Report on the operation of the *Climate Change and Greenhouse Emissions Reduction Act 2007* (South Australia)

Prepared under **Section 7** of the
Climate Change and Greenhouse Emissions Reduction Act 2007 (South Australia)

September 2021

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Report prepared by:

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Report on the operation of the *Climate Change and Greenhouse Emissions Reduction Act 2007* – September 2021, Government of South Australia, through the Department for Environment and Water, Adelaide.

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Executive Summary

Net greenhouse gas emissions have reduced by 36 percent in South Australia between 1989-1990 and 2018-2019. This is significant progress towards South Australia's legislative target "to reduce by 31 December 2050 greenhouse gas emissions within the state by at least 60 percent to an amount that is equal to or less than 40 percent of 1990 levels" stated in South Australia's *Climate Change and Greenhouse Emissions Reduction Act 2007*.

South Australia is also aiming to reduce greenhouse gas emissions by more than 50%, from 2005 levels, by 2030 and to reach net zero emissions by 2050.

The *Climate Change and Greenhouse Emissions Reduction Act 2007* (the Act) sets a framework for government to work with business and the community to reduce emissions and build resilience to the impacts of climate change. Under the Act, a section 7 report is required every two years on progress against emissions reduction and renewable energy targets.

This Section 7 report relates to the 2020 and 2021 calendar years. Since the previous report, several key policies and practical measures have been developed to progress South Australia's reduction of greenhouse gas emissions, in particular:

- *Directions for a Climate Smart South Australia*
- *South Australian Government Climate Change Action Plan 2021-2025*
- initiatives to increase the generation, storage and management of renewable electricity and renewable hydrogen, supporting an ambition to achieve 100% net renewable energy generation for the state by 2030
- reduction in electricity costs and consumption due to increased renewables and storage (including battery storage capacity), and improved residential and commercial energy efficiency measures
- *South Australia's Electric Vehicle Action Plan* and *Hydrogen Action Plan*
- accelerating the transition to a circular economy and managing food waste through the state's new waste strategies - *Supporting the Circular Economy - South Australia's Waste Strategy 2020-2025* and *Valuing our food waste - South Australia's strategy to reduce and divert household and business food waste 2020-2025*
- accelerating action to protect and restore coastal ecosystems through the *Blue Carbon Strategy for South Australia*, released in November 2019, to capture the economic and environmental opportunities from this sector.

1 Introduction

The *Climate Change and Greenhouse Emissions Reduction Act 2007*[1] (the Act) provides for measures to develop and implement strategies to reduce greenhouse gas emissions, foster the use of renewable sources of energy, and facilitate adaptation to climate change.

This report has been prepared in accordance with Section 7 of the Act. This is the seventh report on the operation of the Act, and provides information about the reporting period for the 2020 and 2021 calendar years. To meet the requirements of Section 7 (Appendix A), this report:

1. provides information about levels of greenhouse gas emissions in South Australia
2. reports on progress to achieve the renewable electricity targets
3. assesses the effectiveness of South Australia's climate change initiatives in achieving the SA target
4. describes targets and determinations
5. reports on progress against sector based or interim targets
6. describes climate change sector agreements
7. provides an overview of offset programs and the national emission trading scheme
8. describes inter-governmental agreements
9. describes significant national or international commitments
10. describes impacts of climate change.

This report uses the emissions inventory published in the State and Territory Greenhouse Gas Inventories (STGGI) 2019, which was published in April 2021. These are the most recent figures provided by the Australian Government.

The first six progress reports were completed from 2009 to 2019 are available on the Department for Environment and Water website[2].

[1] http://www.legislation.sa.gov.au/LZ/C/A/CLIMATE%20CHANGE%20AND%20GREENHOUSE%20EMISSIONS%20REDUCTION%20ACT%202007.aspx

[2] https://www.environment.sa.gov.au/about-us/our-reports/climate-change-greenhouse-emissions-reduction-reports

2 Greenhouse gas emissions

This section presents an assessment of the progress being made to achieve the greenhouse gas emissions target.

2.1 2018-19 greenhouse gas emissions and progress towards target

In 2018-19, South Australia emitted 23.9 million tonnes of carbon dioxide equivalent (CO_2-e). In 2018-19, South Australian emissions per capita were 14 tonnes of CO2-e, which is lower than the national average of 21 tonnes of CO2-e.

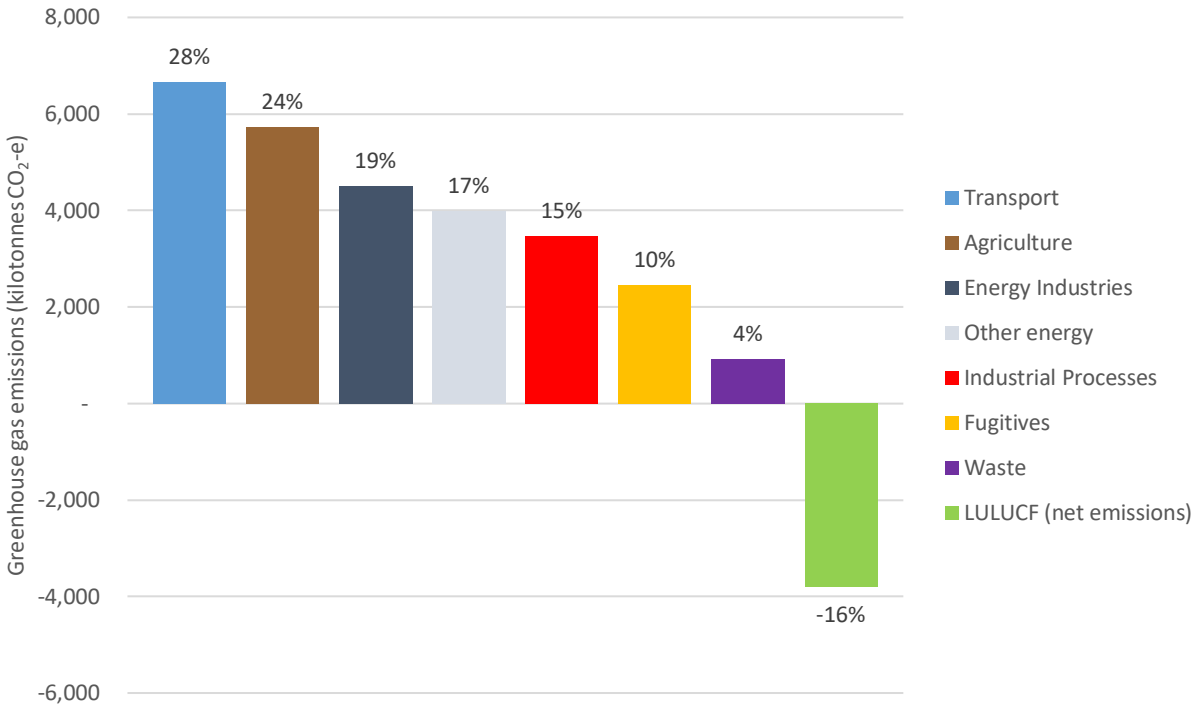
South Australia's legislated target (SA target) is to reduce greenhouse gas emissions to an amount that is equal to or less than 40 percent of the 1990 level, by the end of 2050. This means that a reduction of 60 percent or more will be required from levels in the 1990 base year to 2050.

Between the 1990 base year and 2018-19, net emissions decreased by 36 percent. A further 24 percent reduction from 1990 base year levels is needed to reach the legislated SA target.

South Australia is also aiming to reduce greenhouse gas emissions by more than 50% from 2005 levels by 2030 and to reach net zero emissions by 2050. Between the 2005 base year and 2018-19, emissions reduced by 33 percent, leaving a further 17 percent reduction to reach the 2030 policy target.

It should be noted that the greenhouse gas emissions presented in this report are not comparable to those published in previous Section 7 reports. The Australian Government regularly revises inventory emission factors and methodologies and subsequently revises figures back to 1990 to ensure time series consistency. See Appendix D for more information.

Sources of emissions include the following sectors: transport; energy industries; other energy; fugitives; agriculture; industrial processes; waste; and land use, land use change and forestry (LULUCF) (Figure 1).



Note: percentages may not sum due to rounding

Figure 1: South Australian greenhouse gas emissions percent contribution to total net emissions by sector in 2018-19[3]

The **energy sector** contributed 74 percent to total net state emissions. This is comprised of 28 percent from transport fuels, 19 percent from energy industries with the majority from electricity generation, 17 percent from other energy sources including manufacturing industries and construction, and 10 percent from fugitive emissions from fuels such as from the oil and gas and solid fuels industries.

The **agriculture sector** contributed 24 percent to total net state emissions. This includes emissions from livestock industries, and agricultural soils and soil applications, such as fertiliser use. Emissions trends for this sector are impacted by many factors, including market conditions and seasonal climatic conditions such as drought.

Industrial processes contributed 15 percent to total net state emissions. This includes emissions from the food and beverage industry and the minerals processing industry (including cement and lime production). Emissions from the consumption of halocarbons in air-conditioning and sulphur hexafluoride in electricity supply and distribution have increased since 1990. Since the phase out of ozone depleting refrigerants, hydro-fluorocarbon refrigerants use has increased in Australia.

The **waste sector** contributed 4 percent to total net state emissions. The majority of emissions are from municipal solid waste disposal and wastewater treatment and discharge. Emissions from solid waste disposal are influenced by methane recovery and recycling rates and alternative waste treatment options. Changes in estimates for wastewater treatment and discharge emissions are largely

[3] https://www.industry.gov.au/data-and-publications/national-greenhouse-accounts-2019/state-and-territory-greenhouse-gas-inventories-annual-emissions

due to by changes in industry production, population loads on centralised treatment systems and the amount of methane recovered for combustion or flaring.

The **land use, land use change and forestry (LULUCF) sector** includes both emissions sources and sinks (that is, carbon sequestration). Combined, the LULUCF emissions sources and sinks contributed a net emissions sink of 16 percent of total net state emissions, contributing to a reduction to overall emissions. The emissions sources include deforestation activities. The sinks include plantations and natural regeneration, regrowth on deforested land, activities on cropland and a small amount from harvested wood products and wetlands.

Appendix B provides a detailed breakdown of emissions by sector.

2.2 Change in emissions since the 1990 base year to 2018-19

Progress towards net emissions targets are achieved through a combination of reducing emissions and preventing increases. From the 1990 base year to 2018-19 net emissions have decreased by 36 percent. This consists of a 28 percent reduction in emission sources and 60 percent increase in the contribution of emission sinks (from carbon sequestration).

Figure 2 shows the change in South Australian net emissions since 1990, alongside gross state product (GSP). Since peak emissions in 2006-07, net emissions have reduced while the GSP has continued to increase.

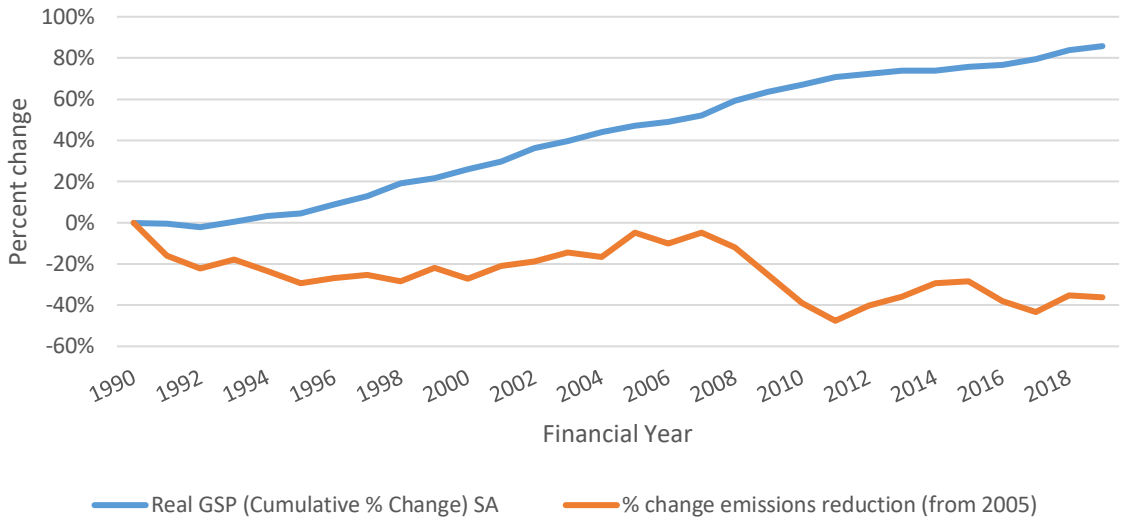


Figure 2: South Australian percent change in GSP and greenhouse gas emissions, since 2005 [4]

2.3 Drivers of change in net emissions from the 1990 base year to 2018-19

The changes observed over the measurement period are the net effect of increases and decreases in the different sectors. Some sector emission sources increased consistently, such as transport and industrial processes, and others decreased, for example, enteric fermentation and fugitive emissions from fuels. Other sectors increased then decreased, for example, electricity generation and waste.

[4] *State and Territory Greenhouse Gas Inventory and Australian Bureau of Statistics 5220.0 - Australian National Accounts: State Accounts, 2018-19*

The change in emissions sources and sinks and their contribution to the increase or decrease in emissions from the 1990 base year to 2018-19 is provided in Table 1. Appendix B provides a more detailed breakdown of emissions by sector.

Drivers of reduced emissions 1989-90 to 2018-19

The main contributors to reductions in net greenhouse gas emissions since 1989-90 are:

1. Land use, land use change and forestry (LULUCF), with an increase in sinks contributing 62 percent of total emissions reduction. This is mainly due to plantations and natural regeneration of forest land, regrowth on deforested land, as well as cropland and land being converted to wetland.
2. Fuel combustion in energy industries, contributed 27 percent of total emissions reduction. This was mainly due to the increase in renewable energy generation and the reduced emissions intensity of non-renewables.
3. Fugitive emissions from fuels, contributed 14 percent of total emission reduction. This is likely to have been driven by a combination of changes in technology as well as the reduction in coal mining and natural gas extraction in South Australia[5].
4. Enteric Fermentation, contributing 12 percent of total emission reduction. This is likely to be driven by the reductions in the numbers of livestock over this period[6]. Reductions in livestock numbers has occurred as a result of drought conditions in South Australia. Stock numbers are expected to recover.

Drivers of increased emissions 1989-90 to 2018-19

The main contributors to increases in emissions over this period are:

1. Transport, contributing 10 percent of the increase in emissions due mostly to heavy-duty trucks and buses and light commercial vehicles. Since 1989-90, there has been a small overall increase in total emissions from cars over this period, however the emissions from cars have declined as a share of total road transportation emissions.
2. Products used as substitutes for ozone depleting substances (ODS) had no emissions in 1989-90, however, since first measured in 1994, use of substitutes have increased steadily, causing emissions to rise.

[5] https://www.energy.gov.au/publications/australian-energy-update-2020 Australian Energy Statistics Table I6 Production of primary fuels in South Australia, physical units (2020)

[6] https://www.abs.gov.au/statistics/industry/agriculture/agricultural-commodities-australia/latest-release ABS Catalogue 7121.0

Table 1: Changes in sources of emissions and sinks and their contribution to change from 1989-90 to 2018-19[7]

Source of emissions	Greenhouse gas emissions (kilotonnes CO_2-e)				Contribution to increase or decrease		% change in GHG emissions	
	1989-90	2018-19		Change		%	1989-90 to 2018-19	
Energy industries	8,176	4,504	↓	-3,673	↓	27%	↓	-45%
Manufacturing and construction	2,006	2,299	↑	293	↑	-2%	↑	15%
Transport	5,329	6,662	↑	1,333	↑	-10%	↑	25%
Fugitive emissions from fuels	4,397	2,448	↓	-1,949	↓	14%	↓	-44%
Other sectors	1,297	1,691	↑	394	↑	-3%	↑	30%
ENERGY	21,205	17,603	↓	-3,602	↓	27%	↓	-17%
Minerals industry	1,092	996	↓	-95	↓	1%	↓	-9%
Products uses as ODS substitutes	n/a	684		n/a	↑	-5%		n/a
Other industrial processes	1,664	1,792	↑	128	↑	-1%	↑	8%
INDUSTRIAL PROCESSES	2,755	3,471	↑	716	↑	-5%	↑	26%
Enteric fermentation	5,346	3,680	↓	-1,666	↓	12%	↓	-31%
Agricultural soils	1,311	1,269	↓	-42	↓	0%	↓	-3%
Manure management	581	525	↓	-56	↓	0%	↓	-10%
Other agriculture	113	251	↑	137	↑	-1%	↑	121%
AGRICULTURE	7,353	5,725	↓	-1,627	↓	12%	↓	-22%
Solid waste disposal	1,152	662	↓	-489	↓	4%	↓	-42%
Waste water treatment and discharge	389	231	↓	-158	↓	1%	↓	-41%
Other waste	3	21	↑	17	↑	-0%	↑	499%
WASTE	1,544	914	↓	-630	↓	5%	↓	-41%
LULUCF sources	7,998	1,656	↓	-6,341	↓	47%	↓	-79%
LULUCF sinks	-3,402	-5,451	↓	-2,050	↓	15%	↓	-60%
LULUCF	4,596	-3,795	↓	-8,390	↓	62%	↓	-183%
Total	**37,453**	**23,919**	↓	**-13,534**		**100%**	↓	**-36%**

Note: Totals may not sum due to rounding

[7] https://www.industry.gov.au/data-and-publications/national-greenhouse-accounts-2019/state-and-territory-greenhouse-gas-inventories-annual-emissions

3 Renewable electricity targets

This section presents an assessment of the progress being made to achieve renewable electricity targets.

3.1 Renewable energy generation in 2019-20

The Department for Energy and Mining (DEM) reports that South Australia generated 8,270 GWh[8] of renewable electricity in 2019-20. The amount of renewable energy generation was 56.6 percent of total energy generation. The Australian Energy Market Operator (AEMO) publicly reports South Australia's energy registered capacity and generation figures for 2019-20 which are provided in Table 2 (See Appendix D for more information).

Table 2: 2019-20 South Australian energy capacity and generation by fuel type

Fuel Type	Registered capacity (MW)	Generation (GWh)	Generation % of total
Gas	2,921	6,278	42.9%
Wind	2,141	5,798	39.7%
Diesel + small non-scheduled generation (SNSG)	613	63	0.4%
Rooftop PV	1,417	1,692	11.6%
PVNSG	129	258	1.8%
Solar	378	485	3.3%
Storage - Battery	205	47	0.3%
Total	**7,804**	**14,621**	**100%**

3.2 Progress against the renewable energy targets under the Act

There are three renewable energy targets under the Act (Table 3). The two generation targets and the consumption target have been achieved.

The South Australian government has a policy target of achieving 100% net renewable energy by 2030 (as generated in the state).

Table 3: Summary of renewable generation targets.

Target	Status
To increase the proportion of renewable electricity generated so that it comprises at least 20% of electricity generated in the State by 31 December 2014.	This target was achieved in 2010-11 when the result was 22% of electricity generated in the State. In 2013, the CSIRO concluded that this target has been met. Source: 2013 Section 7 report
To increase the proportion of renewable electricity consumed so that it comprises at least 20% of electricity consumed in the State by 31 December 2014.	This target was achieved in 2010-11 when the result was 24.1% of the electricity consumed in the State. In 2013, the CSIRO concluded that this target has been met. Source: 2013 Section 7 report)
An additional target of achieving 33% of South Australia's electricity generation to come from renewable energy by 2020 was tabled under Section 5 of Act in 2009.	The electricity generation target was exceeded in 2013-14 when the result was 39%. In 2018, the CSIRO concluded that this target has been met. Source: 2018 Section 7 report

[8] Department for Energy and Mining uses adjusted data from the Australian Energy Market Operator (AEMO) South Australian Electricity Report (SAER) to calculate renewable energy generation.

The proportion of South Australia's electricity generation that is renewables, and progress against the 2014 and 2020 renewable generation targets is provided in Figure 3.

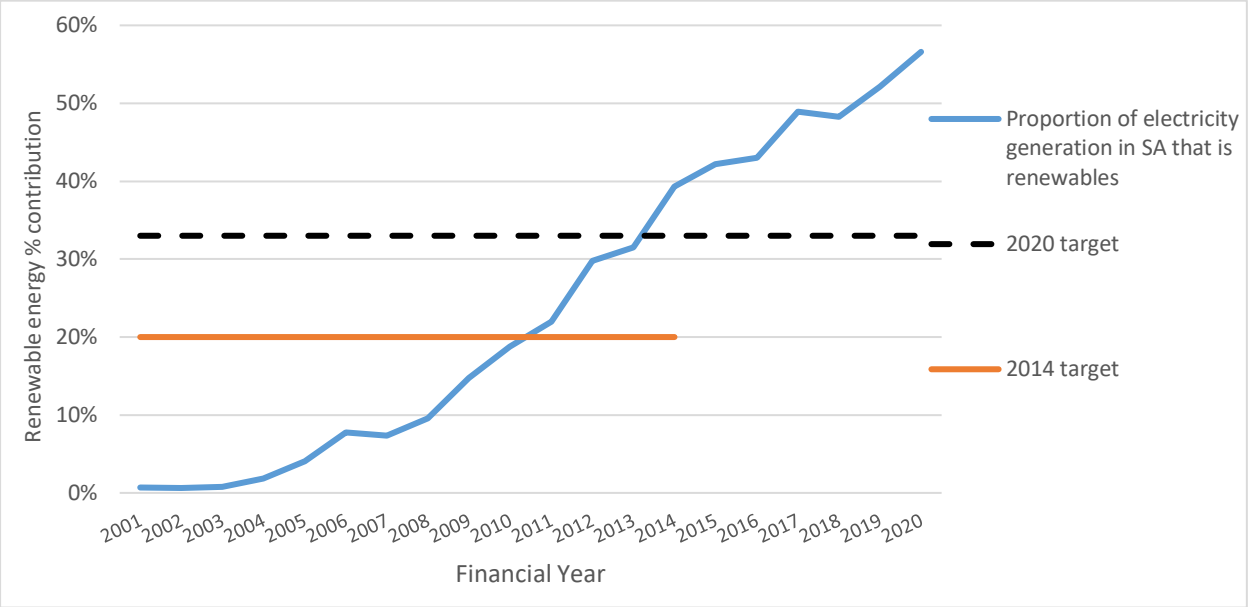


Figure 3: South Australian proportion of electricity generated using renewables, 2000-01 to 2019-20[9]

3.3 Factors that contribute to progress in renewable energy generation

Two types of factors have contributed to progress in renewable energy generation: structural drivers of progress, and the sensitivity of these drivers to changes in context (contextual drivers).

Structural drivers are the mechanics of change, not the cause, and include:

- increased renewable energy generation;
- decreasing electricity generation from non-renewables;
- reduced South Australian electricity demand;
- increasing capacity of residential and utility scale batteries;
- reduced electricity imports; and
- South Australia is a net exporter of electricity.

Contextual drivers include:

- relative market prices of electricity;
- commercial decisions to invest in gas and renewable power plants and battery storage;
- national schemes (for example, Renewable Energy Target scheme);
- increased capacity of interconnectors;
- incentives provided by the Government of South Australia (for example, solar feed-in tariff legislation);
- providing greater certainty of process and supportive policy for windfarm developments in rural areas; and
- changes in costs of technology.

[9] Graphic generated from data provided by the South Australian Department for Energy and Mining

4 Effectiveness of South Australia's climate change initiatives in achieving the SA target

4.1 Effectiveness and overview of key initiatives

Climate change initiatives put in place by government and other organisations have contributed to the net greenhouse gas emissions reduction of 36 percent from the 1990 base year to 2018-19. As outlined in section 3.2, a significant portion of emission reductions within South Australia are attributable to the land use, land use change and forestry (LULUCF) and energy industries sectors.

The LULUCF sector has contributed 62 percent of total emission reductions from the 1990 base year to 2018-19. South Australian government initiatives in the area of afforestation and reforestation, such as the Native Vegetation Heritage Agreement program, and expansion and enhancement of the protected area network, have contributed to the amount of carbon stored in sinks. A reduction in deforestation rates has also contributed towards a reduction in emission sources from this sector.

Energy industries have contributed 27 percent of total emission reductions from the base year to 2018-19. A range of incentives and actions by the South Australian government have contributed to this reduction including: the introduction of market drivers to influence residential and commercial decisions to invest in renewable power and battery storage; improvements in energy efficiency; and technical developments that have reduced the emission intensity of non-renewables. The closure of Port Stanvac, the state's last oil refinery in 2003, and the Northern Power Station, the state's last coal fired power plant in 2016, has also contributed to the reduction.

Key past and present state government initiatives include:

- The Renewable Technology Fund provided grants and loans to support private companies to deliver large scale renewable energy projects, including the Hornsdale Power Reserve.
- Demand management trials to support integration of distributed generation, demand response and demand aggregation assets to increase grid efficiency and incentivise consumers to manage their own electricity demand.
- The Grid Scale Storage Fund and the Home Battery Scheme both support the development of energy storage infrastructure. South Australia's Virtual Power Plant (VPP) is one of the funds most successful projects. Once complete, it will have 20MW/54MWh of storage capacity.
- SA Water's Zero Cost Energy Future Project is increasing renewable energy generation and energy storage capacity and adopting energy efficiency measures at water utility sites. This includes the installation of 154MW of solar PV and 34MWh of energy storage at 33 water utility sites.
- South Australian Retailer Energy Productivity Scheme supports households and businesses to reduce their energy costs while also maximising the benefits to the power system.

Australian Government policy, for example the Renewable Energy Target and the Emissions Reduction Fund have also helped generate financial incentives for investment in renewable energy generation and other emissions reduction projects.

The agriculture sector has contributed to emission reductions from the 1990 base year to 2018-19. This is mainly due to a reduction in emissions from enteric fermentation due to reduced livestock numbers. As mentioned, a reduction in livestock numbers has occurred as a result of drought conditions in South Australia. Stock numbers are expected to recover.

A number of recent policy initiatives are expected to impact upon emission reductions into future reporting periods, including:

- *Directions for a Climate Smart South Australia*, released in December 2019, sets the South Australian government's agenda for achieving the long-term outcomes of a more liveable and resilient state, low emissions jobs and growth, and net zero emissions by 2050.
- The *South Australian Government Climate Change Action Plan 2021-2025,* released in December 2020, sets out government led actions to further reduce greenhouse gas emissions, help South Australia adapt and help build a strong, climate smart economy.
- *South Australia's Electric Vehicle Action Plan*, released in December 2020, aims to accelerate electric vehicle uptake and smart charging by 2025.
- *South Australia's Hydrogen Action Plan* aims to scale up renewable hydrogen production for export and domestic consumption by facilitating investment in hydrogen infrastructure, establishing a world-class regulatory framework, deepening trade and supply capabilities, fostering innovation and workforce skill development, and integrating hydrogen into the state's energy system. In early 2021, Hydrogen Park South Australia became the first facility in Australia to successfully provide a cleaner blended gas, comprising five per cent renewable hydrogen into the local gas network.

5 Targets and determinations

This section reports on any determination or target made or set under section 5 during the reporting period.

There were no determinations or targets made or set under section 5 of the Act during the reporting period.

6 Sector based or interim targets

This section presents an assessment of the progress being made to achieve any sector based or interim target under this Act, including a target set for the State Government, or any government agency or instrumentality.

There were no sector based or interim targets under the Act, in place during the reporting period.

7 Climate change sector agreements

This section reports on any climate change sector agreements between the Minister and any other person or entity entered into under this Act during the reporting period.

The *Climate Change and Emissions Reduction Act 2007* (SA) (the Act) provides for the government to enter into climate change sector agreements with people, organisations, and industry or business groups to further any strategies to meet targets set under the Act.

Climate change sector agreements operate under guiding principles and seek to formalise the joint aspiration of the signatories to achieve the aims of the agreement in a non-legally binding way. Typically the agreements commit the parties to collaborate and work in partnership with a range of stakeholders to deliver the objectives of the agreement.

The climate change sector agreements are published on the website of the Department of Environment and Water.

Climate change sector agreements entered into during 2020-21

Three climate change sector agreements were entered into during this reporting period with the following regional climate partnerships:

- Resilient East
- Resilient Hills & Coasts
- Northern and Yorke.

These agreements have a key focus on adaptation and responding to the impacts, risks and opportunities of climate change in regions.

Climate change sector agreements concluded during 2020-21

The following climate change sector agreements have or will complete their full term during the reporting period:

- Carbon Neutral Adelaide (Adelaide City Council)
- Adapting Northern Adelaide.

The state government is engaging with relevant parties on exploring the renewal of these agreements.

8 Offset programs and national emission trading scheme

This section reports on any emissions offset programs established or recognised under the Act during the reporting period, and on progress in establishing a national emissions trading scheme.

There were no offset programs or emissions trading established or recognised under the Act in place during the reporting period.

9 Intergovernmental agreements

This section presents a report on any intergovernmental agreements relevant to climate change entered into by the Government of South Australia during the reporting period.

On 18 April 2021, the Australian Government and Government of South Australia signed a $1.08 billion energy and emissions reduction agreement[10] that will deliver secure, reliable and affordable energy to South Australians and the east coast market and achieve cost-effective emissions reduction to support South Australia's emissions reduction targets.

[10] https://www.energy.gov.au/publications/commonwealth-south-australia-bilateral-energy-and-emissions-reduction-agreement

10 International commitments

This section presents a report on any significant national or international commitments or agreements relevant to climate change made or entered into during the reporting period.

International commitments and agreements

No additional commitments or agreements were made or entered into during this reporting period.

Existing international commitments are outlined below.

Under2 Coalition / Under2MOU

The Government of South Australia is an Under2 Coalition Steering Group Member.

The coalition is made up of more than 220 governments who represent over 1.3 billion people and 43 percent of the global economy. Governments share expertise on innovative policy, report on measurable climate actions, and drive emission reduction initiatives.

South Australia is a signatory to the Global Climate Leadership Memorandum of Understanding (the Under2MOU) which aims for sub-national governments to reduce their greenhouse gas emissions towards net zero by 2050.

South Australia contributes to the Under2 Ambition Tracker, which is an annual survey to assist in tracking progress of net zero emissions.

States and Regions Compact

South Australia participates in the Network of Regional Governments for Sustainable Development (nrg4SD); R20-Regions of Climate Action (R20); and the CDP (formerly the Carbon Disclosure Project).

South Australia contributes to the Annual Disclosure Report which provides a transparent, global picture of the impact, progress and climate action driven by state and regional governments.

RegionsAdapt

In 2015, South Australia joined RegionsAdapt, a forum to exchange experiences and best practices on adapting to climate change. Regional governments collaborate, exchange knowledge and share best practice on adaptation and resilience to climate change. The practices include: developing a sub-regional plan or strategy on adaptation; concrete actions; and reporting data on the progress of the adaptation annually through the States and Regions Compact reporting platform.

Asia Pacific Climate Leaders' Declaration

On 4 June 2019, South Australia signed the Asia Pacific Climate Leader's Declaration, along with eight other governments pledging their support. The Declaration included protecting marine life, cutting emissions from the land sector and strengthening international cooperation and dialogue on climate action, in line with the goals of the Paris Agreement.

11 Impacts of climate change

This section presents information on any relevant rates, trends or impacts associated with climate change, with particular reference to any identified or assessed impacts of climate change on South Australia or any expected future impacts of climate change that have emerged or become increasingly relevant during the reporting period.

11.1 Climate projections in South Australia

The national *Climate Change in Australia* website and the *South Australian Climate Ready* projections developed by the Goyder Institute for Water Research are key sources of information in relation to climate impacts in South Australia. The *Climate Change Science and Knowledge Plan* for South Australia and the *Guide to Climate Projections for Risk Assessment and Planning in South Australia*, released during this reporting period also provide important data and information relating to climate impacts.

Based on the *Guide to Climate Projections for Risk Assessment and Planning in South Australia*, projections for South Australia indicate that:

- maximum, minimum and average temperatures will increase
- the frequency of very hot days will continue to increase, and periods of hot weather will get longer and hotter
- the frequency of frost events will remain comparable until 2030. In the longer-term, frosts are expected to decrease as the climate warms
- average annual rainfall will decline
- the number and intensity of heavy rainfall events will increase
- the time spent in drought will increase
- sea level will continue to rise
- sea surface temperatures will continue to rise, and acidity will continue to increase
- harsher fire weather will be experienced, and fuels will be drier and more ready to burn.

The Goyder Institute for Water Research has developed projections for individual weather stations across the state's natural resources management regions that extend to 2100, for 'intermediate' and 'high' emissions pathways. This information can be accessed through the Goyder Institute for Water Research website[11] and the Government of South Australia's Enviro Data SA website[12].

The *Guide to Climate Projections for Risk Assessment and Planning in South Australia*[13] provides a summary of the changes in climate that are projected to occur in South Australia over the coming 80 years, drawing on information from a range of sources, primarily the Commonwealth Scientific and

[11] Goyder Institute for Water Research website[12] https://data.environment.sa.gov.au

[12] https://data.environment.sa.gov.au

[13] https://data.environment.sa.gov.au/Content/Publications/Guide%20to%20climate%20change%20projections%20for%20risk%20assmt%20and%20planning%20in%20SA.pdf

Industrial Research Organisation (CSIRO), Bureau of Meteorology (BoM), Intergovernmental Panel on Climate Change (IPCC) and the Goyder Institute for Water Research.

The *Climate Change Science and Knowledge Plan for South Australia*[14] identifies critical science and information that is needed to inform climate change risk assessment, mitigation, planning and adaptation responses in South Australia. It provides a comprehensive plan to prioritise, coordinate, translate and deliver this climate science and information.

11.2 Impacts of Climate Change in South Australia

South Australians are faced with challenges from climate change, including sea level rise, reduced average rainfall, intensification of storm events, and more frequent and severe heatwaves, bushfires and droughts. These changes are likely to impact on agricultural production, public health, community wellbeing, natural landscapes and wildlife habitats, and public and private infrastructure, particularly in coastal areas.

In 2018, the Department for Environment and Water prepared trend and condition report cards[15] that include information on the condition of rainfall, temperatures and sea levels and projected trends under a changing climate.

[14] https://data.environment.sa.gov.au/Content/Publications/Climate-Change-Science-and-Knowledge-Plan.pdf

[15] https://www.environment.sa.gov.au/about-us/our-progress/state-report-cards

Appendix A : Section 7 of the Climate Change and Greenhouse Emissions Reduction Act 2007 (SA)

7—Two-yearly reports

(1) The Minister must, on a two-yearly basis, prepare a report on the operation of this Act.

(2) The report must include—

(a) an assessment of the effectiveness of the initiatives that are being adopted in order to achieve the SA target; and

(b) a report on any determination or target made or set under section 5 during the reporting period; and

(c) an assessment of the progress being made to achieve the renewable electricity target; and

(d) an assessment of the progress being made to achieve any sector-based or interim target under this Act, including a target set for the State Government, or any government agency or instrumentality; and

(e) a report on any sector agreement between the Minister and any other person or entity entered into under this Act during the reporting period; and

(f) a summary of—

(i) the levels of greenhouse gas emissions, and of the use of renewable energy, within the State (as determined or estimated at the time of reporting); and

(ii) the development of technologies to reduce greenhouse gas emissions or to remove greenhouse gases from the atmosphere; and

(g) a report on any emissions offset programs established or recognised under this Act during the reporting period, and on progress in establishing a national emissions trading scheme; and

(h) a report on any inter-governmental agreements relevant to climate change entered into by the South Australian Government during the reporting period; and

(i) a report on any significant national or international commitments or agreements relevant to climate change made or entered into during the reporting periods; and

(j) information on any relevant rates, trends or impacts associated with climate change, with particular reference to any identified or assessed impacts of climate change on South Australia or any expected future impacts of climate change that have emerged or become increasingly relevant during the reporting period.

(3) The Minister must cause a copy of the report to be laid before both Houses of Parliament within 6 sitting days after the report is prepared.

(4) The first report under this section must be completed and tabled in Parliament by the end of 2009.

(5) The first report under this section, and thereafter every alternate report, must incorporate a report from—

(a) the CSIRO; or

(b) if the CSIRO is unwilling or unable to provide a report—an independent entity designated by the Minister by notice in the Gazette,

that assesses the extent to which any determination or target made or set under section 5 is being achieved and, if it appears relevant, should be revised.

(6) In this section—

CSIRO means the Commonwealth Scientific and Industrial Research Organisation.

Appendix B : Review of sources of greenhouse gas emissions by sector

This Appendix presents the 2018-19 South Australian greenhouse gas inventory by sector. It presents the 1989-90 to 2018-19 inventory, the changes from 1989-90 to 2018-19, and graphics, data and summary statistics for each of the sectoral categories.

B.1 All emissions

The South Australian inventory from 1989-90 to 2018-19 is presented in Figure 4, by sectoral source, including:

- Energy (including Energy Industries; Transport; Other Energy and Fugitive emissions)
- Industrial processes
- Agriculture
- Waste
- Land use, land use change and forestry (LULUCF) which is a net calculation of both sources of emissions and greenhouse gas sinks.

The black line shows total net greenhouse gas emissions.

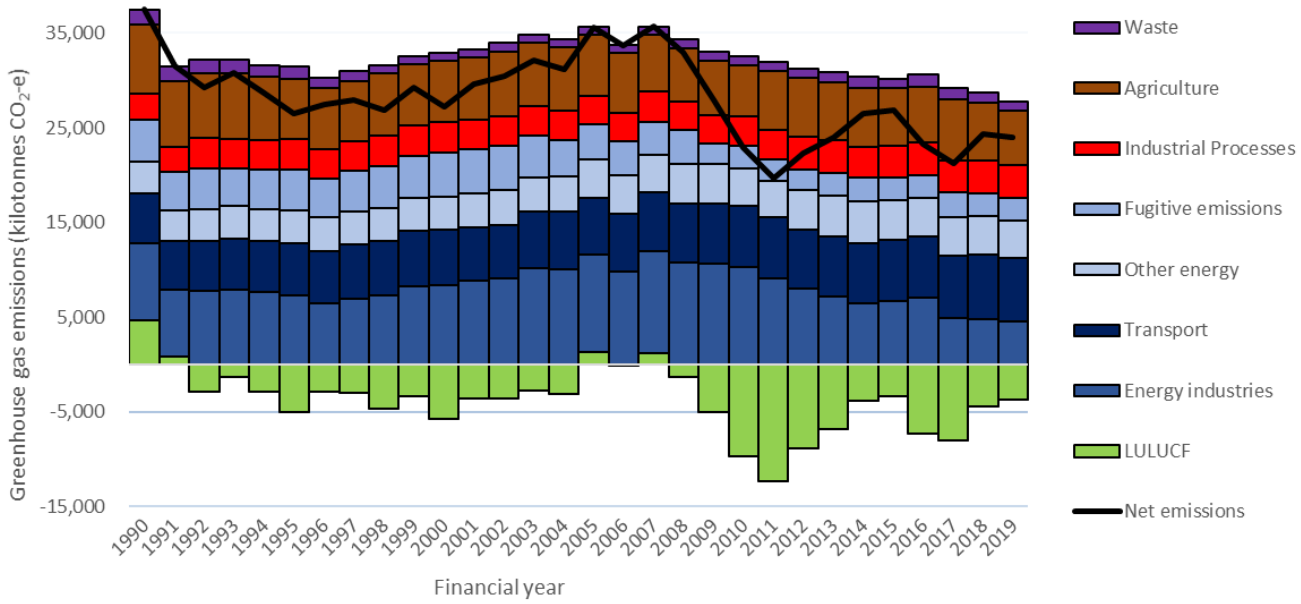


Figure 4: South Australian greenhouse gas inventory, 1989-90 to 2018-19, by source of emissions[16]

[16] https://www.industry.gov.au/data-and-publications/national-greenhouse-accounts-2019/state-and-territory-greenhouse-gas-inventories-annual-emissions

Table 4: South Australian greenhouse gas inventory by source of emissions, percent change from 1990 base year to 2018-19[17]

Source of emissions	Greenhouse gas emissions (kt CO_2-e)		% Change to 2018-19
	1989-90	*2018-19*	*1989-90 to 2018-19*
Energy	*21,205*	*17,603*	*-17%*
Industrial processes	*2,755*	*3,471*	*26%*
Agriculture	*7,353*	*5,725*	*-22%*
Waste	*1,544*	*914*	*-41%*
LULUCF (net)	*4,596*	*-3,795*	*-183%*
Net emissions	***37,453***	***23,919***	***-36%***

Note: Totals may not sum due to rounding

The following sections in this Appendix provide detailed graphics, data and summary statistics about each of the categories. All data is sourced from the South Australian Greenhouse Gas Inventory 2019[18].

B.2 Energy

Energy sector emissions are presented in Figure 5 and Figure 6 and are broken down into the following components:

- *Energy industries* – the combustion of fuel in electricity generation, petroleum refining, gas production and solid fuel manufacture.
- *Transport* – road transportation (passenger cars, trucks, and buses), domestic aviation, domestic navigation and pipeline transport.
- *Manufacturing industries and construction* – direct emissions from fuel combustion in manufacturing industries, ferrous and non-ferrous metals production, plastics production, construction and non-energy mining.
- *Other sectors* – direct fuel combustion in the residential, commercial and institutional sectors, including energy used in mobile equipment in agriculture, forestry, fishing and military sectors.
- *Fugitive emissions from fuels* – emissions other than energy use including in mining activities and oil and gas sector operations (including venting, flaring, exploration, extraction, production, processing and transmission).

[17] https://www.industry.gov.au/data-and-publications/national-greenhouse-accounts-2019/state-and-territory-greenhouse-gas-inventories-annual-emissions

[18] https://www.industry.gov.au/data-and-publications/national-greenhouse-accounts-2019/state-and-territory-greenhouse-gas-inventories-annual-emissions

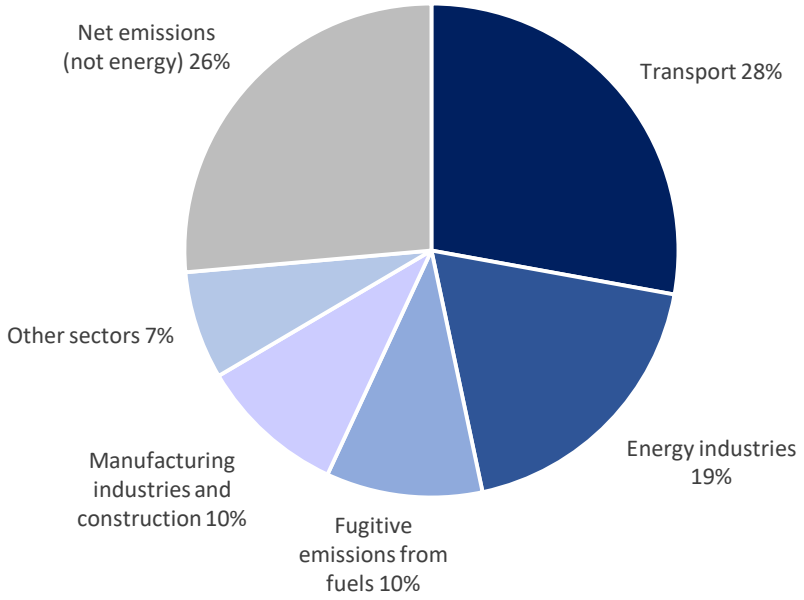


Figure 5: South Australian greenhouse gas emissions energy sector relative to all other net emissions, 2018-19

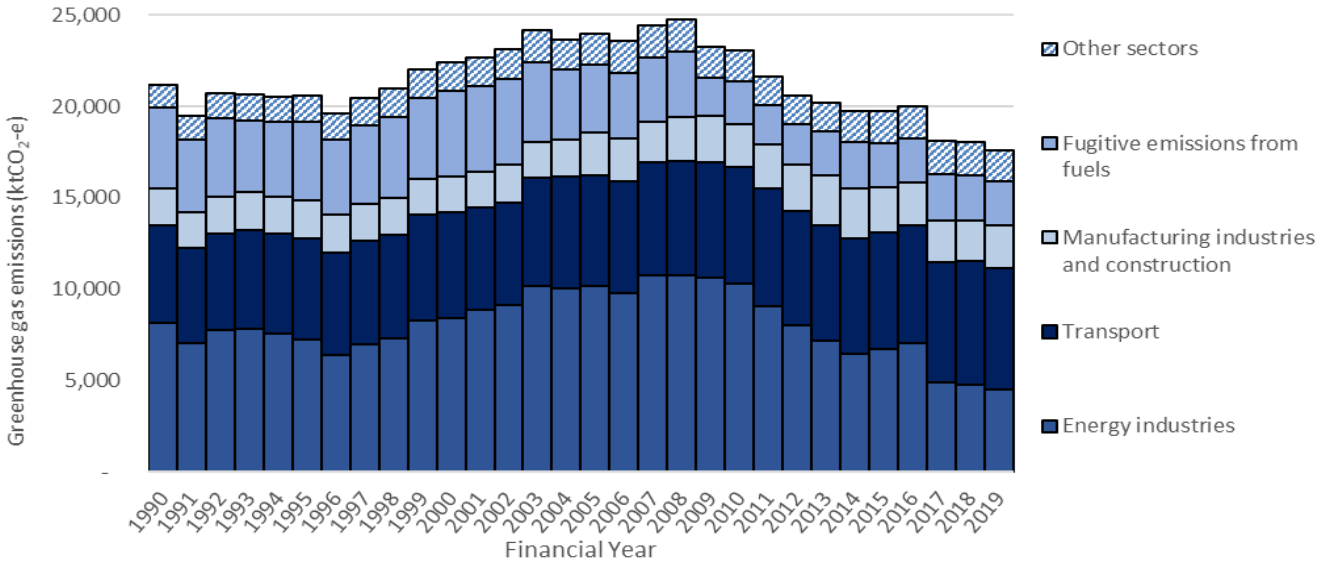


Figure 6: South Australian greenhouse gas emissions energy sector kilotonnes CO_2-e by selected subcategory 1989-90 to 2018-19

Table 5: South Australian greenhouse gas emissions energy sector percent change from 1990 base year to 2018-19

Source of emissions	Greenhouse gas emissions (kt CO_2-e)		% Change to 2018-19
	1989-90	*2018-19*	*1989-90 to 2018-19*
Energy industries	8,176	4,504	-45%
Manufacturing industries and construction	2,006	2,299	15%
Transport	5,329	6,662	25%
Other sectors	1,297	1,691	30%
Fugitive emissions from fuel	4,397	2,448	-44%
Energy	**21,205**	**17,603**	**-17%**

Note: Totals may not sum due to rounding

B.3 Industrial processes

Emissions from industrial processes are presented in Figure 7 and Figure 8 and are broken down into the following components:

- *Mineral industry* – carbon dioxide (CO_2) from cement clinker and lime production, the use of limestone, dolomite and other carbonates in industrial smelting and other processes, soda ash production and use and magnesia production.
- *Product uses as ODS (ozone depleting substances) substitutes* – hydrofluorocarbons, refrigerating and air conditioning equipment, foam blowing, metered dose inhalers, fire extinguishers, solvent use and SF6 from electrical equipment.
- *Non-energy products from fuels and solvent use* - consist of CO_2 emissions arising from the oxidation of lubricants, as well as emissions from solvent use, road paving and other activities.
- *Other industrial processes* – C_{O2} from the consumption of C_{O2} in the food and beverage industry, and the use of sodium bicarbonate.

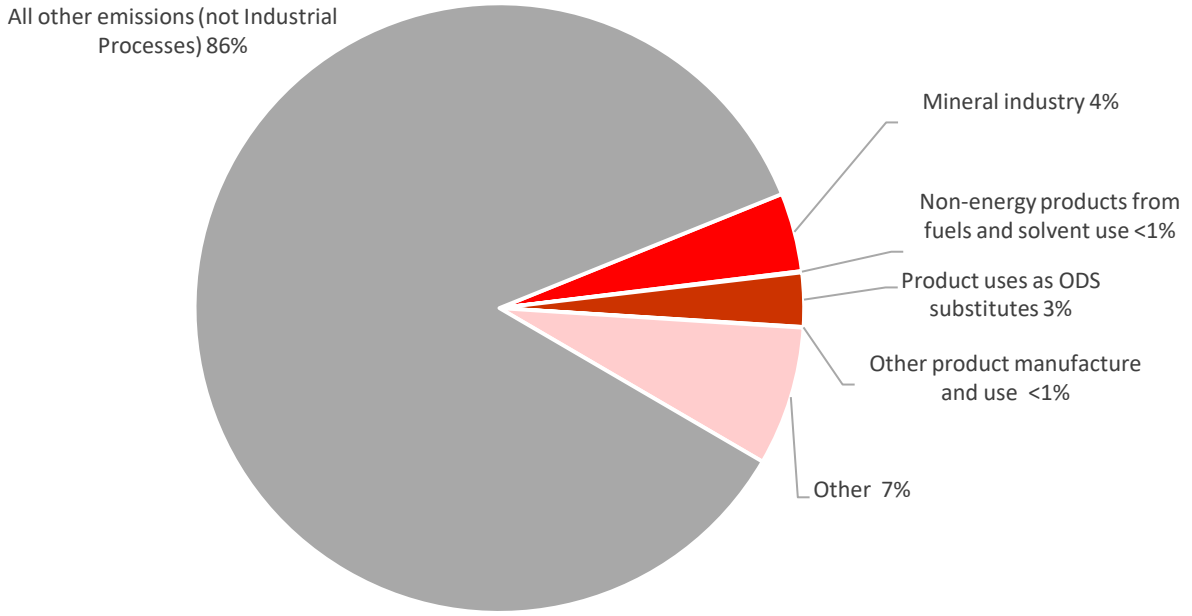


Figure 7: South Australian greenhouse gas emissions industrial processes sector relative to all other net emissions, 2018-19

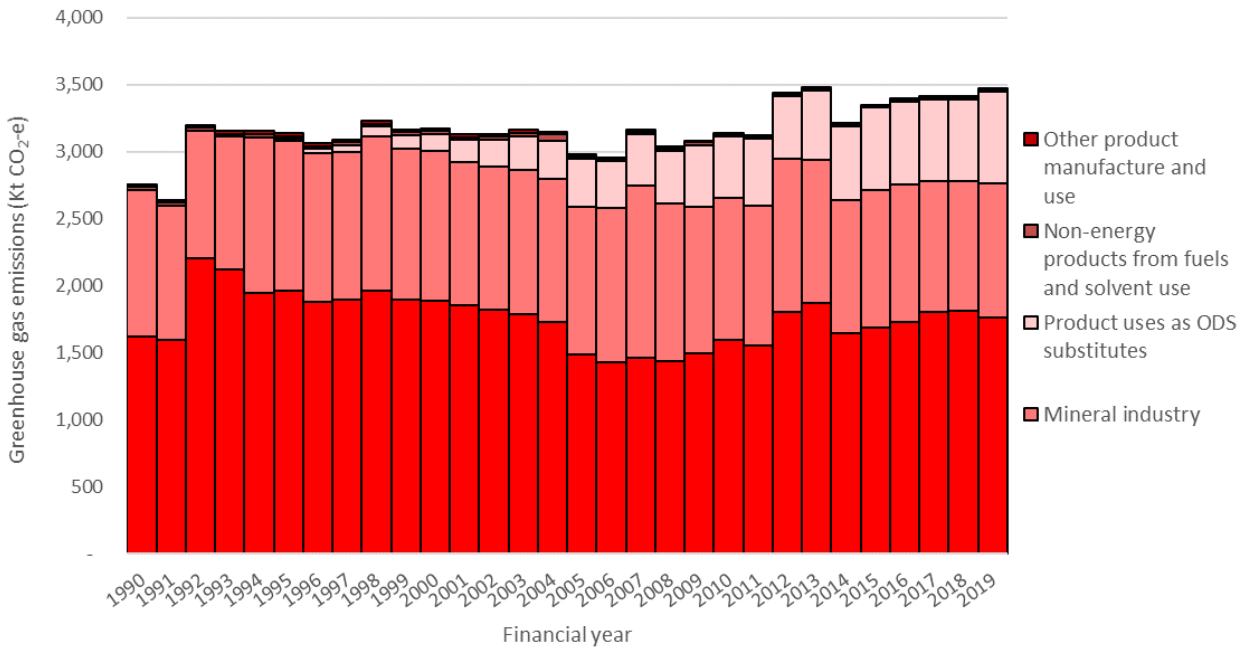


Figure 8: South Australian greenhouse gas emissions industrial processes kilotonnes CO_2-e, by selected subcategory, 1989-90 to 2018-19

Table 6: South Australian greenhouse gas emissions industrial processes sector by source of emissions, percent change from 1990 base year to 2018-19

Source of emissions	Greenhouse gas emissions (kt CO_2-e)		% Change to 2018-19
	1989-90	*2018-19*	*1989-90 to 2018-19*
Mineral industry	1,092	996	-9%
Non-energy products from fuels and solvent use	23	18	-22%
Product uses as ODS substitutes	N/A	684	N/A
Other product manufacture and use	19	10	-49%
Other	1,622	1,764	9%
Industrial processes	**2,755**	**3,471**	**26%**

Note: Totals may not sum due to rounding

B.4 Agriculture

Agriculture sector emissions are presented in Figure 9 and Figure 10, broken down into the following components:

- *Enteric fermentation* – emissions associated with microbial fermentation during digestion of feed by ruminant (mostly cattle and sheep) and some non-ruminant domestic livestock.
- *Manure management* – emissions are produced from the decomposition of the organic matter remaining in manure under anaerobic conditions. These conditions occur when large numbers of animals are managed in a confined area where manure is typically stored in large piles or lagoons.
- *Agricultural soils* – emissions associated with the application of fertilisers, crop residues and animal wastes to agricultural lands and the use of biological nitrogen fixing crops and pastures.
- *Other agriculture* – field burning of agricultural residues and CO_2 from the application of urea and lime.

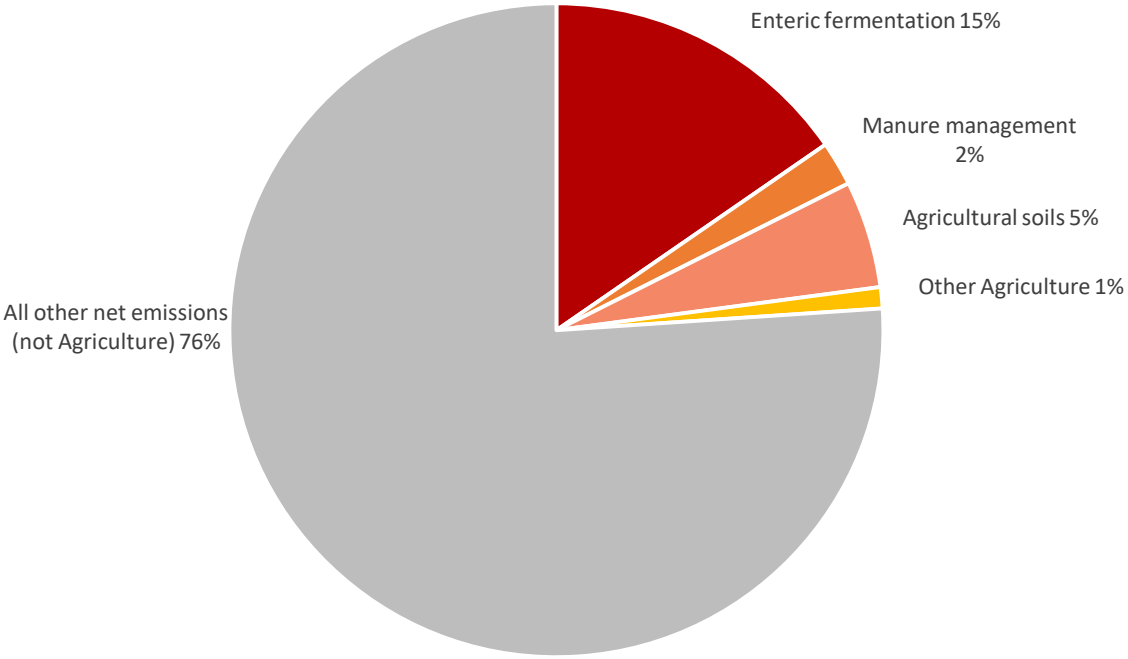


Figure 9: South Australian agriculture sector greenhouse gas emissions relative to all other net emissions, 2018-19

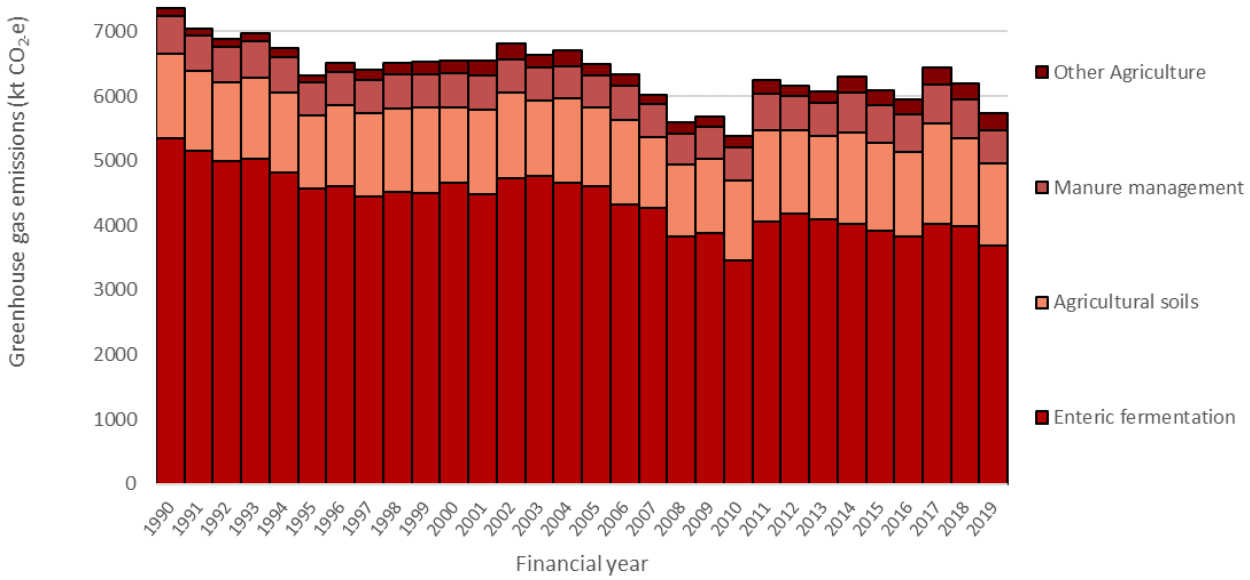


Figure 10: South Australian agriculture greenhouse gas emissions kilotonnes CO_2-e, by selected subcategory, 1989-90 to 2018-19

Table 7: South Australian greenhouse gas emissions agriculture sector by source of emissions, percent change from 1990 base year to 2018-19

Source of emissions	Greenhouse gas emissions (kt CO_2-e)		% Change to 2018-19
	1989-90	*2018-19*	*1989-90 to 2018-19*
Enteric fermentation	5,346	3,680	-31%
Manure management	581	525	-10%
Agricultural soils	1,311	1,269	-3%
Other Agriculture	113	251	121%
Agriculture	**7,353**	**5,725**	**-22%**

Note: Totals may not sum due to rounding

B.5 Land Use, Land Use Change and Forestry (LULUCF)

Emissions and sinks from land use, land use change and forestry (LULUCF) are presented in Figure 11 including each of the subcategories separated by sinks and sources. The principal drivers of change in carbon fluxes across the landscape relate to losses and gains of woody vegetation. *Land converted to forest land* and *harvested wood products* are always sinks while *land converted to cropland* and *grassland* are always sources (deforestation). However, all of the remaining categories can have both sinks and sources contributing in any one year. For example, *forest land remaining forest land* was primarily a sink until 2005, only featuring as a source in 1998 and 2000, however since then it has been both a source and a sink.

The LULUCF subcategories are as follows:

- *Forest land* includes all lands with a tree height of at least 2 metres and crown canopy cover of 20 percent or more, and lands with systems with a woody biomass vegetation structure that currently falls below but which, in situ, could reach the threshold values of the definition of forest land. *Forest land remaining forest land* includes plantations, harvested native forests and other native forests (regeneration after harvest). Emissions from fuelwood consumption and biomass burning in forests (controlled burning and wildfire) are also included as well as the removals associated with post-fire recovery. *Land converted to forest land* includes grassland, croplands, settlements and wetlands (tidal marsh) on which forest is identified to emerge. These changes include plantations and forest regrowth on land previously cleared for other uses, environmental plantings and the regeneration of forest from natural seed sources. Permanent losses of woody vegetation that have been classed as *forest land* are reported under *forest conversion to other land use* classifications.
- *Cropland* includes all land that is used for continuous cropping and those lands managed as crop-pasture (grassland) rotations. Non-CO_2 emissions from cropland remaining cropland are reported in the Agriculture sector. This sector comprises emissions and removals from *cropland remaining cropland* and *forest land converted to cropland* and *wetlands converted to cropland*. Since 1990, there has been no significant consistent trend in emissions, with transient variations driven by fluctuations in climatic conditions and shifts in management practices.
- The *grassland* category represents a diverse range of climate, management and vegetation cover. It also includes increases and decreases in sub-forest forms of woody vegetation (shrubs). This sector comprises emissions and removals from *grassland remaining grassland* and *forest land* and

wetlands converted to grassland. Changes in carbon stocks in *grassland remaining grassland* are largely affected by changes in land management practice and climatic factors.

- For the sub-sectors *forest land converted to cropland* and *forest land converted to grassland*, the total emissions associated with the transition from forest to non-forest land use include the immediate loss of carbon as trees are cleared and burned, as well as an ongoing loss of soil carbon as it decays to a new equilibrium stock level and other ongoing emissions and removals associated with the new land use.
- *Settlements* are areas of residential and industrial infrastructure, including cities and towns, and transport networks. This sector comprises emissions and removals from *settlements remaining settlements* and *forest land* and *wetlands converted to settlements*. The *land converted to settlements* subcategory comprises mangrove and other forest land converted to settlements and wetlands (tidal marsh) converted to settlements. Conversion of tidal marsh is assumed to occur along with any clearing of mangroves for settlements – as such the trends are identical. The key drivers of variation over the time period have been urbanisation and population growth.
- *Wetlands* include areas of perennial lakes, reservoirs, swamps and major water course areas. Land areas that meet the definition of forest land, such as mangroves, are reported under the forest land category. *Wetlands remaining wetlands* include tidal marshes and seagrass meadows. Estimates include net changes in sparse vegetation, loss of seagrass beds due to capital dredging and nitrous oxide emissions from aquaculture operations.

The subcategories *wetland remaining wetland, land converted to wetland and settlements remaining settlements* have been omitted from Figure 11 due to insignificant contributions from 1989-90 to 2018-19.

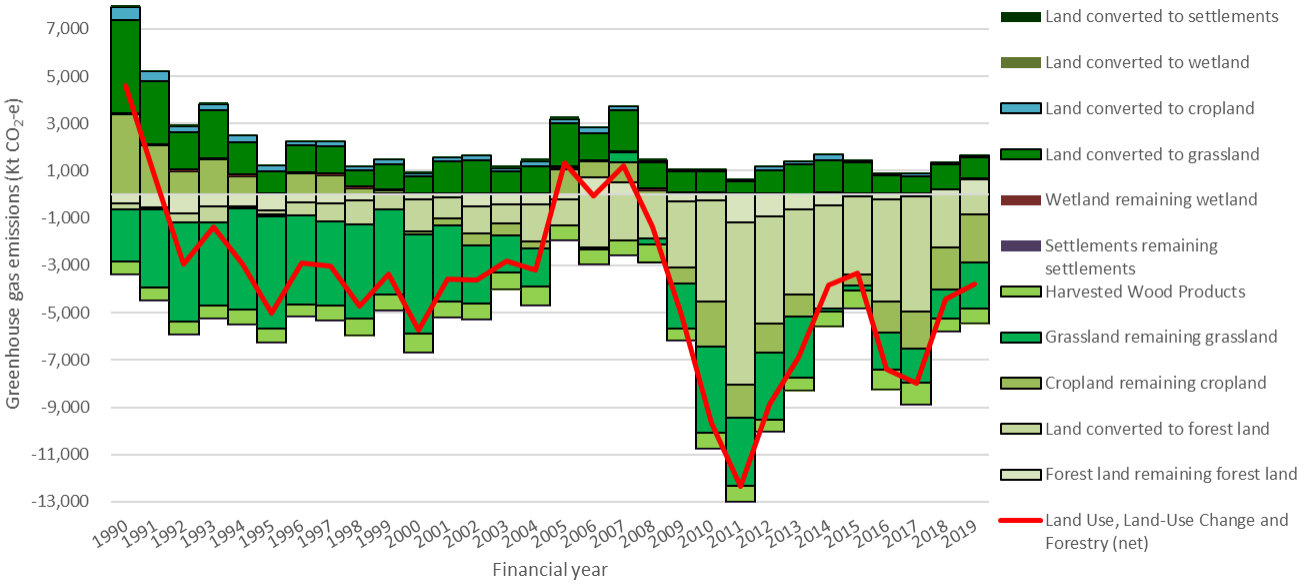


Figure 11: South Australian land use, land use change and forestry by sources and sinks for subcategories, 1989-90 to 2018-19

Table 8: Land use, land use change and forestry sector by source or sink, change from 1990 base year to 2018-19

Source of emissions	Greenhouse gas emissions (kt CO_2-e)		% Change to 2018-19
	1989-90	*2018-19*	*1989-90 to 2018-19*
LULUCF sources	7,998	1,656	-79%
LULUCF sinks	-3,402	-5,451	-60%
Net LULUCF	**4,596**	**-3,795**	**-183%**

B.6 Waste

Waste sector emissions are presented in Figure 12 and Figure 13 are broken down into the following components:

- *Solid waste disposal* – emissions resulting from anaerobic decomposition of organic matter in landfills.
- *Waste water treatment and discharge* – emissions resulting from anaerobic decomposition of organic matter in sewerage facilities (including on-site systems such as septic tanks) during treatment and disposal of wastewater.
- *Biological treatment of solid waste* - the anaerobic decomposition of organic material in composting and anaerobic digester facilities.
- *Incineration and open burning of waste* – emissions resulting from incineration of solvents and clinical waste

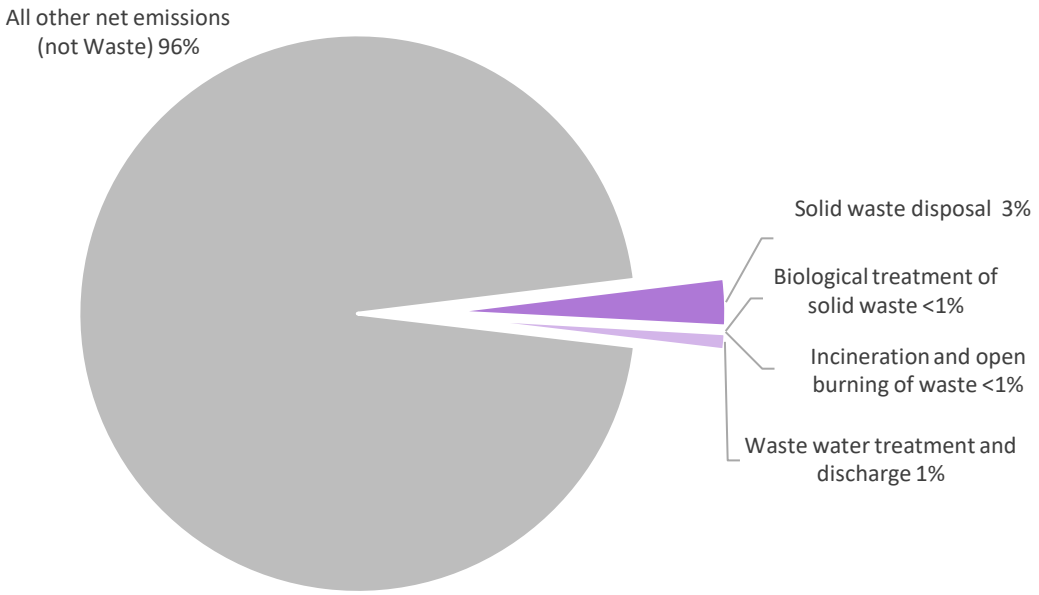


Figure 12: South Australian waste sector greenhouse gas emissions relative to all other net emissions, 2018-19

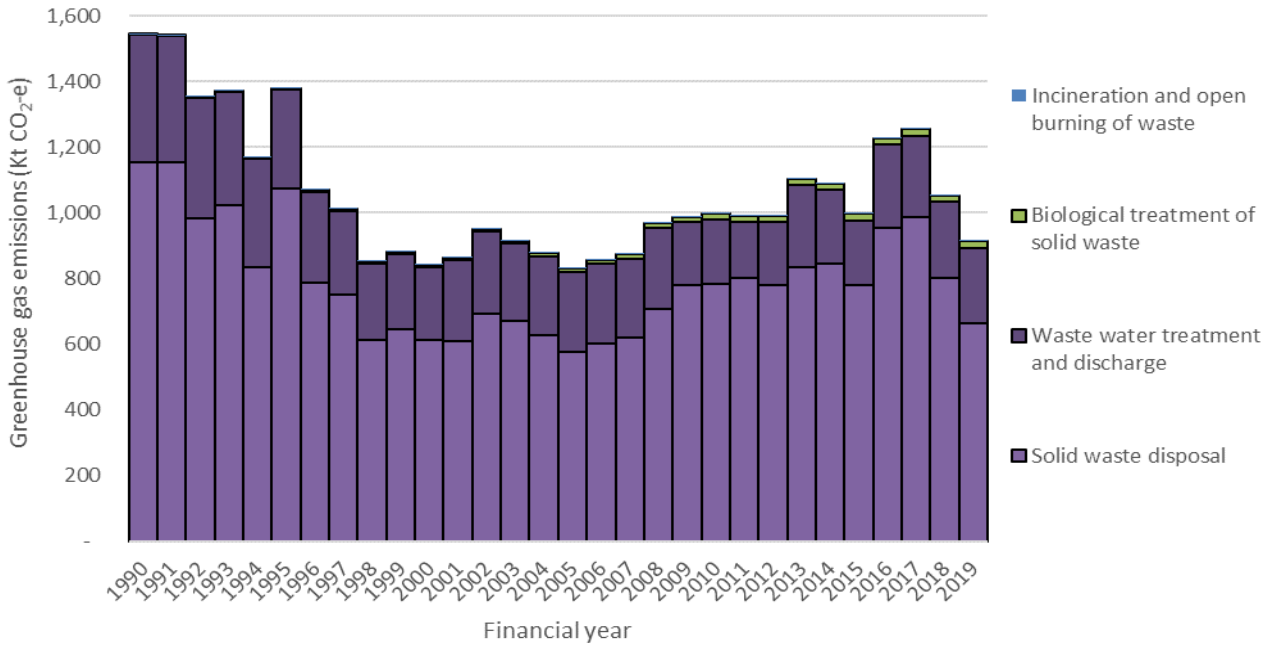


Figure 13: South Australian waste greenhouse gas emissions kilotonnes CO_2-e, by selected subcategory, 1989-90 to 2018-19

Table 9: South Australian greenhouse gas emissions waste sector by source of emissions, percent change from 1990 base year to 2018-19

Source of emissions	Greenhouse gas emissions (kt CO_2-e)		% Change to 2018-19
	1989-90	*2018-19*	*1989-90 to 2018-19*
Solid waste disposal	1,152	662	-42%
Waste water treatment and discharge	389	231	-41%
Biological treatment of solid waste	2	19	956%
Incineration and open burning of waste	2	2	-8%
Waste	**1,544**	**914**	**-41%**

Note: Totals may not sum due to rounding

Appendix C : CSIRO Review of Progress to Achieving Targets Under Section 7 of the Climate Change and Greenhouse Emissions Reduction Act 2007

Appendix D Technical notes

South Australia's *Climate Change and Greenhouse Emissions Reduction Act 2007* (SA) defines the SA target as: "to reduce by 31 December 2050 greenhouse gas emissions within the state by at least 60 percent to an amount that is equal to or less than 40 percent of 1990 levels".

A review of the progress towards the emissions target addresses technical issues, including those related to methods and data sources. The technical points that influenced the interpretation and comparability of the estimates of progress are outlined below.

- This is the seventh Section 7 report on the operation of the Act. The first was prepared in 2009.
- The Australian Government produces all states' and territories' greenhouse gas inventories and publishes them with a two year delay.
- States' and territories' greenhouse gas inventories are developed by the Australian Government in accordance with international guidelines and protocols. The estimates are derived from multiple data sources most of which are collected for other purposes, such as agriculture surveys. Data is collected specifically for greenhouse gas monitoring from Australia's large emitters, excluding governments, under the *National Greenhouse and Energy Reporting Act 2007*.
- The Australian Government regularly revises inventory emission factors and methodologies when new information or more accurate methodologies become available. Under the United Nations Framework Convention on Climate Change rules, the government is required to revise figures back to 1990 to ensure time series consistency. The estimates in the current South Australian inventory supersede all previously published estimates. These revisions can lead to changes in annual emissions reduction due to methodology change. Consequently, the greenhouse gas emissions presented in this report are not comparable to those published in previous Section 7 reports.
- The estimate of South Australia's 1990 base year net emissions published in 2009 was revised by the Australian Government each year to 2019. All previous estimates for each year are revised, for example in 2019 all the 2017 estimates for inventories from 1989-90 to 2015-16 were revised. These revisions occur for all jurisdictions and for Australia overall.

The Department for Energy and Mining (DEM) calculates progress towards renewable energy generation targets based on the amount of renewable energy generated in South Australia as a proportion of total electricity generation. DEM uses adjusted data from the Australian Energy Market Operator (AEMO) South Australian Electricity Report (SAER) to calculate renewable energy generation from wind, solar, and small non-scheduled renewable generation. The renewable component of the small non-scheduled generation figure is not published by AEMO in the SAER.