

**Santos**

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Climate Change Report









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**Disclaimer:** This report contains forward looking statements that are subject to risk factors associated with the oil and gas industry. It is believed that the expectations reflected in these statements are reasonable, but they may be affected by a range of variables which could cause actual results or trends to differ materially, including but not limited to: price fluctuations, actual demand, currency fluctuations, geotechnical factors, drilling and production results, gas commercialisation, development progress, operating results, engineering estimates, reserve estimates, loss of market, industry competition, environmental risks, physical risks, legislative, fiscal and regulatory developments, economic and financial market conditions in various countries, approvals and cost estimates. The report does not purport to represent the views of Santos' joint venture partners across operated or non-operated assets. Information provided in this report does not include the acquisition of ConocoPhillips' Australia-West business announced on 14 October 2019.

# CEO statement



KEVIN GALLAGHER

I am pleased to present Santos' 2020 Climate Change Report, our third annual report demonstrating a strong future for Santos and natural gas in a lower-carbon world.

For 65 years, Santos, a proudly Australian company, has been safely and sustainably exploring and developing oil and natural gas resources in partnership with local communities, landholders and marine users to supply reliable, affordable and cleaner energy essential to improve the lives of people in Australia and Asia. With assets in Australia, Papua New Guinea and Timor-Leste, our focus is on natural gas, which will supply a quarter of the world's total energy demand by 2040 in all International Energy Agency (IEA) scenarios. More than ever, natural gas is a fuel for the future and, when combined with carbon capture and storage, could hold the key to a future hydrogen economy. Right now natural gas is enabling the growth of renewable energy, providing the reliability and flexibility to deliver cleaner power 24/7.

Our liquefied natural gas (LNG) exports to Asia are an important part of the climate solution. For every tonne of carbon dioxide emitted during production in Australia, LNG saves between three and ten tonnes of emissions when it replaces coal in power generation in Asia.

With coal-to-gas switching identified by the IEA as critical to meet global climate goals, our liquefied natural gas exports to Asia are an important part of the climate solution. For every tonne of carbon dioxide emitted during production in Australia, liquefied natural gas saves between three and ten tonnes of emissions when it replaces coal in power generation in Asia. In 2018, the increase in global emissions would have been 15% higher without coal-to-gas switching, particularly in China and the United States.

In all IEA scenarios that Santos has referenced in this report, significant investment in both oil and natural gas is needed to meet energy demand out to 2040. Even at the lower end, more than US\$13 trillion of investment is needed to achieve the Sustainable Development Scenario which limits global temperature increase to well below 2 degrees Celsius by 2100. According to the IEA, ceasing to invest in either oil or natural gas could lead to a significant energy supply shortfall between now and 2040. With growth potential in both oil and natural gas across our portfolio, combined with large scale carbon capture and storage (CCS) opportunities, Santos will continue to be a financially robust business that is part of the solution to both climate change and human progress for decades to come.

**Kevin Gallagher**

Managing Director and Chief Executive Officer  
February 2020

# Executive summary

**Santos' strategy focuses on five core, long-life asset hubs in Australia, Papua New Guinea and Timor-Leste, recognising the critical role of natural gas in a lower-carbon future.**

Natural gas demand is forecast to grow out to 2040 to just over a quarter of total global energy demand.<sup>1</sup> Santos operates and markets our products in the Asia Pacific region, which accounts for 40% of total global energy demand. In line with our vision, Santos is well positioned to be Australia's leading domestic gas supplier and a leading Asia Pacific liquefied natural gas supplier.

This report, our third annual Climate Change Report, provides updated scenario analysis and reports progress against the medium-term emission reduction targets established in our 2019 Climate Change Report.

The report complies with the recommendations of the G20's Task Force on Climate-Related Financial Disclosures and addresses the Company's strategy, metrics and targets, governance and risk management.

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1 IEA, World Energy Outlook 2018



## STRATEGY

- + Climate change considerations, reducing global greenhouse gas emissions and improving air quality continue to be significant inputs into our strategy.
- + Natural gas has a key role to play in a lower-carbon future as it produces 50% less greenhouse gas emissions than coal when used to generate electricity, can significantly improve air quality and is the perfect partner for renewable energy sources.
- + Santos is actively pursuing carbon capture and storage, as this is a critical technology to limit global temperature increases to well below 2 degrees Celsius.
- + Santos' natural gas-focused portfolio is economically resilient under all of the International Energy Agency's World Energy Outlook 2018 scenarios.



## METRICS AND TARGETS

- + Santos has a long-term aspiration of achieving net-zero emissions by 2050.
- + Santos has set medium-term targets and is making excellent progress against these targets.
- + Santos transparently reports its greenhouse gas emissions, including fugitive methane emissions.



## GOVERNANCE AND RISK MANAGEMENT

- + Santos has had a Climate Change Policy since 2008, guiding our management of emissions and climate change risks.
- + A dedicated Environment, Health, Safety and Sustainability Committee of the Santos Board is responsible for monitoring and reviewing the Company's approach to climate change and management of climate change risks.
- + Climate change is incorporated into Santos' Enterprise Material Risk Profile and risk management processes and practices.
- + Key indicators are included in the Short-Term Incentive Scorecard which link climate-related performance to remuneration outcomes for the Executive Committee.

# 1

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# Introduction

## Energy, climate and society

Global progress for society depends on access to reliable, affordable and cleaner energy to enable higher living standards, including a longer and healthier life and the opportunity for all people to fully realise their potential through education and employment. Almost half the world's population lives in countries that rank low to medium on the United Nations' human development index.<sup>2</sup> Of these, almost two billion people, more than 25% of the world's population, live in poverty on less than US\$3.20 per day, all of them in non-OECD countries.<sup>3</sup> Just under one billion people still have no electricity and another billion have access to unreliable electricity. The World Health Organization estimates that eight million people die every year from outdoor and household air pollution, linked to inefficient energy use in every sector of human activity including coal-fired power plants, industry, agriculture and transport.<sup>4</sup>

Access to reliable, affordable and cleaner energy is critical to enable economic progress and improve the quality of life for this very significant proportion of the world's people. The challenge becomes even greater when, by 2040, the global population grows to 9.2 billion from 7.6 billion today and the global economy is set to almost double in size.<sup>5</sup>

Economic expansion is a key driver of energy demand. By 2040, the non-OECD countries will account for about half of global Gross Domestic Product (GDP), up from about a third today. China's GDP per capita is expected to triple and when combined with India's growth, these two economies will be about the same size as the OECD. China and India will each have more than one billion middle-class citizens aiming to improve their living standards and requiring access to energy to do so.

Technology advances and choices by consumers and businesses to use energy more efficiently can moderate growth in energy demand even as the economy expands, allowing society to do more with less, which is vital to address climate change. Global energy intensity is expected to improve at nearly 2% per year out to 2040, more than double the pace of improvement since 2000.<sup>6</sup> The carbon intensity of energy is also expected to trend down as government policies drive efficiency and target a lower-carbon energy mix.

However, the International Energy Agency (IEA) in 2019 estimated in its Tracking Clean Energy Progress analysis that only seven of 45 technologies are on track to help society reach the Paris Agreement climate goals. Technologies identified by the IEA as requiring more effort include natural gas-fired power generation and those not on track include methane emissions and flaring from oil and gas, and carbon capture and storage (CCS). Acceleration of CCS is vital to achieving the world's climate goals.

Santos is playing a key role to increase the supply of natural gas to replace coal and other higher-emission fuels in power generation in Asia, and firm renewable generation in Australia. We are focused on reducing our own emissions through pursuing deployment of CCS, energy efficiency innovation and renewable energy in our operations. Advancing technologies for lower-emissions energy is critical to limit temperature rise to well below 2 degrees Celsius and at the same time supply the reliable, affordable energy needed for a growing population, higher living standards to lift more of the world's people out of poverty and better air quality to improve human health.

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<sup>2</sup> United Nations Development Programme, Human Development Indices and Indicators, 2018 Statistical Update

<sup>3</sup> World Bank, Piecing together the poverty puzzle, 2018

<sup>4</sup> World Health Organisation, <https://www.who.int/health-topics/air-pollution>

<sup>5</sup> IEA, World Energy Outlook 2018

<sup>6</sup> IEA, World Energy Outlook 2018





Just under 1 billion  
people still have  
**no electricity**<sup>7</sup>



World population to  
grow to **9.2 billion**  
**people by 2040**<sup>8</sup>



**8 million people**  
**die every year**  
from outdoor  
and household  
air pollution<sup>9</sup>



**CCS is a critical**  
**technology**  
to achieving  
the world's  
climate goals<sup>10</sup>

7 IEA, World Energy Outlook 2018

8 IEA, World Energy Outlook 2018

9 World Health Organisation, <https://www.who.int/health-topics/air-pollution>

10 IEA Tracking Clean Energy Progress - <https://www.iea.org/topics/tracking-clean-energy-progress>

# Santos' Climate Change Policy



## OUR COMMITMENT

Santos recognises the science of climate change and supports the objective of limiting global temperature rise to less than 2 degrees Celsius.

Our strategy focuses on natural gas which we believe will continue to play a key role in a low carbon future.

We are committed to being part of the solution by supporting the twin objectives of limiting greenhouse gas emissions while providing access to reliable and affordable energy to domestic and global markets.



## GOVERNANCE

The Environment Health Safety & Sustainability Committee is responsible for reviewing the effectiveness of this policy.



## OUR ACTIONS

### We will:

- + Work with governments and stakeholders in the design of climate change regulation and policies
- + Factor carbon pricing and greenhouse gas emissions into all business decision-making
- + Set greenhouse gas emission targets consistent with the objective of limiting global temperature rise to less than 2 degrees Celsius
- + Identify and pursue opportunities to reduce greenhouse gas emissions within our operations and through the supply chain
- + Identify and pursue opportunities to offset greenhouse gas emissions where relevant in further support of achievement of emissions targets
- + Identify, manage and mitigate climate change risks for our activities
- + Report on the Company's climate change governance, strategy, risk management and targets and metrics in a transparent manner

# Taskforce on Climate-Related Financial Disclosures

This is Santos' third annual report against the TCFD recommendations.

Our 2018 and 2019 Climate Change Reports can be accessed via our website [www.santos.com](http://www.santos.com). This report addresses the themes recommended by the G20's Taskforce on Climate-Related Financial Disclosures as outlined below.



## GOVERNANCE

The organisation's governance around climate-related risks and opportunities.



## RISK MANAGEMENT

The processes used by the organisation to identify, assess, and manage climate-related risks.



## STRATEGY

The actual and potential impacts of climate-related risks and opportunities on the organisation's businesses, strategy and financial planning.



## METRICS AND TARGETS

The metrics and targets used to assess and manage relevant climate-related risks and opportunities.



# International Energy Agency scenarios

The IEA is a global intergovernmental organisation that provides energy and climate policy advice including scenarios for future global energy demand and climate change. The IEA publishes an annual World Energy Outlook, providing analysis and insights on trends in energy demand and supply, and what they mean for energy security, environment protection and economic development.

Santos has used the IEA Sustainable Development Scenario published in the 2018 World Energy Outlook, to test the economic resilience of our portfolio.<sup>11</sup> The IEA reports that: “Our Sustainable Development Scenario provides an integrated strategy to achieve energy access, air quality and climate goals, with all sectors and low-carbon technologies – including carbon capture and storage – contributing to a broad transformation of global energy.”

Santos has reported against this scenario because it provides the most robust test of the resilience of our business, with total energy demand remaining flat. Nonetheless, natural gas demand is forecast to increase by 14% by 2040, demonstrating the critical role of natural gas in achieving global climate goals. Under the Sustainable Development Scenario, expected temperature rise is 1.7 to 1.8 degrees Celsius by 2100, consistent with global aspirations to limit temperature rise to well below 2 degrees Celsius.

In contrast, most current forecasts for total energy demand growth are higher and forecasts for natural gas demand growth range from more than 40% to 60% by 2040. With increasing total energy and natural gas demand growth the resilience of our business also increases. However, without energy efficiency and significant technology advances such as CCS, global climate goals are not met.

## Current Policies Scenario (CPS)

Based solely on existing laws and regulations.

Total energy demand projected to grow by 41% and natural gas by 59% by 2040.

## New Policies Scenario (NPS)

Incorporates announced policy ambitions and includes Paris commitments.

Expected temperature rise of ~2.7°C by 2100.

Total energy demand projected to grow by 29% and natural gas by 47% by 2040.

## Sustainable Development Scenario (SDS)

Scenario designed to support universal access to energy; reduce air pollution; combat climate change; and includes a water dimension.

Expected temperature rise of ~1.7 to 1.8°C by 2100, consistent with the global goal to limit temperature rise to well below 2°C.

Total energy demand projected to remain flat, but natural gas demand increases by 14% by 2040.

CCS technologies will play an important role in meeting energy and climate goals, requiring > 2000 Mt CO<sub>2</sub> to be captured annually by 2040.

An aerial photograph of a large oil tanker ship docked at a long pier extending into a body of water. The ship has several large white storage tanks on its deck. The sky is a mix of orange, yellow, and blue, suggesting a sunset or sunrise. The water is calm, and the pier is made of metal structures.

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# Santos' strategy and climate change



Climate change considerations, reducing global greenhouse gas emissions and improving air quality continue to be significant inputs into our strategy.



Natural gas has a key role to play in a lower-carbon future as it produces 50% less greenhouse gas emissions than coal when used to generate electricity, can significantly improve air quality and is the perfect partner for renewable energy sources.



Santos is actively pursuing carbon capture and storage, as this is a critical technology to limit global temperature increases to well below 2 degrees Celsius.



Santos' natural gas-focused portfolio is economically resilient under all of the International Energy Agency's World Energy Outlook 2018 scenarios.



## Our vision and portfolio

Santos' natural gas portfolio puts the Company in a strong position to supply growing global demand out to 2040. Our vision is to be Australia's leading natural gas company by 2025, supplying reliable, affordable and cleaner energy to improve the lives of people in Australia and Asia.

We aspire to reduce emissions and improve air quality across Asia and Australia by replacing coal with natural gas and firming renewable energy.

**We aspire to reduce emissions and improve air quality across Asia and Australia.**

**Figure 1** Santos' clear and consistent Transform, Build and Grow Strategy

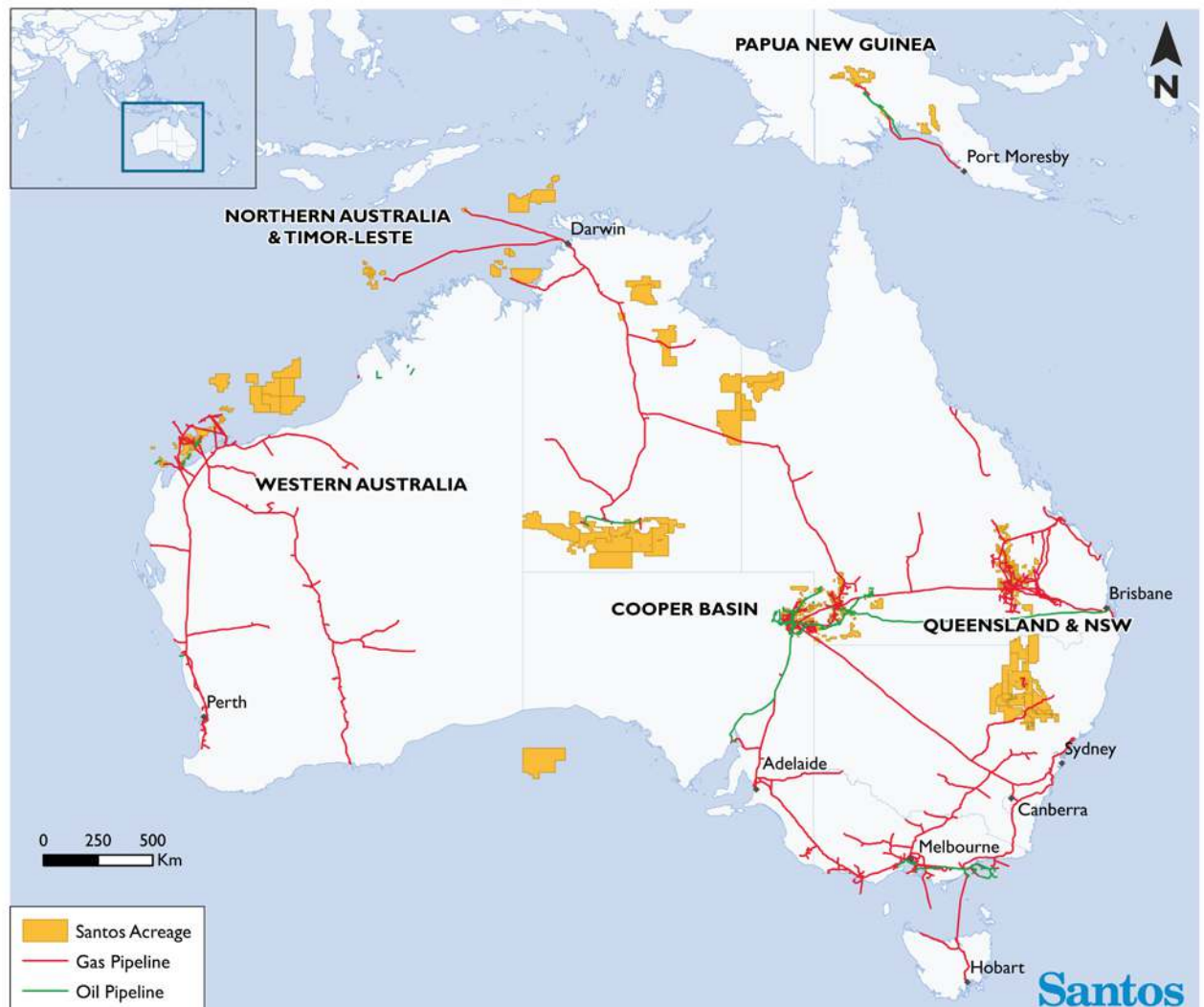




Since 2016, Santos has had a focused strategy to transform, build and grow the business based on five core, long-life asset hubs in the Cooper Basin, Western Australia, Northern Australia & Timor-Leste, Queensland & New South Wales, and Papua New Guinea, as shown in Figures 1 and 2.

Our strategy is delivering outstanding results across the business, as demonstrated in the record EBITDAX and free cash flow reported in our 2019 full year results. This followed 2018 full year results which delivered record underlying profit and free cash flow.

**Figure 2** Santos' five core, long-life asset hubs



# The role of natural gas in a lower-carbon future



## Natural gas: A fuel for the future

There is growing recognition of the role of natural gas, including liquefied natural gas, as the world tackles poor air quality, climate change and energy poverty. As can be seen in Figure 3, natural gas demand is forecast to grow out to 2040 to just over a quarter of total global energy demand. This is the case for all IEA scenarios including the Sustainable Development Scenario, which limits global temperature rise to well below 2 degrees Celsius by 2100.

Asian liquefied natural gas imports again exceeded expectations in 2018, especially in China and South Korea. China's gas consumption continued to rise rapidly in 2018, driven by efforts to improve air quality by coal-to-gas switching. China was the second largest liquefied natural gas buyer in the world in 2018, importing 54 million tonnes of liquefied natural gas, triple the level recorded in 2015. Strong growth in China's gas consumption is expected to continue with the Chinese government aiming to raise the share of gas in the overall energy mix from 7% in 2017 to 15% in 2030.<sup>12</sup>

With Asia accounting for half of the world's 50 billion tonnes of greenhouse gas emissions,<sup>13</sup> the shift to natural gas will have a significant impact on global greenhouse emissions.

The IEA's 2018 World Energy Outlook estimates that significant oil and gas investment is needed to meet growing demand in all scenarios out to 2040. At the lower end, more than US\$13 trillion of investment is needed to achieve the Sustainable Development Scenario, with demand growth and therefore investment required being higher under alternative scenarios.

Natural gas resource estimates are rising as technology unlocks resources that were previously too difficult or costly to produce. Less than 15% of recoverable natural gas resources globally have been produced and remaining natural gas resources can provide about 200 years of supply at current demand. About 45% of remaining natural gas resources are from sources like shale gas, tight gas and coal seam gas.<sup>14</sup>

Without continued investment to sustain existing producing fields and develop new resources, the global supply of oil and natural gas is forecast to decline, requiring a significant need for continuous investment just to sustain existing production levels.<sup>15</sup>

A doubling of electricity demand in developing economies puts cleaner, universally available and affordable electricity at the centre of strategies for economic development and emission reduction, with natural gas playing a vital role. Twenty per cent of the forecast rise in global electricity demand comes just from electric motors in China and rising demand for cooling in developing economies provides a similar boost to growth.<sup>16</sup>

Natural gas is expected to overtake coal in 2030 to become the second-largest fuel in the global energy mix. Industrial consumers make the largest contribution to a 45% increase in worldwide gas use. Trade in liquefied natural gas is forecast to more than double in response to rising demand from developing economies, led by China.<sup>17</sup>

<sup>12</sup> Australian Government, Resources and Energy Quarterly, March 2019

<sup>13</sup> World Resources Institute, CAIT Climate Data Explorer

<sup>14</sup> IEA, World Energy Outlook 2018

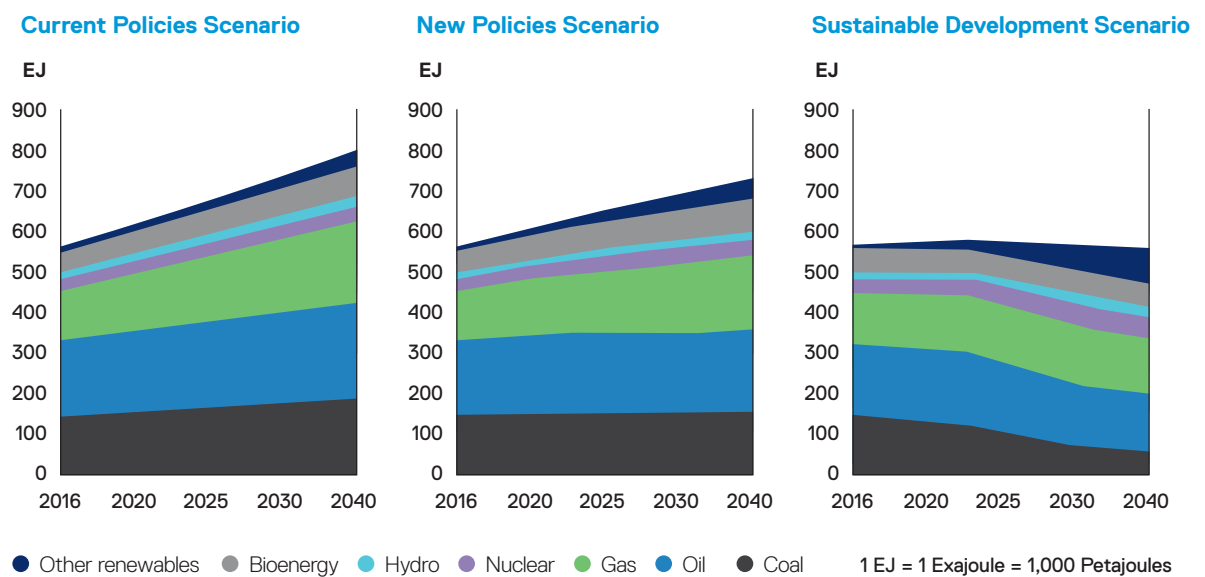
<sup>15</sup> IEA, World Energy Outlook 2018

<sup>16</sup> IEA, World Energy Outlook 2018

<sup>17</sup> IEA, World Energy Outlook 2018

The IEA expects natural gas to grow to supply a quarter of all global energy demand in 2040 in all scenarios.

**Figure 3** Global energy demand under the IEA 2018 scenarios<sup>18</sup>



<sup>18</sup> IEA, World Energy Outlook 2018. Note: source data contains values for 2016, 2025, 2030, 2035, 2040

## Santos is part of the climate solution

Santos is committed to limiting greenhouse gas emissions while providing access to reliable and affordable energy in domestic and global markets.

In 2018, the increase in global emissions would have been 15% higher without coal-to-gas switching, particularly in China and the United States.<sup>19</sup>

As an established exporter of liquefied natural gas in markets including China, South Korea and Japan, Santos is well positioned to supply Asian markets in their pursuit of cleaner air through the use of natural gas. China will continue to demand liquefied natural gas as it continues its program of coal-to-gas switching, as will South Korea. The Japanese market, while flat, still relies on liquefied natural gas for 35% of its power generation. Other developing Asian economies will further electrify the region as they pursue economic growth, creating more demand for liquefied natural gas as a cleaner fuel for power generation than coal and to firm renewables.

Santos currently sells around three million tonnes per annum of liquefied natural gas to Asian customers, predominantly in China, South Korea, Japan and Malaysia.

Our liquefied natural gas (LNG) exports to Asia are an important part of the climate solution. For every tonne of carbon dioxide emitted during production in Australia, LNG saves between three and ten tonnes of emissions when it replaces coal in power generation in Asia.<sup>20</sup>

Reducing  
emissions in  
Asia has a  
global impact.

Our aim is to increase liquefied natural gas production by another 50% by 2025 and our low-cost operating model, geographic proximity and cost-competitive brownfield expansion opportunities mean we are well-placed to satisfy increased Asian demand to help lower emissions and improve air quality.

In Australia where Santos supplies around 14% of the east coast market and nearly 40% of the west coast market, natural gas will be increasingly important to firm renewables and supply industrial demand.

<sup>19</sup> IEA, Global Energy & CO2 Status Report 2019

<sup>20</sup> WorleyParsons, Greenhouse Gas Emissions Study of Australian LNG, 2008, 2011 and WorleyParsons, Greenhouse Gas Emissions Study of Australian CSG to LNG, 2011

<sup>21</sup> IEA, The Role of Gas in Today's Energy Transitions, 2019



Natural gas produces 50% less greenhouse gas emissions than coal when used to generate electricity<sup>21</sup> and helps reduce air pollution, particularly in Asia.

Beijing, China



# The role of carbon capture and storage in a lower-carbon future



## Australia and Santos could be world leaders in carbon capture and storage

CCS is already well established as a safe, large scale, permanent abatement solution, with 18 projects larger than 0.4Mtpa presently in operation worldwide, storing a total of ~40Mtpa of CO<sub>2</sub>.<sup>22</sup> This is the equivalent of the annual emissions of seven million cars. Acceleration of CCS deployment to reach the required two billion tonnes per annum by 2040 is therefore critical to achieve global climate goals.<sup>23</sup>

**CCS is a critical technology to achieving the world's climate goals.**

Australia has a natural competitive advantage to implement CCS with known high quality, stable geological storage basins and expertise gained through more than half a century of oil and gas production. Australia has estimated storage capacity enabling injection at a rate of 300 Mtpa, for at least 100 years.<sup>24</sup> This is equivalent to greater than half of Australia's current annual emissions.

It is already home to the largest commercial CCS project in the world, the Gorgon CCS Project, located in northern Western Australia. CO<sub>2</sub> injection commenced in 2019 into a deep reservoir more than 2km underground. Once fully operational, the project is expected to capture between 3.4 and 4 million tonnes of CO<sub>2</sub> per annum. It is expected to store more than 100 million tonnes over the life of the injection project, which will reduce greenhouse gas emissions from the Gorgon liquefied natural gas project by approximately 40%.<sup>25</sup>

<sup>22</sup> Global CCS Institute, The Global Status of CCS, 2018

<sup>23</sup> IEA, World Energy Outlook 2018

<sup>24</sup> Carbon Storage Taskforce, National Carbon Mapping and Infrastructure Plan - Australia, 2009

<sup>25</sup> Chevron, Gorgon Carbon Dioxide Injection Project Fact Sheet, 2019

<sup>26</sup> Carbon Storage Taskforce, National Carbon Mapping and Infrastructure Plan - Australia, 2009

With a proven, safe low-cost operational history and operating access to potential carbon storage reservoirs in the Cooper and Eromanga basins in South Australia and Queensland, Santos is well-placed to launch a pipeline of CCS projects that could not only reduce our own emissions but provide an important storage hub for other sources of carbon in Australia.

The Cooper and Eromanga basins have the potential for injection of over 20 Mtpa for more than 50 years<sup>26</sup> and could store CO<sub>2</sub> in the same reservoirs that held natural gas in place for millions of years, providing safe, permanent storage of carbon.

Australia needs low cost carbon abatement to maintain its position as a leading energy exporter and ensure international competitiveness in a lower-carbon future.

With scale and experience, the cost of CCS will decrease, creating the potential to deliver competitive, large scale abatement for existing industries such as coal and coal-fired power generation, liquefied natural gas, cement, steel and manufacturing, and for new industries such as hydrogen.

Australia is well positioned to pursue CCS at scale, with proven geological storage sites, existing infrastructure, world class technical expertise and regulatory regimes (environment protection, carbon accounting and reporting, financial services). However, to overcome current barriers to investment and establish CCS at scale, government policy in the form of tradeable credits, financing vehicles and investment incentives will be needed.

**To limit global temperature increase to well below 2 degrees Celsius, the world needs to capture more than two billion tonnes of CO<sub>2</sub> globally every year by 2040. However, deployment of CCS is not progressing fast enough.**

**Santos is testing CCS in the Cooper and Eromanga basins which have injection potential of 20 million tonnes of CO<sub>2</sub> per annum for more than 50 years – one per cent of the two billion tonnes of global reduction needed from CCS by 2040.**

## **What is CCS?**

CCS is the process of capturing carbon dioxide and storing it in suitable, sealed reservoirs deep underground, so it cannot enter the atmosphere.

**CCS is an important enabler to the production of zero emissions hydrogen from natural gas.**

## **CCS is a natural partner for Australia's oil and gas industry**

Following a period of substantial investment (US\$200 billion in the last decade), Australia is now the world's largest liquefied natural gas exporter by installed liquefaction capacity. As a result, emissions related to gas production and processing in Australia have grown, even though liquefied natural gas reduces global emissions by displacing coal in power generation in Asia.

Australia is poised to enter another high investment period for liquefied natural gas, with projects such as Santos' Barossa gas field looking to take final investment decisions.

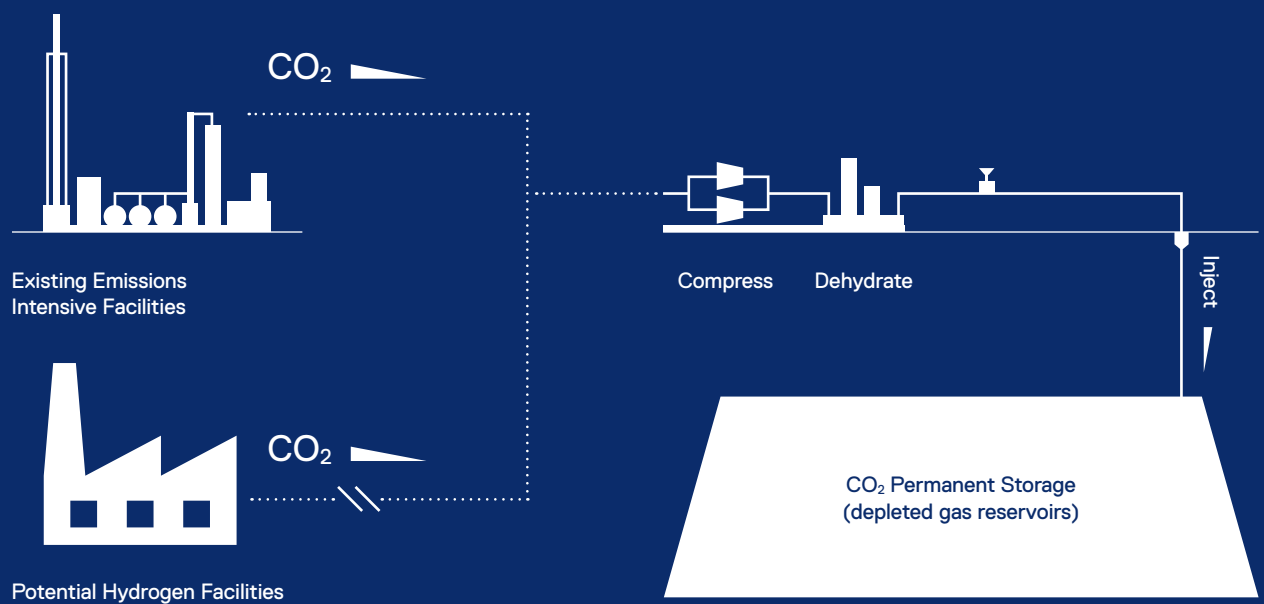
Just as liquefied natural gas is playing an important role in reducing global emissions, CCS in Australia can play an important role in securing the future of Australia's oil and gas industry in a lower-carbon future.

Figure 4 shows a schematic of CCS infrastructure in the context of the Cooper Basin and opportunity to support hydrogen growth.



The Cooper and Eromanga basins could one day be a large-scale, commercial CCS storage hub capturing emissions not only from oil and gas, but from other industries such as power generation, steel, cement and chemicals.

**Figure 4** Schematic of CCS infrastructure in the context of the Cooper Basin and opportunity to support hydrogen growth



## A strategic focus on resilience in a lower-carbon future

Santos has been incorporating greenhouse gas emissions and carbon pricing into economic planning and decision making for over 10 years.

Santos tests existing and new projects against various carbon policy assumptions, using a base case carbon price consistent with Australia's emissions reduction policy, currently the Safeguard Mechanism.

These carbon price assumptions are refreshed annually along with other corporate economic assumptions. The Santos investment screening process and decision making take into account the greenhouse gas emissions from particular projects and the economic impact that a carbon price would have on our business. Sensitivity analyses are performed against the Safeguard Mechanism and other policy scenarios.

Scenario analysis also considers a range of energy mix futures. These scenarios are used to understand the demand for Santos' products and how this changes under different emissions reduction policies.

## Managing emissions under Australia's Safeguard Mechanism

Santos assets are subject to the Australian emissions reduction policy known as the Safeguard Mechanism, which places a cap (baseline) on emissions from Australian facilities emitting greater than 100 kilotonnes carbon dioxide equivalent. Under this policy, annual emissions for each facility are compared against the facility's baseline, and responsible entities must purchase and surrender carbon units for any emissions above the baseline for the year.

Santos has 11 operated facilities, comprising 90% of our operated emissions, covered by the Safeguard Mechanism. Santos has a strong incentive to keep emissions for each facility below its designated baseline, with a carbon price of around A\$17 per tonne CO<sub>2</sub> (December 2019) applying for any emissions above the baseline.

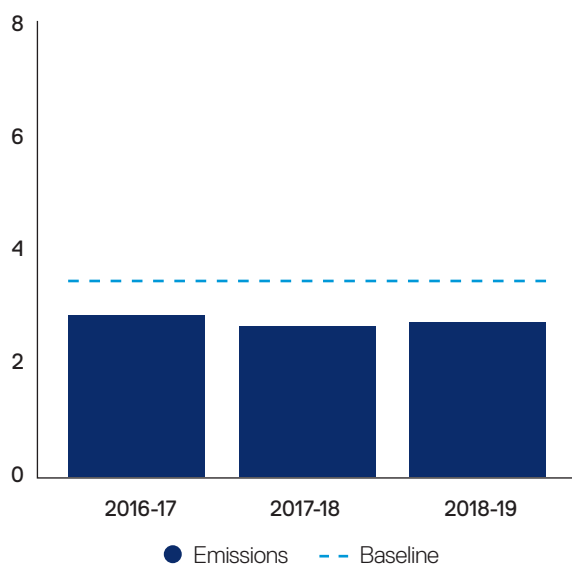
All of our operated assets subject to the Safeguard Mechanism are operating below their designated facility baselines, as shown in Figure 5 below.

The emissions and associated baselines in Western Australia are from assets acquired from Quadrant Energy in 2018. Prior to the acquisition these emissions and baselines were separately reported by Quadrant Energy.

**Figure 5** Santos operated facilities subject to the Safeguard Mechanism

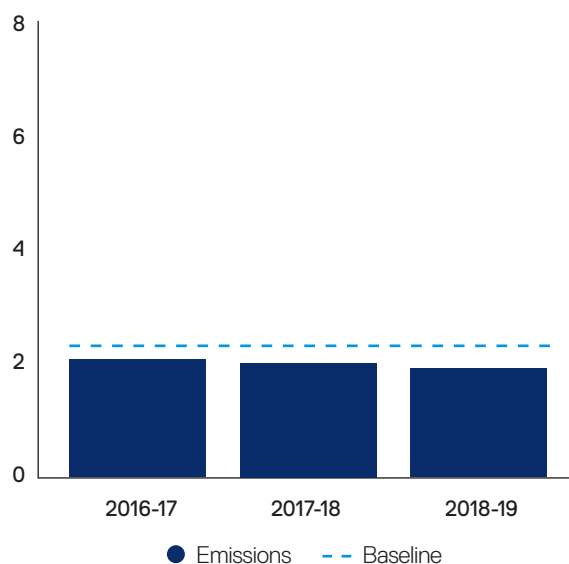
### Cooper Basin

Operated emissions, mtCO<sub>2</sub>e



### Queensland

Operated emissions, mtCO<sub>2</sub>e



**All of our operated assets subject to the Safeguard Mechanism are operating below their designated facility baselines.**

## Focus on emissions reduction

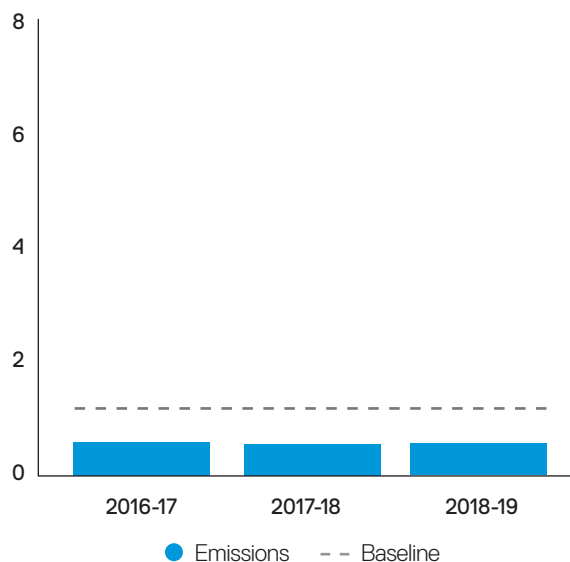
Our greenhouse gas emissions sources include vehicle and equipment fuel combustion, venting, flaring and fugitive emissions.

We are constantly looking at ways to reduce emissions as part of standard operations. Every molecule of gas that is not consumed through fuel, flaring or venting can potentially be supplied to the market. Consistent with this approach Santos established the Energy Solutions team in 2017 to focus on:

- + Reducing fuel gas, flaring and venting to enable more sales gas.
- + Reducing waste and emissions by pursuing economic uses for by-products such as carbon dioxide, produced water and salt.
- + Growing natural gas demand by commercialising gas through new technologies and new market opportunities, including firming for intermittent renewable energy systems.

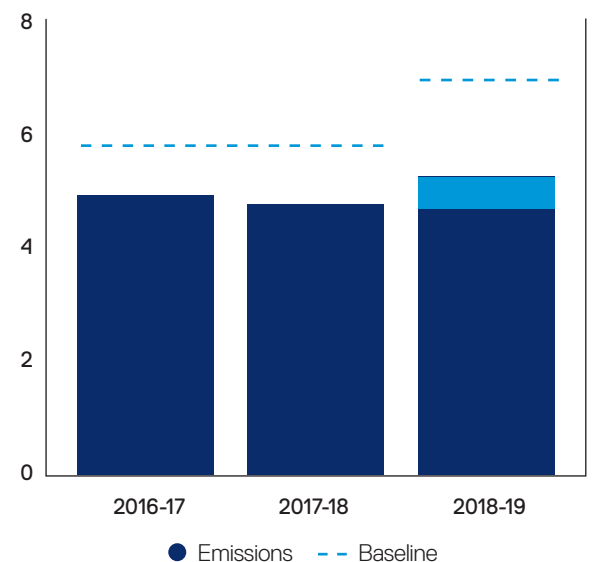
### Western Australia

Operated emissions, mtCO<sub>2</sub>e



### Santos Group<sup>27</sup>

Operated emissions, mtCO<sub>2</sub>e



<sup>27</sup> Santos acquired assets from Quadrant Energy in November 2018. The 2016-17 and 2017-18 data does not include these assets as they were separately reported by Quadrant Energy

## Scenario modelling

Scenario analysis is a standard part of Santos' strategic planning process, analysing the impact of changes in the future energy mix, market conditions, technology, consumer behaviour and policy settings.

In our inaugural Climate Change Report in 2018, Santos modelled the impact of changing climate policy on the Company's portfolio of assets, consistent with the requirements of the TCFD. Santos used the IEA's scenarios from their Energy Technology Perspectives 2017 to understand the economic resilience of its portfolio under different climate change policies. We have subsequently modelled the impact using the IEA's scenarios from the 2018 World Energy Outlook.

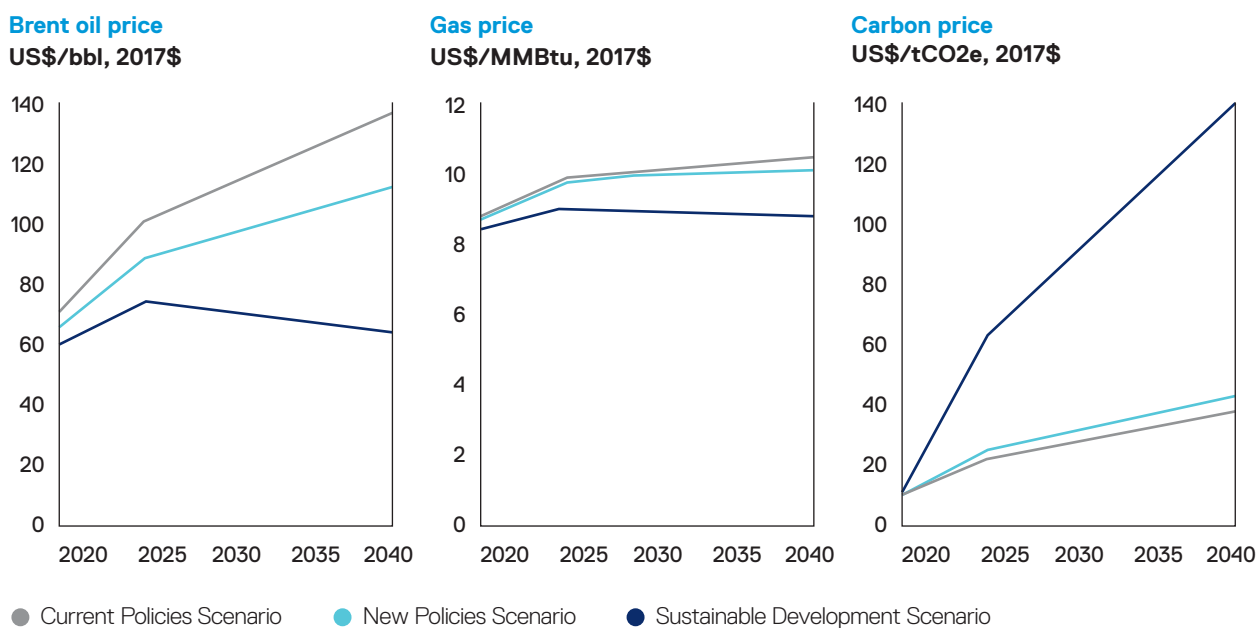
While the future may differ from forecast scenarios, modelling discrete scenarios provides us with relevant insights and understanding of potential trends and opportunities that enable Santos to ensure business

resilience and create value for our shareholders, stakeholders and communities where we operate.

Santos' base oil and gas price assumptions take into account the impact of a changing energy mix over the longer term and are more conservative than the IEA's oil and gas price assumptions under each of their scenarios. The IEA scenarios use higher carbon price assumptions to reflect the more stringent climate change policies required to limit global temperature rise.

Under the IEA scenarios, all emissions incur a carbon price, whereas the Santos base case reflects Australia's current carbon policy, the Safeguard Mechanism. Under the Safeguard Mechanism, only emissions above the agreed baseline for each facility incur a carbon offset cost. The Santos base case models the baselines for our facilities declining over time in line with Australia's emission reduction targets.

**Figure 6** Oil, gas and carbon price assumptions under the CPS, NPS and SDS scenarios from the IEA<sup>28</sup>



<sup>28</sup> IEA, World Energy Outlook 2018. Gas price assumptions represent the delivered price of gas into Japan

As oil and gas demand continues to grow under the Current Policies and New Policies Scenarios, prices are projected to increase in real terms from today's levels to incentivise the development of new supply. The oil price is projected to return to above US\$90/bbl in real terms by the middle of next decade. The price for gas delivered into Japan is projected to rise above US\$10/MMBtu in real terms by 2030. The carbon price gradually increases in these scenarios.

The Sustainable Development Scenario provides an integrated strategy to achieve energy access, air quality, climate goals and, for the first time, water access. Under the Sustainable Development Scenario, temperature is expected to rise by 1.7 to 1.8 degrees Celsius by 2100, in line with the Paris Agreement ambition of limiting global temperature rise to well below 2 degrees Celsius.

Delivering this future requires rapid improvement and deployment of technology in the innovation pipeline, including significant growth in bioenergy and the implementation of large-scale carbon capture and storage.

This is modelled through very high carbon price assumptions reaching US\$140/tCO<sub>2</sub>e by 2040. Under this scenario, oil prices decline in real terms from 2025 but continue to average above US\$60/bbl through to 2040. Gas prices rise to 2025 before slowly decreasing in real terms to around US\$8/MMBtu delivered into Japan by 2040.

Figure 6 shows the oil, gas and carbon price assumptions under each of the IEA's 2018 World Energy Outlook scenarios.

**While the future may differ from forecast scenarios, modelling discrete scenarios provides us with relevant insights and understanding of potential trends and opportunities that enable Santos to ensure business resilience and create value for our shareholders, stakeholders and communities where we operate.**



## Scenario analysis demonstrates strong net present value and earnings outcomes

### Value of our pre-growth portfolio

Santos' pre-growth portfolio represents assets currently in production and reflects our published reserves position.

Our pre-growth portfolio also includes ongoing development of our existing acreage in the Cooper Basin in South Australia and Queensland, and in the Surat and Bowen Basins in Queensland. The portfolio does not include the acquisition of ConocoPhillips' Australia-West business announced on 14 October 2019, as that deal did not complete in 2019.

The net present value of our pre-growth portfolio is economically resilient under the IEA's Sustainable Development Scenario and more robust under other scenarios which have a higher natural gas demand outlook, maintaining value in excess of, or close to Santos' current portfolio valuations. The Santos scenario shown for reference in this section is consistent with the assumptions published in our 2019 half-year results.

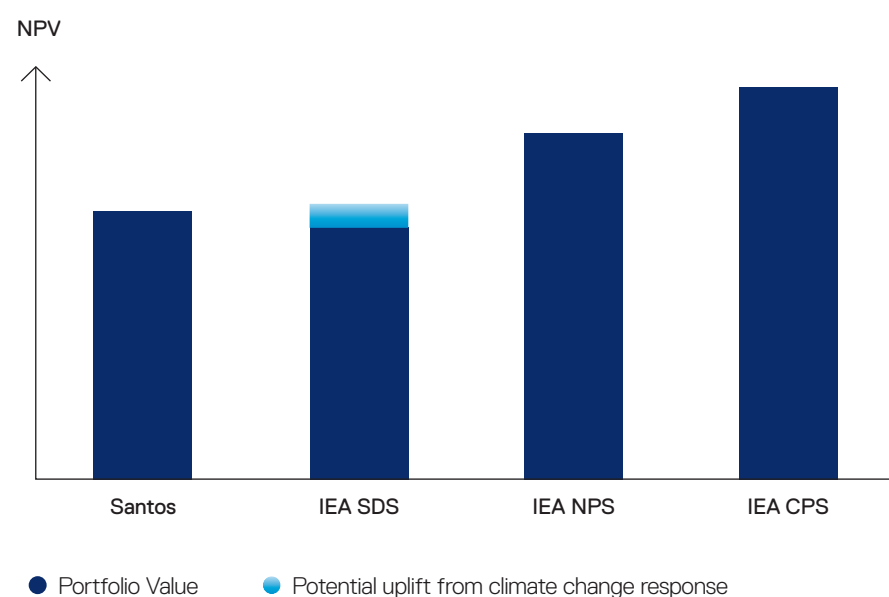
The Company's relative portfolio value under each scenario is shown in Figure 7.

Although value is impacted by significant carbon costs under the Sustainable Development Scenario, this can potentially be offset by investment in emission reductions across our portfolio and incorporating zero-emission products and services into our portfolio as shown in light blue in the chart below.

Santos is already pursuing activities that both lower our emissions and add value to our portfolio, including:

- + Conversion of existing operations to run partially or fully on renewable power to reduce fuel usage. This reduces the emissions from operations and helps to improve reliability, as there is less equipment to maintain. Fuel saved is then available for sale to the market.
- + Investigation of carbon capture and storage (CCS) feasibility which takes advantage of our core competencies and infrastructure position, and will be critical in meeting greenhouse gas emission targets in the longer-term.
- + Pursuing economic uses for our by-products, such as carbon dioxide extracted from our product stream to convert a waste product into a new source of revenue.

**Figure 7** Relative value of pre-growth portfolio under Santos and IEA assumptions<sup>29</sup>



<sup>29</sup> No change in portfolio assumed between scenarios

## Earnings of our growth portfolio

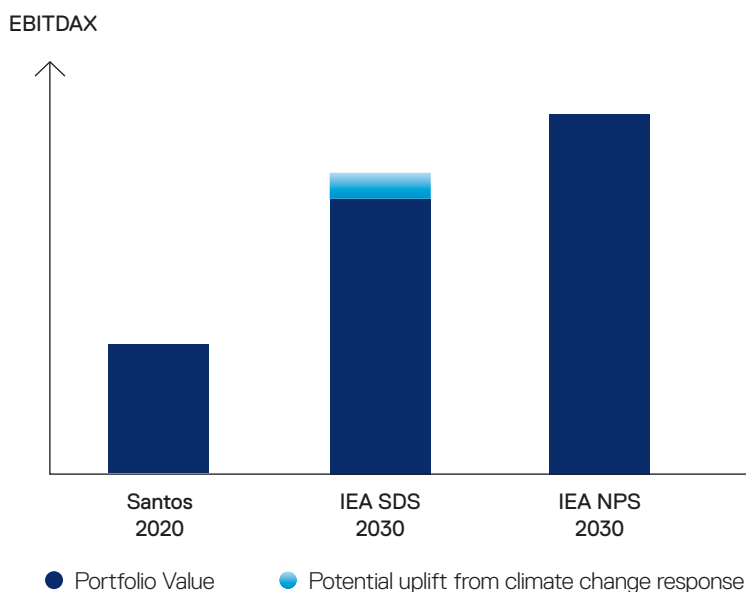
Santos' growth portfolio includes the pre-growth portfolio plus liquefied natural gas backfill and expansion opportunities, backfill opportunities for our existing Australian infrastructure position, new onshore gas developments and a new offshore oil and gas development. These opportunities take advantage of Santos' disciplined low cost operating model and are consistent with the development of our contingent resources position. The growth portfolio does not include the acquisition of ConocoPhillips' Australia-West business announced on 14 October 2019.

Santos' growth portfolio continues to be economically resilient under the IEA's Sustainable Development Scenario and more robust under other scenarios which have a higher natural gas demand outlook, maintaining earnings in 2030 in excess of Santos' current 2020 EBITDAX forecast. Figure 8 shows the relative earnings under each scenario.

Similar to the valuation impact, the earnings impact from high carbon costs under the Sustainable Development Scenario can potentially be offset by investment in emission reductions across our portfolio and incorporating zero-emission products and services into our portfolio.

**The value and earnings across our portfolio are economically resilient under the scenarios consistent with global efforts to reduce greenhouse gas emissions.**

**Figure 8** Relative earnings of growth portfolio (including existing pre-growth portfolio) under Santos and IEA assumptions<sup>30</sup>



<sup>30</sup> No change in portfolio assumed between scenarios





3

# Metrics and targets

**Port Bonython, South Australia**  
2MW solar PV project





Santos has a long-term aspiration of achieving net-zero emissions by 2050.



Santos has set medium-term targets and is making excellent progress against these targets.



Santos transparently reports its greenhouse gas emissions, including fugitive methane emissions.

## Emissions targets

In our 2018 Climate Change Report we set a long-term aspiration to achieve net-zero emissions from our operations by 2050, in line with global ambitions to limit temperature rise to well below 2°C. This represents a significant shift from business as usual and will require considerable effort to achieve.

In our 2019 Climate Change Report we set medium-term targets that are aligned with our natural gas-focused corporate strategy and our commitment to limiting greenhouse gas emissions, while providing access to reliable and competitively priced energy for domestic and international markets.

Santos is making excellent progress against its medium-term targets.



GLNG, Curtis Island, Queensland





## Target 1

### Reduction of global emissions through liquefied natural gas export growth

The greatest impact Santos can have in reducing global greenhouse emissions in a meaningful way will be to export more liquefied natural gas, replacing higher-emitting coal in household heating and cooking, industrial processes and power generation in Asia.

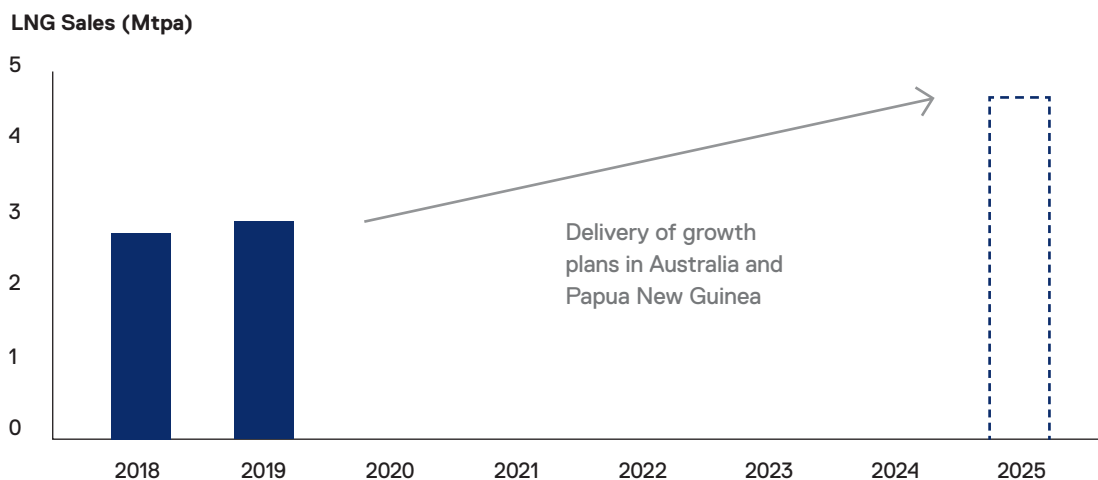
Our target is to grow liquefied natural gas exports to at least 4.5 million tonnes per annum (mtpa) by 2025.

By achieving this target, Santos' cumulative liquefied natural gas exports from 2020 to 2030 could displace the equivalent of 15% of Australia's total cumulative emission reduction target for this period.<sup>31</sup>

As shown in Figure 9, Santos continues to make progress towards achieving our target of growing liquefied natural gas sales volumes to at least 4.5 Mtpa by 2025 through delivery of growth plans in Australia and Papua New Guinea.

- + In the Northern Territory, progress continues to be made towards a final investment decision on Barossa with major contracts being awarded and the project entering exclusive negotiations for the supply of backfill gas to Darwin LNG. Santos is also in advanced discussions with a number of liquefied natural gas buyers for Barossa offtake volumes and expects to take a final investment decision around the end of the first quarter of 2020.
- + In PNG, the signing of a binding letter of intent to farm-in to P'nyang marked an important milestone towards the expansion of the PNG LNG plant. Santos continues to work with its partners and the PNG Government to finalise the farm-in and gas agreement to make expansion a reality.
- + GLNG in Queensland delivered a record six million tonnes of liquefied natural gas sales in 2019. GLNG capacity of 8.6 Mtpa provides opportunity for further liquefied natural gas sales growth in the future.

**Figure 9** Progress towards target to grow liquefied natural gas sales to at least 4.5 million tonnes per annum by 2025



<sup>31</sup> Australian emissions reduction from 2020 to 2030 of 868 MtCO<sub>2</sub>e is from Tracking Australia's Emissions Reduction Targets, December 2017, Department of Environment and Energy



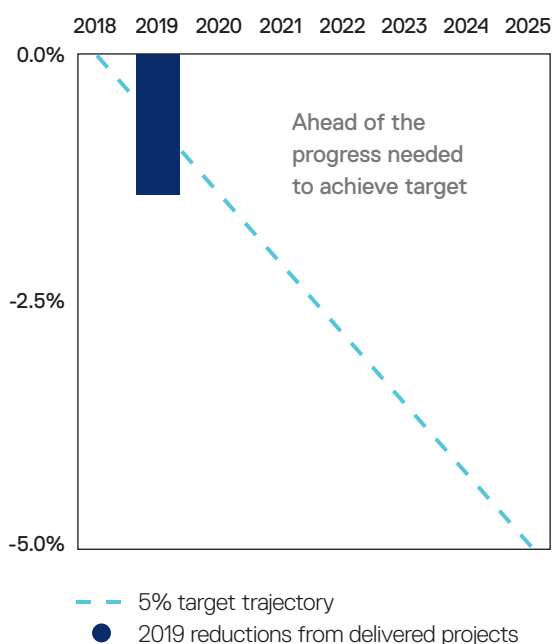
## Target 2

### Economically reduce emissions from our base operations

In addition to our global emissions impact, we are committed to minimising the emissions footprint of our operations. Our target is to reduce emissions by more than 5% across current operations in the Cooper Basin and Queensland by 2025.

As shown in Figure 10, we are ahead of the progress needed to achieve this target.

**Figure 10** Progress towards target to reduce emissions by more than 5% across existing operations by 2025



These reductions have been achieved through solar and battery conversion of oil well pumps in the Cooper Basin, the installation of a solar photovoltaic power generation system at the Port Bonython hydrocarbon processing plant, a heat-energy recovery system at Moomba and a range of other efficiency projects across our operations which have reduced fuel gas usage by over four terajoules per day in 2019.

In November 2019, Santos awarded a contract for the design and construction of a solar and battery-powered microgrid for the Charo oil field in the Cooper Basin. This project will reduce fuel usage by 35% across the Charo oil field and is targeting installation in Q4 2020.

Santos and GLNG have also sanctioned a project to convert five of GLNG's gas turbine compressors in Roma and Fairview to electric motor drive compressors. This project will reduce fuel consumption by 15 terajoules per day and reduces emissions as well, as more renewables are connected into the Queensland electricity grid. Over the life of the project, the overall emissions benefit is forecast to average approximately 50 ktCO<sub>2</sub>e per year.

In addition, more energy efficiency projects have been identified and planned for 2020 and beyond. One example of these projects investigates the opportunity to optimise and electrify our compressor fleet across the Cooper Basin, increasing efficiency and reducing our gas consumption and emissions. This potentially supports the development of a centralised power generation system at Moomba that incorporates large-scale renewables.



### Target 3

#### Pursue step-change emissions reductions technology

Our third target is to assess the feasibility and, if feasible, invest in technology and innovation which can deliver a step change in emissions such as:

- + Carbon capture and storage (CCS) to capture carbon dioxide that would otherwise be emitted and safely and permanently store it underground or use it to increase the productivity of underground oil deposits.
- + Solar thermal technology to harness solar energy for power generation.

#### Reducing emissions with carbon capture and storage

In 2019 Santos drilled two wells in the Cooper Basin as part of our appraisal program. This program assessed the potential for improvements in oil recovery and associated CO<sub>2</sub> storage from reservoirs in the Cooper Basin. Activities assessing injectivity are now planned for the coming year.

Initially, we plan to capture around 300,000 tonnes of CO<sub>2</sub> emissions per annum from the Moomba Gas Plant. The CO<sub>2</sub> would be compressed, dehydrated (removing any water) and transported to a target field nearby for injection. Santos is collaborating with experts including Occidental Petroleum, which has world-leading operational expertise in CO<sub>2</sub> injection in the United States.

In 2020 we will complete the design phase and be ready to make a final investment decision, subject to the required Government policy being in place. CO<sub>2</sub> injection could commence from as early as 2022.

With the right policy settings and incentives to accelerate CCS deployment, the Cooper Basin could become a large-scale, commercial CCS hub capturing emissions not only from oil and gas, but from other industries such as power generation, steel, cement and chemicals. The Cooper Basin could play an important role to help Australia meet its Paris emission reduction targets.



Cooper Basin

# Santos emissions reduction in action



## Solar and battery powered oil wells in the Cooper Basin



In 2018 Santos commenced work on a program to convert oil well pumps to run on solar power.

A pilot pump at the Hobbes-1 oil well at Limestone Creek has been operating on solar power since August 2018, proving that solar PV and batteries can maintain reliability and availability in the harsh environment of the Cooper Basin. This was Australia's first oil well running on solar and battery, off grid.

Santos has since identified a further 56 wells that can benefit from this solution, based on the success of the pilot. The project will cost just over \$16 million, with the Australian Renewable Energy Agency (ARENA) contributing \$4.2 million, or about 25% of the cost.

In 2019, Santos has delivered 22 of the 56 wells. Santos aims to commercialise this technology by providing adequate scale to achieve supply chain and execution synergies. The rollout to 22 wells included trialling multiple vendors and designs to reduce unit costs.

Santos is now focused on delivering the next 34 wells, to be executed in 2020. There are over 200 existing pumps across the Cooper Basin that could be covered and ultimately Santos aims to use solar power as the standard energy source for new onshore oil wells.

Converting oil well pumps to solar power will deliver environmental and commercial benefits by reducing crude oil consumption, long distance fuel haulage and emissions associated with burning crude oil.

## Reducing emissions through more efficient power generation at Devil Creek in Western Australia



In a review of emission reduction opportunities across our operations, Santos identified that power generation units at the Devil Creek gas processing facility near Karratha in Western Australia were running inefficiently at existing power output rates.

In 2019, Santos initiated a project to replace these engines with three reciprocating gas engine alternators to improve fuel efficiency and reduce emissions by around 14,500 tonnes of carbon dioxide equivalent per year. The new engines commenced operation in late 2019, reducing carbon emissions from the Devil Creek facility by 25% and also reducing power costs.

The project is approved by Australia's Clean Energy Regulator to generate Australian Carbon Credit Units (ACCUs) under the Emissions Reduction Fund and is expected to generate around 100,000 ACCUs over the life of the project. It is the first time an upstream oil and gas company has accessed ACCUs through the Emissions Reduction Fund's electricity and fuel efficiency methodology.

## Solar PV powering Santos' Port Bonython plant in South Australia



Opened in 1982, Port Bonython is a hydrocarbon processing plant named after Santos' founding Chairman, Mr. John Bonython AO. The plant receives liquid hydrocarbons in a mixed stream from Moomba, via a 659 kilometre pipeline. The mixture of condensate, crude oil and liquid petroleum gas is processed in distillation towers and molecular sieves to produce high value products such as naphtha, propane and butane, which are shipped to customers around Australia and in Asia.

In June 2019, a 2MW solar photovoltaic system was commissioned to power the Port Bonython plant.

The solar system will generate more than three gigawatt hours of emissions-free electricity every year which is over 6% of total electricity use.

This project is part of Santos' ongoing strategy to integrate renewables into our operations to reduce emissions and free up fuel gas and energy for sale. As a larger industrial user of electricity, this project helps to reduce the burden on South Australia's electricity grid by generating new supply in a remote area.



## Emissions measurement and reporting

### Santos' emissions intensity continues to trend lower.

Australia has a comprehensive greenhouse gas reporting scheme, established by the federal National Greenhouse and Energy Reporting Act 2007 (NGER). The NGER Act is supported by the National Greenhouse and Energy Reporting (Measurement) Determination 2008, which provides methods and criteria for calculating greenhouse gas emissions and energy data under the NGER Act.

The NGER reporting scheme covers<sup>32</sup>

- + Scope 1 and Scope 2 emissions, energy produced and consumed.<sup>33</sup>
- + Greenhouse gases including carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O).
- + Emission sources including the combustion of fuels for energy and fugitive emissions from the extraction of natural gas.

Santos has been reporting under the NGER scheme since its inception in 2008. In addition our Scope 1 greenhouse gas emissions are independently audited each year. Table 1 shows the latest 2018-19 data and comparison over the prior 5 years.

On 27 November 2018, Santos completed the acquisition of Quadrant Energy. The 2018-19 dataset incorporates these assets, which were previously separately reported by Quadrant Energy.

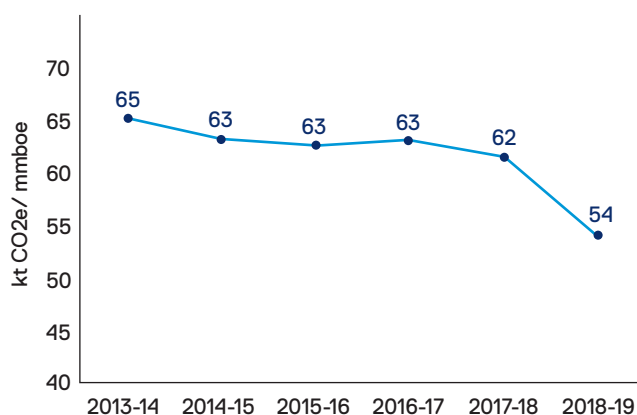
Santos' operated Scope 1 emission sources consist of fuel combustion (58%); flare, vent and CO<sub>2</sub> removal (42%); and fugitive leaks (<1%). Since 2016-17 our underlying operated Scope 1 emissions (excluding assets associated with the acquisition of Quadrant Energy) continue to decrease.

Santos' operated Scope 2 emission sources consist of electricity purchased for our operations in Fairview and Roma in Queensland, Port Bonython processing facility near Whyalla in South Australia and minor amounts for other activities including office buildings. Emissions are calculated from electricity purchased multiplied by prescribed state-based electricity emission factors.

Santos' operated Scope 3 emissions are reported as the emissions associated with the combustion of our products. The calculations assume that all products are combusted as a fuel, even though a portion of Santos' products are used as a feedstock, for example ethane produced by Santos is used as a feedstock in the manufacture of polyethylene.

Santos' emissions intensity (Scope 1, equity share) continues to trend lower as seen in Figure 11.

**Figure 11** Santos emissions intensity (Scope 1, equity share)



<sup>32</sup> For further information, please refer to <http://www.environment.gov.au/climate-change/climate-science-data/greenhouse-gas-measurement/nger> and <http://www.cleanenergyregulator.gov.au/NGER/About-the-National-Greenhouse-and-Energy-Reporting-scheme/Greenhouse-gases-and-energy>

<sup>33</sup> Scope 1 emissions occur from sources controlled by the Company, for example emissions from fuel, flare and vent; Scope 2 emissions are indirect, mainly electricity consumption

**Table 1**  
Greenhouse gas emissions data<sup>34</sup>

Greenhouse gas (GHG) emissions and energy consumption (Santos gross operated, unless otherwise stated, financial years)							
	Units	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19 <sup>35</sup>
Direct energy consumption	PJ	32	34	48	65	65	71
Indirect energy consumption <sup>36</sup>	PJ	0.18	0.19	0.19	1.47	1.85	2.54
Scope 1 (Quadrant Energy)	MtCO <sub>2</sub> e						0.62
Scope 1 (Santos ex Quadrant)	MtCO <sub>2</sub> e	3.94	4.35	5.04	5.82	5.49	5.21
Scope 1 (direct GHG emissions)	MtCO <sub>2</sub> e	3.94	4.35	5.04	5.82	5.49	5.83
Scope 2 (purchased electricity) <sup>37</sup>	MtCO <sub>2</sub> e	0.03	0.03	0.03	0.31	0.39	0.53
Scope 3 (product use)	MtCO <sub>2</sub> e	18.0	15.5	18.8	20.4	20.0	24.5
Scope 1 (Santos equity share)	MtCO <sub>2</sub> e	3.36	3.63	3.79	3.79	3.57	3.65
Intensity (Santos equity share)	ktCO <sub>2</sub> e/mmboe	65	63	63	63	62	54
Scope 2 (Santos equity share)	MtCO <sub>2</sub> e				0.13	0.16	0.20
Scope 3 (Santos equity share)	MtCO <sub>2</sub> e				19.2	18.4	21.6
Further details of Scope 1 emissions and flared and vented hydrocarbon (Santos gross operated)							
Emissions of CO <sub>2</sub>	MtCO <sub>2</sub> e	3.49	3.86	4.51	5.09	4.99	5.35
Emissions of CH <sub>4</sub>	MtCO <sub>2</sub> e	0.45	0.48	0.53	0.72	0.49	0.47
Emissions of N <sub>2</sub> O	MtCO <sub>2</sub> e	0.00	0.01	0.01	0.01	0.01	0.01
Emissions from fuel	MtCO <sub>2</sub> e	1.70	1.67	2.38	3.19	3.18	3.37
Emissions from flare	MtCO <sub>2</sub> e	0.30	0.54	0.38	0.25	0.18	0.29
Emissions from vent	MtCO <sub>2</sub> e	0.30	0.30	0.30	0.31	0.24	0.15
Emissions from CO <sub>2</sub> removal	MtCO <sub>2</sub> e	1.62	1.81	1.94	2.03	1.85	1.98
Emissions from fugitives	MtCO <sub>2</sub> e	0.02	0.02	0.03	0.04	0.04	0.04
Volume of flared hydrocarbon	Million m <sup>3</sup>	94.1	212.2	134.8	93.8	56.8	96.5
Volume of vented hydrocarbon	Million m <sup>3</sup>	35.4	38.0	45.0	38.7	33.0	26.2

<sup>34</sup> Emissions and energy are reported on an Australian financial year basis in accordance with the National Greenhouse and Energy Report Act, 2007.

Scope 1 emissions occur from sources controlled by the Company, for example emissions from fuel, flare and vent; Scope 2 emissions are indirect, mainly electricity consumption; Scope 3 emissions represent indirect emissions when our products are combusted by our customers to produce energy

<sup>35</sup> 2018-19 data includes assets associated with the the acquisition of Quadrant Energy (ASX release - Santos completes acquisition of Quadrant Energy – 27 November 2018)

<sup>36</sup> Increase since 2016-17 is primarily due to the purchase of electricity at Fairview and Roma Hub in Queensland

<sup>37</sup> Increase since 2016-17 is primarily due to the purchase of electricity at Fairview and Roma Hub in Queensland

## Santos' fugitive leak detection and repair practices

Fugitive emissions are minor losses from oil and gas equipment, for example, from valves on pipelines and within gas plants.

While fugitive emissions comprise less than 1% of Santos' operated emissions, fugitives are an emission source attracting greater attention globally. Santos requires each asset to develop and implement a specific well integrity guide, which outlines the defined regulatory framework and accountability required by legislation, as well as the frequency of well integrity assessments.

In Santos' Queensland operations, leak detection practices are undertaken in accordance with the Petroleum and Gas (Production and Safety) Regulation 2004 and the Queensland Government's Code of Practice for Leak Management, Detection and Reporting for Petroleum Facilities. These regulations and codes require operators to take all reasonable and necessary steps to avoid leakage from gas processing infrastructure and apply a risk-based approach to inspection frequencies with minimum timeframes and triggers.

In New South Wales a leak detection and repair program is implemented in accordance with the Environment Protection Licence (EPL) requirements. The program covers all relevant components of plant and equipment in order to detect leaks and specifies triggers for repair responses and timeframes.

## Scientific studies into background methane

Natural background biological and geological sources of methane must be identified and understood in order to assess the impact of fugitive emissions from oil and gas operations.

Santos has engaged CSIRO to undertake initial field monitoring across its operated onshore assets, including measuring background levels of methane, investigating fluxes and identifying sources of elevated methane levels.

**This program builds on previous work by CSIRO in New South Wales and Queensland in 2013 and 2014, which measured fugitive emissions from 43 coal seam gas wells and found it was very low, especially when compared to the volume of gas produced from the wells.<sup>38, 39, 40</sup>**

<sup>38</sup> Regional methane emissions in NSW CSG Basins, September 2017. CSIRO Australia.

<sup>39</sup> Characterisation of Regional Fluxes of Methane in the Surat Basin, Queensland. Report to the Gas Industry Social and Environmental Research Alliance (GISERA). Report No. EP185211, October 2018. CSIRO Australia.

<sup>40</sup> Refer <http://www.environment.gov.au/climate-change/climate-science-data/greenhouse-gas-measurement/publications/csg-fugitive-emissions> for further information

<sup>41</sup> Refer <https://www.csiro.au/en/News/News-releases/2018/New-partnership-to-deliver-methane-emission-science-for-the-NT> for further information

<sup>42</sup> Pre-Exploration Measurement and Monitoring of Background Landscape Methane Concentrations and Fluxes in the Beetaloo Sub-Basin, Northern Territory. Report to the Gas Industry Social and Environmental Research Alliance (GISERA). Report No. EP193975, July 2019. CSIRO Australia.

## McArthur Basin baseline study

In 2018 and 2019 CSIRO conducted field monitoring in Santos areas in the Northern Territory's McArthur Basin in line with recommendations of the Final Report of the *Scientific Inquiry into Hydraulic Fracturing in the Northern Territory*.<sup>41</sup> Three surveys commissioned by the Northern Territory Government, each traversing approximately 4000-5500km on trafficable roads and tracks over a 7-12 day period were conducted during the dry and fire seasons in 2018 and the wet season in 2019.<sup>42</sup>

The average atmospheric methane concentration across the survey area ranged from 1.80 to 1.82 parts per million (ppm). This is consistent with normal background concentrations of methane expected in rural or natural areas. Each survey observed isolated pockets of slightly elevated methane concentrations. In summary, CSIRO found:

- + Background atmospheric methane concentrations in the region are close to global average methane concentrations.
- + The main sources detected were grazing cattle, townships, a section of above-ground gas pipeline and associated valves, fires, termites and wetlands.
- + The largest source of emissions was grazing cattle but generally, the sources detected were small.
- + Seasonal variation was observed around natural sources such as fires, termites, wetlands and soils.
- + No geological seeps were identified during the surveys.

## Arcadia baseline study

Santos engaged CSIRO to undertake a similar study in the Arcadia coal seam gas fields in Queensland's Bowen Basin. This program monitored background methane levels during the summer of 2018 and winter of 2019. The survey traversed around 900km of roads through active production areas, historical/disused wells, a workover rig, a hydraulic fracturing operation, water bores, coal exploration and cattle grazing areas.

Preliminary analysis indicated background concentrations of methane were in the range of 1.78 to 1.82 ppm consistent with normal background methane concentrations of methane expected in rural or natural areas. Isolated pockets



of slightly elevated methane concentrations (over 1.9 ppm) were identified. These sources were mainly attributed to grazing cattle, camp sewage treatment facilities and, in some instances, bush fires which were observed on all three days close to the survey area.

## Amadeus Basin baseline study

Santos engaged CSIRO to conduct a baseline methane study across its tenures in the Amadeus Basin south of Alice Springs in March 2019. The survey traversed 1,330km of roads and tracks and included specific examination of plugged and abandoned oil and gas wells, water bores and the Santos Dukas-1 well site, which was under construction at the time.

The results of the mobile surveys, using a vehicle-mounted Los Gatos Research methane/acetylene gas analyser, showed very consistent methane concentrations across the entire region averaging 1.82 ppm. Elevated levels were observed when cattle were close to the survey vehicle and one morning, at the Erldunda Roadhouse, most likely due to a sewage treatment facility. Methane levels at the Dukas-1 well site were at normal background levels.

Santos will continue background methane studies in other asset areas in 2020.



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# Governance and risk







Santos has had a Climate Change Policy since 2008, guiding our management of emissions and climate change risks.



A dedicated Environment, Health, Safety and Sustainability Committee of the Santos Board is responsible for monitoring and reviewing the Company's approach to climate change and management of climate change risks.



Climate change is incorporated into Santos' Enterprise Material Risk Profile and risk management processes and practices.



Key indicators are included in the Short-Term Incentive Scorecard which link climate-related performance to remuneration outcomes for the Executive Committee.

## Company policy and Board oversight

Santos is committed to a lower-carbon future and our Climate Change Policy guides the Company's activities to reduce carbon emissions as it produces the reliable, affordable and cleaner energy required to meet domestic and global demand. Through the commitments made in our Climate Change Policy, Santos is striving to contribute to the global aspiration to limit temperature rise to less than 2 degrees Celsius.

The Environment, Health, Safety and Sustainability (EHSS) Committee of the Santos Board regularly monitors and reviews the Company's policy and approach to climate change including management of climate change risk. The EHSS Committee provides advice to the Santos Board on climate-related issues and the Company's performance in managing climate change risks.

The EHSS Committee receives regular updates on climate change developments from subject matter experts. These include information about risks, opportunities and the financial impacts for the Company arising from climate-related issues. Delivery of our climate change objectives is supported by teams who continually monitor and assess trends and changes in Australian and international energy markets, assess and model a range of energy mix scenarios based on varying policy and technology drivers, and conduct portfolio and asset reviews of our business and strategy.

The Santos Climate Change Policy, EHSS Committee Charter and 2018 and 2019 Climate Change Reports are available at [www.santos.com](http://www.santos.com).

## Executive remuneration

In Santos' 2018 Climate Change Report we communicated our long-term aspiration to achieve net-zero emissions from our operations by 2050, in line with global aspirations to limit temperature rise to well below 2 degrees Celsius.

In 2019, key indicators were included in the Short-Term Incentive Scorecard which link climate-related performance to remuneration outcomes for members of the Executive Committee.

These key indicators include the delivery of short and medium-term emission reduction projects and initiatives as well as the achievement of specific run rates for emission reduction.

Below a threshold level of performance, no amount will be payable under the Short-Term Incentive for climate-related measures. Achieving the target level of performance delivers 2.5% of the Short-Term Incentive. Achieving or exceeding the stretch performance delivers a maximum of 4.17% of the Short-Term Incentive (payout cannot go beyond 1.67 times the target level).

The overall scorecard outcome is applied as a multiplier to individual performance outcomes. All outcomes are reviewed and approved by the Santos Board. Performance against targets and remuneration outcomes are disclosed in the remuneration report released following the end of the performance year.

In addition, executives participate in the Company's Long-Term Incentive Plan which delivers Santos shares at the end of a four-year performance period subject to the achievement of performance hurdles including total shareholder return relative to ASX100 companies and the constituent members of the Standard and Poor's 1200 Global Energy Index. This is expected to promote a focus on climate-related risks to ensure long-term business resilience.

**In 2019, key indicators were included in the Short-Term Incentive Scorecard which link climate-related performance to remuneration outcomes for members of the Executive Committee.**

## Managing climate change risks

### An integrated and active risk management approach

The Santos Risk Management Framework is consistent with the International Standard (AS/NZS ISO 31000) Risk Management Guidelines and the ASX Corporate Governance Principles and Recommendations. The Framework incorporates a Risk Management Policy, Risk Management Standard and risk processes to facilitate the identification, assessment and treatment of risk.

The Framework is reviewed annually by the Audit and Risk Committee of the Santos Board, and the Santos Board of Directors, to confirm that it adequately and comprehensively addresses known and emerging risks, including those risks related to sustainability and climate change. Climate change risk has been and continues to be a matter of particular interest and oversight by the Audit and Risk and EHSS Committees and the Board, with the Enterprise Material Risk Profile reviewed at least twice annually by the full Santos Board.

Santos has dedicated staff who manage the Company's compliance with all carbon reporting requirements. Our teams collaborate across the business and the Executive Committee to ensure that external and internal climate change developments, and risks are identified and integrated into the Company's strategy and activities.

### Material climate risks

The Company's material risks relating to climate change consider physical, policy and legal, technological, market and reputational risks in the context of the internal and external environments relevant to Santos' business activities. These risks have potential to impact on our corporate objectives, including material financial implications such as increased cost, lost profitability, product demand and revenue disruptions. These risks are summarised below.

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#### Risk Category Climate-related risks and potential impacts

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<b>Physical Risks</b> <small>(acute and chronic)</small>	Increased frequency or severity of extreme weather events could impact facilities onshore and offshore. These risks may potentially result in injuries, damage to facilities and infrastructure, and disruption of operations.
<b>Policy Risks</b>	Carbon pricing policies, including a carbon tax, emissions trading scheme, or any other regulatory carbon pricing mechanism may increase operating costs or impact the international competitiveness of Santos projects. Project approvals may not be granted due to associated greenhouse gas emissions, or the conditions of approval (or operation) may be too onerous to proceed, potentially impacting operating and development costs.
<b>Legal Risks</b>	Litigation against governments and companies for compensation for climate change impacts may adversely affect Santos' reputation, development or operating costs.
<b>Technology and Market Risks</b>	Innovation in oil and gas could occur at a slower pace than coal, while technology breakthroughs could allow coal to significantly decrease emissions or renewables to manage intermittency issues. Natural gas could be displaced by more rapid advances in hydrogen or other technologies. These factors could all reduce demand for gas and its position in the energy mix.
<b>Reputational Risks</b>	Increased public and consumer activism on climate change and alternate views about the role of natural gas in supporting a lower-carbon future present a risk to Santos' reputation, with the potential to impact project approvals and licence to operate.

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## Risk mitigation

Santos' key controls for those identified climate change risks include the following:

Control Category	Key controls to prevent and mitigate identified risks
Strategic and Commercial	Modelling of carbon price scenarios, with integrated costs of carbon included in business planning and decision making at portfolio, asset and project levels. Potential impacts and opportunities resulting from current and future climate change policies is considered in commercial and strategic decision-making.
Access to domestic and export markets	Santos continues to monitor carbon and energy policies in Australia and export markets, including Japan, South Korea and China – markets which are highly supportive of natural gas, due to both lower greenhouse gas emissions and air quality benefits.
Operational and project risk management	Robust risk management practices are embedded across Santos' operations.
Advocacy	<p>Through direct engagement with policy makers and industry associations, Santos advocates for environmentally effective and economically efficient carbon policy.</p> <p>Santos is proactive in supporting awareness of the availability, responsible extraction, demand for, and advantages of natural gas to achieve a lower-carbon future in Australia and our region.</p> <p>Santos seeks to work with governments and stakeholders in sharing information to support the design of climate change regulation and policy.</p>
Technology	Investment in carbon capture and storage, energy efficiency and increased use of renewables in our operations.
Low cost base	Santos has been able to significantly reduce costs of development and production of natural gas over the past five years. This low cost base puts Santos in a stronger position to bear commodity price fluctuations and carbon pricing or abatement costs. It also increases Santos' competitiveness in the market and helps put downward pressure on consumer prices.
Access to infrastructure and storage	Santos has access to significant storage facilities due to its acreage and infrastructure position, enabling the Company to minimise disruption to customers in the event of physical events which may impact operations for a period of time. Santos includes climate-related risks, such as flooding and other extreme weather events in crisis and incident planning and training.

Santos has a long history of safe and sustainable operations, having planned for and successfully managed extreme weather events and changes in Australian carbon policy over past decades. The Company's approach to climate-related risk management from physical operations through to financial and strategic impacts makes the Company well positioned to remain resilient and continue to supply affordable reliable and cleaner energy to Australia and Asia in a lower-carbon future.

Santos' experience with flooding across some of its key onshore asset areas and extreme temperatures in remote locations has led the Company to innovate and enhance the effectiveness of its operations. This has been demonstrated through the development of remote operations capabilities and facilities, access and transportation improvements and evolving work practices that enable personnel to conduct

activities both more efficiently and during the least intense periods of weather. Two examples of the improvements and opportunities that have resulted from these experiences in relation to heat and flooding were included in the Company's 2018 Climate Change Report on page 16, which can also be found on the Santos website [www.santos.com](http://www.santos.com), along with this report.

With changes to policy and social dynamics in relation to climate change, also come opportunities in innovation, technological advances and the demand for natural gas in the energy mix. More information in relation to the role of natural gas in a lower-carbon future can be found on pages 18-21, the role of carbon capture and storage on pages 22-25 and case studies in relation to opportunities Santos is actively pursuing in emissions reduction and operational efficiencies can be found on pages 36-39.



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# Resilience and opportunity in a lower- carbon future





**Santos is in a strong position to supply Australia and Asia's growing energy demands in a lower-carbon future.**

Santos is committed to supporting the twin objectives of limiting greenhouse gas emissions while providing access to reliable, affordable and cleaner energy to domestic and international markets. We have set medium-term targets that align with these objectives and set our Company on a pathway to achieve our long-term aspiration of net-zero emissions by 2050. In 2019 we have progressed each of the elements of our medium-term targets. Santos is actively implementing projects to deploy renewables, reduce fuel use and emissions across our business, and identify and assess step-change technologies that will help achieve our long-term aspiration.

Our portfolio of oil and gas assets is economically resilient under all IEA 2018 World Energy Outlook scenarios.

Santos recognises the risks that climate change poses for our business and manages these risks through our enterprise-wide risk management process and oversight by the Executive Committee and the Board.

The transition to a lower-carbon future also creates opportunities for Santos. Natural gas has a critical role to play in providing energy in a lower-carbon future, rising to a share of a quarter of total global energy demand by 2040 in all IEA World Energy Outlook 2018 scenarios. With a high quality portfolio of natural gas assets in Australia, Papua New Guinea and Timor-Leste, Santos is well placed to benefit from the positive outlook for natural gas in the global energy mix over at least the next two decades.

Through our disciplined, low-cost operating model, proximity to Asian markets and the scale of our natural gas business, Santos is in a strong position to supply Australia's and Asia's growing energy demands in a lower-carbon future.

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STO

## Santos Website

To view Annual Reports, shareholder and Company information, news announcements and presentations, quarterly activities reports and historical information, please visit our website at [www.santos.com](http://www.santos.com)

## Annual Reports

You can view our Annual Report online at [www.santos.com](http://www.santos.com) or request a printed copy from the Share Registrar either by email at [santos@boardroomlimited.com.au](mailto:santos@boardroomlimited.com.au) or by telephone on 1300 096 259 (within Australia) or +61 2 8016 2832.

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# Santos