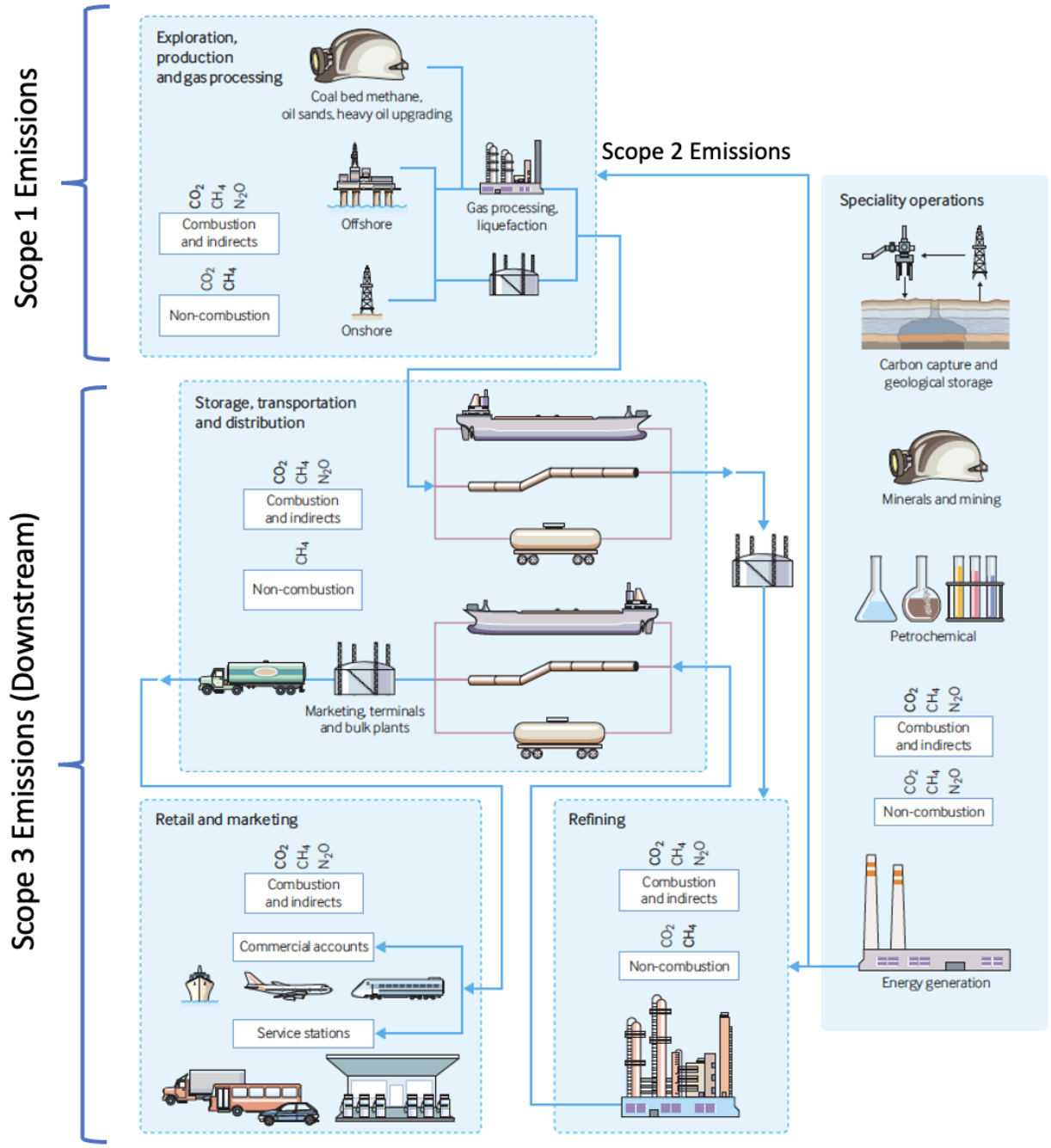
The Paris Agreement can be distilled down to one simple fact. To counter extreme weather events increasing around the world, we must reduce greenhouse gas emissions. Emissions of methane must fall, not maintain the current steep rise.

[1] UNEP. New global methane pledge aims to tackle climate change. 21 September 2021.
[2] IEEFA. Global methane pledge needs action, not transition. 5 November 2021.
[3] NOAA. Despite pandemic shutdowns carbon dioxide and methane surged in 2020. 7 April 2021.

What Are the Greenhouse Gas Emissions Scopes?

The categorisation of greenhouse gas emissions (GHG) is important in setting net-zero targets for any company in any sector.

Figure 2: Visualisation of Scope 1, 2 and 3 Emissions in Oil and Gas Sector



Source: Compendium of Greenhouse Gas Emissions Estimation Methodologies for the Oil and Natural Gas Industry, American Petroleum Institute, 2009.

The most common framework was introduced in 2001 by the World Resources Institute (WRI) and World Business Council for Sustainable Development as part of their Greenhouse Gas Protocol Corporate Accounting and Reporting Standard.[4] The goal was to develop a standardised method for businesses to measure and report the emissions associated with their operations.

Scope 3 emissions are produced when the product, gas or LNG, is burnt or used.

The three scopes enable businesses to distinguish between the emissions they directly emit into the atmosphere - over which they have the most control - and the emissions to which they contribute indirectly.

Put simply, Scope 1 and 2 emissions are the emissions produced in the production of the gas or LNG. Scope 3 emissions are produced when the product, gas or LNG, is actually burnt or used.

Santos 2022 Climate Change Report

In recent years, Santos has strengthened its stated climate commitments. In Santos's 2022 Climate Change Report[5] the targets are stated as follows:

By 2030:

- Reduce absolute Scope 1 and 2 emissions by 30% from a 2019-20 baseline of 5.9 Mt CO2e (million tonnes carbon dioxide equivalent)
- Reduce Scope 1 and 2 emissions intensity by 40%
- Use carbon, capture and storage (CCS) technology to accelerate the economic feasibility of hydrogen and deliver a step change in emissions reduction
- Reduce customers' emissions by at least 1.5 million tonnes per annum of CO2e from the supply of clean fuels

By 2040:

- Net-zero Scope 1 and 2 emissions

[4] Greenhouse Gas Protocol. Corporate Standard.
[5] Santos. 2022 Climate Change Report. March 2022. Page 7.

Scope 3 Emissions

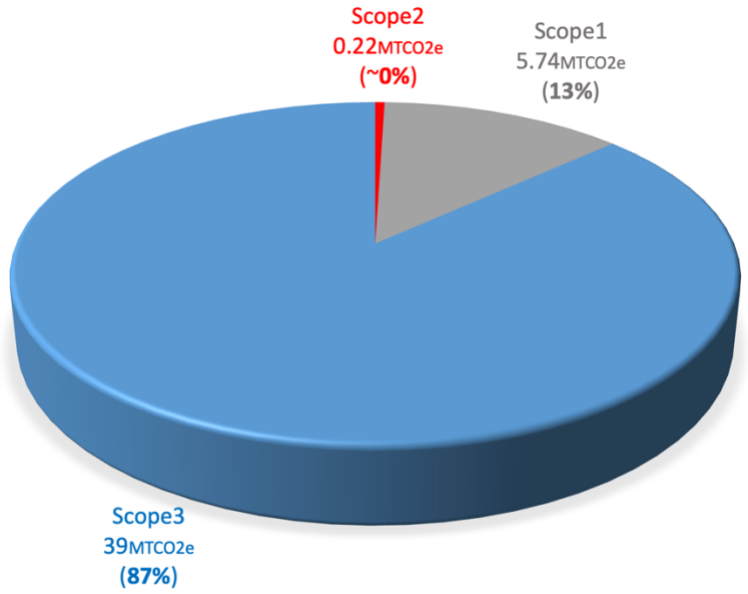
Santos has a policy to only sell to customers from countries that have a net-zero commitment or are signatories to the Paris Agreement.[6]

Santos (including Oil Search equity emissions) had total equity Scope 3 emissions of 39 Mt CO2e in 2020-21.

87% of Santos's emissions are Scope 3 emissions.

It is important to note that 87% of Santos's emissions are Scope 3 emissions.

Figure 3: Santos's Greenhouse Gas Emissions – Total



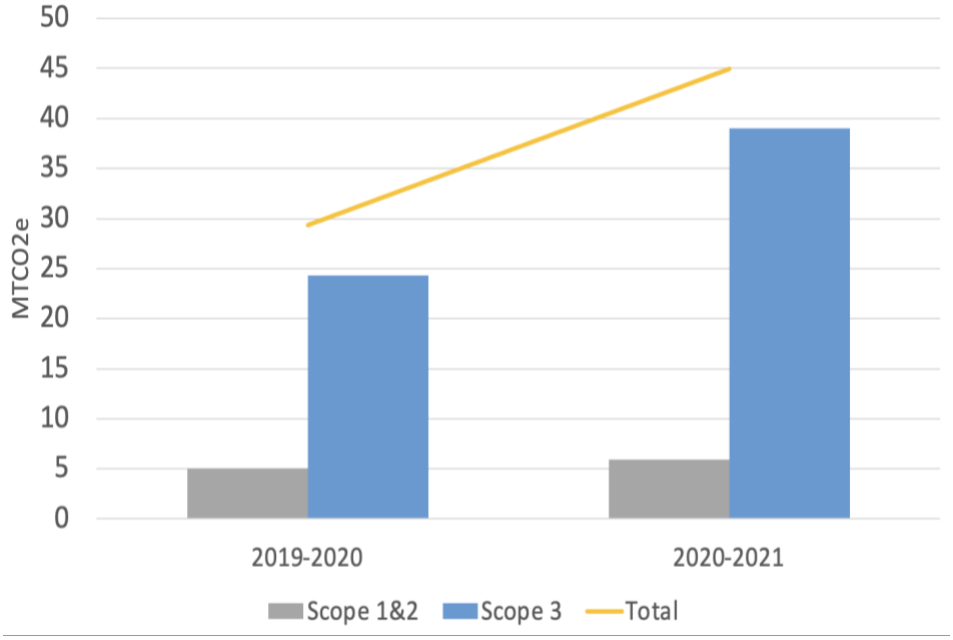
Source: Santos 2022 Climate Change Report.

Emissions Rose Strongly in 2020-21

Total emissions grew by 53% over the year to June 2021. Even Santos's directly controllable Scope 1 and 2 emissions grew by 18%.

[6] Santos. 2022 Climate Change Report. March 2022.

Figure 4: Santos Scope 1, 2, 3 and Total Emissions (2019-2020 to 2020-2021)



Source: Santos 2022 Climate Change Report.

The numbers include Oil Search's equity contribution post-merger. Even without Oil Search, existing businesses' emissions increased in 2020-2021 compared to 2019-2020. The total emissions of Santos (excluding Oil Search equity) increased by about 20% in 2020-2021 compared to the previous financial year.

Table 1: Santos Scope 1, 2 and 3 Emissions and Percentage Change (2019-2020 to 2020-2021)

Emissions/Year	2019-2020	2020-2021	% Change
Scope 1 & 2	5.04	5.96	+18%
Scope 3	24.3	39	+60%
Total	**29.34**	**44.96**	**+53%**

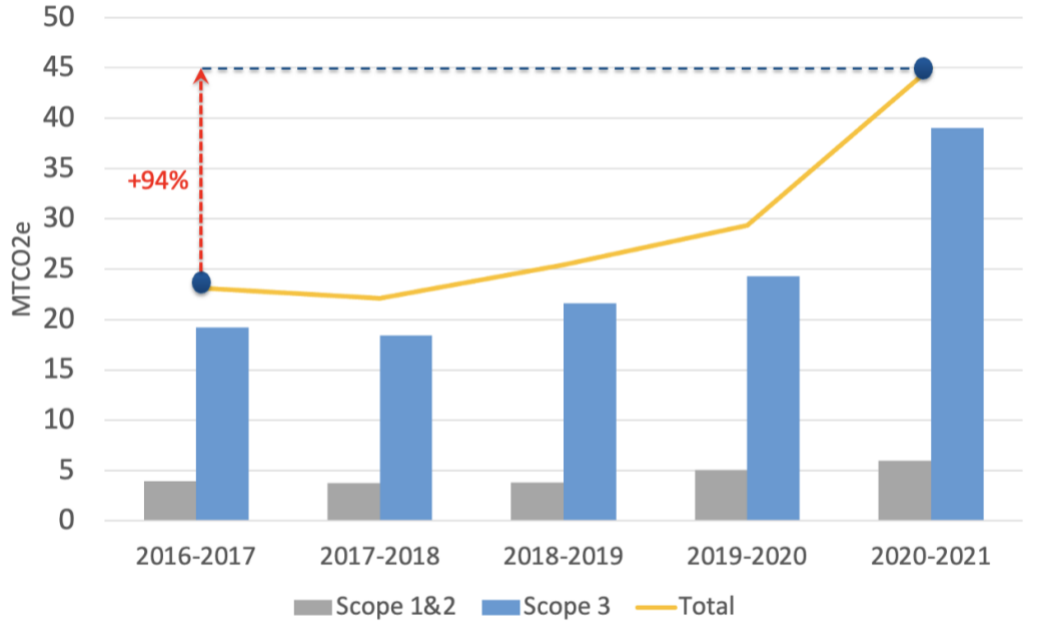
Source: Santos 2022 Climate Change Report.

Emissions Rose Strongly in 2016–2021

Emissions grew by 94% over the five-year period between 2016-2021. Santos included the acquisitions of ConocoPhillips northern Australian assets and Oil Search's equity contribution in this period.

Acquisitions are a clear management decision to allocate capital towards high emitting fuels, with the attendant climate risks, rather than low emitting fuels and green investments such as renewables and batteries.

Figure 5: Santos's Emissions Over the Past Five Years



Source: Santos 2022 Climate Change Report.

Product Stewardship

Santos must take the majority of the responsibility for all emissions from what it produces. The gas must be produced by Santos before it can be burnt or used. Without production, there are no Scope 3 emissions.

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Product stewardship is not a new concept and has been an accepted practice in many industries for decades. In the automotive industry, for example, a maker will issue a recall to remedy a problem at no cost to the owner.

Product stewardship applies to managing the environmental impacts of different products and materials, at different stages in their production, use and disposal. It acknowledges that all involved in the production, sale, use, and disposal of products share a responsibility to ensure that those products are managed in a way that reduces their impact on the environment and on human health and safety, throughout their lifecycle. The greatest responsibility lies with whoever has the most ability to affect the full life cycle environmental impacts of the product. This is

most often the producer, though all within the product chain of commerce have roles.[7]

Santos may be able to reduce Scope 1 and 2 emissions, but it is much harder to reduce the bulk of the emissions (Scope 3) that occur when the gas Santos produces is burnt or used.

Scope 3 Emissions - The Elephant in the Room

For many industries, once a product is created, it generates few additional emissions from consumption or end use. As a result, in terms of emissions scope, the emissions associated with the use of sold products (classified as part of Scope 3) are minor when compared to those associated with manufacturing. This is true for a variety of industries, ranging from textiles to high-polluting cement.

Considering cement, the majority of CO_2 emissions occur during the chemical process that converts calcium carbonate (CaCO3) to lime (CaO). A direct emission from the production process and under control of the company is categorised as Scope 1.

This is not the case in the oil and gas industry where the bulk of emissions are Scope 3 (i.e. mostly related to the end use of the fuel). This 'elephant in the room' used to be often overlooked in oil and gas companies' pledging to net-zero emissions or providing emission reduction solutions.

There is escalating pressure from stakeholders, regulators and civil societies on oil and gas companies to take their liability for Scope 3 emissions into account. For example, in Chevron's annual investor meeting in May 2021, 61% of shareholders backed a proposal for the company to further reduce emissions including Scope 3.[8] Similarly, ConocoPhillips was pressed to consider a full-scope emissions reduction target in an approach backed by 58% of investors.[9]

Some big oil and gas companies have adopted "absolute measures" to reduce their Scope 3 emissions.

Consequently, some big oil and gas companies have adopted "absolute measures" to reduce their Scope 3 emissions. Eni, Total and BP are the top three largest where Eni

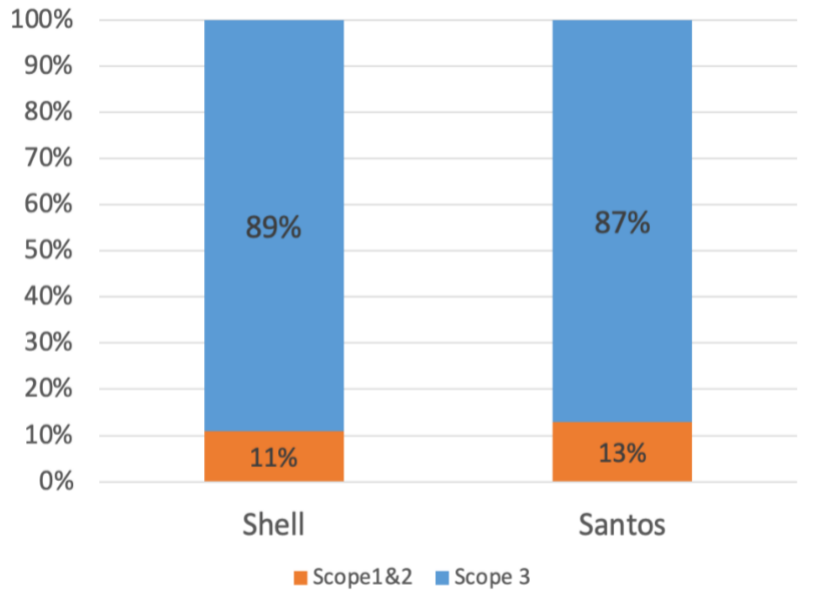
[7] Northwest Product Stewardship Council. What is Product Stewardship?
[8] Bloomberg Green. Chevron Investors Back Climate Proposal in Rebuke to C-Suite. May 2021.
[9] Bloomberg Green. Chevron Investors Back Climate Proposal in Rebuke to C-Suite. May 2021.

has defined Scope 3 reduction targets for all of its emissions, and Total and BP have defined Scope 3 reduction for part of its operations.[10]

The magnitude of Scope 3 emissions in the emission portfolio of oil and gas companies is staggering. Estimates and calculations vary, but almost all of them fall into the range of 85-90% as an industry average.[11, 12]

Figure 6 illustrates Scope 3 emissions' share in the 2020 emission profile of Shell, and the 2020-2021 emissions profile of Santos. These figures highlight the importance of Scope 3 emissions in setting net-zero targets. Focusing only on reduction of Scope 1 and 2 emissions is by no means enough as it covers a very small proportion of the whole lifecycle emissions of the oil and gas industry.

Figure 6: Scope 1 and 2 vs Scope 3 Emissions – Santos and Shell



Source: Offshore-technology, 2021, Santos 2022 Climate Change Report.

The oil and gas industry, as whole, releases 42% of the global emissions.[13] This illustrates the necessity and the urgency of monitoring, reporting and reducing Scope 3 emissions.

Focusing on Santos, the planned Scope 1 and 2 emission 2030 targets would reduce total emissions by only about 4% of its 2020-2021 total. Santos has a target of

[10] Carbon Tracker. Absolute Impact 2021: Why oil and gas 'net zero' ambitions are not enough. May 2021.
[11] HIS Markit – S&P Global. Oil, gas companies under pressure to manage Scope 3 emissions to reach net-zero goals: analysts. 2021.
[12] Total Energies. Getting to Net Zero. September 2020.
[13] McKinsey & Company. The future is now: How oil and gas companies can decarbonize. January 2020.

reducing Scope 3 emissions by 1.5 million tonnes per year, a figure that also represents only about 4% of its Scope 3 emissions in 2020-2021.

If the company achieves its Scope 1 and 2 net-zero target by 2040, and assuming it doubles the current Scope 3 emissions target until 2040, Santos's total emissions will reduce by just 19% against the current 2020-2021 emissions profile as the baseline. This is clearly not in line with global peers or an acceptable target if Santos wishes to achieve genuine net-zero emissions by 2050.

It is difficult to see how Santos will materially reduce emissions along the customers' value chain. It points to CCS, blue hydrogen and offsets as potential methods to reduce customers' emissions. Each method is problematic. The technical difficulties faced by CCS projects, the high emissions and currently uneconomic nature of blue hydrogen, and the efficacy of emission offsets all have problems.

Carbon Capture and Storage

Santos is heavily betting on Carbon Capture and Storage (CCS) technologies as one of the avenues by which the company could reduce emissions while continuing to expand its oil and gas business.

There are four CCS projects listed in the 2022 Climate Change Report of which Moomba has received final investment decision (FID) and others are in different stages pre-FID.

Table 2: Santos's Planned CCS Projects

The table below outlines the CCS hubs that Santos is working on including indicative status (project phase) and timelines[44]

Initiatives	Description	Project phase	Indicative Timeline
Moomba CCS (South Australia)	Santos has taken a final investment decision on phase 1 of our Moomba CCS project, a commercial-scale project which will store approximately 1.7 million tonnes per annum of CO2 captured at the Moomba Gas Plant. If new sources of CO2 are made available, the potential exists to store approximately 20 million tonnes per annum across the Cooper and Eromanga Basins for up to 50 years. As the Moomba CCS project is designed to utilise existing processing capability at Moomba and existing infrastructure associated with depleted reservoirs in the Cooper Basin, Santos expects that it will be one of the lowest-cost CCS projects globally with full lifecycle cost of less than US$24 per tonne of CO2.	Under construction	Current and ongoing 2021 FID 2024 online
Bayu-Undan CCS (Northern Australia / Timor-Leste)	In March 2022 front end engineering design (FEED) commenced for the Bayu-Undan CCS project. Santos is working with both the Australian and Timor-Leste governments with a view to progressing the development of this project, with initial injection and storage of approximately 2.3 million tonnes of CO2 per annum once natural gas production from the field ceases. The project has storage capacity of around 10 million tonnes of CO2 per annum and will look to capture CO2 from nearby projects up to its potential. The Bayu-Undan CCS project will utilise the existing Bayu-Undan to Darwin pipeline and the offshore Bayu-Undan facilities to minimise the cost of the project. Potential CO2 sources include natural gas developments and industrial sources in northern Australia with customers and investors in Korea and Japan also interested in the project for emissions reduction from their activities.	FEED underway	2025 FID 2027 online
Reindeer CCS (Western Australia)	The Reindeer CCS project has the potential to store up to 2.4 million tonnes of CO2 per annum for approximately 20 years, with availability for third party CO2 and with potential CO2 sources including industrial sources and natural gas developments in the Pilbara region of Western Australia.	Under assessment	2025 FID 2028 online
PNG CCS	PNG CCS would potentially support the LNG industry, with potential storage of approximately 0.3 million tonnes of CO2 per annum.	Under assessment	2028 FID 2031 online

Source: Santos 2022 Climate Change Report.

Santos's CCS plans are backed by increasing government support of this technology. The company placed conditions on the FID of Moomba CCS on the decision of the government on whether to include CCS under the Emission Reduction Fund (ERF). The CEO of the company stated in October 2021: "With the new CCS method now approved, Santos will seek to have the Moomba CCS Project registered and generate

ACCUs through the Emissions Reduction Fund. Once the project has been registered, we will be in a position to make a Final Investment Decision to proceed."[14]

Such an announcement reveals the fact that this technology could not economically stand alone and needs government support. CCS has been utilised for 50 years. It is not a technology in its infancy when generally speaking government support is needed.

The Australian Government is investing more than A$300 million in Carbon Capture Use and Storage (CCUS) over 10 years[15]:

- The A$250 million CCUS Hubs and Technologies program will support CCUS deployment at scale.
- The A$50 million CCUS Development Fund supported six new carbon capture use and storage projects.

Santos's CCUS projects would attract both types of support.

Moreover, on October 2021, the Clean Energy Regulator introduced incentives for CCS projects in Australia. The company can now claim carbon credits for each tonne of CO_2 it does not emit.

The technology has been struggling in terms of technical viability and economic feasibility for decades and there is track record of failure for CCS/CCUS projects around the world.

Carbon Capture technology has been struggling in terms of technical viability and economic feasibility for decades.

In comprehensive joint research by the University of California, Carleton University and the Imperial College London, Ahmed Abdullah and his colleagues demonstrated that more than 300 CCUS projects of all types have been proposed or built worldwide since 2000. Of these, approximately 50% (149) have sought to store some or all of the CO_2 they captured. [16]

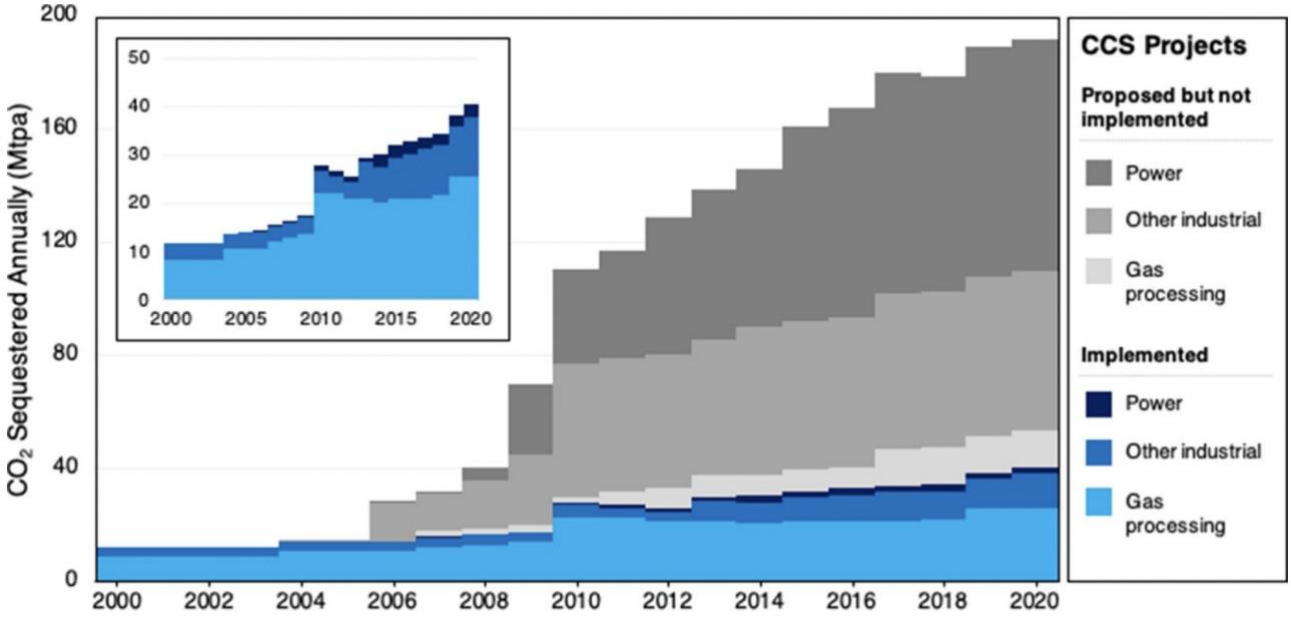
More than 100 of the 149 CCS projects originally planned to be operational by 2020 have been terminated or placed on indefinite hold (Figure 7). These were set to capture more than 130 million tons of CO_2 per annum once completed—more than three times the amount of CO_2 captured today.[17] According to the study: "While

[14] Santos. Santos welcomes CCS method for Emissions Reduction Fund, clearing way for Moomba CCS project to apply for registration. October 2021.
[15] Australian Government. Department of Industry, Science, Energy and Resources. Reducing Emissions Using Carbon Capture, Usage and Storage.
[16] Ahmed Abdulla et al. Environmental Research Letters. Explaining successful and failed investments in U.S. carbon capture and storage using empirical and expert assessments. 2021.
[17] Global CCS Institute. Global Status of CCS 2021. 2021.

many projects essential to commercializing the technology have been proposed, most (>80%) end in failure."[18]

Figure 7 below shows the historical failure of the technology despite US government support. Especially in the 2000s, we saw the largest US push to commercialize the technology, with private industry and government investing tens of billions of dollars in dozens of industrial and power plant capture projects.[19]

Figure 7: Historical Failure of CCS Projects (2000-2020)



Source: Environmental Research Letters. Explaining successful and failed investments in U.S. carbon capture and storage using empirical and expert assessments. 2021.

Carbon capture has been around for half a century, not necessarily as a climate-friendly solution to curb CO_2 emissions and avert climate consequences, but as an inevitable step in the natural gas production process.

The economic viability of projects has been enhanced by selling the captured CO_2 [20] (especially for gas fields with low methane and high CO_2 content). A key component of the business model for commercial development of such gas fields is capturing CO_2 and then selling it for enhanced oil recovery (EOR) to recover more oil and gas from depleted fields. The EOR process ultimately produces more CO_2 emissions when the oil or gas is combusted.

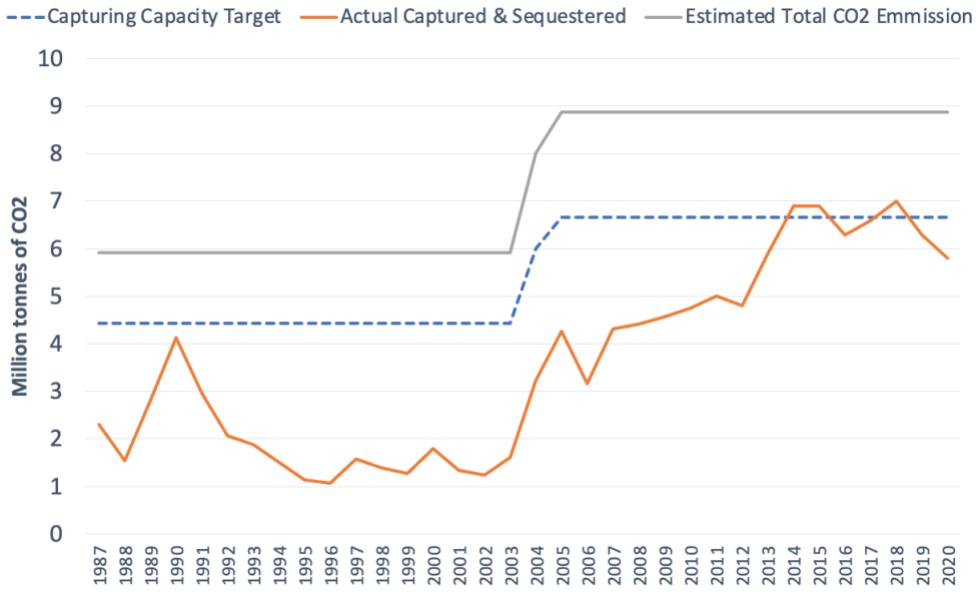
[18] Ahmed Abdulla et al. Environmental Research Letters. Explaining successful and failed investments in U.S. carbon capture and storage using empirical and expert assessments. 2021.
[19] Environmental Research Letters. Explaining successful and failed investments in U.S. carbon capture and storage using empirical and expert assessments. 2021.
[20] E.J. Mackay. Heriot-Watt University UK. 3 - Modelling the injectivity, migration and trapping of CO_2 in carbon capture and storage (CCS). Geological Storage of Carbon Dioxide (CO_2). 2013.

This older version of the technology, known as CCUS, is used in more than 73% of current carbon capture capacity around the world. Many of the CO_2-EOR (CCUS) projects were initiated at a time when climate change was not a mainstream issue. They have been re-labelled as a climate-saviour. The more recent application, CCS, sequesters the CO_2 in dedicated geological structures and accounts for the balance of projects worldwide.[21]

However, the vast majority of carbon capture projects in the gas industry are for EOR. Essentially the technology serves the fossil fuel industry to produce more oil and extend the life of oil wells.

The largest project of this kind is the Shute Creek gas treating facility operated by ExxonMobil since 1986. IEEFA found[22] that over its lifetime, the facility has captured about 34% less than its targets and almost all of that captured CO_2 has been sold to nearby oil companies for EOR. The recovered oil and gas produces more emissions when it is burnt.

Figure 8: Capturing Performance Trend of Shute Creek CCUS Plant (1987-2020)



Source: *IEEFA Estimates, ExxonMobil Energy and Carbon Summary Reports 2019, 2020, 2021. Energy Procedia.*

The Shute Creek CCUS project accounts for about 40% of all anthropogenic CO_2 captured during the 50 years of the technology's existence. The large share of this one project points to the fact that the technology has *not* been successfully scaled up, despite its longevity.

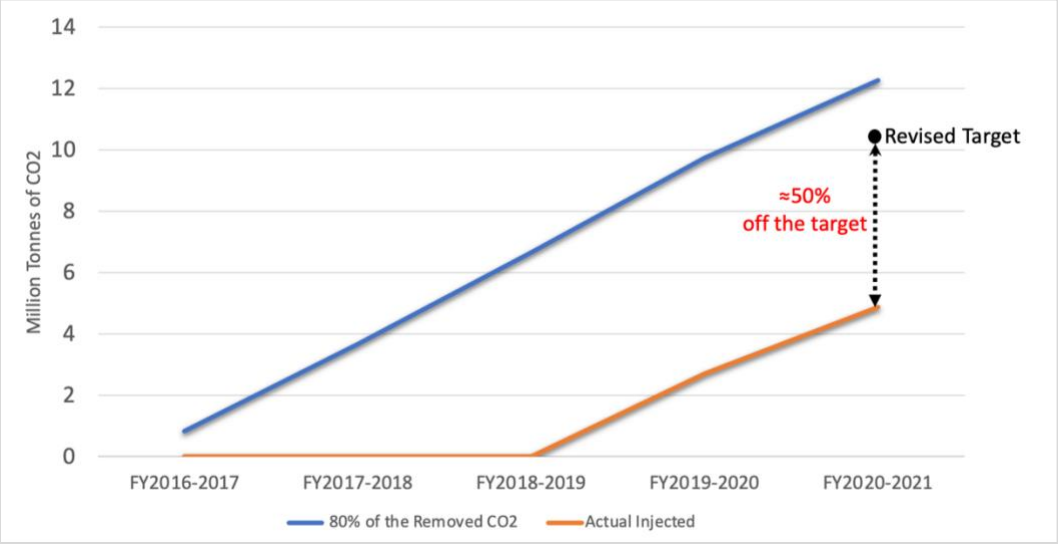
[21] Global CCS Institute. Global Status of CCS 2021. 2021.
[22] IEEFA. Carbon Capture to Serve Enhanced Oil Recovery: Overpromise and Underperformance. March 2022.

Among carbon capture projects with dedicated geological storage (CCS), the largest is in Australia - the Gorgon LNG project on Barrow Island off the Pilbara coast of Western Australia (WA).

The $3.1 billion Gorgon plant produced its first LNG cargo in March 2016[23] as planned[24], but the first CO_2 injection from its CCS facility[25] did not occur until August 2019 – a three-and-a-half-year delay. The project suffered numerous technical problems and unexpected difficulties along the way.

Despite being owned by a blue-chip list of companies including oil and gas global majors Shell, ExxonMobil and Chevron, the Gorgon CCS project has failed to deliver, underperforming its targets for the first five years by more than 50%. The shortage has been claimed to be 5.23 Mt of CO_2.

Figure 9: Gorgon CCS Plant's Performance (Cumulative Trend, 2016-2021)



Source: Gorgon Environmental Performance Reports 2015-2020 & 2021.

Some projects have been operating successfully, such as Sleipner in Norway and Quest in Canada, but they are among very few that went ahead with huge subsidies or in the presence of a high carbon tax. Generally, CCS/CCUS has not been successful historically.

The only potential application that could be justified and applied genuinely in line with climate targets is using carbon capture technology in "hard-to-abate" heavy industries such as steel and cement, and only then if the captured CO_2 is *not* used for EOR. Among all carbon capture projects, only one CCS project has been applied to decarbonise steel production (in Qatar with 2.2MTPA capacity, or just 5% of the

[23] Chevron. Gorgon Carbon Capture and Storage Fact Sheet. 2021.
[24] Massachusetts Institute of Technology. CCS Project Database. Gorgon Fact Sheet.
[25] Financial Times. Monster problem; Gorgon project is a test case for carbon capture. 26 July 2021.

global total carbon capture capacity in operation). To IEEFA's knowledge, no public data has been provided on the capturing performance or economics of the project.

Santos's 2022 Climate Change Report relies heavily on carbon capture technologies to achieve its reductions in emissions. The history of delivery of CO_2 abatement by this technology is poor by any standards. Some the world's best petroleum engineers, from Chevron, Shell and Exxon Mobil, could not make CCS work at Gorgon.

Blue Hydrogen

Santos uses CCS to promote the expansion of hydrogen made from natural gas. This type of hydrogen is typically labelled blue hydrogen as opposed to hydrogen made with renewable energy which is labelled green hydrogen.

Blue hydrogen is an emissions-intensive process, even with CCS. It is also currently uncompetitive with its green cousin as global gas prices soar.

Recent research[26] from Cornell and Stanford Universities found that: "Considering both the uncaptured carbon dioxide and the large emissions of unburned, so-called 'fugitive' methane emissions inherent in using natural gas, the carbon footprint to create blue hydrogen is more than 20% greater than burning either natural gas or coal directly for heat, or about 60% greater than using diesel oil for heat."

Blue hydrogen is an emissions-intensive process, even with CCS, and uneconomic in the face of high gas prices.

A January 2022 scientific paper from the ANU[27] came to similar conclusions: "We find that emissions from gas or coal based hydrogen production systems could be substantial even with CCS, and the cost of CCS is higher than often assumed."

Since last summer, European gas prices have risen fivefold to more than €100/MWh, radically changing the cost dynamics for blue hydrogen. Even with gas at €80/MWh, Bernstein, the global asset management firm, has estimated blue hydrogen exceeds €6/kg.[28]

Green hydrogen's unit costs are at least €4/kg, significantly cheaper than blue hydrogen in today's high-priced gas world.

[26] Cornell Chronicle. Touted as clean, "blue" hydrogen may be worse than gas. August 2021.
[27] Science Direct. Clean Hydrogen? Comparing the emissions and costs of fossil fuel versus renewable electricity based hydrogen. January 2022.
[28] Reuters. Hydrogens civil war reveals its winner. 31 March 2022.

Carbon Offsets

In Australia, via the Emission Reduction Fund (ERF), Australian Carbon Credit Units (ACCUs) have been developed to create offsetting opportunities for carbon polluters. Santos hopes to generate ACCUs through its future CCS projects.

A number of activities are eligible under the scheme and participants can earn ACCUs for emissions reductions. One ACCU is earned for each tonne of carbon dioxide equivalent (tCO2-e) stored or avoided by a project. ACCUs can be sold to generate income, either to the government through a carbon abatement contract, or in the secondary market.

In October 2021, CCS was recognised by the Australian government as a means of reducing emissions and creating ACCUs.[29] Considering CCS as an emission reduction method to generate offsets brings problems, as follows:

Credibility Is a Serious Issue With Carbon Credits (Offsets)

Carbon offset is a double-edged sword. It can be useful in reducing emissions in hard-to-abate industries but also can create loopholes for others to avoid materially reducing their emissions. There are also doubts about the credibility of these offsets, globally and domestically.

In Australia, the ACCU market – dominated by carbon credits generated through carbon farming, regenerative agriculture and vegetation[30] – has been a matter of debate recently as to its validity and credibility. Professor Andrew Macintosh and colleagues from the Australian National University (ANU) have published a series of papers posing serious questions about the ERF mechanism and outlining systemic flaws in the fund and the way it issues ACCUs. They have labelled the ERF an "environmental and taxpayer fraud": "The available data suggests 70 to 80 per cent of the ACCUs issued to these projects (current carbon offset projects covered by ERF) are devoid of integrity – they do not represent real and additional abatement," Professor Macintosh said.[31]

There are doubts about the credibility of carbon offsets, globally and domestically.

[29] Australian Government. Clean Energy Regulator. Emission Reduction Fund. Carbon Capture and Storage. November 2021.
[30] Australian Financial Review. Money grows on trees in Australia's secret carbon market. June 2021.
[31] Australian National University. College of Law. Australia's carbon market a 'fraud on the environment'. March 2022.

In response, the Clean Energy Regulator believes that the ERF mechanisms and the ACCU generation methods have integrity and has defended the policy against the criticisms raised by Macintosh.[32]

International offsets such as those issued under the Verified Carbon Standard Program by Verra, a global organisation that develops and manages carbon market standards[33], have also come in for criticism.[34]

Eligibility Requirements of the Emission Reduction Fund Violate the Original Goal of the Policy

One of the eligibility requirements that a CCS project could be considered under the ERF mechanism is "newness", which means "the CCS method requires that a project involve a new greenhouse gas source. For greenhouse gases generated from an industrial process, this will be a new greenhouse gas capture point. For greenhouse gases extracted from a new hydrocarbon field, this will be a new hydrocarbon field."[35]

This condition could violate the very first goal of ERF as an emission reduction policy. It implies that the government assumes new "hydrocarbon fields" will be developed in coming years, and indirectly incentivises the development of new oil and gas fields by providing an extra potential revenue stream. This is in stark contrast with the IPCC's findings, the IEA's Net-Zero Report and other scientific studies that demonstrate that the world cannot afford any "new" oil and gas projects based on the remaining carbon budget. This condition in the ERF policy is also not in-line with the Australian government and Santos's claimed net-zero targets.

There Is a Huge Risk Of "Multiple Counting" by Considering CCS as a Method of Emission Reduction

There is a potential loophole in the way the ERF policy interacts with the emission accounting of the companies involved. If the company operating an ERF project is a big polluter itself under the safeguard mechanism, there is a potential risk of double counting of emission reductions. For example, with Santos and its upcoming Moomba-CCS project, the company may want to have all abatement achieved by the CCS project recognised against its net-zero target.

However, as CCS is an eligible method of creating ACCUs, the project can produce ACCUs and sell them to the government. Essentially it could reduce emissions as part of its mandatory requirement under the safeguard mechanism and probably get paid for doing so. It could be more complicated if the ACCUs are supplied to the

[32] Australian Government. Clean Energy Regulator. CER response to claims by Professor Andrew MacIntosh. March 2022.
[33] Verra. About Verra.
[34] The Guardian. Carbon offsets used by major airlines based on flawed system, warn experts. May 2021.
[35] Australian Government. Clean Energy Regulator. Emission Reduction Fund. Carbon Capture and Storage Method. December 2021.

voluntary market and third parties purchase those offsets and claim them against their emission targets. Then there would another type of double counting occurring.

According to the GHG Management Institute and Stockholm Environment Institute, double claiming can occur if offset credits are issued to a project, but another entity (e.g. a government or private company) then counts the same credits towards its own GHG reduction goal.

The Paris Agreement explicitly prohibits such "double counting" among countries.[36] The same strict regulations and monitoring should be in place inside of each country, such as Australia, to prevent double counting between private sector entities and the government as well.

Although the Clean Energy Regulator has addressed the issue[37], there is still potential for carbon accounting miscalculations in such an evolving and complicated regulatory area.

CCS Liability and Technical Risks in Long Term

Some proponents regard CCS projects as an emission abatement solution, but in the long-term there are many uncertainties and challenges for such projects.

The first risk is the leakages and fugitive emissions in long-term. It is not possible to guarantee that the stored CO_2 will stay underground and will not emit into the atmosphere. There are several real-world examples of failure in storing gas underground. The best example is the California Aliso Canyon gas leak in 2015, the worst man-made greenhouse-gas disaster in US history, when 97,000 metric tonnes of methane were released into the atmosphere.[38]

Whilst the gas involved was methane, the principles are exactly the same for CO_2 storage. In a 258-page investigation report, investigators said that groundwater had corroded the metal lining of a 50-plus-year-old underground well, leading to its rupture at 892 feet below ground. The report revealed that the operator company did not properly monitor its wells at the site, adding that “the approach to well integrity at Aliso Canyon had been reactive rather than proactive.”[39]

There will always be a risk of such disasters for any CCS project, especially in the Moomba field, where thousands of wells have been drilled in the past decades for hydrocarbon extraction. The IPCC’ Carbon Dioxide Capture and Storage Special Report stated: "CO_2 storage is not necessarily permanent. Physical leakage from

[36] GHG Management Institute. Stockholm Environment Institute. Securing Climate Benefit: A Guide to Using Carbon Offsets. November 2019.
[37] Australian Government. The safeguard mechanism: carbon offsets and avoiding double counting of emissions reductions.
[38] The Washington Post. California gas leak was the worst man-made greenhouse-gas disaster in U.S. history, study says. February 2016.
[39] The New York Times. Corroded Well Lining Caused Aliso Canyon Gas Lek That Displaced Thousands, Report Says. 2015.

storage reservoirs is possible via (1) gradual and long-term release or (2) sudden release of CO_2 caused by disruption of the reservoir."[40]

The other challenge is liability. The question of who will be responsible for long-term monitoring of the geological structure is very important. Santos must be liable for any failure/leakage and monitoring cost of Moomba and its other CCS projects, specifically in the event that the company is paid for capturing the carbon. However, it seems that this is not the case as the lifetime of CCS projects under the ERF is considered just 25 years.[41]

The most recent example of the liability challenge is the Gorgon CCS project in which the project is expected to run for 40-45 years, after which there will be a closure period of 15 years. Post closure, the liability of the project is handed over to the WA government[42] – essentially, Australian taxpayers.

Santos Needs to Clarify If Moomba Is an EOR Project or a CCS Project

The Clean Energy Regulator explicitly excludes any type of enhanced oil and gas recovery from the CCS method under ERF regulations. As stated in the Carbon Capture and Storage Method 2021 - Simple Method Guide: "The term 'carbon capture, utilisation and storage' (CCUS) is often applied to the use of carbon dioxide for enhanced oil or gas recovery. These activities are not eligible under the CCS method, which specifically excludes projects involving enhanced oil recovery, enhanced gas recovery and enhanced hydrocarbon recovery."[43] Hence, the ERF method is about CCS, not CCUS.

It is not completely clear whether the Santos's Moomba CCS is an enhanced oil/gas recovery project. As Santos has repeatedly acknowledged the need for support to go ahead with the Moomba project and has welcomed the recent decision of the government to consider CCS as a new method under ERF policy, it is critical that Santos clarify whether the project is purely CCS or is it enhanced oil/gas recovery (CCUS), or a mixture of these.

Moomba's feed gas is very high in CO_2 content (up to 47% CO_2 by mole).[44] As an inevitable step in producing marketable gas to be transported by pipelines, the vast majority of this CO_2 content should be removed and normally would be vented.

Santos has been exploring using this CO_2 for EOR activities in the Cooper Basin. In its 2020 Climate Change Report, it stated that the appraisal activities for Moomba CCS

[40] Intergovernmental Panel on Climate Change. Carbon Dioxide Capture and Storage Report. 2005.
[41] Australian Government. Clean Energy Regulator. Emission Reduction Fund. Carbon Capture and Storage Method. December 2021.
[42] WA Department of Mines, Industry Regulation and Safety. Gorgon Carbon Dioxide injection project.
[43] Santos. Santos welcomes $1.9 billion technology-neutral investment to reduce carbon emissions. September 2020.
[44] Santos. Moomba Environmental Impact Report Carbon Storage. March 2021. Page 18.

"assessed the potential for improvements in oil recovery and associated CO_2 storage from reservoirs in the Cooper Basin".[41]

Also, according to the Moomba environmental impact report, A$10 million was invested in 2019 to advance carbon storage technology with the testing of CO_2 enhanced oil recovery.[45]

Statements in the more recent environmental approval documents for the Moomba CCS project confirm CO_2-EOR to be part of Santos's tentative plan for the project. The environmental impact report of the project, published in March 2021, states: "In the Cooper Basin, gas used in gas injection schemes is sourced from nearby satellites. Prior to injection into the reservoir, the gas is subject to biocide and corrosion inhibitor dosing and filtration. The gas for a dedicated CO_2 EHR (Enhanced Hydrocarbon Recovery) scheme would be sourced from Moomba."[46]

In another statement, Santos elaborates on the metering and monitoring of injected and trapped gases during EOR activities: "Injection and production volumes during EOR operations would be metered. Following the completion of any EOR activity, CO_2 remaining in the reservoir could be viewed as permanently stored. This would be managed in line with the Carbon Storage SEO and associated monitoring, verification requirements and international standards."[47]

Santos itself states that only "up to 50%" of CO_2 injected at Moomba may be stored.

Santos claims that only up to 50% of CO_2 injected during EHR becomes trapped in the reservoir, which confirms the inefficiency of the EOR method as an emission reduction method. Santos itself states that only "up to 50%" of CO_2 injected at Moomba may be stored.

EOR directly leads to higher hydrocarbon output, and hence the emission benefit from the CO_2 injection activity is further compromised and potentially entirely disappears. If the EOR process is successful, it produces higher emissions.

[45] Santos. Moomba Environmental Impact Report Carbon Storage. March 2021. Page 3.
[46] Santos. Moomba Environmental Impact Report Carbon Storage. March 2021. Page 17.
[47] Santos. Moomba Environmental Impact Report Carbon Storage. March 2021. Page 68.

The Numbers in the 2022 Climate Change Report Are Wrong, Very Wrong

The numbers outlined in the Santos Climate Change Report are wrong. They significantly understate the amount of emissions from the process of producing gas and LNG in Australia.

In many cases where emissions are actually measured rather than estimated, the emissions from gas and LNG production are found to be multiples of those claimed.

The most recent example of this is the study by Stanford University of methane leaks from the New Mexico portion of the Permian Basin.[48] The study[49] completed a comprehensive aerial survey of nearly 27,000 sites covering 90% of all wells. The results were astonishing. The study found that oil and gas operations in New Mexico's Permian Basin are releasing 194 metric tons per hour of methane. That is more than six times as much as the latest estimate from the Environmental Protection Agency.

It is not just the US where such problems of under-reporting methane emissions exist. In Australia the situation is particularly dire.

The emission estimates are taken from the Gas Industry Social and Environmental Research Alliance (GISERA)[50], the gas industry-funded and gas industry-controlled arm of the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Where independent measurements have been taken, they have been found to be out by orders of magnitude.

Where independent measurements of methane emissions have been taken, they have been found to be out by orders of magnitude, compared to industry estimates.

One of Santos's five core operations is the Coal Seam Gas (CSG) operations in the Bowen and Surat Basins in Queensland.[51] According to an international study[52] on emissions[53] from the Surat Basin: "The CSG

[48] The New York Times. Methane Leaks in New Mexico Far Exceed Current Estimates, Study Suggests. 24 March 2022.
[49] ACS Publications. Quantifying Regional Methane Emissions in the New Mexico Permian Basin with a Comprehensive Aerial Survey. 23 March 2022.
[50] GISERA. Greenhouse gas and air quality.
[51] Santos Ltd. What We do.
[52] The Royal Society. Coal seam gas industry methane emissions in the Surat Basin, Australia: comparing airborne measurements with inventories. 27 September 2021.
[53] ABC News. Methane emissions higher than estimates in coal seam gas region. 28 September 2021.

CH4 emission per unit of gas production determined in this study is two to three times higher than existing inventories for the region."

The IEA has weighed in on the emissions accounting fraud being perpetrated, stating that methane emissions from the energy sector are 70% higher than official figures.[54]

IEEFA has also previously analysed the understatement of emissions by the gas industry in detail, in the report "Is the Gas Industry Facing Its Volkswagen Moment?"[55]

The numbers published in the Santos Climate Change Report understate the true emissions produced by the company's operations.

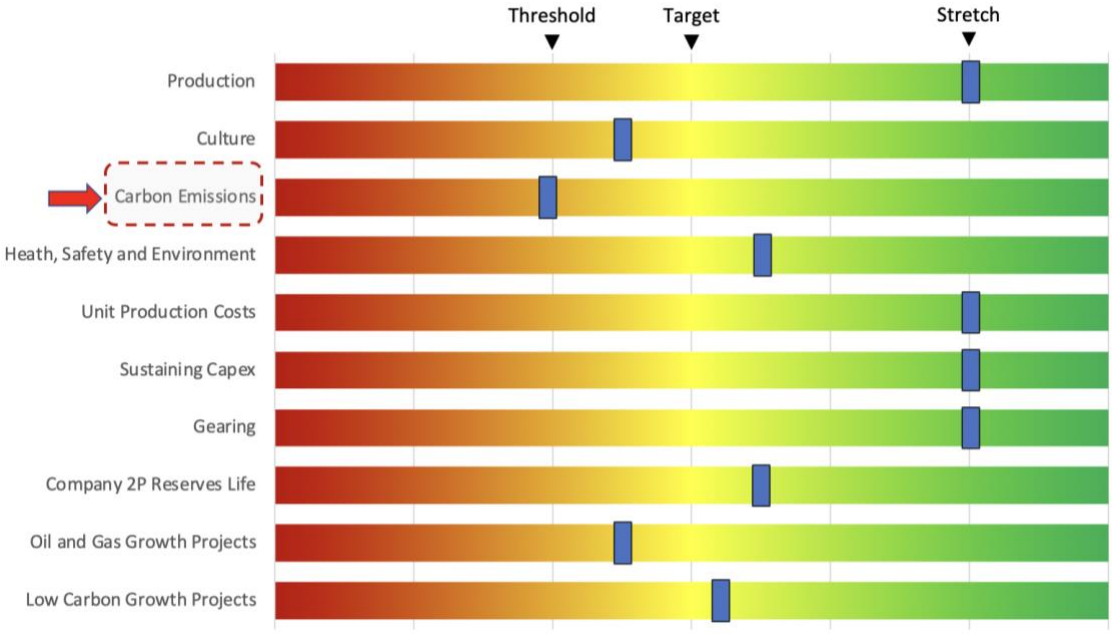
Climate Performance Through the Company's Internal Perspective

As depicted in Figure 10, there are ten key performance indicators (KPIs) reflecting performance of the company in different aspects of financial, sustainability, production and growth.

Based on the disclosure, it is evident that despite the ambitious climate-friendly announcements the company delivered, the worst performance was for carbon emission activities/policies. The KPI shows the company could not hit the predefined target. This is prominent when we notice that Santos has outperformed the target in the majority of KPIs.

[54] International Energy Agency. Methane emissions from the energy sector are 70% higher than official figures. 23 February 2022.
[55] IEEFA. Is the Gas industry Facing its Volkswagen Moment. March 2020.

Figure 10: Santos KPI's Assessment Result - 2021[56]



Source: Santos Annual Report 2021, IEEFA analysis.

According to the definition of the carbon emissions KPI, the "threshold performance" is defined as "the reduction of Scope 1 and Scope 2 emissions from Cooper Basin and Queensland operated assets set based on the glidepath to achieve the Company's public commitments by 2025". According to the explanation provided in its annual report 2021, the company could barely reach this threshold. Also, the definition of this threshold excludes numerous other assets that Santos has a stake in across Australia and Papua New Guinea (PNG).

Santos is not achieving its stated targets for carbon emissions, as defined by its KPIs in its annual report for 2021.

Numerous Expansion and Development Projects Contradicts Net-zero Targets and IEA's Advice

According to Santos's annual report, its assets are divided into six categories, namely Western Australia, Cooper Basin, Northern Australia and Timor-Leste, Queensland and New South Wales, Papua New Guinea and North America in which Santos has gained some assets after the acquisition of Oil Search. The table in **Appendix 1** outlines coming or in-operation recent development or expansion projects. The list of developed and coming expansion projects in different parts of

[56] As achievement for each KPI is explained qualitatively, the slider's positions don't show the exact quantitative value of each KPI. Instead, the slider's position relative to each other demonstrates the relative achievement of each KPI compared to others.

Australia and overseas shows that Santos is investing in numerous new oil and gas ventures.

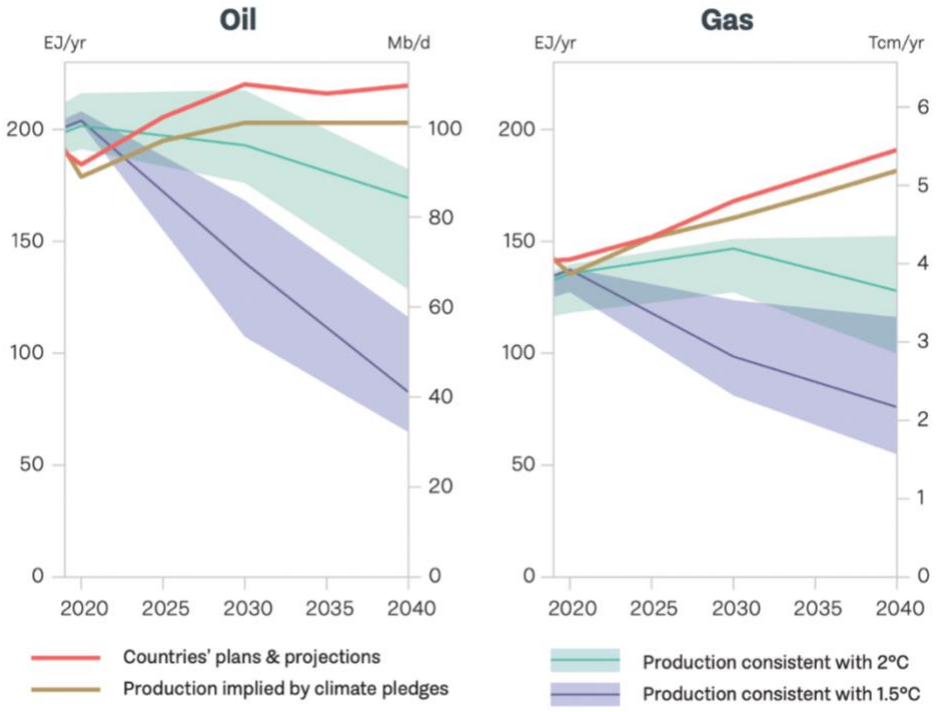
According to the IEA's seminal Net-Zero Report published in 2021, to reach net zero in 2050, no new oil or gas projects are needed beyond those already under development*:* "No new natural gas fields are needed in the NZE beyond those already under development. Also not needed are many of the liquefied natural gas (LNG) liquefaction facilities currently under construction or at the planning stage. Between 2020 and 2050, natural gas traded as LNG falls by 60% and trade by pipeline falls by 65%."[57]

Santos is investing in numerous new oil and gas ventures.

It is a sobering outlook for those involved in oil and gas production.

The UN Production Gap report similarly states that if we are to have a chance at limiting global warming to 1.5°C, gas and oil production must fall from 2020, not rise, as Santos proposes.

Figure 11: Oil and Gas Production Scenario Analysis – 2021



Source: Production Gap Report. 2021.

[57] IEA. Net Zero by 2050. A RoadMap for the Global Energy Sector. 2021.

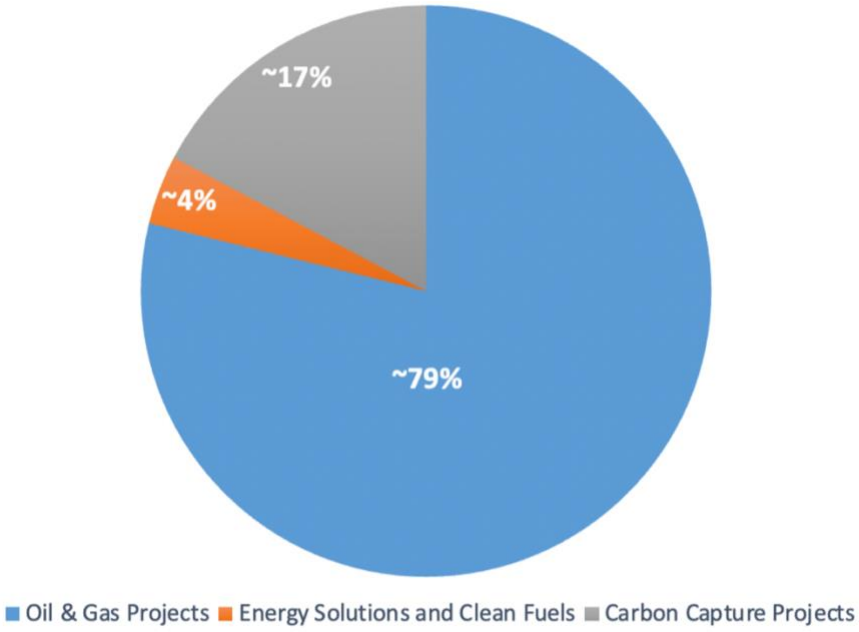
This is in line with recent research[58] by the University of Manchester emphasising that there is no capacity in the carbon budget for opening up new production facilities of any kind, whether coal mines, oil wells or gas terminals.

However, as depicted in **Appendix 1**, Santos's major growth projects' capital expenditure in 2022 is expected to be in the range of US$1.15 billion to US$1.3 billion. A contingent amount of up to about US$400 million could be added should the Dorado and Pikka[59] projects take FIDs.

Among these growth projects, US$50 million would be spent on energy solutions and clean fuels. If it means energy efficiency programs and renewable energies, then it would be positive and in line with the spirit of net-zero. They are not large enough to offset the considerable expansion plans outlined by Santos.

Figure 12 below illuminates around 79% of the major growth projects are oil and gas and in stark contrast with the IEA's Net-Zero Report's advice.

Figure 12: Capital Expenditure – Major Growth Projects[60]



Source: Full year results report 2021, IEEFA analysis.

Overall, Santos's considerable oil and gas expansion projects are *not* consistent with any net-zero emissions by 2050 scenario.

[58] The University of Manchester Research. Phaseout Pathways for Fossil Fuel Production Within Paris-compliant Carbon Budgets. 2022.
[59] Although Santos commissioned Moelis bank to sell the Pikka stake, it is still considered a company asset and is among potential growth projects in the company's documents.
[60] Figure excludes Pre-FID projects.

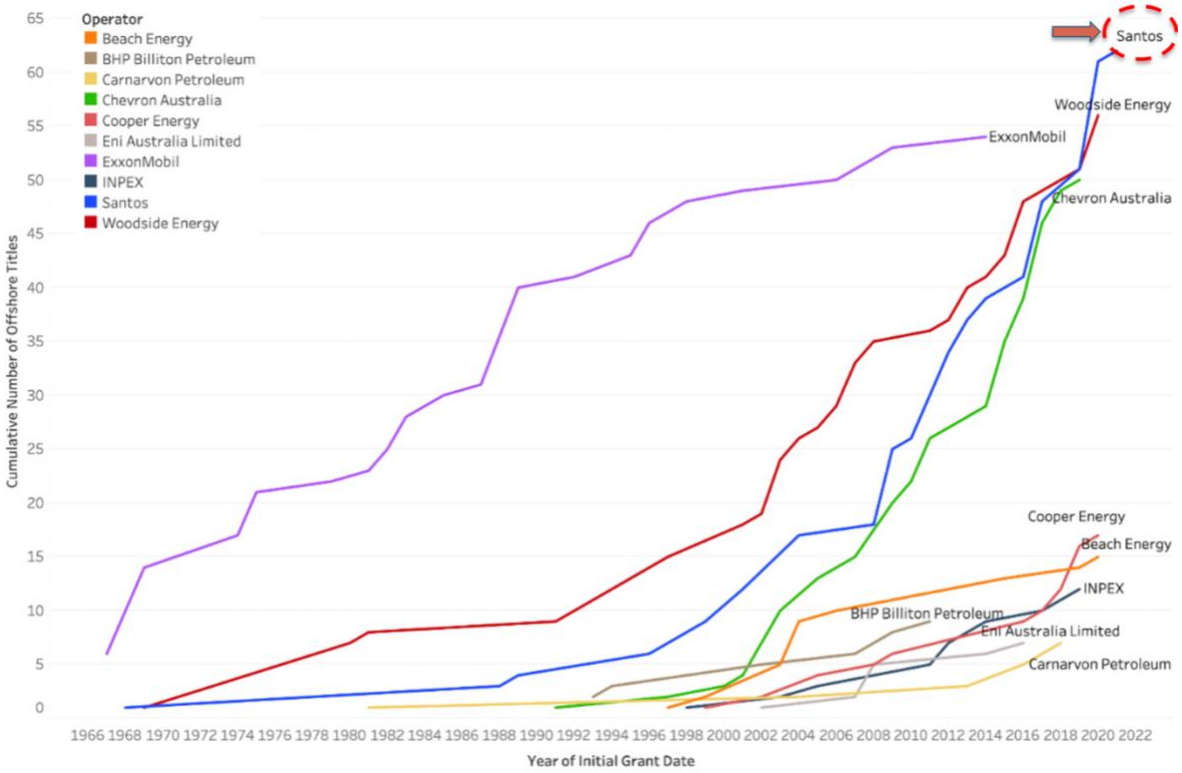
Santos Is Involved in Offshore Exploration Activities More Than Any Other Company in Australia

Based on the dataset published by the government-led authority National Offshore Petroleum Titles Administrator (NOPTA) under the National Electronic Approvals Tracking System (NEATS) in May 2021, there were 373 licences and permits in Commonwealth waters at the time of publication.[61]

The four main types of title are exploration permits, retention leases, production licences and pipeline licences. Exploration permits and to some extent retention leases (mostly issued in the appraisal phase) could be considered as good indicators of "new" oil and gas projects, while production licences are issued for established and commercialized projects.

As demonstrated in Figure 13, Santos is leading the big four operators (with the others being Woodside, ExxonMobil and Chevron) with more than 50 active permits each as operator.

Figure 13: Top-10 Offshore Operators in Australia (1965-2020)



Source: NEATS 2021, IEEFA analysis.

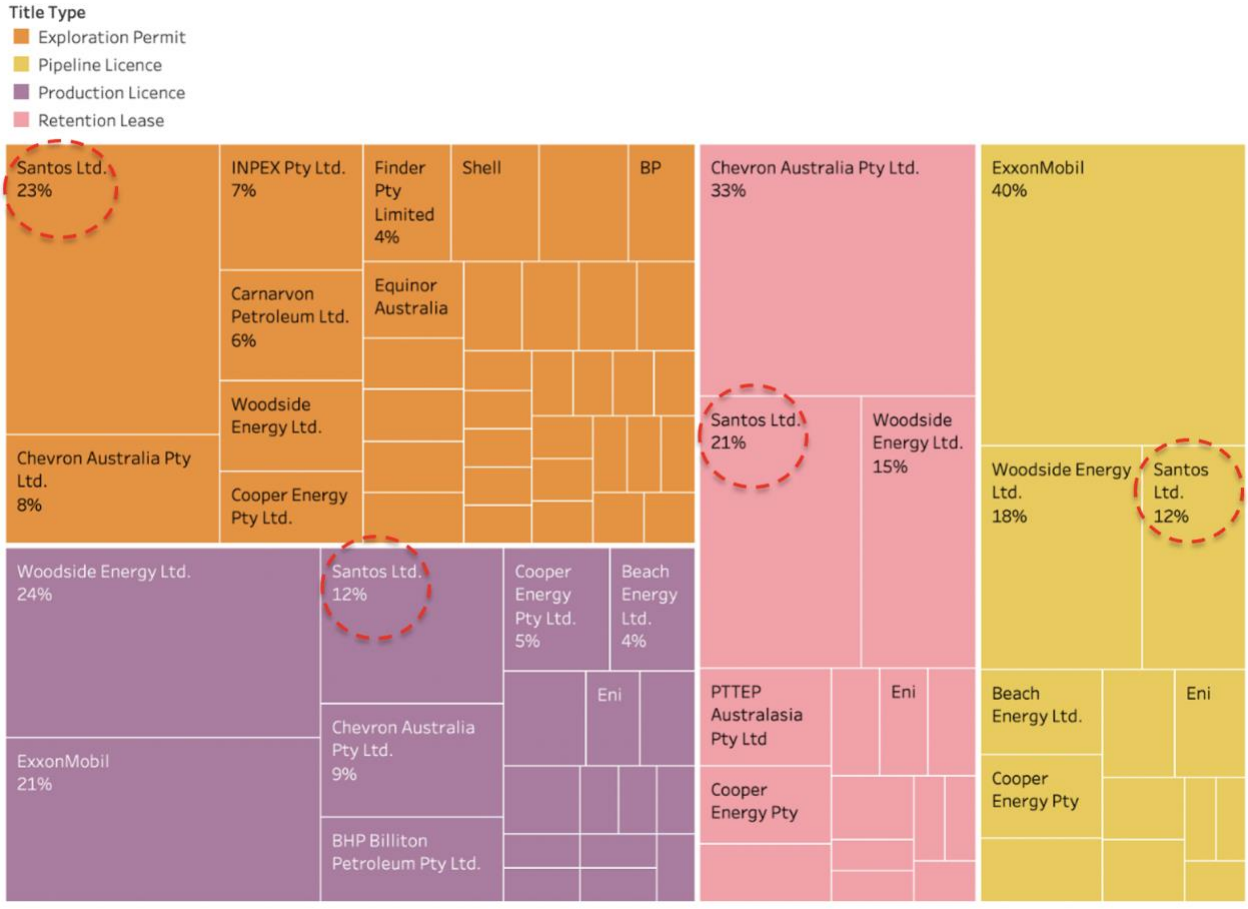
[61] A comprehensive analysis of dynamics of Australian offshore gas sector, regulatory environment and potential risk ahead of the sector has been conducted by IEEFA in the report: IEEFA. Australia's Offshore Industry: A Half-Century Snapshot. September 2021.

Offshore active permits reflect the level of O&G-related activities of operators. Santos is aggressively exploring new oil and gas fields and launching new oil and gas projects.

Older established players in the offshore sector of Australia such as ExxonMobil and Woodside have been recently overtaken by the aggressive oil and gas domestic player, Santos.

Santos is ranked first in terms of holding the highest number of active petroleum titles (62 titles). Figure 14 demonstrates the share of operators in each of the major four types of offshore titles in Australia. Santos is annotated with dotted circles.

Figure 14: Companies with Lions' Share in Four Types of Permits



Source: NEATS 2021, IEEFA analysis.

Santos's dominance in offshore exploration permits is evident as the company is the biggest explorer operator by a considerable margin, followed by Chevron and INPEX. The company is aggressively proceeding with pre-production activities (acquiring exploration and appraisal).

Santos was more of an onshore driller historically. In recent years however it transformed itself into a large offshore operator with the acquisition of both the Dorado project, Van Gogh field development project (offshore West Australia) and ConocoPhillips' offshore assets in the Northern Territory.

In a deal with ConocoPhillips in 2019, Santos acquired the Darwin LNG plant which sources its gas from the nearly depleted offshore Bayu-Undan field. It is now looking to replace this field with the carbon-intensive Barossa gas project. All of these projects need a lot of E&P drillings.

Santos Exploration Activity Until 2027 - Area and Cost Analysis

Based on NEATS data[62], until May 2021, out of the 373 offshore permits, there were 101 active and 5 pending exploration permits in Commonwealth waters.

Exploration permits are granted on the basis of a work-bid.[63] This means that companies bid on the amount of exploration work they will undertake in an area should they be awarded a permit. Companies including Santos provide the indicative cost incurred and the value of the area affected by each exploration activity to NOPTA.

Figure 15 shows the area that these companies would be operating in to explore oil and gas until 2027.

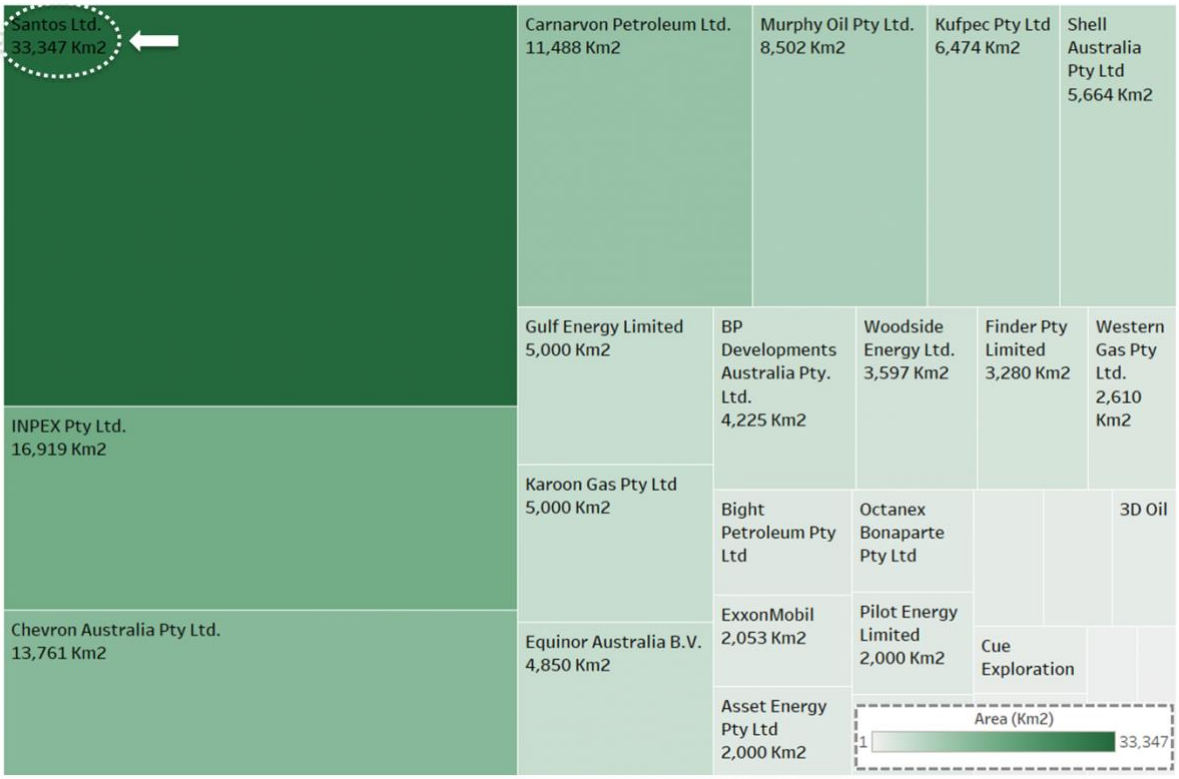
The maximum area needed for an activity in a specific permit has been considered as the geographical scope of the project that would be affected by the seismic / explorative activities. The total area under direct exploration activities until 2027 is 153,800 km^2 which is more than twice the size of the state of Tasmania.[64]

Santos will cover a much larger exploration area than any other operator.

A breakdown of these exploration activities by operator companies reveals that Santos will cover a much larger area (33,347 km^2) than any other operator. Its exploration activities as an operator in the next six years would cover an area greater than Belgium -- more than 21% of the total under exploration in Australian waters.

[62] Australian Government. National Offshore Petroleum Titles Administrator (NOPTA). National Electronic Approvals Tracking System (NEATS) reporting. 12 May 2021.
[63] Australian Government. Department of Industry, Science, Energy and Resources. Offshore Petroleum Exploration Guideline: Work-bid. In relation to the Offshore Petroleum and Greenhouse Gas Storage Act 2006. 1 July 2019.
[64] Assuming that there would be no new exploration permits to be awarded.

Figure 15: Companies' Area of Exploration Activities



Source: NEATS[65] 2021, IEEFA analysis.

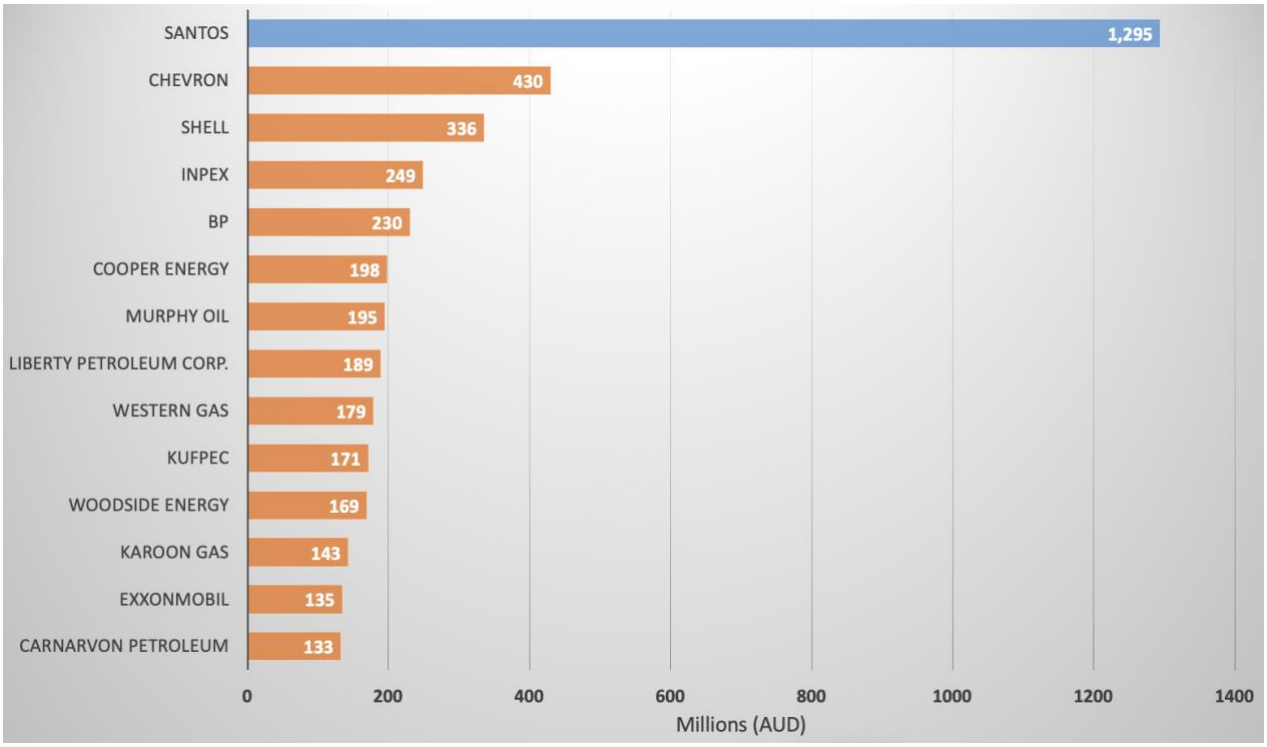
Santos's aggressive spending is evident when looking at the share of companies investing in offshore exploration (Figure 16).

Santos is the operator of exploration projects worth about A$1.3 billion collectively; 25% of the total exploration expenditure to 2027. There are other partners in each permit, and while the operator would not be the only one spending capital, the operator is generally the dominant partner in joint ventures.

Santos as operator and its other non-operator partners will account for 25 cents of every dollar spent on offshore exploration.

[65] ABC. Bight Petroleum application to extend Great Australian Bight work rejected. 13 February 2021. The exploration permits EPP41 and EPP42 was still active in the NOPTA database in 2021. However, after Equinor's discontinuation of exploration activities in the Bight Basin in 2020, there is news that NOPTA has rejected Bight Petroleum's application to extend its exploration permits in this basin.

Figure 16: Operators' Cost of Exploration Activities Until 2027[66]



Source: NEATS 2021, IEEFA analysis.

Santos, based on the estimates it provided to NOPTA, is the biggest spender on exploration in offshore Australian permits. Aggressive expansion of gas is not ideologically or practically aligned with net-zero commitments.

Barossa, Santos's Latest Development, Is a Great Example of Expanding Emissions

Emissions Intensity

In April 2020, IEEFA released a paper estimating that between 2014 and 2019, the emissions intensity of Australia's gas production increased by about 30% as newer projects released higher rates of greenhouse gas emissions.[67] Barossa is no exception to this trend, and in fact shows an acceleration of it.

Barossa is the most emissions intensive offshore gas-to-LNG project proposed in Australia to date. Barossa gas has an unusually high CO_2 gas content – 18 volume % or about twice that of the next dirtiest gas being made into LNG in Australia, from Ichthys through to Gorgon. The emissions from Barossa are so high that IEEFA guest contributor, John Robert stated: "When the venting and combustion emissions both

[66] Operators with exploration expenditure less than A$100million have not been depicted in this chart.
[67] IEEFA. Australia's LNG industry growth and emissions standards decline. April 2020.

off- and on-shore are calculated, the Barossa to Darwin LNG project looks more like a CO_2 emissions factory with an LNG by-product."[68]

Carbon Capture and Storage Is Not the Solution

CCS at Bayu-Undan has been proposed to lower emissions at Barossa. There are two major problems with such a solution:

1. The timing of the two projects, Barossa gas production and Bayu-Undan CCS, is not the same. Barossa received FID on 30 March 2022[69], with production expected to commence in H1 2025.[70] FID for the Bayu-Undan CCS project is not expected before 2025[71], to come online in 2027, two years after the Barossa gas project starts. Meanwhile, Santos and its partners SK E&S and JERA will be producing the most emission-intensive LNG in Australia as all the removed CO_2 is vented.

Santos and its partners SK E&S and JERA will be producing the most emission-intensive LNG in Australia.

2. Using unproven CCS for the remaining portion of the emissions would still make the Barossa project the "dirtiest" in Australia and possibly in the world. Most of the Barossa project's CO_2 emissions will be from combustion, which cannot be captured. CO_2 capture processes post-combustion are not currently economically feasible onshore, let alone offshore, anywhere in the world. Even with CCS, Santos's proposed Barossa project remains an emissions factory with an LNG by-product – more waste than product.[72]

Summary of Barossa Emissions

Santos's Barossa gas project is emblematic of the problems that Santos faces. Even with CCS, the high-emitting project will increase the company's emissions and is entirely inconsistent with the stated aims in the Santos Climate Change Report of reducing emissions.

Investors in Santos should judge the company by its actions, not its aspirations, and Barossa shows clearly that it pays little heed to emission reductions.

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[68] IEEFA. Santos Barossa gas field emissions create major risks for shareholders. March 2021.
[69] Santos. Santos announces FID on the Barossa gas project for Darwin LNG. 30 March 2022.
[70] Santos. 2021 Results Presentation. Page 35.
[71] Santos. 2022 Climate Change Report. Page 26.
[72] IEEFA. Santos won't solve the problem of Barossa LNG with carbon capture and storage. October 2021.

Appendix 1

Coming/Current Gas and Oil Development Projects[73]

Asset Category	Development Project	Size of the Project(s)	Asset's Total Production in 2021 (MMBOE)	Stage	Est. Capex for the Growth Projects	Ref.
Western Australia	Ningaloo Vision floating production storage and offloading unit (FPSO) maintenance was finished and production from Van Gogh, Coniston and Novara fields resumed.	Part of the 3.5 mmbbl (million barrels) crude oil added to the production of WA assets was due to this project.	33.7	Production	$300 million (Includes Dorado)	1 2 3
	Two new infill wells drilled in the Van Gogh field (Van Gogh phase 2 infill development).	First well has produced at a peak rate of 23,200 barrels per day (bbl/d), well ahead of expectations.		Production		1
	Dorado (Phase 1 – Liquids Development).	150 million barrels.		Pre-FID and will be FID-ready in 2022. Entered Stage 2 of assessment of Offshore Project Proposal (OPP).		1 2
	Dorado (Phase 2 – Gas Development).	Drilling of two exploration wells have commenced.		Drilling of exploration well Pavo has commenced, to be followed by Apus.		1 2

[73] $50 million Capex on energy solutions and clean fuels is not included in the table as this table mainly covers oil/gas growth projects.

Asset Category	Development Project	Size of the Project(s)	Asset's Total Production in 2021 (MMBOE)	Stage	Est. Capex for the Growth Projects	Ref.
Northern Australia and Timor-Leste	Barossa Gas Project to backfill Darwin LNG	DLNG has a 3.7 MTPA capacity and the Barossa gas field development would extend the DLNG plant's lifetime.	15.2	FID reached and the project is 25% completed– Preparations to start drilling in Q3 2022 well advanced and first gas to be produced in 2025.	$650million-$700million Includes Barossa	1 2
Queensland and New South Wales	Narrabri gas project in northwest NSW.	It has been claimed that half of NSW's gas demand could be supplied through this project.	13.7	Received environmental approvals from the State and Federal governments in 2020. Company plans to start appraisal program in 2022.	$50 million (Includes Narrabri Appraisal)	1 2
	Gladstone LNG plant: Expect to drill ~180 wells in 2021 (3 rigs) and ~350 wells in 2022 (4 rigs) to supply more gas to GLNG plant in Queensland.	6.3 MT of LNG through shipping 109 cargoes		Working at record-high production rate.		1 2
Papua New Guinea	The Papua LNG project has been proposed as a two-train LNG expansion.	Planned 5.6 MTPA.	14.2	Progress has been made on regulatory, commercial and social/environmental activities in 2021 – FEED is expected in 2022.	$150 million - $200 million (Includes Angore and Papua LNG)	1 2
	Angore gas field development.			FID taken; first gas expected in 2024.		1 2

Asset Category	Development Project	Size of the Project(s)	Asset's Total Production in 2021 (MMBOE)	Stage	Est. Capex for the Growth Projects	Ref.
	P'nyang gas agreement (to back-fill PNG LNG two trains with construction following Papua).			Deal signed with PNG government.		1 2
North America	Pikka Phase 1 in Alaska.[74]	80,000 barrel of oil per day = 29.2 MMBOE	-	All major regulatory and environmental approvals have been received for FID.	$300 million (Includes Pikka)	1
Cooper Basin	Fourth rig added for the second half of the year 2021.		15.3	The rig is being used for drilling more wells in the basin.	$50 million - $100 million (includes Moomba CCS)	1

[74] Although Santos has commissioned Moelis & Co, bank to sell 51% of Pikka stake, including operating rights, it is still considered a company asset and provided as potential growth project in the company's disclosures.

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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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