Climate Change Office

Tasmanian Greenhouse Gas Emissions Report 2023

June 2023

Renewables, Climate and Future Industries Tasmania
Department of State Growth

Tasmanian Government

We acknowledge Tasmanian Aboriginal people as the traditional owners of this Land and respect their culture and identity, which has been bound up with the Land, Sea, Waterways and Sky for generations.

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Minister's Message

The Tasmanian Government is committed to taking action to reduce greenhouse gas emissions across the state, particularly in energy, transport, agriculture, industrial processes, waste, and forestry.

I am pleased to report on the latest greenhouse gas inventory for Tasmania. Our net greenhouse gas emissions for 2021 were minus 4.80 megatonnes (Mt) of carbon dioxide equivalent (CO_2-e), which is a decrease of 125.5 per cent between 1990 and 2021.

In 2013, we were the first Australian jurisdiction to achieve net zero emissions and we have maintained this status for the last nine reported years. This accomplishment reflects the carbon sink in our forests, and our longstanding investment in renewable energy generation.

Last year, amendments to the Tasmanian Government's climate change legislation, the *Climate Change (State Action) Act 2008* (the Act), passed Parliament. The new Act sets a legislated target of net zero emissions, or lower, from 2030. This is the most ambitious legislated emissions reduction target in Australia and one of the most ambitious in the world. Our legislation requires the government to prepare a climate change action plan within one year, and a climate change risk assessment, and emissions reduction and resilience plans for key sectors, within two years. The Act also includes other measures to strengthen accountability and transparency, such as tabling this report in both Houses of Parliament.

Tasmania's Climate Change Action Plan 2023-25 was released on 1 June 2023. It is a whole-of-government plan that will guide the government's action on climate change through to 2025. We have committed $10 million to implement new actions in this plan, in addition to significant investment already underway in climate change activities across government.

The action plan includes practical actions across government to improve information and knowledge about climate change, reduce emissions, and build resilience. The plan has been informed by consultation with state and local government, business, industry, non-government organisations and the community, including young people, the best available science, and the findings of the Tasmanian Emissions Pathway Review.

In addition to delivering the measures in our Act, the government's other climate change strategic priorities include:

- updating fine-scale climate change projections for Tasmania
- a whole-of-government policy framework to embed climate change consideration in government decision making, including an emissions reduction and resilience plan for government operations
- Tasmania's first statewide climate change risk assessment.

These initiatives complement the significant investment in climate change activities in other government portfolio areas, including environment, health, infrastructure and transport,

tourism, housing, and emergency management. The Tasmanian Government is committed to an integrated, whole-of-government response to climate change and supporting a successful transition to a low-emissions economy.

Roger Jaensch MP

Minister for Environment and Climate Change

Introduction

This report presents an overview of Tasmania's greenhouse gas emissions (emissions) sources and sinks from 1990 to 2021. The report details emissions from goods and services produced in, and exported from, Tasmania.

Emissions are reported in financial years to 30 June, so the year 2021 refers to the financial year 1 July 2020 to 30 June 2021. This report uses the most recent official data in Australia on annual emissions. The data are prepared and released by the Australian Government, in accordance with agreed international reporting frameworks.

Under Tasmania's climate change legislation, the *Climate Change (State Action) Act 2008*, Tasmania has an emissions reduction target of net zero emissions, or lower, from 2030. The *Climate Change (Greenhouse Gas Emissions) Regulations 2022* require the Minister to publish Tasmania's greenhouse gas emissions for the calendar year to which the Australian Government's *State and Territory Greenhouse Gas Inventories 2021* relates.

What are greenhouse gases?

Greenhouse gases trap heat in the atmosphere and make the earth warmer. Those with the most significant impact on global warming are water vapour, carbon dioxide, methane, and nitrous oxide. Other common greenhouse gases include hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride.

How are emissions measured?

Each greenhouse gas varies in terms of its contribution to climate change. Global warming potentials (GWPs) are values that allow direct comparison of the impact of the different greenhouse gases in the atmosphere by comparing how much energy one tonne (t) of a gas will absorb compared to one tonne of carbon dioxide. The consistent value of carbon dioxide equivalent (CO_2-e) has the lowest GWP factor of 1. All other greenhouse gases have a GWP which is *x* times greater than carbon dioxide, as outlined in the table below.

Greenhouse Gas	Global Warming Potential
Carbon dioxide	1
Methane	28
Nitrous oxide	265
Perfluoromethane (tetraflurormethane)	6,630
Perfluoroethane (hexafluroethane)	11,100
Sulphur hexafluoride	23,500
Hydrofluorocarbons (HFCs)	Dependent on HFC type

For example, 1 t methane (CH_4) results in the equivalent global warming of 28 t carbon dioxide (CO_2), and is therefore measured as 28 t CO_2-e.

What are carbon sinks?

A carbon, or emissions, sink removes more carbon from the atmosphere than it emits. The removed carbon is stored, often in the form of growing vegetation.

How are emissions reported?

Reporting framework

Tasmania's emissions are reported in accordance with the Intergovernmental Panel on Climate Change (IPCC) reporting framework for national greenhouse gas inventories. This framework is used by the 199 members who are party to the international United Nations Framework Convention on Climate Change (UNFCCC) to report their greenhouse gas inventories.

Data sources

State and Territory Greenhouse Gas Inventories (STGGI)

The main source of data on Tasmania's emissions is the Australian Government's *State and Territory Greenhouse Gas Inventories 2021* (STGGI).

The STGGI is a disaggregation of the data contained in the National Inventory Report (NIR), which is submitted annually by the Australian Government, in accordance with the international guidelines agreed under the UNFCCC and the Paris Agreement.

Australia fulfils its international greenhouse gas inventory reporting commitments by submitting annual NIRs to the UNFCCC.

For the financial year 2020-21, the first year of the Paris Agreement reporting period, and onwards, estimates of Australia's emissions are compiled consistent with:

- modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement
- guidance for operationalising the modalities, procedures and guidelines for the enhanced transparency framework referred to in Article 13 of the Paris Agreement
- the Intergovernmental Panel on Climate Change (IPCC) 2006 Guidelines for National Greenhouse Gas Inventories (the Guidelines)
- the IPCC 2019 Refinement of the 2006 IPCC Guidelines
- the IPCC 2013 Wetlands Supplement
- country-specific methodologies consistent with the Guidelines and intended to improve emissions accuracy.

Australia mostly uses country-specific methodologies and emission factors to compile NIRs. The methodologies used to estimate Australia's inventory have been improved over time and will continue to be refined as new information emerges, and as international practice evolves.

The Department of Climate Change, Energy, the Environment and Water (DCCEEW) is responsible for Australia's greenhouse gas emissions reporting. DCCEEW is responsible for all aspects of the national inventory systems, including activity data coordination, emissions estimation, quality control, and preparation of reports and its submission to the UNFCCC on behalf of the Australian Government.

The NIR runs two years behind the current date and represents the most recent official data in Australia on annual emissions. The current NIR shows estimates of Australia's emissions for the period 1990 to 2021.

Under the UNFCCC, the NIR must report net emissions from the following sectors:

- energy
- industrial processes and product use (IPPU)
- agriculture
- land use, land use change and forestry (LULUCF)
- waste.

For the purposes of this report, the energy sector is broken down into three sub-sectors:

- electricity generation
- the direct combustion of fuels from all other forms of stationary energy, excluding electricity generation (direct combustion)
- transport.

Within the STGGI, electricity generation is reported under the energy sub-sector 'Energy Industries'. In this report 'Direct combustion', for Tasmanian emissions, has been aggregated to include the STGGI energy sub-sectors of 'Fugitive emissions', 'Manufacturing Industries and Construction' and 'Other Sectors'. There are very few industrial sites that produce fugitive emissions in Tasmania, therefore the Australian Government treats Tasmania's fugitive emissions as confidential to avoid identification.

The STGGI uses the information provided in the NIR and disaggregates it for each jurisdiction.

The STGGI data relate to production-based, rather than consumption-based emissions in Tasmania, which are called Scope 1 emissions. The data account for emissions from goods and services produced in, and exported from, Tasmania.

Australian Bureau of Statistics (ABS)

This report also compares Tasmania's STGGI data to the state's Gross State Product (GSP) and population as at June 2021. GSP data were sourced from the ABS *Australian National Accounts: State Accounts 2021-22 (Cat No 5220.0)*.

Tasmania's population data are sourced from *ABS National, State and Territory Population September quarter 2022 (Cat No 3101.0)*.

Units of measure

Greenhouse gases are frequently reported in megatonnes (Mt) CO_2-e, where 1 Mt of CO_2-e is equal to 1,000 kilotonnes (kt) CO_2-e and 1 kt of CO_2-e is equal to 1,000 t or 1 gigagram (Gg) of CO_2-e.

Confidential information

In accordance with the Australian Government's reporting protocols, where reporting at a sub-sector level could lead to the disclosure of commercially sensitive emissions data, the Australian Government treats the information as confidential and aggregates it with other sectors before publication. Examples in Tasmania include fugitive emissions, manufacturing industries and construction and other sectors which are not directly reported in the energy sector, and emissions from the metal industry, and the food and beverage industry, which are reported as combined emissions in the IPPU sector.

Discrepancies in table totals

Data in the tables of this report are sourced directly from the STGGI. Any discrepancy between table totals and the sum of sectors and sub-sectors reflects rounding anomalies and/or the inclusion of confidential emissions data.

Variations in chart scaling

The sector-specific charts in Chapter 2 are plotted on different scales for readability purposes and are not directly comparable.

Report structure

Chapter One: changes in Tasmania's emissions over the period 1990 to 2021, emissions per person and per unit of Gross State Product (GSP) and the state's contribution to national emissions.

Chapter Two: Tasmanian emissions by sector and energy sub-sectors using the IPCC sector categories.

A list of Abbreviations and Acronyms is included at the end of this report.

Appendix A: a summary of methodological changes included in the 2021 STGGI.

Appendix B: LULUCF data sources and reporting methodology.

Appendix C: UNFCCC emissions reporting sectors and descriptions.

Appendix D: a table of greenhouse gas source and sink categories by sub-sector for Tasmania 2020-21.

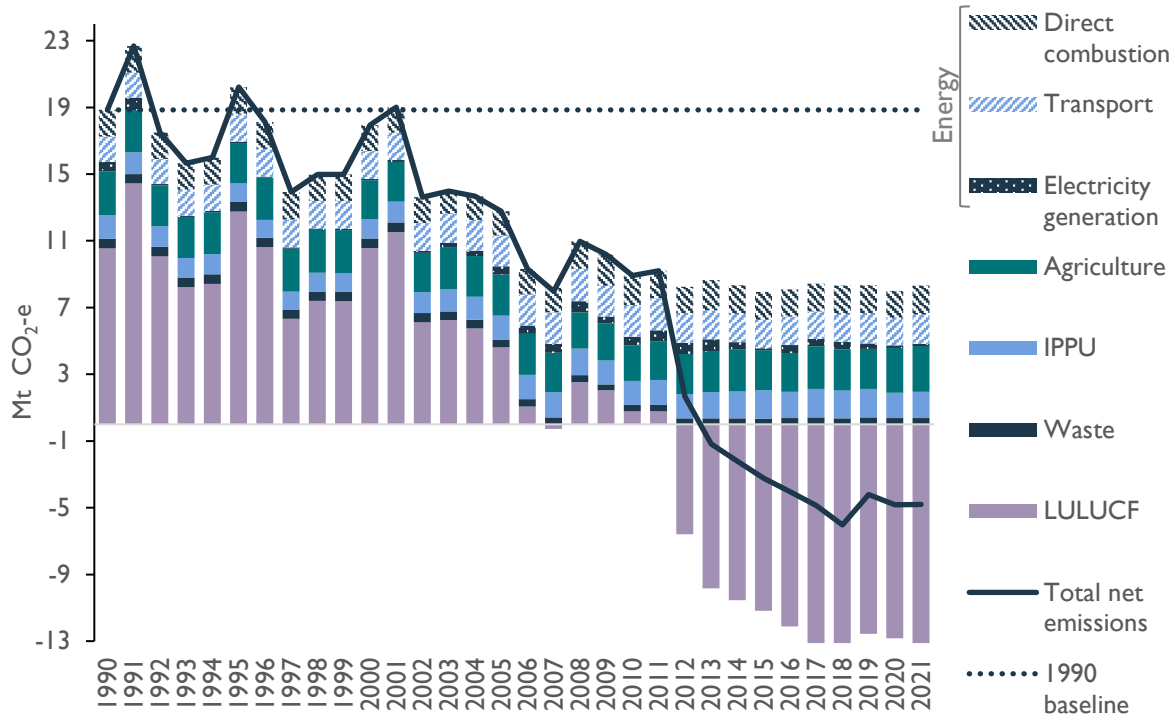
1. Changes in Tasmania's emissions

1.1 Tasmania's emissions - 1990 to 2021

In 2021, Tasmania's net emissions were minus 4.80 megatonnes (Mt) of CO_2-e. Tasmania's emissions decreased by 23.65 Mt CO_2-e between 1990 and 2021.

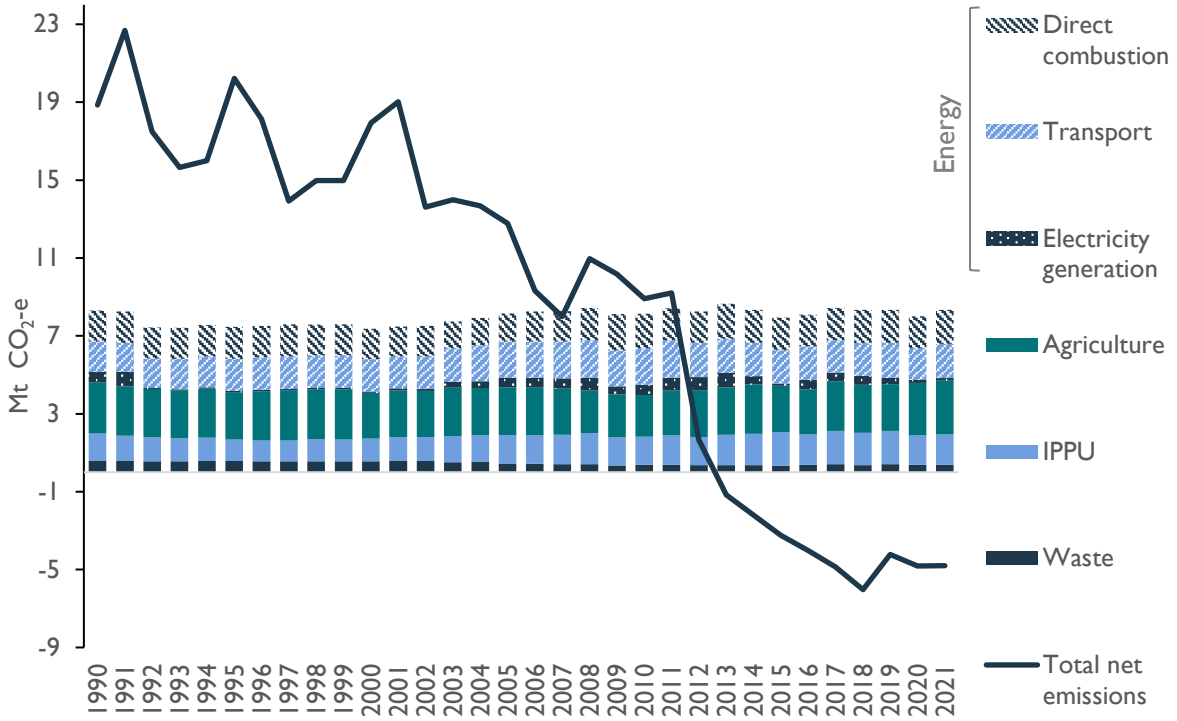
There is a clear downward trend in Tasmania's net annual emissions from 1990 to 2021 (Figure 1). Tasmania first achieved negative net emissions in 2013 and subsequently maintained this level each year to 2021.

Figure 1: Tasmania's emissions by sector and energy sub-sector - 1990 to 2021



Changes in the LULUCF sector have had a major influence on Tasmania's total annual emissions, reducing emissions and increasing carbon sequestration by 23.68 Mt CO_2-e (Table 1) from 1990 levels.

Figure 2: Tasmania's emissions by sector and energy sub-sector, excluding LULUCF - 1990 to 2021



Excluding LULUCF, Tasmania's emissions in 2021 were 8.33 megatonnes (Mt) of CO_2-e. Tasmania's emissions increased by 0.03 Mt CO_2-e between 1990 and 2021. Emissions excluding LULUCF were lowest in 2000 (7.36 Mt CO_2-e), highest in 2013 (8.65 Mt CO_2-e), and averaged 7.98 Mt CO_2-e between 1990 and 2021.

Reductions in emissions from 1990 to 2021 occurred in waste (down 0.19 Mt CO_2-e), and the electricity generation sub-sector (down 0.44 Mt CO_2-e).

Sectors that increased in emissions over the period 1990 to 2021 were IPPU (up 0.14 Mt CO_2-e), agriculture (up 0.15 Mt CO_2-e), and the transport (up 0.22 Mt CO_2-e) and direct combustion sub-sectors (up 0.14 Mt CO_2-e).

Table 1: Tasmania's emissions by sector and energy sub-sector - 1990 to 2021

Sector/Sub-sector	Emissions (Mt CO_2-e)		Change (Mt)	Change (%)
	1990	2021		
Energy	3.70	3.63	-0.07	-1.9
Direct combustion	*1.60*	*1.74*	*0.14*	*9.0*
Transport	*1.53*	*1.75*	*0.22*	*14.5*
Electricity generation	*0.57*	*0.13*	*-0.44*	*-76.5*
Agriculture	2.61	2.76	0.15	5.6

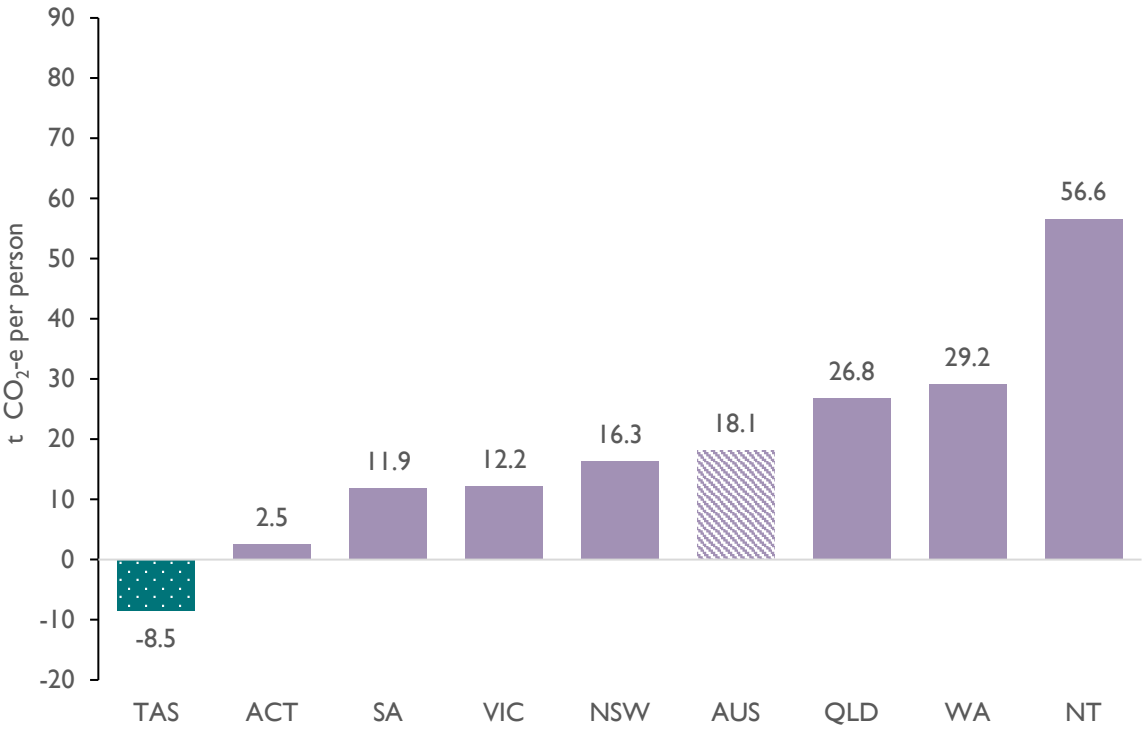
Sector/Sub-sector	Emissions (Mt CO_2-e)		Change (Mt)	Change (%)
	1990	2021		
IPPU	1.42	1.56	0.14	10.1
Waste	0.57	0.38	-0.19	-32.9
LULUCF	10.55	-13.13	-23.68	-224.4
Total	**18.85**	**-4.80**	**-23.65**	**-125.5**

Note: the percentage change for 2020 to 2021 for the land use, land use change and forestry sector, and total emissions, reflects an increase in the size of the carbon sink; in other words, a larger negative outcome.

1.2 Tasmania's emissions per person

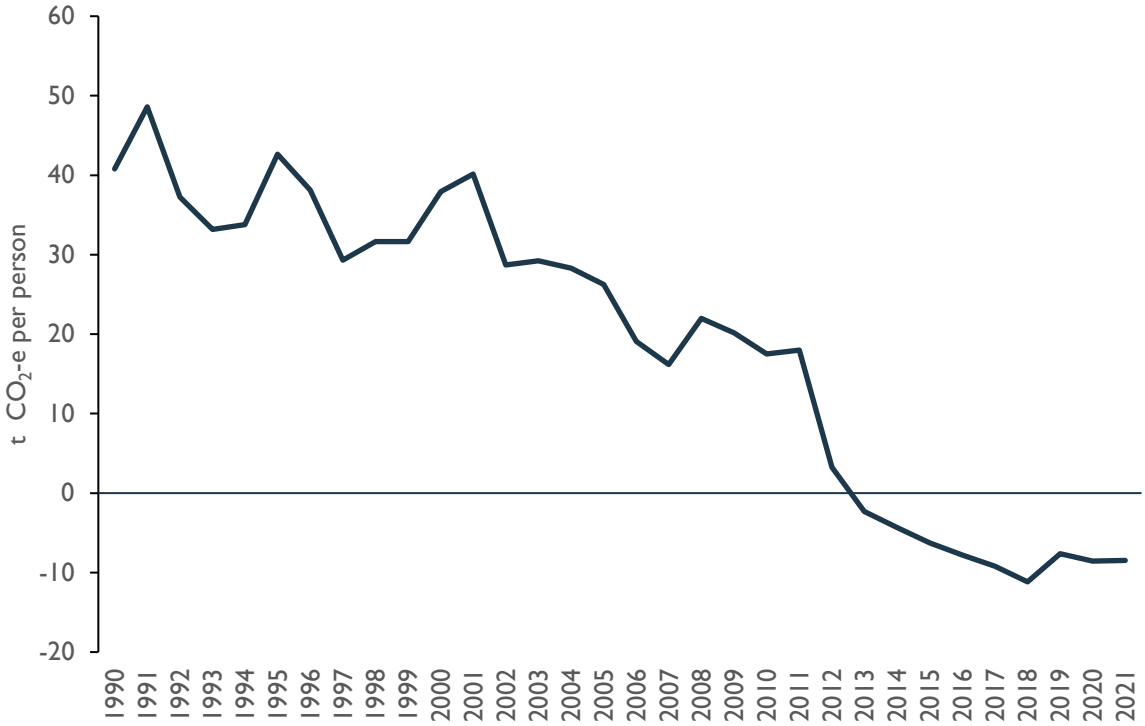
In 2021, Tasmania had the lowest emissions per person of any Australian jurisdiction, at minus 8.5 t CO_2-e per person (Figure 3). This is the only negative emissions figure per person of any jurisdiction and compares with the national average of 18.1 t CO_2-e per person.

Figure 3: Tasmania's emissions per person relative to Australia and other states and territories - 2021



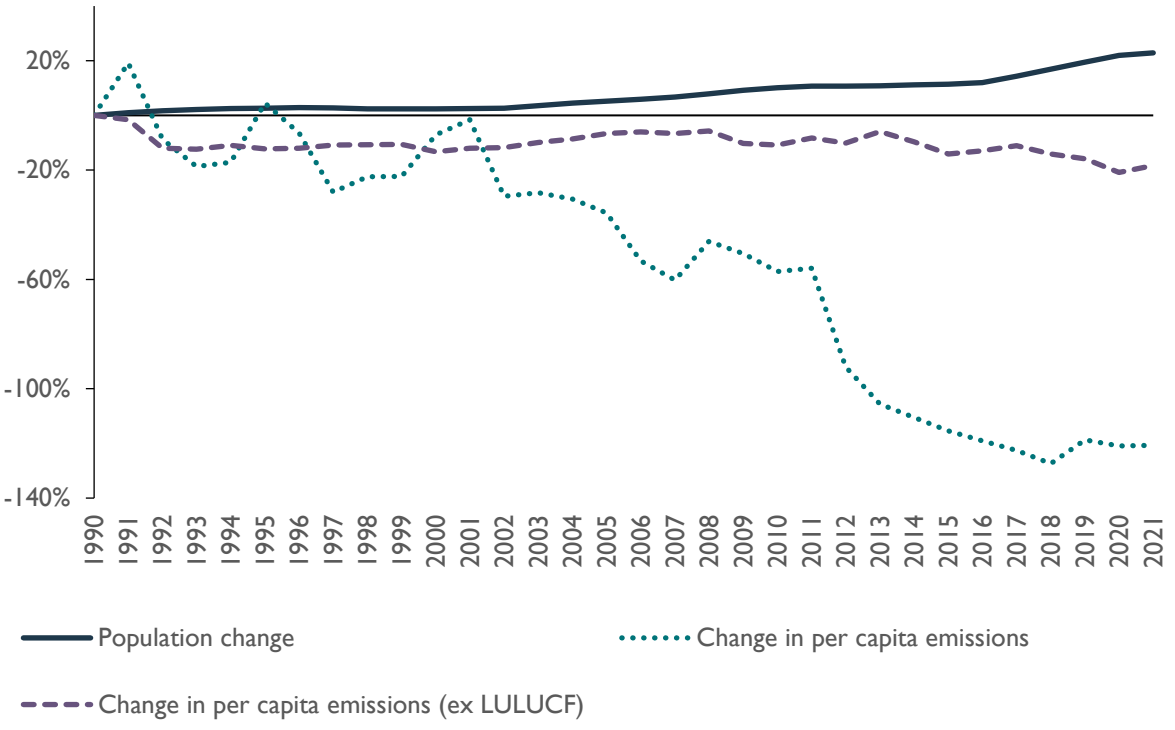
Tasmania's emissions per person have decreased from 40.8 t CO_2-e in 1990 to minus 8.5 t CO_2-e in 2021, a reduction of 120.7 per cent (49.2 t CO_2-e) over 31 years (Figure 4).

Figure 4: Change in Tasmania's emissions per person - 1990 to 2021



When emissions from the LULUCF sector are excluded, the percentage change in Tasmania's emissions per person relative to 1990 (baseline year) also declines, while Tasmania's population has steadily grown (Figure 5).

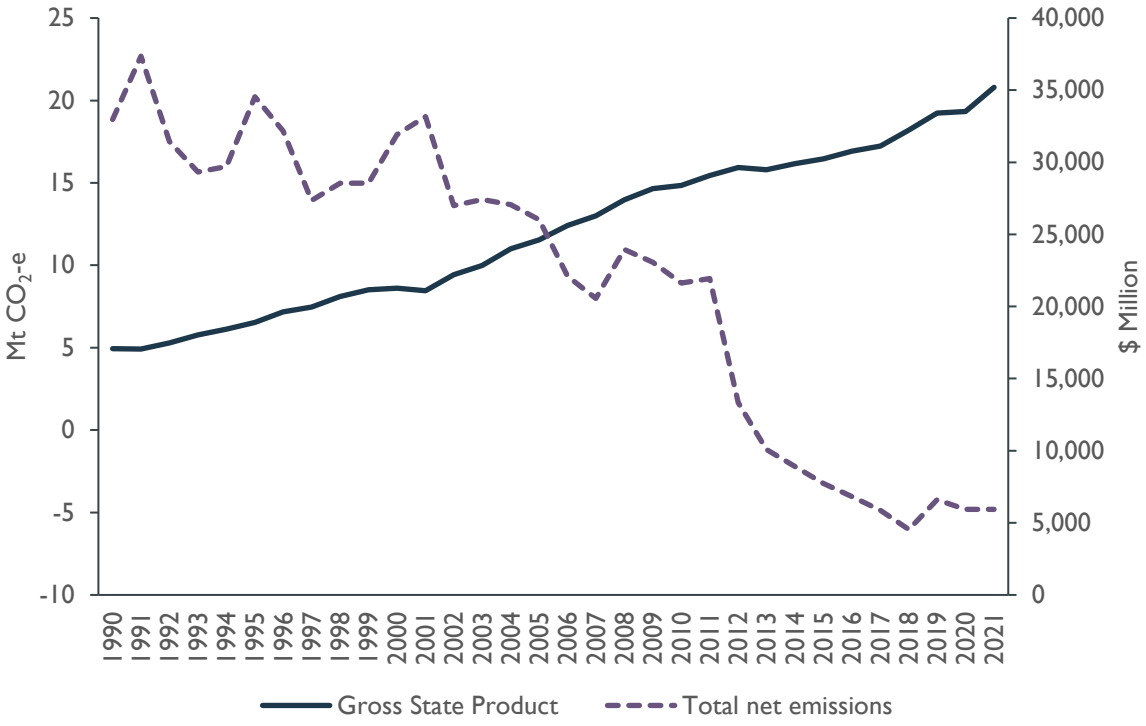
Figure 5: Percentage change in Tasmania's population and emissions per person - 1990 to 2021



1.3 Tasmania's emissions and Gross State Product

From 1990 to 2021, Tasmania's real GSP increased by 106.2 per cent (to over $35 billion) while Tasmania's emissions decreased by 125.5 per cent (Figure 6).

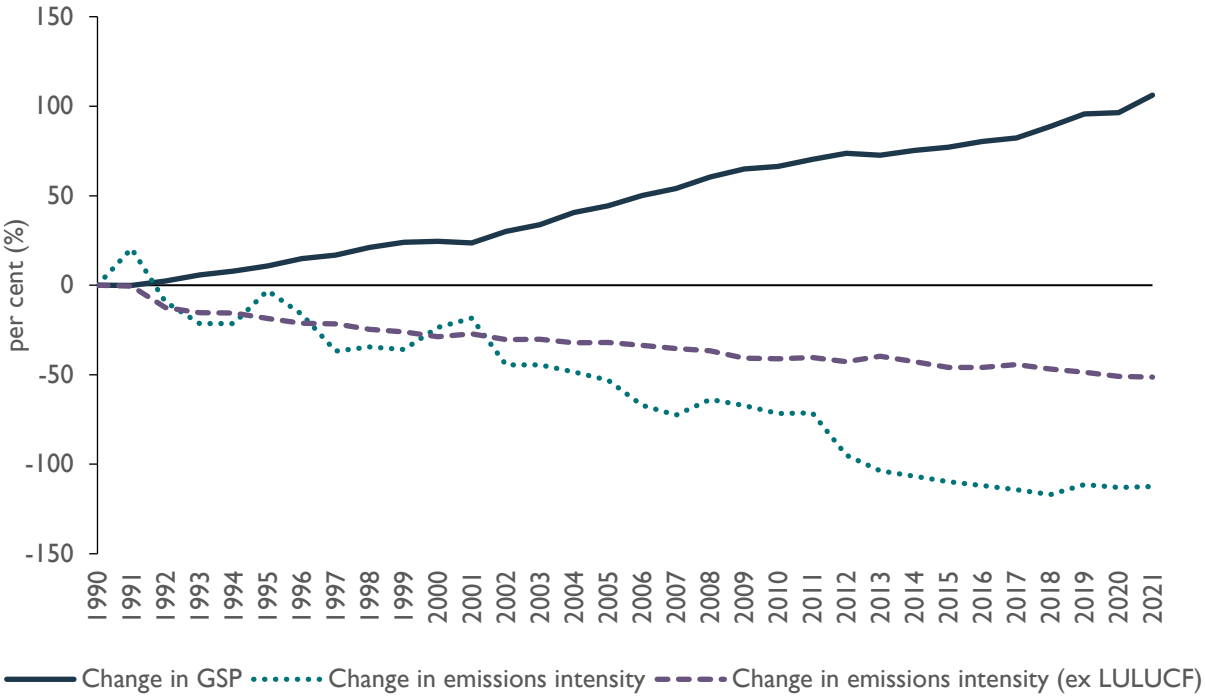
Figure 6: Change in Tasmanian emissions and real Gross State Product - 1990 to 2021



The increase in Tasmania's GSP, coupled with the decrease in Tasmania's emissions, resulted in a reduction in the emissions intensity of the Tasmanian economy, from 1,104.3 to minus 136.4 t CO_2-e per million dollars of GSP (a reduction of 112.3 per cent) (Figure 7).

When the emissions from the LULUCF sector are excluded, the emissions intensity of Tasmania's economy demonstrates a downward trend, declining from 486.0 t CO_2-e to 236.6 t CO_2-e per million dollars of GSP between 1990 and 2021, which is a reduction of 51.3 per cent over this period.

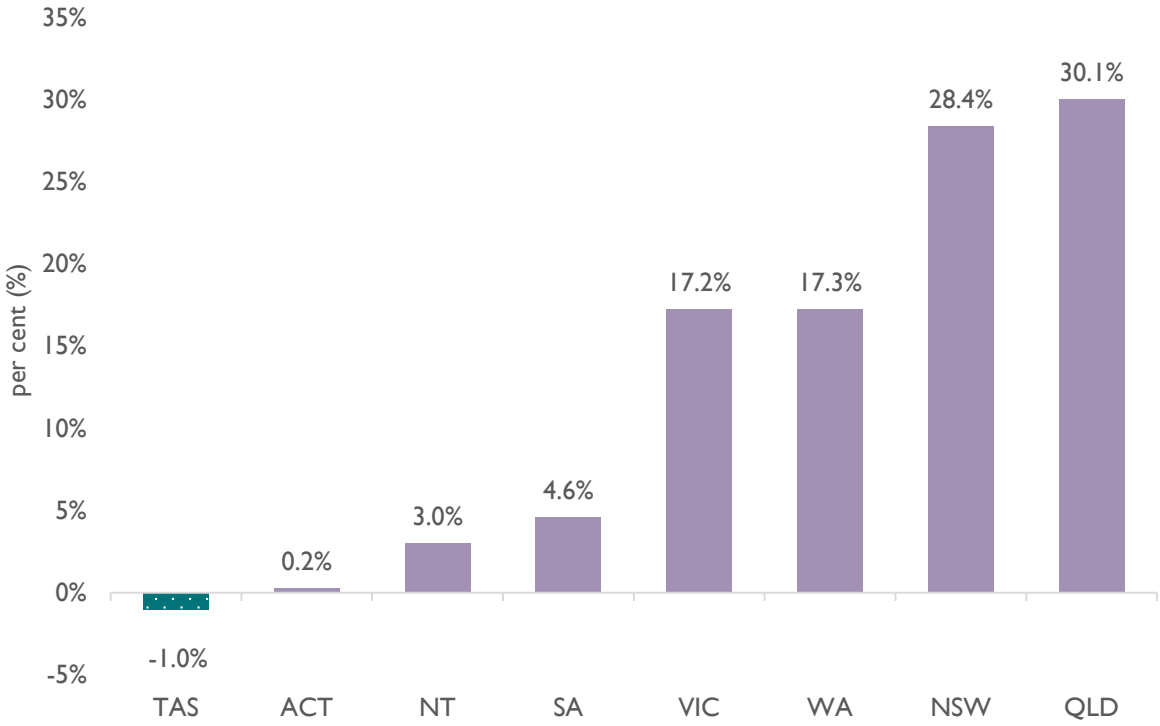
Figure 7: Percentage change in Tasmania's real GSP and emissions intensity - 1990 to 2021



1.4 Tasmania's contribution to national emissions

In 2021, Tasmania helped reduce Australia's total emissions (464.77 Mt CO_2-e) by 1.0 per cent (Figure 8).

Figure 8: Tasmania's contribution to national emissions - 2021



2. Tasmania's emissions by sector

This chapter details Tasmania's emissions by the IPCC sectors of energy, agriculture, IPPU, waste, and LULUCF.

The energy sector is disaggregated into three sub-sectors: electricity generation, direct combustion (of fuels for stationary energy uses), and transport.

Tasmania's emissions in 2021

Tasmania's emissions for 2021 by sector and energy sub-sector (Figure 9):

- Tasmania's net emissions in 2021 were minus 4.80 Mt CO_2-e.
- The LULUCF sector provided net sequestration of emissions (a carbon sink) of minus 13.13 Mt CO_2-e, offsetting emissions from all other sectors.
- Excluding LULUCF, the remaining sectors contributed 8.33 Mt CO_2-e to Tasmania's emissions, which comprised emissions from the following sectors: energy (43.5 per cent), agriculture (33.1 per cent), IPPU (18.7 per cent), and waste (4.6 per cent).
- The energy sector contributed 3.63 Mt CO_2-e to Tasmania's net emissions. Excluding LULUCF, the energy sub-sectors accounted for the following share of emissions: transport (21.0 per cent of total emissions), direct combustion (20.9 per cent) and electricity generation (1.6 per cent).

Figure 9: Tasmanian emissions by sector and energy sub-sectors - 2021

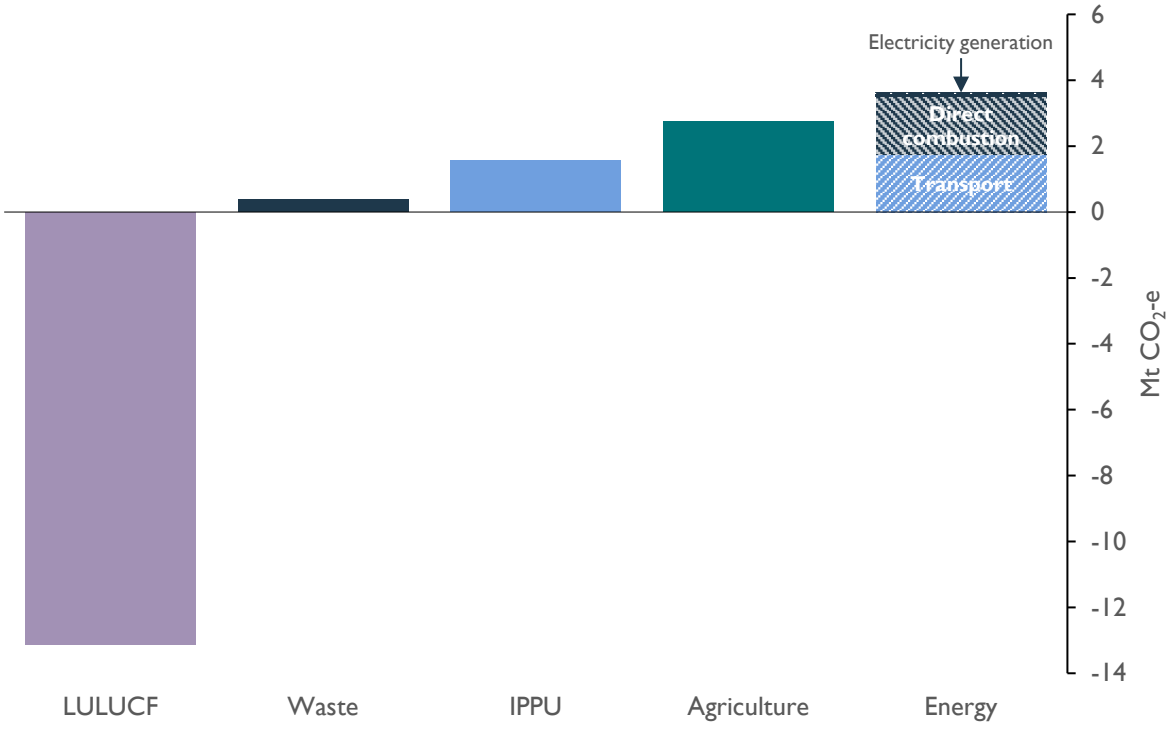
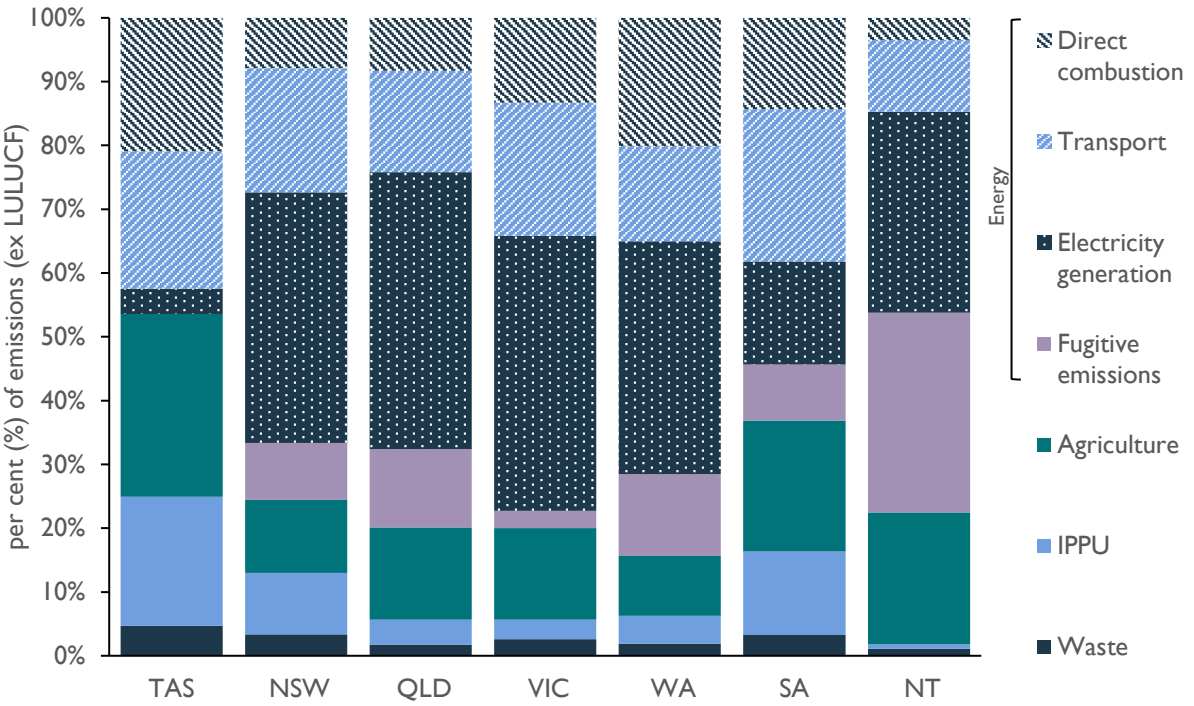


Figure 10 highlights the differences in the relative contribution of each sector and energy sub-sector to an Australian state or territory's total emissions. The LULUCF sector has been excluded from this analysis. The Australian Capital Territory is also excluded from this analysis as it only has a partial inventory, because its electricity is supplied by New South Wales.

Tasmania's emissions profile differs from other Australian states and territories, due to much lower contributions from the electricity generation sub-sector to Tasmania's total emissions. Emissions from Tasmania's transport, direct combustion, IPPU and agriculture sectors make a larger relative contribution to the state's total emissions than in most other jurisdictions.

Figure 10: Relative contribution of each sector and energy sub-sector to an Australian state or territory's emissions, excluding LULUCF - 2021



Note: Fugitive emissions in Tasmania are confidential and have been aggregated in the direct combustion sub-sector.

2.1 Energy

Tasmania's energy sector comprises electricity generation, direct combustion, transport, and fugitive emissions. There are very few industrial sites that produce fugitive emissions in Tasmania, therefore the Australian Government treats Tasmania's fugitive emissions as confidential to avoid identification. For this report, fugitive emissions, manufacturing industries and construction and other sectors are included in the direct combustion sub-sector. Tasmania's energy sector contributed 3.63 Mt CO_2-e in 2021, accounting for 43.5 per cent of Tasmania's emissions when LULUCF is excluded.

Compared to other states and territories (Figure 10), Tasmania has high levels of renewable energy generation. This means most of Tasmania's energy emissions are attributed to direct combustion and transport (Figure 11).

Figure 11: Breakdown of Tasmanian emissions by energy sub-sector (ex LULUCF) - 2021

<table>
<tr><td colspan="3">Energy 43.5%</td></tr>
<tr><td colspan="2">Stationary energy 22.5%</td><td rowspan="2">Transport

21.0%</td></tr>
<tr><td>Direct combustion
20.9%</td><td>Electricity generation
1.6%</td></tr>
</table>

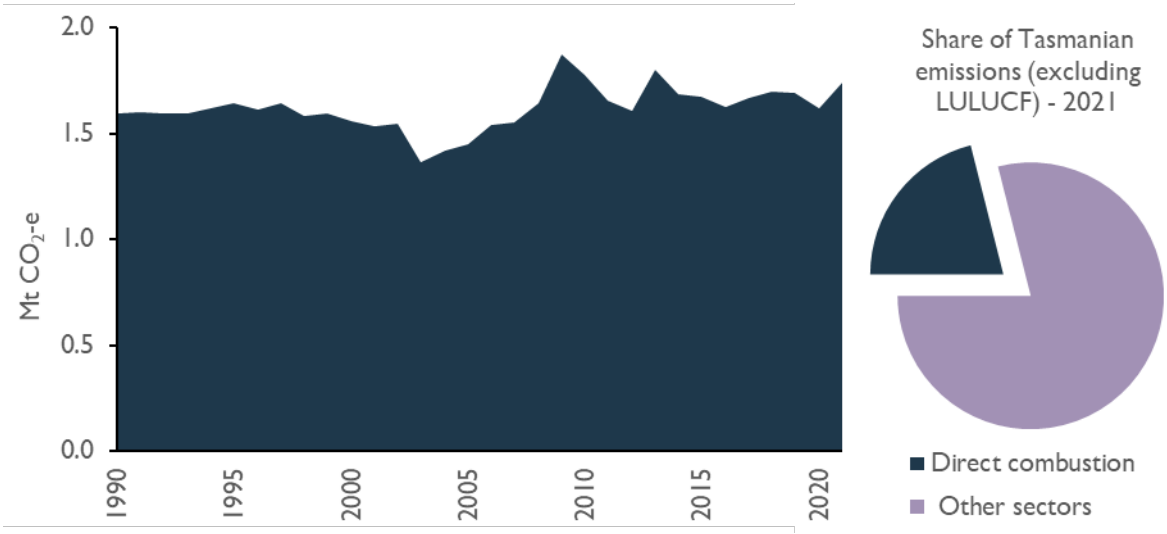
2.1.1 Direct combustion

The direct combustion sub-sector is made up of emissions from the combustion of fossil fuels, for stationary energy purposes used directly on site, and fugitive emissions. Direct combustion includes burning coal, gas, agricultural waste, or forestry residue to generate heat, steam, or pressure for commercial and major industrial operations, and burning wood or gas for household heating and cooking. The activities and industries that cause these emissions include manufacturing, construction, agriculture, fisheries, residential, and commercial operations. There is no double counting of emissions from biomass consumption, including fuelwood, between the LULUCF and energy sectors.

Emissions from electricity, or from fuel combustion in transport, are accounted for in the electricity generation and transport sub-sectors respectively.

Direct combustion accounted for 20.9 per cent of Tasmania's emissions in 2021, excluding the emissions from LULUCF (Figure 12). The emissions from direct combustion increased by 0.14 Mt CO_2-e (9.0 per cent) between 1990 and 2021.

Figure 12: Tasmanian emissions from direct combustion - 1990 to 2021



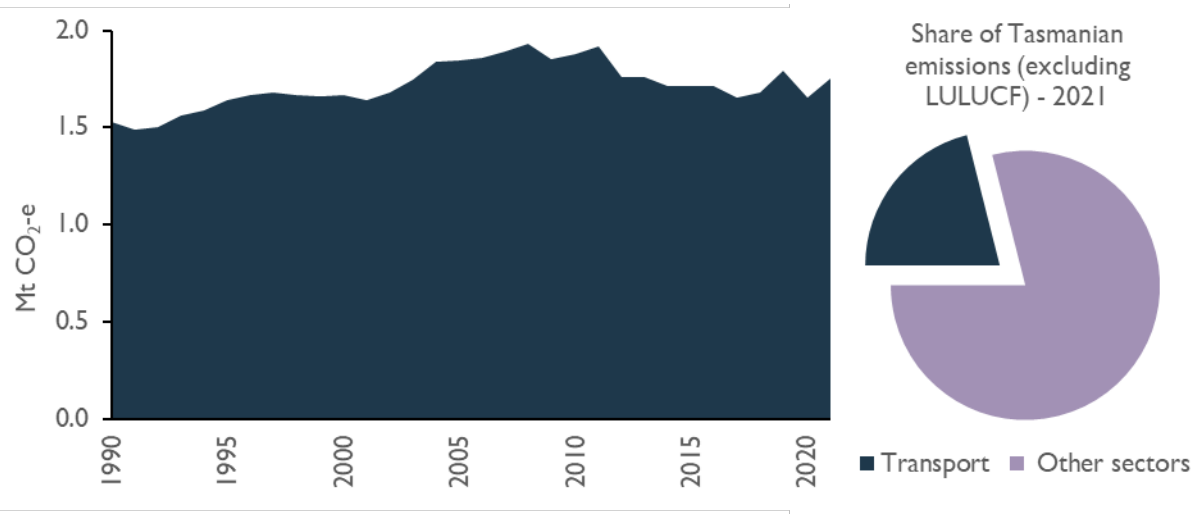
2.1.2 Transport

Emissions from the transport sub-sector are produced by the combustion of fuels such as petrol, diesel, and liquefied petroleum gas (LPG), in passenger and commercial motor vehicles, railways, domestic aviation and shipping.

Emissions from electricity used to power electric vehicles, and from liquid fuels used to run logging and farming machinery such as log skidders and tractors, are accounted for in the electricity generation and direct combustion sub-sectors respectively.

Transport accounted for 21.0 per cent of Tasmania's emissions in 2021, excluding LULUCF (Figure 13). The emissions from transport increased by 0.22 Mt CO_2-e (14.5 per cent) between 1990 and 2021.

Figure 13: Tasmanian emissions from transport - 1990 to 2021



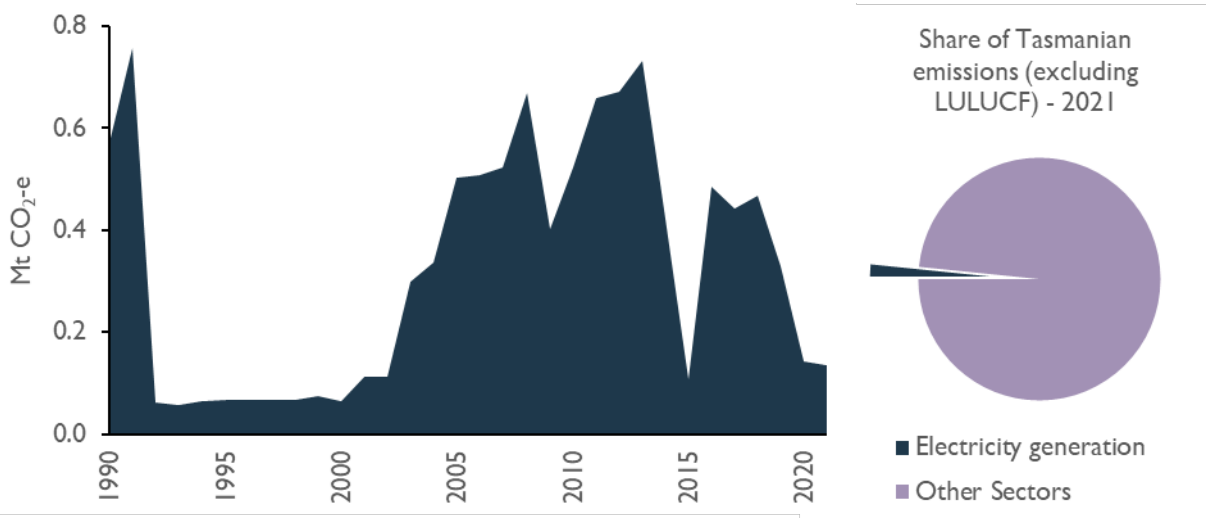
2.1.3 Electricity generation

Emissions from electricity generation are produced by the combustion of fuels to generate electricity that is supplied to the electricity grid for domestic and commercial use.

This sub-sector covers emissions from electricity that is generated in Tasmania, some of which is exported to the National Electricity Market via Basslink. Emissions from electricity imported into Tasmania via Basslink are accounted for in the greenhouse gas inventory of the state that generates the electricity.

Electricity generation accounted for 1.6 per cent of Tasmania's emissions, excluding LULUCF (Figure 14). The emissions from electricity generation decreased by 0.44 Mt CO_2-e (76.5 per cent) between 1990 and 2021.

Figure 14: Tasmanian emissions from electricity generation - 1990 to 2021



2.2 Agriculture

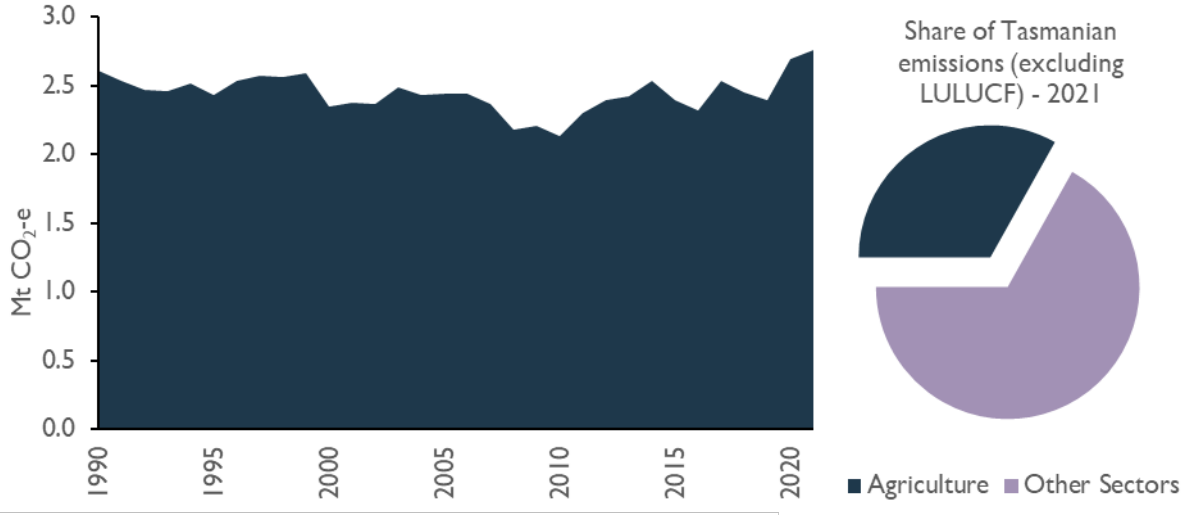
Sources of emissions from the agriculture sector include livestock digestive systems (enteric fermentation), the release of nitrous oxide from cropping and pastureland, and manure management.

- Enteric fermentation of plant material that is digested by livestock (for example, cattle, sheep, and pigs) results in methane emissions.
- Urine and dung deposited by grazing animals, and nitrogen leaching and run-off, result in emissions from microbial and chemical transformations that produce and consume nitrous oxide in the soil.
- Manure management produces emissions through the anaerobic (without oxygen) decomposition of the organic matter contained in manure.
- Land management practices such as lime, fertiliser and urea applications, produce nitrous oxide emissions.

Emissions associated with the use of electricity, fuel consumption from operating agricultural equipment, and fuel consumption in transport, are accounted for in the energy sector. Emissions associated with land use change, including the clearing and re-clearing of vegetation, are accounted for in the LULUCF sector.

Tasmania's agriculture sector accounted for 33.1 per cent of Tasmania's emissions, excluding LULUCF (Figure 15). The emissions from agriculture increased by 0.15 Mt CO_2-e (5.6 per cent) between 1990 and 2021.

Figure 15: Tasmanian emissions from agriculture - 1990 to 2021



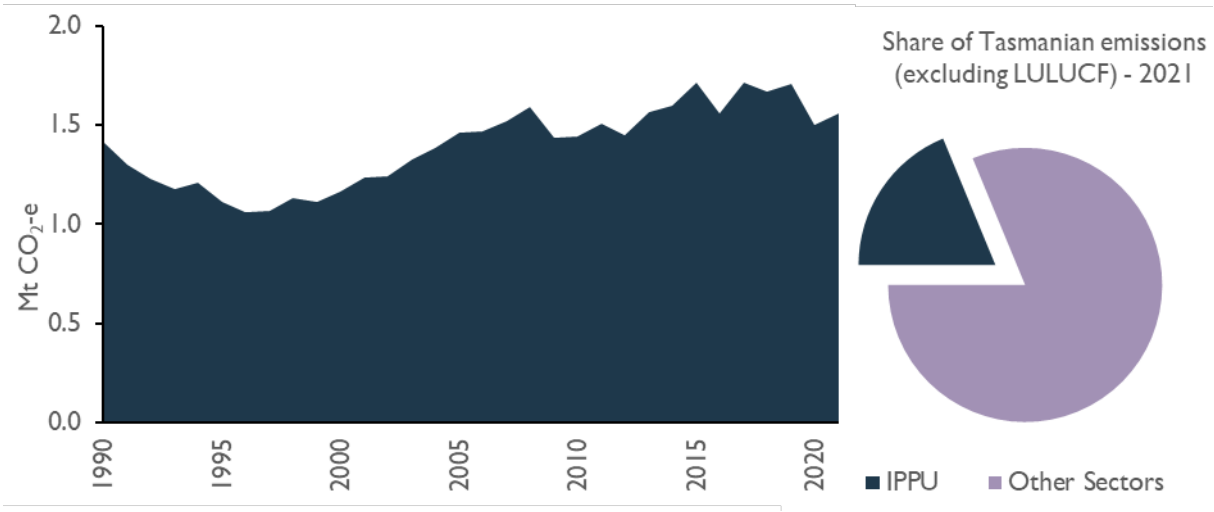
2.3 Industrial processes and product use

Emissions from the IPPU sector are generated from a range of production processes that include the calcination of carbonate compounds (for example, cement, lime or glass production), carbon when used as a chemical reductant (for example, iron, steel or aluminium production), and the production and use of synthetic gases such as hydrofluorocarbons (HFCs) (used in refrigeration and air conditioning equipment and as solvents) and sulphur hexafluoride (electrical equipment).

Emissions associated with the energy used in industrial production processes are accounted for in the electricity generation and direct combustion sub-sectors. For example, the emissions from cement manufacture may include combustion of fuels (coal or natural gas) used to heat kilns in the manufacturing process. However, these combustion-related emissions are reported in the energy sector (as direct combustion) and not with IPPU, which only includes the emissions from calcination.

Tasmania's IPPU sector accounted for 18.7 per cent of the state's emissions, excluding LULUCF (Figure 16). The emissions from IPPU increased by 0.14 Mt CO_2-e (10.1 per cent) between 1990 and 2021.

Figure 16: Tasmanian emissions from IPPU – 1990 to 2021



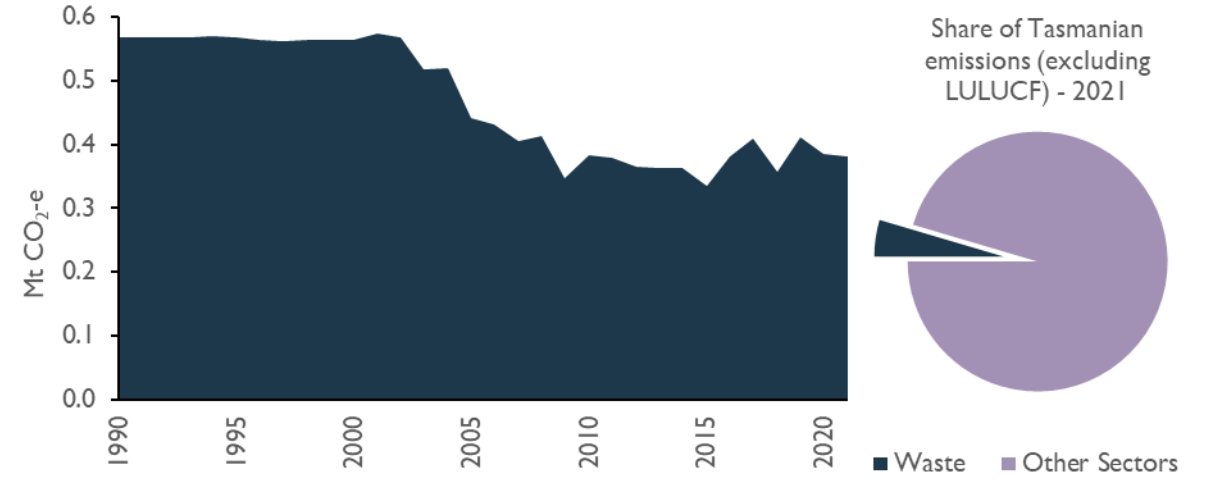
2.4 Waste

Emissions from the waste sector are produced by the anaerobic decomposition of organic matter from solid waste in landfills and from the release of greenhouse gases during the treatment of wastewater. Methane is produced by anaerobic digestion processes in wastewater treatment plants, and the nitrification and denitrification of urea and ammonia produces nitrous oxide emissions.

Emissions associated with the energy used in the management and transportation of waste are reported in the electricity generation, direct combustion, and transport sub-sectors.

Tasmania's waste sector accounted for 4.6 per cent of Tasmania's emissions, excluding LULUCF (Figure 17). The emissions from waste decreased by 0.19 Mt CO_2-e (32.9 per cent) between 1990 and 2021.

Figure 17: Tasmanian emissions from the waste sector - 1990 to 2021



2.5 Land use, land use change, and forestry

The LULUCF sector includes emissions and sequestration (removals or carbon sinks) of greenhouse gases from direct human-induced land use, land use change and forestry activities. This includes emissions and sequestration associated with:

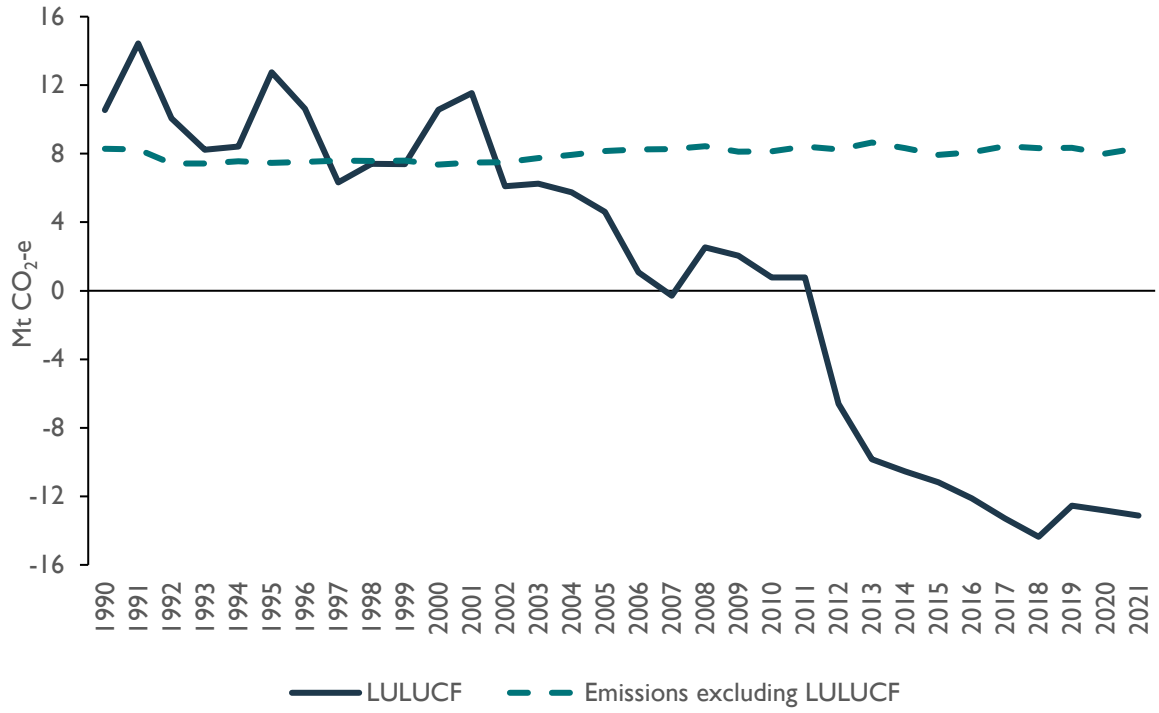
- the clearance of forested land and conversion to other land uses (for example cropland, grassland, wetlands and settlements)
- the establishment of new forests planted on previously unforested land
- other practices that change emissions and sequestration, such as forest management, cropland management and grazing land management.

Emissions from fuelwood consumption, controlled burning, and wildfires on forest land, are also included in the LULUCF sector, as are removals associated with post-fire recovery. Carbon that is stored in harvested wood products is included as a carbon sink.

The combustion of fossil fuels associated with forestry activity and land management (for example diesel to run logging machinery and farming equipment) is accounted for in the direct combustion sub-sector of the energy sector. Non-CO_2 emissions associated with livestock (such as enteric fermentation) and cropping (such as release of nitrous oxide from agricultural soils) are accounted for in the agriculture sector.

In 2021, Tasmania's LULUCF sector was a net carbon sink, resulting in minus 13.13 Mt CO_2-e. This sink offset the emissions from other sectors that had a combined contribution of 8.33 Mt CO_2-e (Figure 18). The emissions from LULUCF decreased by 23.68 Mt CO_2-e (224.4 per cent) between 1990 and 2021. The sector previously contributed to total emissions but now acts as a carbon sink.

Figure 18: Tasmania's emissions from LULUCF relative to other sectors - 1990 to 2021



Glossary

Term	Description
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
AES	Australian Energy Statistics
Baseline	The standard definition of 'baseline' is a minimum, or starting point, used for comparison. In greenhouse gas emissions reporting, the term 'baseline' is often used in different contexts to refer to different 'baseline data'. In this report, the term is used to refer to the '1990 baseline year', which is the financial year 1989-1990 and the first reported year in the STGGI. Tasmania's climate change legislation does not require reporting against this baseline, but it is a common convention used by the Australian Government.
Carbon sink	A carbon, or emissions, sink removes more carbon than it emits. The removed carbon is stored, often in the form of growing vegetation.
CH_4	Methane, a greenhouse gas
CO_2	Carbon dioxide, a greenhouse gas
CO_2-e	Carbon dioxide equivalent
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEEW	Australian Government Department of Climate Change, Energy, Environment and Water
Direct combustion	Burning of fuel(s) for energy predominantly in manufacturing, mining, residential and commercial sectors.
Emissions	Greenhouse gas emissions
FullCAM	Full Carbon Accounting Model
Gg	Gigagrams

Term	Description
GSP	Gross State Product
HFCs	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
LPG	Liquefied petroleum gas
LULUCF	Land Use, Land Use Change and Forestry
Mt	Megatonnes
N_2O	Nitrous oxide
NGER	National Greenhouse and Energy Reporting
NIRs	National Inventory Reports
ReCFIT	Renewables, Climate and Future Industries Tasmania
Stationary energy	Emissions from the production of electricity and other direct combustion of fossil fuels in industries such as manufacturing and construction
STGGI	State and Territory Greenhouse Gas Inventories
t	Tonnes
Tier	The IPCC methods for estimating emissions and removals are divided into 'tiers' encompassing different levels of activity, methodological complexity and technology detail. Tier 1 methods are generally very simple and require less data and expertise than the most complicated tier 3 methods. Tier 2 and 3 methods generally require more detailed country-specific information on things such as technology type or livestock characteristics.
Time series	A sequence of data taken at successive equally spaced points in time
UNFCCC	United Nations Framework Convention on Climate Change

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Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2023, *National Inventory Report Volume 1*, viewed 2 May 2023. https://www.dcceew.gov.au/sites/default/files/documents/national-inventory-report-2021-volume-1.pdf

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Appendix A

Summary of methodological changes to 2021 STGGI

- Each year the Australian Government reviews how it calculates greenhouse gas emissions to ensure national and state inventories reflect the latest available data, improved modelling techniques, and any changes in sectoral classifications and estimation methodologies.
- The *National Inventory Report 2021* was Australia's first national inventory submission under the Paris Agreement. Updated reporting requirements present emissions for each of the major greenhouse gases as carbon dioxide equivalents using the 100-year GWPs, which are different from those applied to NIRs submitted in previous years. Most recently, NIRs submitted for the years 2013 to 2020 applied 100-year GWPs from the 2007 IPCC Fourth Assessment Report. In accordance with Paris Agreement requirements, the latest NIR applies 100-year GWPs contained in the 2014 IPCC Fifth Assessment Report. As greenhouse gases vary in their radiative activity, and in their atmospheric residence time, converting emissions into CO_2-e allows the integrated effect of emissions of the various gases to be compared.
- Development of recalculations is undertaken in line with the *Inventory Improvement Plan* for the Australian inventory. This plan aims to improve transparency, accuracy, completeness, consistency and comparability, with a focus on those areas where the Australian community is introducing new emissions-reducing approaches and technologies. These generally align with key categories. The improvement plan also responds to international expert reviews and changes in international practice.
- This revision process includes the recalculation of historical emissions data between 1990 and 2021, nationally and for each state and territory, to ensure that the estimates of emissions are accurate, transparent, complete, consistent through time and comparable with those produced in other countries.
- The Australian Government has been working with Sustainable Timber Tasmania to apply a new spatially-explicit modelling method for estimating emissions from harvested native forests on public lands, which comprises part of the 'forest land remaining forest land' sub-category of the LULUCF reporting sector.
- The new modelling approach improves the accuracy of estimating emissions for this sub-category compared to the previous estate method. The estate method calculated the areas logged each year based on aggregated log volumes published by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES).
- The new spatially-explicit modelling method calculates the emissions from specific harvesting events, including areas affected, types of harvesting practices and vegetation species, and overlays other variables such as weather patterns, fire history, local vegetation and biomass spatial datasets. These variables affect tree growth, dead organic matter and soil composition, which contribute to the production and sequestration of emissions.

- The new spatially-explicit model allows for more accurate data on harvested log volumes allocated to private native forests.
- The recalculations undertaken for the 2021 STGGI have resulted in significant changes in Tasmania's emissions figures across all sectors, but particularly in the LULUCF sector.
- As a result of these recalculations, the emissions figures in the 2021 STGGI are not directly comparable to the figures published in the STGGI reports of previous years.

Revisions in Tasmania's emissions between the 2020 STGGI and 2021 STGGI

- The effect of the recalculated data on Tasmania's net emissions show that:
  - Tasmania's net emissions figure in the baseline year of 1990 is revised up 0.96 Mt CO_2-e to 18.85 Mt CO_2-e.
  - Tasmania's net emissions figure in 2020 is revised down by 1.08 Mt CO_2-e to minus 4.82 Mt CO_2-e.
  - The reduction in Tasmania's net emissions figure between 1990 and 2020 is revised up from 114.0 to 125.6 per cent.
  - Tasmania's net emissions figures are wholly revised, resulting in Tasmania first achieving net negative emissions from 2013 onward, rather than in 2014 as reported in the 2020 STGGI.
- Table 2 presents a summary of the changes in Tasmania's 2020 emissions by sector and energy sub-sector between the 2020 STGGI and 2021 STGGI. The table shows that the recalculations have resulted in changes across most sectors. The most significant change is concentrated in the LULUCF sector. This is replicated across the time series.
- When compared with the 2020 STGGI, methodological changes in the 2021 STGGI have had different effects in LULUCF emissions data since 1990. The changes have resulted in an increase in emissions in the LULUCF sector of approximately 0.97 Mt CO_2-e in 1990 and an increase in the net sink provided by the LULUCF sector of approximately minus 1.18 Mt CO_2-e in 2020.

Table 2: Revisions to Tasmania's emissions for 2020 by sector and energy sub-sector, following recalculations

Sector/Sub-sector	2020 Emissions (Mt CO_2-e)		Change (Mt CO_2-e)
	2020 STGGI	2021 STGGI	
Energy	3.35	3.42	0.072
Direct combustion	*1.55*	*1.62*	*0.074*
Transport	*1.66*	*1.65*	*-0.002*
Electricity generation	*0.14*	*0.14*	*0.000*
Agriculture	2.69	2.70	0.007
IPPU	1.50	1.50	0.000
Waste	0.37	0.38	0.013
LULUCF	-11.64	-12.82	-1.176
Total	**-3.73**	**-4.82**	**-1.084**

- The main methodological changes in the sub-categories that have materially contributed to the revision in Tasmania's emissions between the 2020 STGGI and 2021 STGGI are summarised in Table 3. This information is gathered from the *National Inventory Report Volume I*, Australian Government (2023), Department of Climate Change, Energy, the Environment and Water.

Table 3: Methodological changes and data revisions contributing to change in Tasmania's emissions between the 2020 STGGI and 2021 STGGI

Sector/Sub-sector	Methodological Change
Energy	
Energy Industries	A cell reference error led to the use of incorrect activity data for oil and gas extraction, which was corrected for this submission. Australia's official statistics on energy production and use receive periodic updates to support improved understanding of Australia's energy systems, including for time series consistency. These updates are reflected in the inventory. National Greenhouse and Energy Reporting (NGER) scheme data has been included for the black coal mining sector with the Australian Energy Statistics (AES) now forming the residual of the difference between NGER and the AES. During their 2022 review, the UNFCCC Technical Expert Review Team identified that the use of other gaseous fuels by a single

Sector/Sub-sector	Methodological Change
	refinery had not been included in the estimation emissions for the period of 2012-13 to 2015-16. This has now been corrected. During their 2022 review, the UNFCCC Technical Expert Review Team recommended that emissions from the combustion of non-biomass waste be reported as other fossil fuels in Category 1.A, in line with the 2006 IPCC Guidelines (Volume 2, Table 1.1). A recalculation between 2016-17 to 2019-20 gives effect to that recommendation. Recalculations between 1999 and 2003 relate to the treatment of residual diesel combustion in electricity generation. The process of balancing total AES diesel consumption with facility data in circumstances where facility data exceeded the AES total led to a negative balance in residual facilities in certain states and certain years. This has been corrected to ensure residual facilities balance to zero where negative balances are identified.
Manufacturing Industries and Construction	Recalculations relate to the inclusion of NGER facility-specific activity data and emission factors for Pulp, Paper and Print; Non-Metallic Minerals (Glass and glass product manufacturing); and Mining (excluding fuels) and Quarrying.
Transport	A revision to activity data related to pipeline transport has resulted in a revision to the 2019-20 estimate from this source. A time series reallocation of emissions from the combustion of lubricants from 2.D Non-Energy Use of Fuels to 1.A.3 transport and 1.A.4.b residential sectors has been completed for this submission. This includes motorcycles, domestic marine, residential (such as mowers), and off-road vehicles. In response to a recommendation from the UNFCCC Technical Expert Review Team, Australia has adopted a Swiss assumption that 0.05 per cent of lubricants are assumed combusted in the transport and residential sectors. A correction to aviation gasoline consumption data for 2007-08 has resulted in a recalculation. Motor vehicle stocks were incorrectly reported by the ABS for the 2019-20 inventory year. This has been corrected for this submission and results in a recalculation in non-CO_2 emissions in road transport in 2019-20. To disaggregate AES transport fuel combustion between road transport, and miscellaneous uses such as military, off-road and utility engines, fuel allocations are applied based on data from the ABS survey of motor vehicle use and information from the Department of

Sector/Sub-sector	Methodological Change
	Defence. Minor corrections to these allocations have resulted in recalculations in 1990-91 to 1992-93, 1997-98, 1999-2000, and 2001-02. LPG allocations within road transport have been corrected for 2012-13.
Agriculture	
Agricultural Soils	Due to a change in the reporting of fodder crops by the ABS, the allocations for the last two inventories were recalculated to maintain time series consistency. The estimates for soil carbon are recalculated for the entire time series in every inventory. This leads to small changes in the estimates of nitrogen mineralisation due to loss of soil carbon.
IPPU	
Mineral Industry	An update to data on lime kiln dust from one facility and residual carbonate use across the economy impacted emissions in 2019-20. Revised information on construction activity, received from the ABS, impacted emissions from ceramics production from 2010-11 onwards.
Chemical Industry	Recalculations relate to the introduction of estimates associated with methanol production between 1994-95 and 2015-16.
Non-energy Products from Fuels and Solvent Use	Consistent with a recommendation from the UNFCCC Technical Expert Review Team, emissions associated with the use of lubricants in 2-stroke engines have been reallocated to the Transport sector. Periodic revisions to time series information in the AES for accuracy and consistency have been incorporated into the inventory.
Product Uses as Substitutes for Ozone Depleting Substances	Recalculations are due to a revision in activity data concerning light vehicle stocks.
Other Product Manufacture and Use	Recalculations are due to a correction to a mistaken interpretation of source data made in the previous submission for 2019-20.

Sector/Sub-sector	Methodological Change
Waste	
Solid Waste Disposal	Revisions were made to the way that residual disposal and capture, not covered by the NGER scheme, is estimated. This improved inventory alignment with state and territory reported data. Revisions to the harvested wood products activity data also contributed to these revisions. These improvements contributed to revisions of between -0.01 and 7.21 per cent between 1989-90 and 2019-20.
Waste Water Treatment and Discharge	A revision to the emission factor for N_2O generated from domestic and commercial wastewater treatment in the NGER Measurement Determination 2008 was incorporated into inventory estimates for this submission. The emission factor for N_2O was reduced from 4.9 to 2.082 tonnes of nitrous oxide (CO_2-e) per tonne of nitrogen produced. The revision brings the inventory into alignment with the 2006 IPCC Guidelines. The update has contributed to revisions of between -7.45 and -1.88 per cent between 1989-90 and 2019-20. Revisions to activity data in industrial wastewater contributed to revisions of 0.25 per cent in 2019-20.
LULUCF	
All	The spatial time series for the Forest Productivity Index (FPI) used in FullCAM's Tree Yield Formula, have been changed. This variable affects the rate of tree growth based on seasonal and inter-annual variations in local growing conditions. Monthly Normalized Difference Vegetation Index (NDVI) data is an essential input to the FPI. New spatial data has been introduced to the NDVI time series beginning from 2001, with recalibration to maintain time series consistency. This correction causes increased tree growth modelled for recent years, which had been underestimated, and a corresponding increase in CO_2 removals. A discrepancy with FullCAM's implementation of the patchiness function was causing temperate fire simulations to be non-repeatable (no two simulations would produce identical results), and for emissions to occasionally be modelled even in areas where no fires occurred. These issues have been resolved for this submission, and this resolution has allowed simulations to be repeatable and caused a general decrease in fire emissions across the time series. Activity data updates implemented in this submission include addition of activity data and climate data for 2021-22, and annual updates to spatial datasets (Woody Change, Plant Type and Land Use spatial layers) based on recent satellite observations. These result in a

Sector/Sub-sector	Methodological Change
	reallocation of lands between land use categories, resulting in recalculations across most subsectors. A range of issues identified in the implementation of previous improvements to the FullCAM system, including functions and databases, have been made to improve system reliability.
Forest land remaining forest land	Spatial updates implemented in this submission include tier 3 spatial data for prescribed burning in Western Australia. With this inclusion, all prescribed burning in Australia's temperate forests is now modelled at the tier 3 level.
Land converted to forest land	Allocation parameters for selected native species were corrected and a few other errors were also fixed in the FullCAM input datasets.
Cropland remaining cropland	Due to the derivation of the mean soil organic carbon near steady state, recent years are recalculated due to longer-term variations in the monthly data simulated by FullCAM. Crop yields were updated using the crop model resulting in a minor decrease in emissions across the time series.
Grassland remaining grassland	Due to the derivation of the mean soil organic carbon near steady state, recent years are recalculated due to longer-term variations in the monthly data simulated by FullCAM.
Wetland remaining wetland	Continuing improvement in the reservoir model, including extension of the gauge to surface area tables to capture a greater annual variation in reservoir surface area, which improves its accuracy, and the removal of a duplicate data set attributed to one reservoir. Application of a new model that estimates farm dam water surface area and methane emission rates based on an established relationship with climate variables (by applying machine learning techniques) has updated estimates of annual farm dam methane emissions.
Land converted to wetland	Continuing improvement in the reservoir model, including extension of the gauge to surface area tables to capture a greater annual variation in reservoir surface area, which improves its accuracy, and the removal of a duplicate data set attributed to one reservoir.
Harvested wood products	Recalculations are due to time series revisions to the underlying source data on forestry and wood products produced by ABARES, and revisions in the Waste sector which impact harvested wood products in solid waste disposal sites.

Appendix B

LULUCF data sources and reporting methodology

- The LULUCF sector covers greenhouse gas emissions and removals associated with land management practices that impact the carbon stored in vegetation and soils. Since vegetation can absorb carbon from the atmosphere, this sector can function as a net sink of emissions.

Carbon stock changes

- Predominantly, country-specific methodologies and Tier 3 models are used to estimate LULUCF emissions and removals. Australia's land sector inventory system integrates spatially-referenced data with the Full Carbon Accounting Model (FullCAM), an empirically constrained, mass balance, carbon cycling ecosystem model, to estimate carbon stock changes and greenhouse gas emissions (including all carbon pools, gases, lands and land use activities).
- FullCAM has been designed to comply with IPCC Guidelines and to meet the Australian Government's international treaty estimation and reporting commitments. It is designed to fully integrate the estimation of carbon stock changes and related emissions across the Australian landscape. Model parameterisation has been informed by the latest empirical science and is continuously updated.
- A comprehensive modelling approach to the estimation of carbon stock changes was originally chosen for the Australian land sector because of the absence of extensive forest inventory or measurement systems, reflecting the circumstance that timber industry activity has been confined in recent times to approximately 10 per cent of Australia's forested land.
- Spatial datasets for key disturbance events such as land clearing, forest planting and natural regeneration are derived from LandSat satellite imagery held by the Australian Geoscience Datacube (Digital Earth Australia). These datasets are processed by CSIRO Data61 and are informed by land use and vegetation datasets provided by ABARES and DCCEEW.
- Both spatially explicit and non-spatially explicit models have been implemented in the estimation of emissions and removals from harvested native forests. For public forests in Victoria, New South Wales and Tasmania, a spatially explicit Tier 3 FullCAM model for harvested native forests has been used.
- The FullCAM spatial method for harvested native forests simulates carbon stock changes due to tree growth, timber harvesting and associated management, and fire. In the spatial method for harvested native forests, the type, location and date of timber harvesting activities in Tasmania are drawn from historical harvest data provided by Sustainable Timber Tasmania.
- The non-spatially explicit estate modelling capability of FullCAM is used for both public and private forests in Queensland and Western Australia, and for private native forests only, in Victoria, New South Wales and Tasmania. The area of native forests harvested in

each broad forest type and age class is derived from roundwood log volumes removals for each state (ABARES, 2022) using an historical relationship between roundwood removals and harvest area data collated by state agencies.

Natural disturbances

- Fire (biomass burning) is the principal form of natural disturbance which impacts terrestrial carbon stocks in Australia. Most Australian eucalypt forests are adapted to fire, and fires, whether wildfires or prescribed fires, are generally not stand-replacing. The fire-adapted ecology of Australian eucalypt-dominated temperate forests leads to infrequent, extreme wildfires characterised by fire intervals on the decadal scale.
- 'Natural background' emissions and removals caused by natural disturbance fires are considered to be caused by non-anthropogenic events (for example ignition from lightning strike) and circumstances beyond the control of, and not materially influenced by, Australian authorities. These fires are considered to be part of the 'natural background' of non-anthropogenic emissions and removals, which are assumed to average out over time and space.
- This national definition of natural disturbances applies to wildfires on temperate forests and does not apply to fires reported as controlled burning (for example in temperate forests or in wet-dry tropical forests and woodlands). All fires on land converted to forest land are treated as anthropogenic.
- The impacts of human activities (for example salvage logging, prescribed burning, deforestation) are excluded from the identification of natural disturbances.
- The identification of lands subject to natural disturbances and monitoring for forest recovery uses the Tier 3, Approach 3, modelling system using FullCAM, which has been designed to comply with the following safeguard mechanisms:
  - the use of geo-located time series wildfire activity data
  - coverage of all forest lands
  - the ability to monitor if there is a permanent land use change on those lands following a wildfire event during the commitment period
  - the inclusion of emissions associated with salvage logging in the accounting
  - identification of lands where the natural disturbance is followed by another disturbance event, to avoid double counting.
- FullCAM uses two remote sensing data sources. The Advanced Very High Resolution Radiometer is used to identify and map natural disturbance impacts due to wildfire on forest lands, whereas Landsat data is used to map forest cover changes and identify permanent land-use changes across all forest lands.
- FullCAM spatially tracks areas and carbon stocks at the 25 metre x 25 metre pixel-level on lands identified as experiencing natural disturbances in a particular year, until another anthropogenic activity occurs (for example non-natural disturbance fire, salvage logging or land-use change).
- All forest land is monitored for harvesting and land-use change events. Where forest cover loss events are identified, these areas are visually attributed by experienced operators to either direct, human-induced land-use change, or a temporary forest loss

which does not constitute land-use change such as harvesting, fire and other non-anthropogenic disturbance.

Forest Land Remaining Forest Land

- There are four broad sub-divisions to forest land remaining forest land: harvested native forests, plantations, other native forests and fuelwood. Emissions from these four sub-divisions are not disaggregated and reported in the STGGI. This means Tasmanian-specific emissions for these sub-divisions cannot be included in this report.
- **Harvested native forests** are those forests comprising native species subjected to harvesting practices and natural regrowth. Various silvicultural techniques may be applied to initiate and promote particular growth characteristics. The areas included in this sub-division include multiple-use public forests, and public forest areas which have been available for harvesting at any time since 1990, and private native forests subject to harvest, or regrowing from prior harvest.
- **Plantations** included within forest land remaining forest land are commercial plantations (hardwood and softwood) established in Australia up to the end of 1989. Softwood plantations make up the vast majority of these pre-1990 plantations. Hardwood plantations (primarily eucalypt species) make up only a minor part of the plantation estate. Until the mid-1960s, most new areas of softwood plantation were derived from clearing of native forest or scrublands. In later years, some of the hardwood plantations were also established after clearing native forest. By the mid-1980s, clearing of native forests for the establishment of plantations had ceased in most states, and most new plantations were established on farmland.
- **Other native forests** include those forests that comprise native species, which are not harvested native forests or plantations. The other native forests sub-division includes protected areas (such as wilderness areas and national parks) not previously subject to harvesting, and extensive areas of forests including woodlands.
- Harvested wood products are not reported in this category. Carbon stocks in wood products are transferred to the harvested wood products sub-category.
- As for all forests, the harvested native forests sub-category is monitored for forest conversions. Areas that are identified as direct human induced forest conversions are excluded from forest land remaining forest land from the time of the conversion event, and any harvesting losses associated with the conversion event are also excluded and reported only under the new land use category, to avoid double-counting.

Appendix C

UNFCCC emissions reporting sectors and descriptions

- The STGGI provides estimates of emissions sources and sinks across five sectors. The five sectors included in the STGGI are:
  - energy
  - IPPU
  - agriculture
  - LULUCF
  - waste.
- Due to the significance of the energy sector in Tasmania, this sector is disaggregated into three sub sectors:
  - electricity generation
  - direct combustion (of fuels for stationary energy)
  - transport.

Sector Description	
Energy	
Electricity generation	Emissions from electricity generation are included in the energy industries sub-sector in the STGGI. Emissions are produced by the combustion of fuels to generate electricity that is supplied to the electricity grid for domestic and commercial use. This sub-sector covers emissions resulting from electricity that is generated in Tasmania, some of which is exported for consumption in the National Electricity Market (NEM) via Basslink. Emissions from electricity imported via Basslink from other states in the NEM are accounted for in the emissions inventory for the state where the energy is generated.
Direct combustion	For the purposes of this report, emissions from direct combustion are covered by a number of energy sub-sectors in the STGGI (Manufacturing Industries and Construction, Other Sectors, and Other). These sub-sectors include all emissions that arise from the combustion of fuel for stationary energy used directly on site, such as

<table>
<tr><th colspan="2">Sector Description</th></tr>
<tr><td></td><td>burning coal, liquefied natural gas or forestry residue to generate heat, steam or pressure for major industrial operations
burning wood or gas for household heating and cooking.
The industries that generate these emissions include manufacturing, construction, agriculture and fisheries, residential, and commercial activities.

Emissions from these industries associated with the combustion of fuels to generate electricity, or fuel combustion in transport, are accounted for in the electricity generation and transport sub-sectors respectively.</td></tr>
<tr><td>Transport</td><td>Emissions from the transport sub-sector are produced by the combustion of fuels such as petrol, diesel and LPG in passenger and commercial motor vehicles, railways, domestic aviation, and shipping.

Emissions from the electricity used to power electric vehicles are accounted for in the electricity generation sub-sector.</td></tr>
<tr><td colspan="2">Industrial processes and product use (IPPU)</td></tr>
<tr><td colspan="2">Emissions from the IPPU sector are generated from a range of production processes that include:
the calcination of carbonate compounds (cement, lime or glass production)
carbon when used as a chemical reductant (iron, steel or aluminium production)
the production and use of synthetic gases such as hydrofluorocarbons (refrigeration, air conditioning, solvents) and sulphur hexafluoride (electrical equipment).
Emissions associated with the energy used in industrial production processes are accounted for in the electricity generation and direct combustion sub-sectors. For example, the emissions from cement manufacture include the combustion of fuels (coal) for heat used in the manufacturing process. However, these combustion-related emissions are reported as energy emissions (direct combustion sub-sector) and not with IPPU, which only includes the emissions from calcination.</td></tr>
<tr><td colspan="2">Agriculture</td></tr>
<tr><td colspan="2">Emissions from the agriculture sector include emissions from:
livestock digestion (enteric fermentation)
the release of nitrous oxide from cropping and pasture land, and manure management.</td></tr>
</table>

Sector Description
Enteric fermentation of plant material that is digested by livestock (cattle, sheep and pigs) results in methane emissions. Urine and dung deposited by grazing animals, and nitrogen leaching and run-off, results in emissions from microbial and chemical transformations that produce and consume nitrous oxide in the soil. Manure management produces emissions through the anaerobic decomposition of the organic matter contained in manure. Emissions associated with the use of electricity, fuel consumption from operating agricultural equipment, and fuel consumption in transport, are accounted for in the energy sector. Emissions from land use change (such as clearing of forest land for the purpose of creating cropping and pasture land) are accounted for under the LULUCF sector.
Land use, land use change and forestry (LULUCF)
The LULUCF sector includes emissions and sequestration (removals or carbon sinks) of greenhouse gases from direct human-induced land use, land use change and forestry activities. This includes emissions and sequestration associated with clearance of forested land and conversion to other land uses (cropland, grassland, wetlands and settlements), from new forests planted on previously unforested land, and from other practices that change emissions and sequestration (forest management, cropland management and grazing land management). Emissions from fuelwood consumption, controlled burning and wildfires on forest land are also included, as are removals associated with post-fire recovery. Carbon that accumulates in harvested wood products is included as a sink. Combustion of fossil fuels associated with forestry and land management (diesel to run logging machinery and farming equipment) are accounted for in the direct combustion sub-sector. Emissions associated with livestock (enteric fermentation) and cropping (release of nitrous oxide), are accounted for in the agriculture sector.
Waste
Emissions from the waste sector are produced by the decomposition of organic waste in landfills and from the release of greenhouse gases during the treatment of wastewater. The anaerobic decomposition of organic matter from solid waste in landfills and wastewater treatment plants produces methane. The nitrification and denitrification of urea and ammonia in wastewater treatment plants produces nitrous oxide emissions. Emissions associated with the energy used in the management and transportation of waste are reported in the electricity generation, direct combustion and transport sub-sectors.

Appendix D

Greenhouse gas source and sink categories for Tasmania 2020-21

Sector/Sub-sector	Emissions Mt CO_2-e
Energy (including fugitive emissions)	3.6262
Direct combustion and fugitive emissions	1.7395
Electricity generation	0.1341
Transport	1.7525
IPPU	1.5612
Mineral industry	0.7012
Chemical industry	0.0067
Non-energy products from fuels and solvent use	0.0018
Product uses as ozone depleting substances substitutes	0.2522
Other product manufacture and use	0.0036
Agriculture	2.7603
Enteric fermentation	2.0675
Manure management	0.1659
Agricultural soils	0.4389
Field burning of agricultural residues	0.0004
Liming	0.0510
Urea application	0.0367
LULUCF	-13.1289
Forest Land	-14.0646

Sector/Sub-sector	Emissions Mt CO_2-e
Forest land remaining forest land	-11.2193
Land converted to forest land	-2.8453
Cropland	0.1247
Cropland remaining cropland	0.1182
Land converted to cropland	0.0065
Grassland	1.0923
Grassland remaining grassland	-0.0959
Land converted to grassland	1.1882
Wetland	0.1978
Wetland remaining wetland	0.1976
Land converted to wetland	0.0002
Settlements	0.0148
Settlements remaining settlements	-0.0014
Land converted to settlements	0.0162
Harvested Wood Products	-0.4938
Waste	0.3810
Solid waste disposal	0.2682
Biological treatment of solid waste	0.0060
Waste water treatment and discharge	0.1069
Total	**-4.8002**

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