Climate Change Office

Tasmanian Greenhouse Gas Emissions Report 2024

August 2024

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.

Author: Climate Change Office | Renewables, Climate and Future Industries Tasmania

Publisher: Department of State Growth

ISBN: 978-1-921527-93-7

Date: August 2024

Cover images: Chris Crerar

Contents

Contents

Minister’s message

I am pleased to report that Tasmania has again achieved net negative greenhouse gas emissions. In the latest greenhouse gas inventory for Tasmania, our net greenhouse gas emissions for 2022 were minus 4.34 megatonnes (Mt) of carbon dioxide equivalent (CO_2-e), which is a decrease of 122.2 per cent from the baseline year of 1990.

We were the first Australian jurisdiction to achieve net zero emissions, which we reached in 2014. We have maintained this status for the last nine reported years. This accomplishment reflects our longstanding investment in renewable energy generation, and the sequestration capacity of our forests. Our economy and population have also grown significantly since the baseline year, demonstrating that a low emissions transition is achievable.

Tasmania’s climate change legislation sets a target of net zero emissions, or lower, by 2030. The target complements our commitment to increasing Tasmania’s renewable energy output to 200 per cent of our 2020 demand by 2040, recognising that clean energy is at the core of our decarbonisation agenda.

In addition to the target, the legislation also requires the government to prepare a climate change action plan, climate change risk assessment, and emissions reduction and resilience plans for key sectors, and update them every five years.

Other initiatives underway include a large-scale trial of *Asparagopsis* seaweed feed supplements to help farmers to reduce livestock methane emissions, and assisting landowners to plant trees on their land through the Stems for CO2 program, in partnership with Private Forests Tasmania. In the transport sector, our e-transport support package provided rebates for electric vehicles, e-mobility devices like e-bikes, and interest-free loans for charging infrastructure.

We are committed to an integrated, whole-of-government approach to climate change action and supporting the Tasmanian economy in a successful low emissions transition.

The Honourable Nick Duigan MLC

Minister for Energy and Renewables

Introduction

This report presents an overview of Tasmania's greenhouse gas emissions (called 'emissions' in this report) sources and sinks from 1990 to 2022. 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 2022 refers to the financial year 1 July 2021 to 30 June 2022. 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 and guidelines.

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 legislation requires the government to prepare a report about Tasmania's greenhouse gas emissions and our progress towards achieving our emissions reduction target.

The *Climate Change (Greenhouse Gas Emissions) Regulations 2022* require the responsible Minister to publish Tasmania's greenhouse gas emissions for the calendar year to which the Australian Government's Greenhouse Gas Inventory relates.

What are greenhouse gases?

Greenhouse gases trap heat in the atmosphere and make the earth warmer. These gases occur naturally but are also produced by human activities.

Gases with the most significant impact on global warming are water vapour, carbon dioxide (CO_2), 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 one. All other greenhouse gases have a GWP which is a certain number of times greater than carbon dioxide, as shown in the table below.

Table 1: Global Warming Potential of greenhouse gases

Greenhouse gas	Global warming potential (number of times greater than carbon dioxide)
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 tonne of methane results in the equivalent global warming of 28 tonnes of carbon dioxide, and is therefore measured as 28 t CO_2-e.

What are carbon sinks?

Plants, soils, and oceans can remove more carbon dioxide from the atmosphere than they emit. The removed carbon is stored, often in the form of growing vegetation. This process is known as sequestration. An area that stores a lot of carbon, like a forest, is called a ‘carbon sink’.

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 signed up to the international United Nations Framework Convention on Climate Change (UNFCCC) to report their greenhouse gas inventories.

Data source – Australia’s National Greenhouse Gas Accounts

The main source of data on Tasmania’s emissions is the Australian Government’s State and Territory Greenhouse Gas Inventories (STGGI). The STGGI is a disaggregation of the data contained in Australia’s National Greenhouse Gas Accounts and the National Inventory Report (NIR).

To meet our international greenhouse gas inventory reporting commitments, including compliance with the Paris Agreement, the Australian Government submits the NIR to the UNFCCC every year.

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

- procedures and guidelines in the Paris Agreement, particularly Article 13
- 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 best 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. DCCEEW submits the reports 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 2022. As historical figures are revised each year, to account for recalculations and methodology changes, the latest NIR data cannot be compared with reports from previous years.

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’.

The STGGI data relates to production-based, rather than consumption-based emissions in Tasmania, which are called scope 1 emissions. This means that the data account for emissions from goods and services produced in Tasmania, rather than from goods and services that are imported and consumed.

Confidential information

As part of the National Energy and Greenhouse Reporting Scheme, the Australian Government treats some data as confidential. These data are aggregated with other sectors before publication. This happens when reporting at a sub-sector level could lead to the disclosure of commercially-sensitive emissions data reported by an organisation.

For example, there are very few industrial sites that produce fugitive emissions in Tasmania, so the Australian Government treats Tasmania’s fugitive emissions as confidential to avoid identification of individual businesses.

This rule also applies to emissions from the ‘metal industry’, and ‘other’ sub-sectors, including ‘pulp and paper’ and ‘food and beverage industry’, which are reported as combined emissions in the IPPU sector.

Data source – Australian Bureau of Statistics (ABS)

This report also compares the time series of Tasmania’s emissions to the state’s Gross State Product (GSP) and population from 1990 to June 2022. GSP data were sourced from the ABS Australian National Accounts: State Accounts, 2022-23 (Cat No 5220.0).

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

Units of measure

Greenhouse gases are often 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.

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 this report are plotted on different scales to make them easier to read and may not be directly comparable with each other.

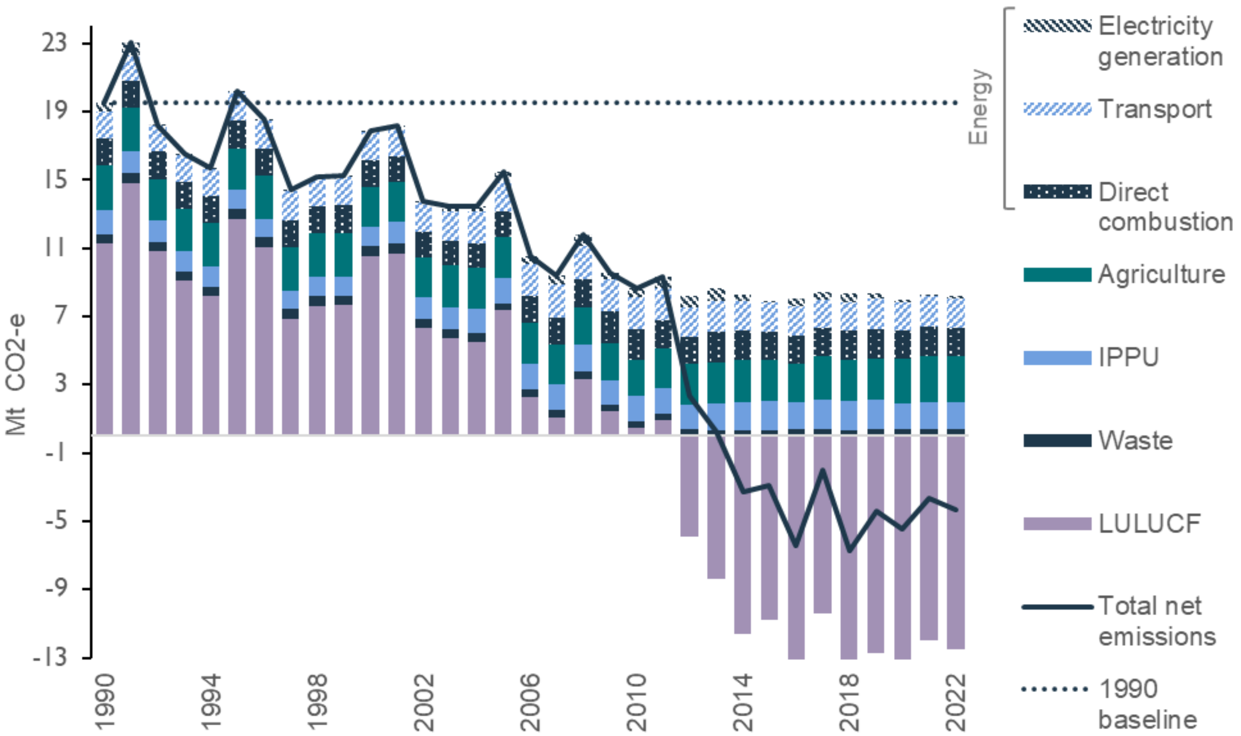
Changes in Tasmania's emissions

Tasmania's emissions – 1990 to 2022

In 2022, Tasmania's emissions were **minus 4.34 Mt CO_2-e**. Tasmania's emissions decreased by 23.88 Mt CO_2-e between 1990 and 2022, which is a **reduction of 122.2 per cent**.

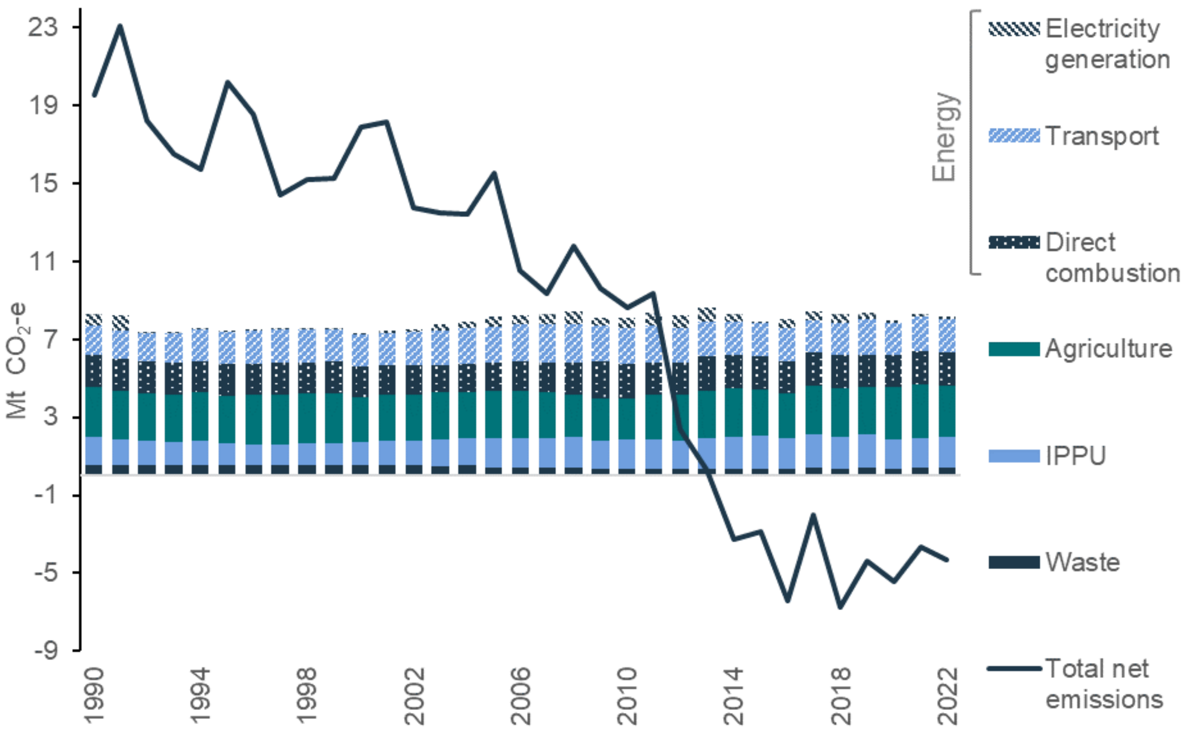
There is a clear downward trend in Tasmania's net annual emissions from 1990 to 2022 (Figure 1). Tasmania first achieved net negative emissions in 2014 and has maintained this level each year to 2022.

Figure 1: Tasmania's emissions by sector and energy sub-sector - 1990 to 2022



Changes in the Land Use, Land Use Change and Forestry (LULUCF) sector have resulted in increased carbon sequestration, which has had a major influence on reducing Tasmania's greenhouse gas emissions. LULUCF emissions were 23.78 Mt CO_2-e (Table 2), or 211.1 per cent, lower than 1990 levels.

Figure 2: Tasmania's emissions by sector and energy sub-sector, excluding LULUCF - 1990 to 2022



Excluding LULUCF, Tasmania's emissions in 2022 were 8.17 Mt CO_2-e. This is a decrease of 0.11 Mt CO_2-e between 1990 and 2022.

Tasmania's emissions, excluding LULUCF, were lowest in 2000 (7.35 Mt CO_2-e), highest in 2013 (8.64 Mt CO_2-e), and averaged 7.97 Mt CO_2-e between 1990 and 2022.

Emissions reductions

Reductions in emissions from 1990 to 2022:

- waste sector (down 0.17 Mt CO_2-e)
- energy sector (down 0.18 Mt CO_2-e)
- electricity generation sub-sector (down 0.45 Mt CO_2-e).

Emissions increases

Increases in emissions over the period 1990 to 2022:

- IPPU sector (up 0.17 Mt CO_2-e)
- agriculture sector (up 0.08 Mt CO_2-e)
- transport sub-sector (up 0.19 Mt CO_2-e)
- direct combustion sub-sector (up 0.09 Mt CO_2-e).

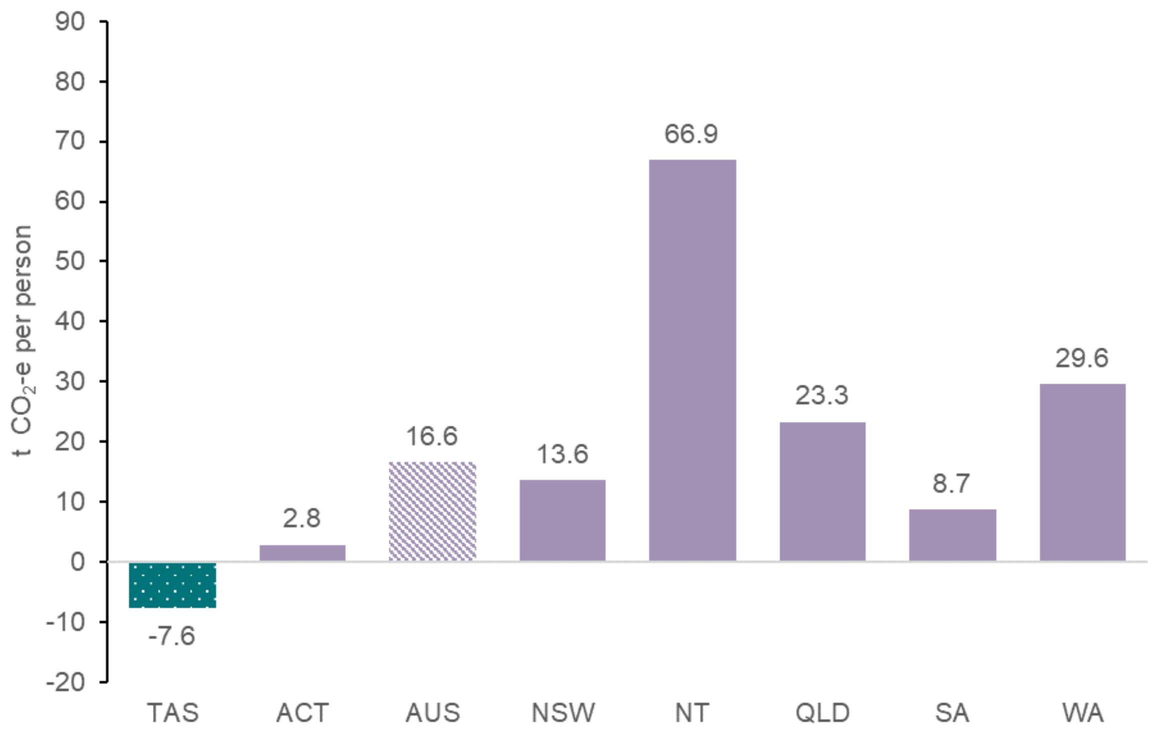
Table 2: Tasmania's emissions by sector and energy sub-sector - 1990 to 2022

Sector/Sub-sector	Emissions (Mt CO_2-e)		Change (Mt)	Change (%)
	1990	2022		
Energy	3.70	3.52	-0.18	-4.8
Electricity generation	*0.57*	*0.12*	*-0.45*	*-79.4*
Transport	*1.53*	*1.72*	*0.19*	*12.4*
Direct combustion	*1.60*	*1.68*	*0.08*	*5.3*
Agriculture	2.60	2.68	0.08	3.0
IPPU	1.42	1.59	0.17	11.9
Waste	0.57	0.39	-0.17	-30.6
LULUCF	11.26	-12.51	-23.78	-211.1
Total	**19.54**	**-4.34**	**-23.88**	**-122.2**

Tasmania’s emissions per person

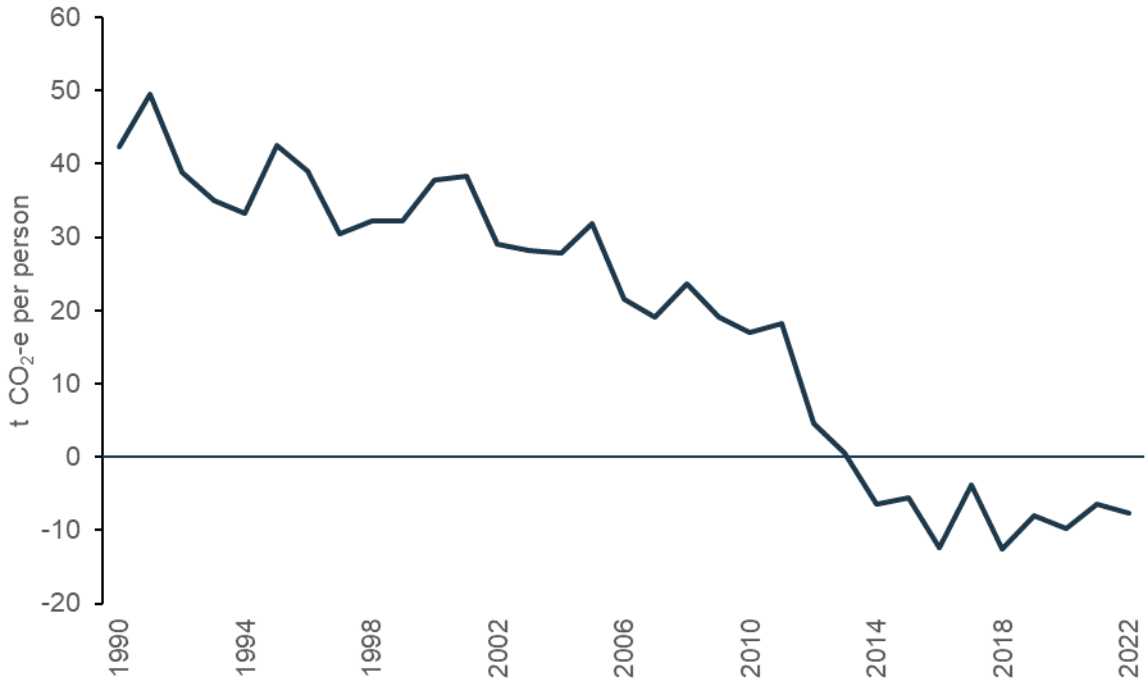
In 2022, Tasmania had the lowest emissions per person of any Australian jurisdiction, at minus 7.6 t CO_2-e per person (Figure 3). This is the only negative emissions figure per person of any Australian jurisdiction. The national average is 16.6 t CO_2-e per person.

Figure 3: Tasmania's emissions per person relative to Australia and other states and territories - 2022



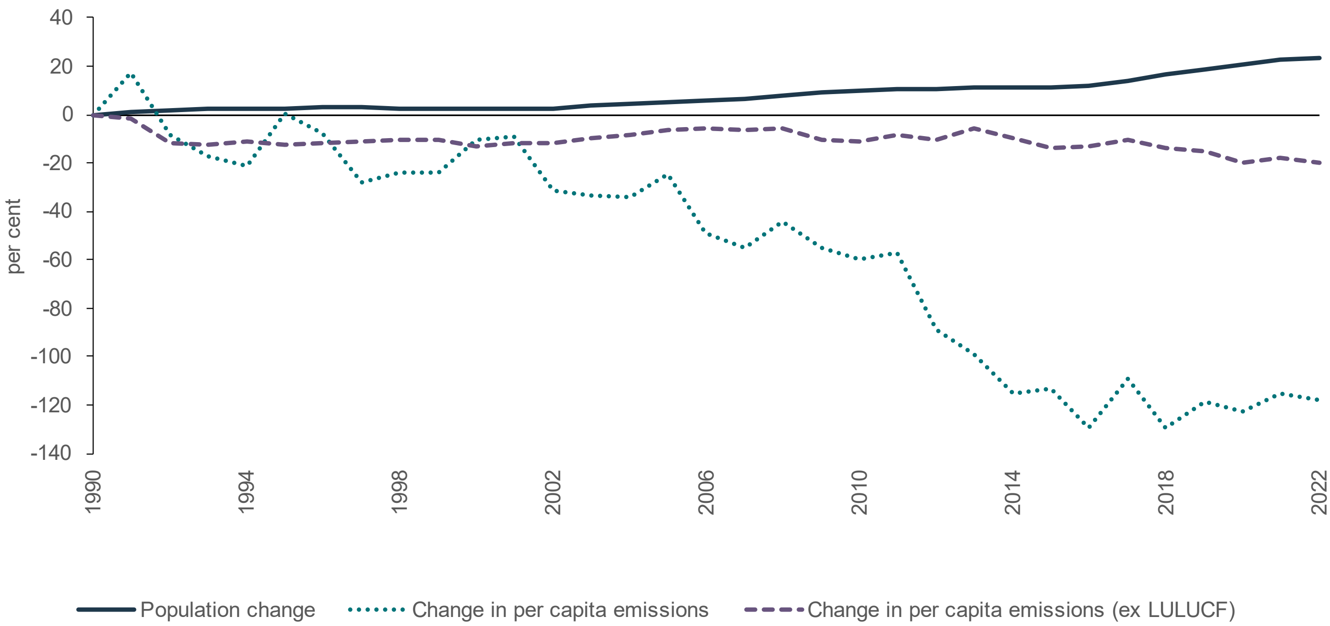
Tasmania’s emissions per person have decreased from 42.3 t CO_2-e in 1990 to minus 7.6 t CO_2-e in 2022, a reduction of 118.0 per cent (-49.9 t CO_2-e) over 32 years (Figure 4).

Figure 4: Change in Tasmania's emissions per person - 1990 to 2022



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

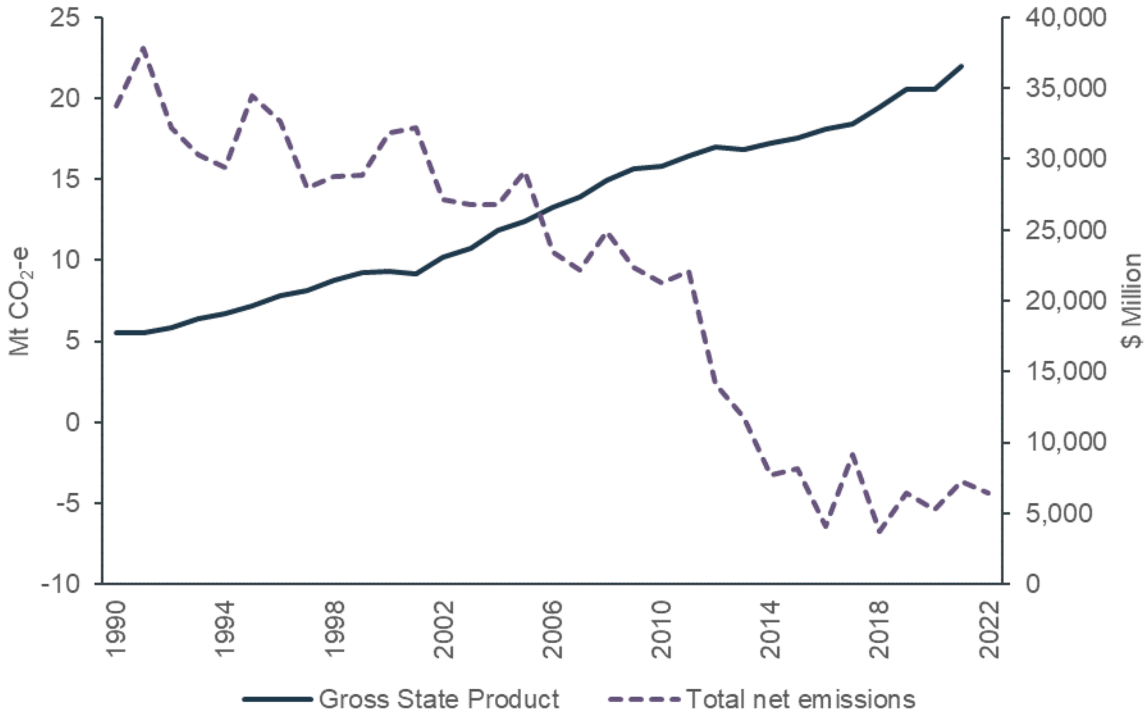
Figure 5: Percentage change in Tasmania's population and emissions per person against 1990 baseline - 1990 to 2022



Tasmania's emissions and Gross State Product

From 1990 to 2022, Tasmania's real Gross State Product (GSP) increased by 115.4 per cent (to over $38 billion) while Tasmania's emissions decreased by 122.2 per cent (Figure 6).

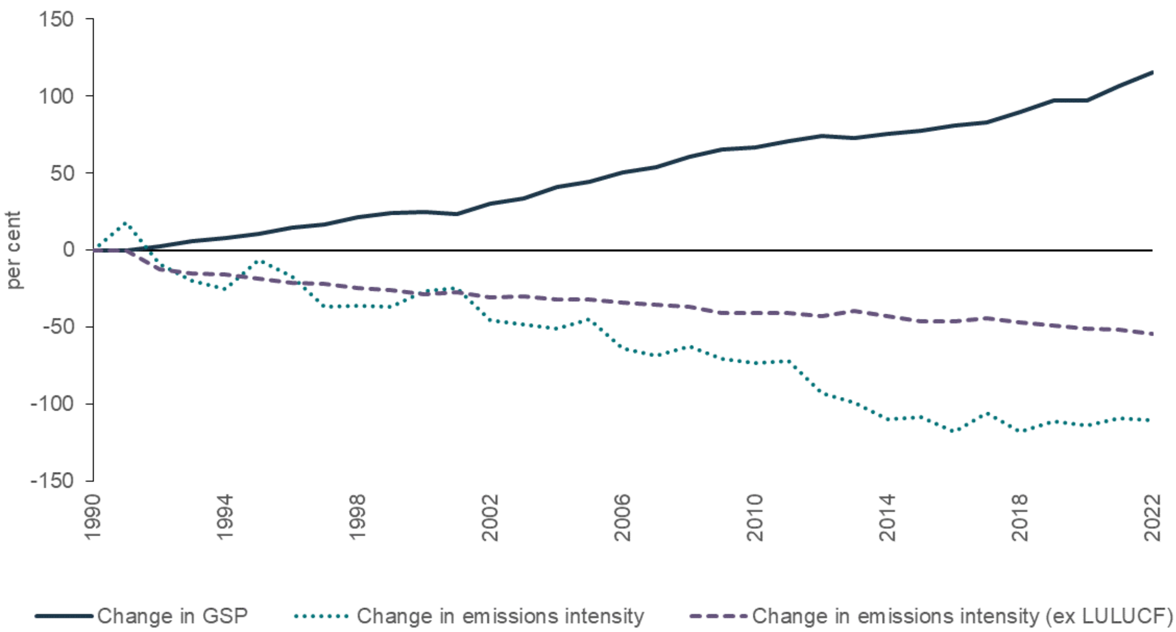
Figure 6: Change in Tasmanian emissions and real Gross State Product - 1990 to 2022



The increase in Tasmania's GSP, coupled with the decrease in Tasmania's emissions, has resulted in a reduction in the emissions intensity of the Tasmanian economy, from 1,102.8 to minus 113.6 t CO_2-e per million dollars of GSP (a reduction of 110.3 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 467.3 t CO_2-e to 214.2 t CO_2-e per million dollars of GSP between 1990 and 2022, which is a reduction of 54.2 per cent over this period.

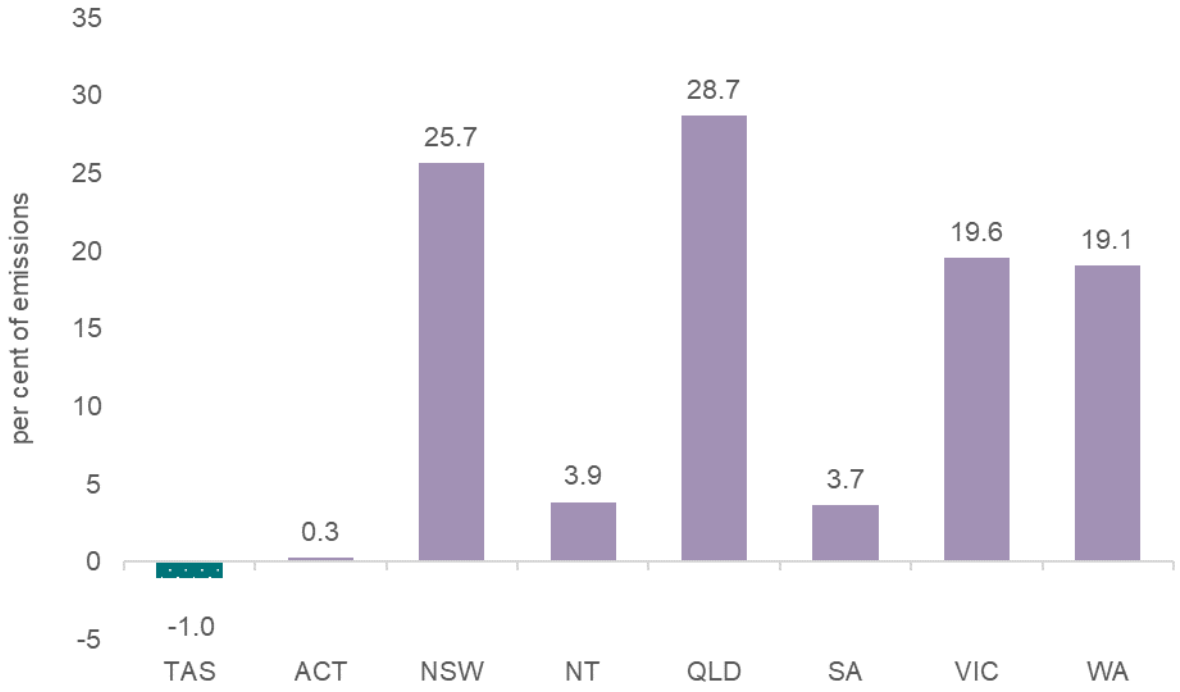
Figure 7: Percentage change in Tasmania's real GSP and emissions intensity against 1990 baseline - 1990 to 2022



Tasmania’s contribution to national emissions

In 2022, Tasmania helped reduce Australia’s total emissions (432.62 Mt CO_2-e) by 1.0 per cent (Figure 8).

Figure 8: Tasmania's contribution to national emissions - 2022



Tasmania's emissions by sector

This chapter details Tasmania's emissions by the IPCC sectors of energy, agriculture, industrial processes and product use (IPPU), waste, and land use, land use change and forestry (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 2022

Tasmania's emissions in 2022 were minus 4.34 Mt CO_2-e. Emissions by sector and energy sub-sector are shown in Figure 9.

- The LULUCF sector provided net sequestration of emissions (a carbon sink) of minus 12.51 Mt CO_2-e, offsetting emissions from all other sectors.
- Excluding LULUCF, other sectors contributed 8.17 Mt CO_2-e to Tasmania's emissions, as follows: energy (43.0 per cent), agriculture (32.7 per cent), IPPU (19.4 per cent), and waste (4.8 per cent).
- Excluding LULUCF, the energy sub-sectors accounted for the following share of total emissions: transport (21.1 per cent of emissions), direct combustion (20.6 per cent) and electricity generation (1.4 per cent).

Figure 9: Tasmanian emissions by sector and energy sub-sectors - 2022

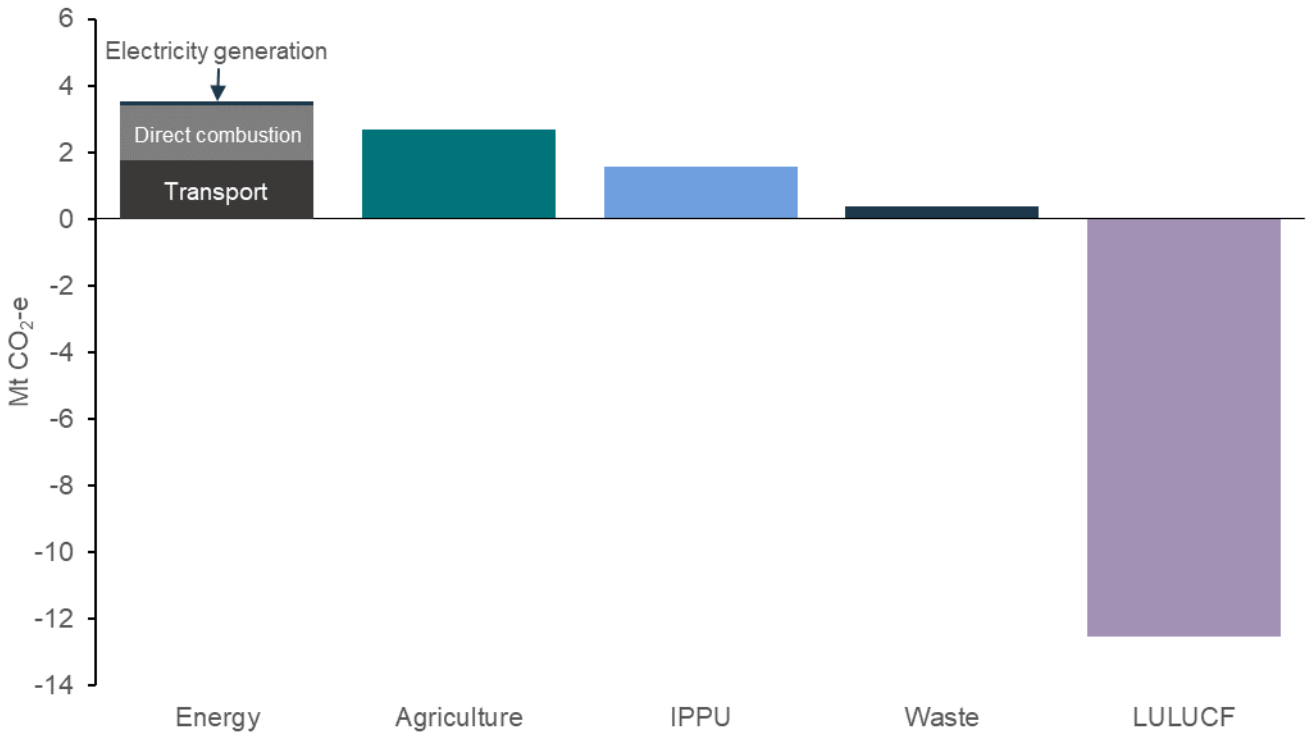
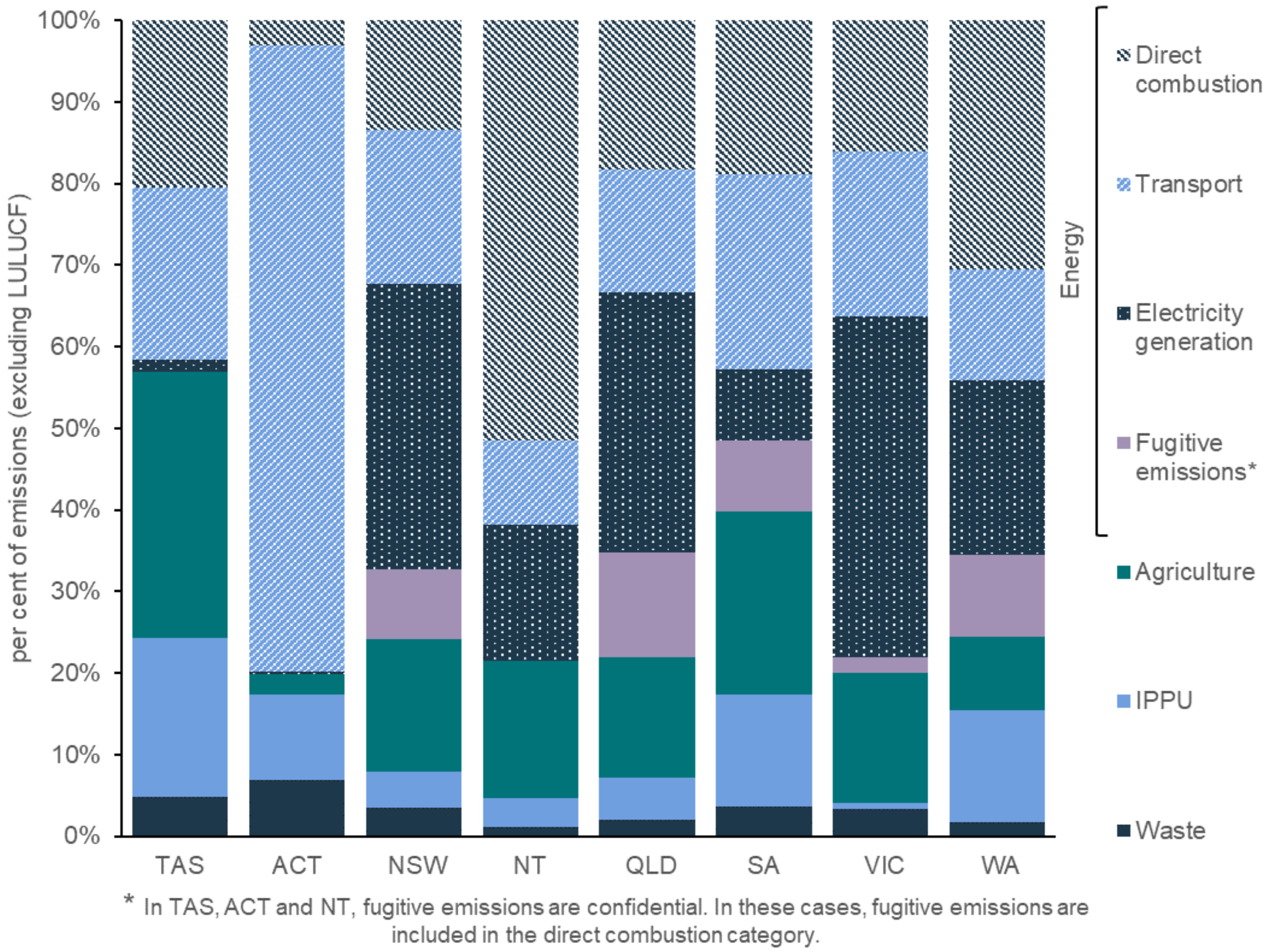


Figure 10 highlights the differences in the relative contribution of each sector and energy sub-sector for each Australian jurisdiction's emissions. The LULUCF sector has been excluded from this analysis. The Australian Capital Territory has a unique emissions profile, as most of its electricity is supplied from renewable sources in 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. 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 - 2022



Energy

Tasmania's energy sector comprises electricity generation, direct combustion, transport, and fugitive emissions. There are very few sites that produce fugitive emissions in Tasmania, so the Australian Government treats Tasmania's fugitive emissions as confidential to avoid identification of individual organisations.

For this report, 'fugitive emissions', 'manufacturing industries and construction' and 'other' sub-sectors are included in direct combustion. Tasmania's energy sector contributed 3.52 Mt CO_2-e in 2022, accounting for 43.0 per cent of Tasmania's emissions when LULUCF is excluded.

Compared to other states and territories (Figure 10), Tasmania has high levels of renewable electricity 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) 2022

Energy 43.0%		
Stationary energy	22.0%	Transport
Direct combustion 20.6%	Electricity generation 1.4%	21.1%

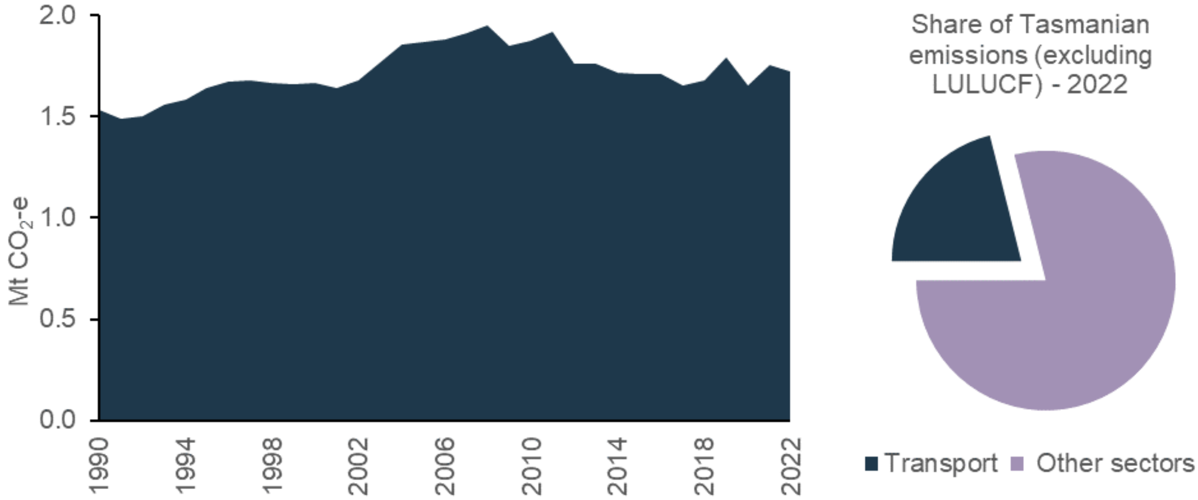
Transport

Emissions from the transport sub-sector are produced by the combustion of fuels such as petrol, diesel, and liquefied petroleum gas (LPG), in passenger, light commercial and heavy freight vehicles, railways, recreational boating and marine navigation, and aviation fuel for domestic airlines.

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 1.72 Mt CO_2-e, which was 21.1 per cent of Tasmania’s emissions in 2022, excluding LULUCF (Figure 13). The emissions from transport increased by 0.19 Mt CO_2-e (12.4 per cent) between 1990 and 2022.

Figure 12: Tasmanian emissions from transport - 1990 to 2022



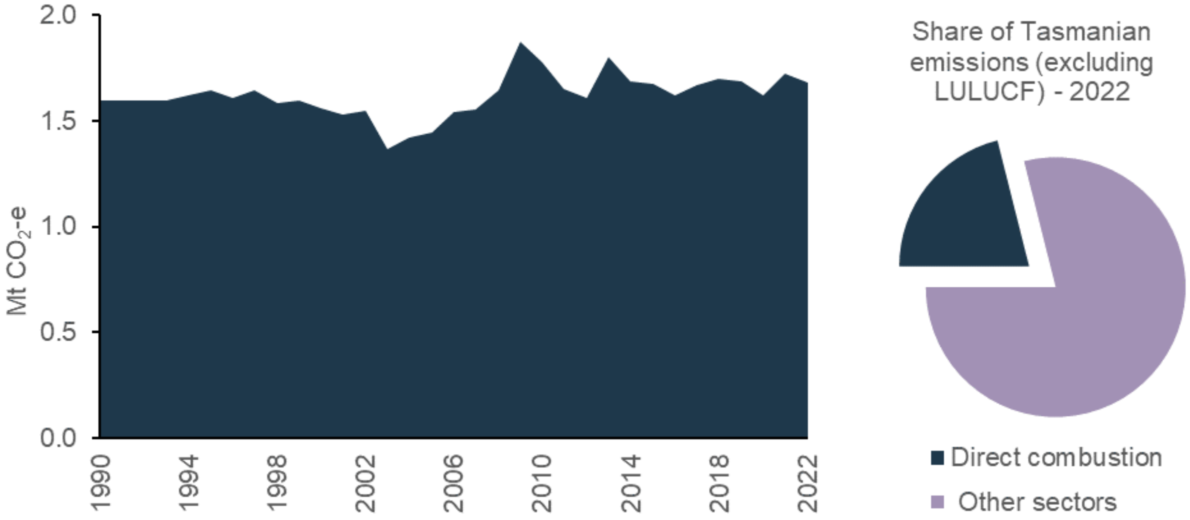
Direct Combustion

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 uses, and commercial operations. There is no double counting of emissions from biomass consumption, including fuelwood, between the LULUCF and energy sectors.

Direct combustion accounted for 1.68 Mt CO_2-e, which was 20.6 per cent of Tasmania’s emissions in 2022, excluding the emissions from LULUCF (Figure 13). The emissions from direct combustion increased by 0.09 Mt CO_2-e (5.3 per cent) between 1990 and 2022.

Emissions from the combustion of fossil fuels such as natural gas at the Tamar Valley Power Station, and petrol and diesel used in passenger and heavy vehicles, are accounted for in the electricity generation and transport sub-sectors respectively.

Figure 13: Tasmanian emissions from direct combustion - 1990 to 2022



Electricity generation

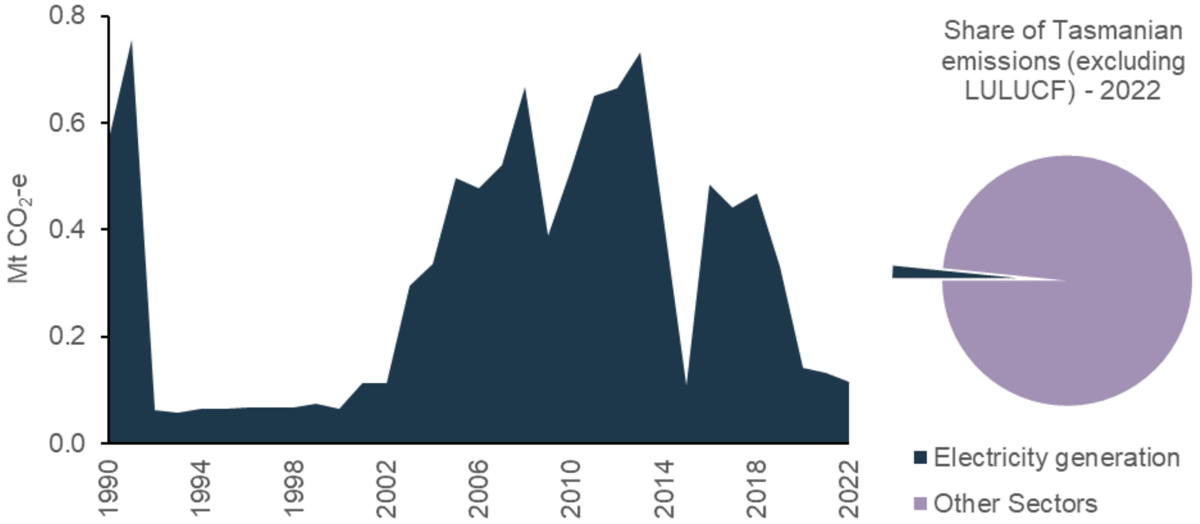
Emissions from electricity generation are produced by the combustion of fossil fuels to generate electricity that is supplied to the electricity grid for domestic and commercial use.

This sub-sector covers emissions from electricity that is generated in Tasmania, some of which is exported to the National Electricity Market via Basslink.

In 2022, emissions from electricity generation accounted for 0.12 Mt CO_2-e, which was 1.4 per cent of Tasmania's emissions, excluding LULUCF (Figure 14). The emissions from electricity generation decreased by 0.45 Mt CO_2-e (79.6 per cent) between 1990 and 2022.

Emissions from electricity imported into Tasmania via Basslink are accounted for in the greenhouse gas inventory of the state that generates the electricity.

Figure 14: Tasmanian emissions from electricity generation - 1990 to 2022



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. Agricultural emissions comprise:

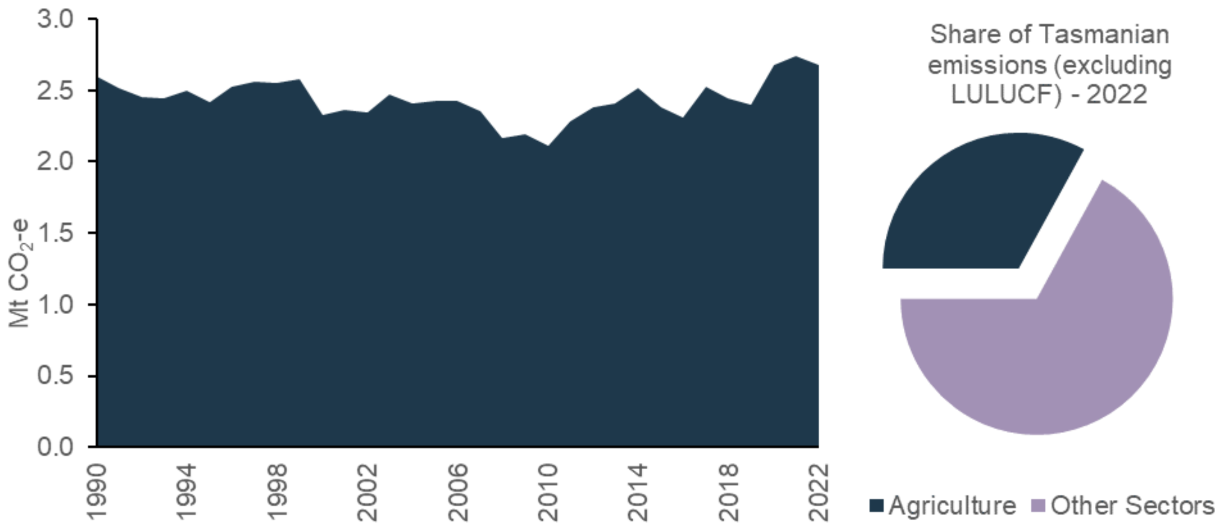
- enteric fermentation of plant material that is digested by livestock (for example, cattle, sheep, and pigs) that results in methane emissions

- urine and dung deposited by grazing animals, and nitrogen leaching and run-off, resulting in emissions from microbial and chemical transformations that produce and consume nitrous oxide in the soil
- manure management practices that produce emissions through the anaerobic (without oxygen) decomposition of the organic matter contained in manure
- land management practices such as lime, fertiliser and urea applications, that produce nitrous oxide emissions.

Tasmania's agriculture sector accounted for 2.68 Mt CO_2-e, which was 32.7 per cent of Tasmania's emissions, excluding LULUCF (Figure 15). The emissions from agriculture increased by 0.08 Mt CO_2-e (3.0 per cent) between 1990 and 2022.

Emissions associated with the use of electricity and fuel consumption from operating agricultural equipment, and the fuel consumption used to transport farm products, 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.

Figure 15: Tasmanian emissions from agriculture - 1990 to 2022



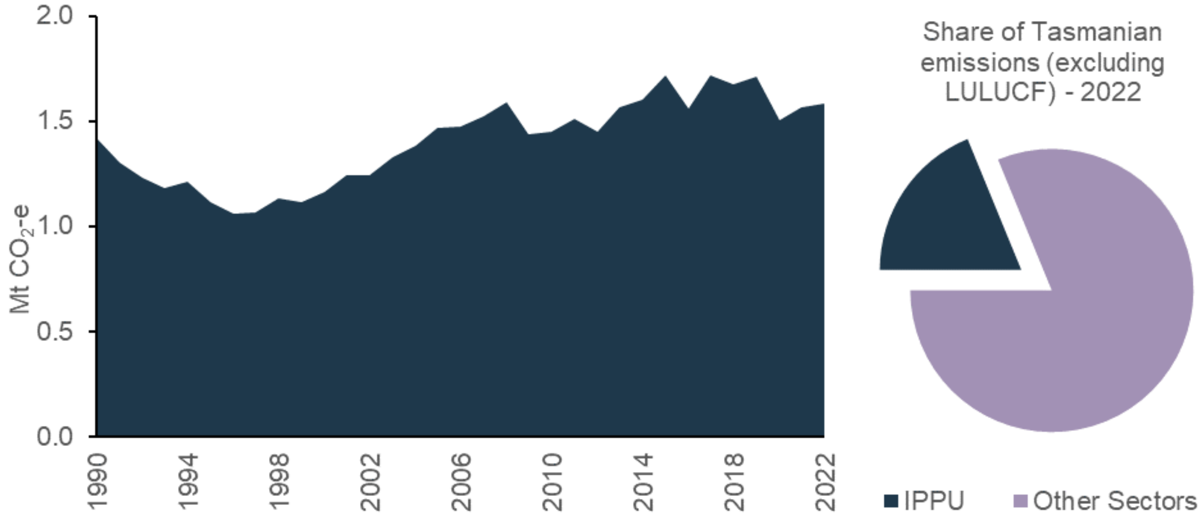
Industrial processes and product use (IPPU)

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 (used in refrigeration and air conditioning equipment and as solvents) and sulphur hexafluoride (used in electrical equipment).

In 2022, Tasmania's IPPU sector accounted for 1.59 Mt CO_2-e, which was 19.4 per cent of the state's emissions, excluding LULUCF (Figure 16). The emissions from IPPU increased by 0.17 Mt CO_2-e (11.9 per cent) between 1990 and 2022.

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.

Figure 16: Tasmanian emissions from IPPU - 1990 to 2022



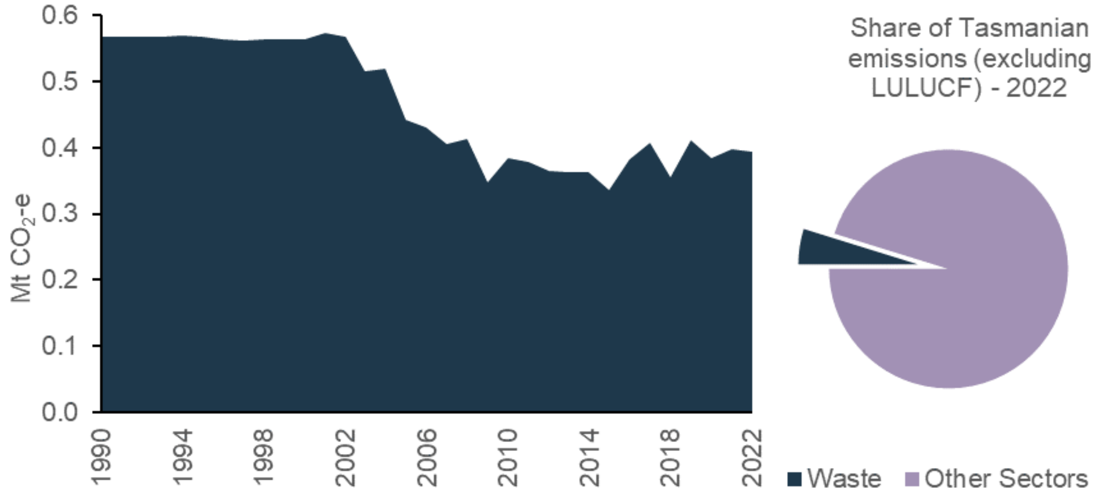
Waste

Emissions from the waste sector are produced by the anaerobic decomposition of organic matter from solid waste in landfills and 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.

In 2022, Tasmania's waste sector accounted for 0.39 Mt CO_2-e, which was 4.8 per cent of Tasmania's emissions, excluding LULUCF (Figure 17). The emissions from waste decreased by 0.17 Mt CO_2-e (30.6 per cent) between 1990 and 2022.

Figure 17: Tasmanian emissions from the waste sector - 1990 to 2022



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 uses, land use changes and forestry activities. These activities include emissions and sequestration associated with:

- the clearance of forested land and plantations, and the conversion to other land uses (for example cropland, grassland, wetlands and settlements)
- the establishment of new forests and plantations planted on previously unforested land

- other practices that change emissions and sequestration, such as forest management, cropland management and grazing land management.

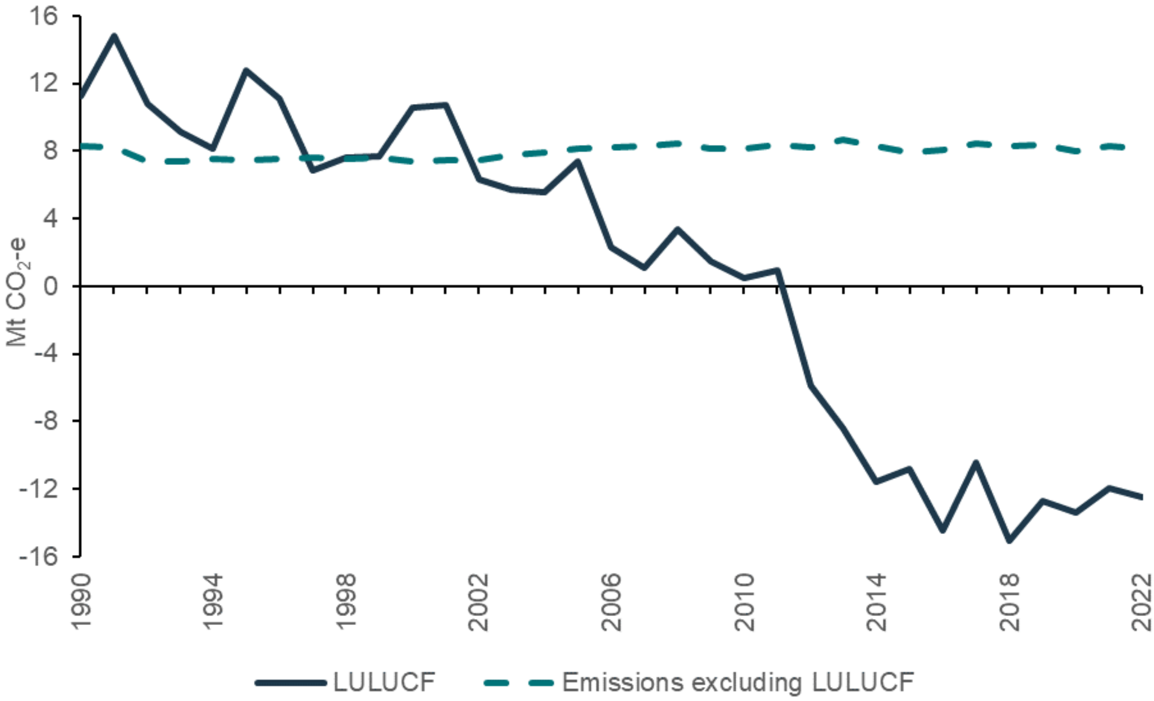
Emissions from fuelwood consumption, controlled burning, and wildfires on forest land, are also included in the LULUCF sector, as are removals associated with post-fire recovery. Carbon that is stored in harvested wood products is included as a carbon sink.

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-e emissions associated with livestock (such as methane from enteric fermentation) and cropping (such as release of nitrous oxide from agricultural soils) are accounted for in the agriculture sector.

In 2022, Tasmania's LULUCF sector was a net carbon sink, resulting in minus 12.51 Mt CO_2-e. This sink offset the emissions from other sectors that had a combined contribution of 8.17 Mt CO_2-e (Figure 18). The emissions from LULUCF decreased by 23.78 Mt CO_2-e (211.1 per cent) between 1990 and 2022. From 1990 to 2011 the sector contributed as a source of emissions but now acts as a carbon sink.

More details on the emissions and removals for the LULUCF sub-sectors and sub-categories are provided in Attachment D.

Figure 18: Tasmania's emissions from LULUCF relative to other sectors - 1990 to 2022



Attachment A

Greenhouse gas source and sink categories for Tasmania 2022

Table 3: Emissions for Tasmania's sectors and sub-sectors for 2022

Sector/Sub-sector	Emissions (Mt CO_2-e)
Energy (including fugitive emissions)	3.5191
Transport	1.7214
Direct combustion	1.6802
Electricity generation	0.1175
Industrial Processes and Product Use (IPPU)	1.5857
Mineral industry	0.6320
Chemical industry	0.0067
Non-energy products from fuels and solvent use	0.0023
Products used as substitutes for ozone depleting substances	0.2425
Other product manufacture and use	Confidential
Agriculture	2.6753
Enteric fermentation	2.0180
Manure management	0.1643
Agricultural soils	0.4086
Field burning of agricultural residues	0.0005
Liming	0.0510
Urea application	0.0329
Land Use, Land Use Change and Forestry (LULUCF)	-12.5126
Forest Land	-12.7787
Cropland	0.0383
Grassland	0.8163
Wetland	0.2069
Settlements	-0.0130

Sector/Sub-sector	Emissions (Mt CO_2-e)
Harvested Wood Products	-0.7823
Waste	0.3943
Solid waste disposal	0.2691
Biological treatment of solid waste	0.0060
Wastewater treatment and discharge	0.1192
Total	**-4.3381**

Attachment B

UNFCCC emissions reporting sector 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:
  - transport
  - direct combustion (of fuels for stationary energy)
  - electricity generation.

Table 4: Description of the UNFCCC sectors and selected sub-sectors

Sector Description	
Energy	
Transport	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.
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: • 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. Emissions are generated from the manufacturing, construction, agriculture and fisheries industries, and 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.

<table>
<tr><th colspan="2">Sector Description</th></tr>
<tr><td>Electricity generation</td><td>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 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 electricity is generated.</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 impacts on soil carbon from the application of lime and urea to farm land
the release of nitrous oxide from the application of fertilisers, animal wastes, sewage sludge and crop residues to farm land
manure management.
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.</td></tr>
<tr><td colspan="2">Land use, land use change and forestry (LULUCF)</td></tr>
<tr><td colspan="2">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 sector includes emissions and sequestration associated with clearing forested land and conversion to other land uses (cropland, grassland, wetlands and settlements), from new forests and plantations planted on previously unforested land, and from other practices that change emissions and sequestration (forest management, cropland management and grazing land management).</td></tr>
</table>

Sector Description
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) is 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.

Attachment C

Summary of methodological changes to 2022 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.

DCCEEW administers a quality assurance/quality control plan to maintain the integrity of the data, identify any errors and omissions, and document inventory materials and quality control activities that relate to the National Inventory Report (NIR).

The *National Inventory Report 2022* was Australia's second national inventory submission under the Paris Agreement. In line with international reporting requirements, emissions for each of the major greenhouse gases are presented as carbon dioxide equivalents using the 100-year GWPs. In accordance with Paris Agreement requirements, the latest NIR applies 100-year GWPs contained in the 2014 IPCC Fifth Assessment Report. As greenhouse gases behave differently in the atmosphere over time, converting emissions into CO_2-e allows the various gases to be compared equally. Previous NIRs submitted for the years 2013 to 2020 applied 100-year GWPs from the 2007 IPCC Fourth Assessment Report.

The Australian Government develops recalculations for the Australian inventory in line with its *Inventory Improvement Plan*. 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-reduction approaches and technologies. 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 2022, 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.

In the 2021 STGGI, the Australian Government applied a new spatially-explicit modelling approach to estimate emissions from harvested native forests on public lands in Tasmania, 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 and has now been applied to public multiple use forests in New South Wales, Queensland, Victoria and Tasmania.

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 2022 STGGI have resulted in changes in Tasmania's emissions figures across all sectors, but are particularly significant in the LULUCF sector.

As a result of these recalculations, the emissions figures in the 2022 STGGI are not directly comparable to the figures published in the STGGI reports of previous years.

Revisions in Tasmania's emissions between the 2022 STGGI and 2021 STGGI

The recalculated data on Tasmania's emissions show that:

- Tasmania's emissions figure in the baseline year of 1990 is revised up 0.69 Mt CO_2-e to 19.54 Mt CO_2-e.
- Tasmania's emissions figure in 2021 is revised up by 1.14 Mt CO_2-e to minus 3.66 Mt CO_2-e.

- The reduction in Tasmania's emissions figure between 1990 and 2021 is revised down from 125.5 per cent to 122.2 per cent.
- Tasmania's emissions figures are wholly revised, resulting in Tasmania first achieving net negative emissions from 2014 onward, rather than in 2013 as reported in the 2021 STGGI.
- Tasmania has maintained net negative emissions for the nine reporting years from 2014 to 2022.

Table 5 presents a summary of the changes in Tasmania's 1990 emissions and Table 6 presents a summary of the changes in Tasmania's 2021 emissions by sector and energy sub-sector reported between the 2021 STGGI and 2022 STGGI.

The tables show 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 2021 STGGI, methodological changes in the 2022 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 0.71 Mt CO_2-e in 1990 and an increase in the sink provided by the LULUCF sector of approximately minus 0.71 Mt CO_2-e in 2021.

Table 5: Revisions to Tasmania's emissions for 1990 by sector and energy sub-sector, following calculations

Sector/Sub-sector	1990 Emissions (Mt CO_2-e)		Change (Mt CO_2-e)	Change (%)
	2021 STGGI	2022 STGGI		
Energy	3.70	3.70	0.00	0.0
Direct combustion	*1.60*	*1.60*	*0.00*	*0.0*
Transport	*1.53*	*1.53*	*0.00*	*0.0*
Electricity generation	*0.57*	*0.57*	*0.00*	*-0.1*
Agriculture	2.61	2.60	-0.02	-0.6
IPPU	1.42	1.42	0.00	0.0
Waste	0.57	0.57	0.00	0.0
LULUCF	10.55	11.26	0.71	6.7
Total	**18.85**	**19.54**	**0.69**	**3.7**

Table 6: Revisions to Tasmania's emissions for 2021 by sector and energy sub-sector, following recalculations

Sector/Sub-sector	2021 Emissions (Mt CO_2-e)		Change (Mt CO_2-e)	Change (%)
	2021 STGGI	2022 STGGI		
Energy	3.63	3.61	-0.01	-0.4
Direct combustion	*1.74*	*1.73*	*-0.01*	*-0.8*
Transport	*1.75*	*1.75*	*0.00*	*0.0*
Electricity generation	*0.13*	*0.13*	*0.00*	*-1.4*
Agriculture	2.76	2.74	-0.02	-0.7
IPPU	1.56	1.56	0.00	0.1
Waste	0.38	0.40	0.02	4.5
LULUCF	-13.13	-11.97	1.15	-8.8
Total	**-4.80**	**-3.66**	**1.14**	**-23.7**

The main methodological changes in the sub-categories that have materially contributed to the revision in Tasmania's emissions between the 2021 STGGI and 2022 STGGI are summarised in Table 7. This information is taken from the *National Inventory Report Volume I*, Australian Government (2024), Department of Climate Change, Energy, the Environment and Water.

Table 7: Methodological changes and data revisions contributing to change in Tasmania's emissions between the 2021 STGGI and 2022 STGGI

Sector/Sub-sector	Methodological Change
Energy	
Fuel Combustion	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.
Energy Industries	Recalculations between 1999 and 2003 relate to the treatment of residual diesel combustion in electricity generation. The process of balancing total diesel consumption from the Australian Energy Statistics (AES) with facility data, in circumstances where facility data exceeded the AES total, led to negative balances 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	Historic activity data has been updated to align with the AES in the 'chemicals' and 'non-ferrous metals' categories. An energy conversion error has been rectified for 2021 within the 'mining (excluding fuels) and quarrying' category for natural gas consumption.
Transport	Corrections to 'domestic navigation' black coal consumption in 2008 and 'domestic aviation' gasoline consumption in 2009 have resulted in recalculations.

Sector/Sub-sector	Methodological Change
	A time series correction to the allocation of ethanol consumption between various transport categories has resulted in minor recalculations between 2006 and 2021. A revision of ‘road transport’ natural gas consumption in 2021 has also resulted in a recalculation. Motor vehicle stock data used to calculate road transport non-CO_2 emissions were revised by the Bureau of Infrastructure and Transport Research Economics for the 2020–21 inventory year. The correction has been made in this report and results in a recalculation in non-CO_2 emissions in road transport in 2021. Several minor corrections across several transport modes and fuels have been implemented to accurately reflect the latest release of the AES.
Other Sectors	A time series reallocation of emissions from the combustion of lubricants from IPPU ‘non-energy use of fuels’ to the ‘transport’ and ‘residential’ sectors has been completed for this report. The reallocation includes motorcycles, domestic marine, residential (such as mowers), and off-road vehicles. Australia has adopted an assumption from Switzerland that 0.05 per cent of lubricants are combusted in the transport and residential sectors.
Agriculture	
Enteric Fermentation	The 2021 emissions estimate was recalculated, updating the statistics for the number of lactating cows. This number affects the calculation of feed intake, and hence the estimate of enteric fermentation.
Manure Management	Emission factors for fertiliser use on crop and pasture land were updated based on a new meta-analysis of N_2O emissions from Australian agriculture from 2003 to 2021. Although they are primarily used in estimating emissions from ‘agricultural soils’, these source-specific emission factors are also used to calculate the indirect emissions from ‘manure management’. From 2015 onward, the manure management system allocation for dairy cattle was updated, based on Dairy Australia’s Land, Water and Carbon Survey Report (2020). The methane conversion factor for anaerobic lagoons and drains to paddocks has been estimated for each year using the annual temperature of dairy regions and piggery regions in each state and territory.
Agricultural Soils	This report introduces use of crop residue emission factors from the 2019 Refinement to the 2006 IPCC Guidelines (Chapter 11). Instead of a single default value, there are now two new disaggregated emission factors, for wet and dry climates. Emission factors for fertiliser use on crop and pasture land were updated based on a new meta-analysis of N_2O emissions from Australian agriculture from 2003 to 2021. The estimates for soil carbon are recalculated for the entire time series in every inventory. This recalculation leads to small changes in the estimates of nitrogen mineralisation due to loss of soil carbon.
IPPU	
Mineral Industry	Updates to construction activity data received from the ABS resulted in minor revisions to emissions estimates in the ‘other process uses of carbonates’ from the year 2011 onwards.

Sector/Sub-sector	Methodological Change
	Revised carbonate consumption data in the production of ceramics has resulted in a revision to emissions estimates for the ‘other process uses of carbonates’ from the year 2021.
Metal Industry	Revised activity data associated with the consumption of petroleum coke in the production of carbon anodes at one facility has resulted in a revision to CO_2 emissions estimates from the production of aluminium in 2021.
Product Uses as Substitutes for Ozone Depleting Substances	Emissions have been revised in the year 2021 due to updated vehicle stock data from the ABS.
Other Product Manufacture and Use	Emissions have been revised for 2008 and subsequent years due to revised CSIRO emission estimates used to calibrate sulphur hexafluoride (SF_6) operational leakage rates in electrical equipment.
Waste	
Solid Waste Disposal	Revisions to the harvested wood products activity data contributed to revisions of between -0.56 and 0.35 per cent between 1990 and 2021.
Wastewater Treatment and Discharge	Improved reporting of commodity production across some industrial sectors resulted in revised activity data for industrial wastewater. These improvements contributed to revisions of 0.70 and 6.87 per cent in 2020 and 2021, respectively. Minor revisions to activity data in domestic wastewater contributed to a revision of 0.25 per cent in 2021.
LULUCF	
All	Significant improvements have been made to the way the Full Carbon Accounting Model (FullCAM) reflects climate impacts on crop and grass production and soil carbon. Refinements have also been made to a range of parameters used in FullCAM, including updates to grazing pressure, crop and grass regimes and crop yield tables, as well as minor enhancements, including for implementation of perennial grass parameters in the savanna fire model. Activity data updates implemented in this report include addition of activity data and climate data for 2022, and annual updates to spatial datasets based on recent satellite observations. These result in a re-allocation of lands between land use categories, resulting in recalculations across most subsectors.
Forest land remaining forest land	The spatial methodology introduced in the 2019 inventory for NSW and Victoria and in 2021 for Tasmania to estimate emissions from native forestry on public lands has been extended in this report to include Queensland. The adopted spatial model with specific, reported timber harvesting events and locations changed reported emissions for public multiple use forests. These changes also reflect the effects of the weather record on tree growth, and particularly on the soil carbon pool which responds strongly to inter-annual variability in rainfall.
Cropland remaining cropland	Changes to FullCAM this year include the revision of the yield model. Yield response to rainfall has been revised through improvements to the water balance sub-model used in calculation of yields. The ranges of crop yields aligned better with those reported in ABS Agricultural Commodities statistics,

Sector/Sub-sector	Methodological Change
	especially in wetter climates. Annual grass growth was also modified to accept input yields as monthly growth increments rather than a single yearly value. This better captured the pasture growth and its response to climate. Annual grasses now grow for 9-12 months. These changes have led to large recalculations in some years, particularly over 2021 where the onset of La Nina brought more rain, lower evaporation and temperatures. Overall, La Nina increased crop production and as a result more carbon was retained within the soil. Refinements were also made to other parameters used in FullCAM, including updates to grazing pressure, crop and grass regimes, and crop yield tables. Grazing pressure tables now reflect revised yields. Grazing is handled as a fraction of the crop mass. Annual grasses regimes were modified so the growth season is a minimum of nine months to better reflect trends in annual pasture cultivations.
Grassland remaining grassland	Changes to FullCAM this year include the revision of the yield model. Yield response to rainfall has been revised through improvements to the water balance sub-model used in calculation of yields. Significant changes were made to the handling of grasses this year. Perennial grass handling has been modified so that yields are provided as a monthly growth increment, rather than a total standing dry matter mass. The die-off component has been removed and FullCAM now handles removal of turnover at each time step. Annual grass growth was also modified to accept input yields as monthly growth increments rather than a single yearly value. These changes better captured the pasture growth and its response to climate and aligns both perennial and annual grass growth. The major difference is now their growth periods: multiple years for perennial grasses and 9–12 months for annuals. Refinements were made to other parameters used in FullCAM, including updates to grazing pressure, crop and grass regimes and crop yield tables. Grazing pressure tables now reflect revised yields. Grazing is handled as a fraction of the crop mass. Annual grasses regimes were modified so the growth season is a minimum of nine months to better reflect trends in annual pasture cultivations. Crop and grass yield tables were updated according to the revised yield. Recalculations for soil carbon due to the above changes lead to a recalculation of nitrogen (N) leaching and N_2O emissions from N-mineralisation due to loss of soil carbon. Minor enhancements have also been made to the grass productivity parameters in the savanna fire model.
Wetland remaining wetland	Refinements were made to the model used to estimate farm dam emissions. The 2023 model introduces a local weather and satellite-based method to model methane emissions from agricultural ponds, accounting for fluctuations in water surface area and temperature-dependent methane flux.
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.

Attachment D

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.

The emissions and removals from the LULUCF sector have a significant impact on Tasmania's net emissions, and the LULUCF sector currently offsets emissions from all other sectors.

UNFCCC framework

Under the UNFCCC reporting framework, emissions from the LULUCF sector include emissions sources and sequestration (emissions removals or carbon sinks) of greenhouse gases from direct human-induced land use, land use conversions and forestry activities, as well as the impact of bushfires. The main driver of change in carbon fluxes across the Tasmanian landscape and the associated emissions relates to losses and gains of woody vegetation.

The UNFCCC reporting framework includes many sub-sectors, categories and sub-categories used to classify and disaggregate the various sources of emissions and removals in LULUCF. To make it easier to understand the hierarchy level of a particular sub-category and the sub-sector to which it belongs, the alpha-numeric descriptors for all LULUCF classifications are included, together with the name of the reporting category.

Under the UNFCCC reporting framework, emissions and removals for the LULUCF sector are attributed to the sub-sectors of:

- forest land (4.A)
- cropland (4.B)
- grassland (4.C)
- wetland (4.D)
- settlements (4.E)
- other land (4.F)
- harvested wood products (4.G).

The first five sub-sectors are further disaggregated into two components, a 'remaining' category and a 'land converted to' category (for example, the grassland sub-sector comprises the grassland remaining grassland (4.C.1) and land converted to grassland (4.C.2) categories).

The 'remaining' categories broadly include carbon stock changes and associated emissions and removals from human-induced activities, such as timber harvesting of native forests and plantations established before 1990, biomass burning, and farming and land management practices that result in changes to woody vegetation, woody crops and soils.

The 'land converted to' categories broadly include carbon stock changes and associated emissions and removals from human-induced activities that result in a conversion of land tenure, such as planting and harvesting of hardwood and softwood plantations established after 1990, environmental plantings, and natural regeneration and regrowth on cleared lands.

Methods to estimate emissions from biomass burning, nitrous oxide emitted from nitrogen mineralisation, and nitrogen leaching and run-off are applied across all land use classifications.

Australia does not report emissions in the other land sub-sector (4.F). These land tenures typically occur in central Australia and have minimal impact on biomass, dead organic matter and soil carbon.

Australia applies the stock-change approach for the harvested wood products sub-sector (4.G), which includes solid wood, paper and paperboard products in use and in solid waste disposal sites. The emissions from wood products that contribute to Tasmania's greenhouse gas inventory are products in service life and consumed in Tasmania, including those imported and excluding those exported.

Forest land remaining forest land

The forest land remaining forest land category (4.A.1) has a significant influence on the fluctuations in Tasmania's LULUCF emissions since 1990 and comprises emissions and removals from changes in carbon stored in:

- fuelwood for domestic use (4.A.1.i.a)
- other native forests, which includes wilderness areas and national parks not previously subjected to harvesting. The main processes affecting emissions and removals from these forests include fire management practices and wildfires (4.A.1.i.c)
- harvesting activities in private native forests (4.A.1.i.d)
- harvesting activities in multiple use public forests, including regenerative burning after harvesting events (4.A.1.i.e)
- commercial hardwood and softwood plantations established before 1990 (4.A.1.i.f).

Harvested native forests (whether on private or public lands) 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 forest lands included in this category are private native forests subject to harvest or regrowing from prior harvest and multiple-use public forests, and public forest areas which have been available for harvesting at any time since 1990.

As for all forests, the harvested native forests sub-categories are monitored for forest conversions. Areas that are identified as direct human-induced forest conversions are excluded from the forest land remaining forest land category 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.

Modelling carbon stock changes

Predominantly, country-specific methodologies and Tier 3 spatially-explicit models and Tier 1 and 2 non-spatially explicit 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 the 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. The parameters of FullCAM have been informed by the latest empirical science and are 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.

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 the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) and DCCEEW.

Improvements to LULUCF modelling

In the 2021 NIR and STGGI, the Australian Government introduced a spatially-explicit Tier 3 FullCAM model to estimate emissions from harvesting events in Tasmania's multiple-use public forests. This approach was initially introduced to model the emissions and removals from harvesting in public forests in Victoria and New South Wales in the 2020 NIR and STGGI and was extended to public forests in Queensland for this year's inventory.

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 Western Australia, and for private native forests only in Victoria, New South Wales, Queensland 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.

Bushfires and natural disturbance provisions

Fire (biomass burning) is the principal form of natural disturbance that impacts terrestrial carbon stocks in Australia. Most Australian eucalypt forests are adapted to fire, and fires, whether wildfires or prescribed burns, are generally not stand-replacing (when stands of trees or forests are killed by rare high-severity wildfires). The fire-adapted ecology of Australian eucalypt-dominated temperate forests leads to infrequent, extreme wildfires characterised by fire intervals on the decadal scale.

All forest land is monitored for bushfires, harvesting and other land use change events. Where forest cover loss events are identified, these areas are attributed to either a direct, human-induced (anthropogenic) or a natural background (non-anthropogenic) land use change. The forest loss is monitored to determine whether this is temporary with subsequent post-event recovery or there is evidence of a permanent land use change.

Natural background emissions and removals caused by natural disturbance fires are considered to be caused by non-anthropogenic events (for example ignition from lightning strikes) and are beyond the control of, and not materially influenced by, the efforts of Australian authorities to prevent, manage and control them. 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.

Consistent with the IPCC accounting guidelines, two wildfire emissions estimates are reported. The first estimate includes the net emissions from non-anthropogenic natural disturbances and the second is the long run trend in net anthropogenic emissions from the wildfire disturbances and post-fire removals as the forest recovers and regrows.

In order to identify emissions from human activity, a statistical approach is applied to identify non-anthropogenic natural disturbances on forest land remaining forest land (4.A.1). For these fires, the carbon stock loss and subsequent recovery from non-anthropogenic natural disturbances are modelled to average out over time, leaving emissions and removals from anthropogenic fires as the dominant result in the national inventory.

The IPCC accounting guidelines allow for the national emissions inventory and natural disturbance provisions to include an annual upper threshold on the impact of major bushfires. A statistical approach is applied by comparing each year’s emissions data with a national natural disturbance threshold for the calibration period 1989-90 to 2019-20. Once natural disturbance years are identified at a national level, the bushfires are spatially identified and the area burned tracked at the sub-national level. A state and territory level threshold is then applied and natural disturbance areas identified where both national and sub-national thresholds are exceeded.

This effectively means that the impact of wildfires in Tasmania can be excluded from the national inventory, provided the area burned is restored over an allocated monitoring period. If the original forest is converted to a different land use post-wildfire, the land use conversion and associated emissions are then recorded in both the national and the Tasmanian inventories.

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). The impacts of human activities (for example salvage logging, prescribed burning, deforestation) are also excluded from the identification of natural disturbances. All fires on land converted to forest land (4.A.2) are treated as anthropogenic.

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).

Constructed reservoirs

Methane emissions from constructed reservoirs and dams (as opposed to naturally occurring lakes) are included in the flooded land remaining flooded land sub-category (4.D.1.2) for existing reservoirs or dams and land converted to wetland sub-category (4.D.2) for new reservoirs or dams. These reservoirs and dams in Tasmania include those used or established by Hydro Tasmania, TasWater and Irrigation Tasmania.

Other forestry and land-related emissions

The combustion of fossil fuels associated with forestry activity and land management (such as diesel to operate logging machinery and farming equipment) is accounted for in the direct combustion (or stationary energy) sub-sector of the energy sector.

Methane emissions associated with livestock (such as enteric fermentation) and nitrous oxide emissions associated with cropping (such as the application of nitrogen fertilisers) are accounted for in the agriculture sector.

LULUCF emissions and removals

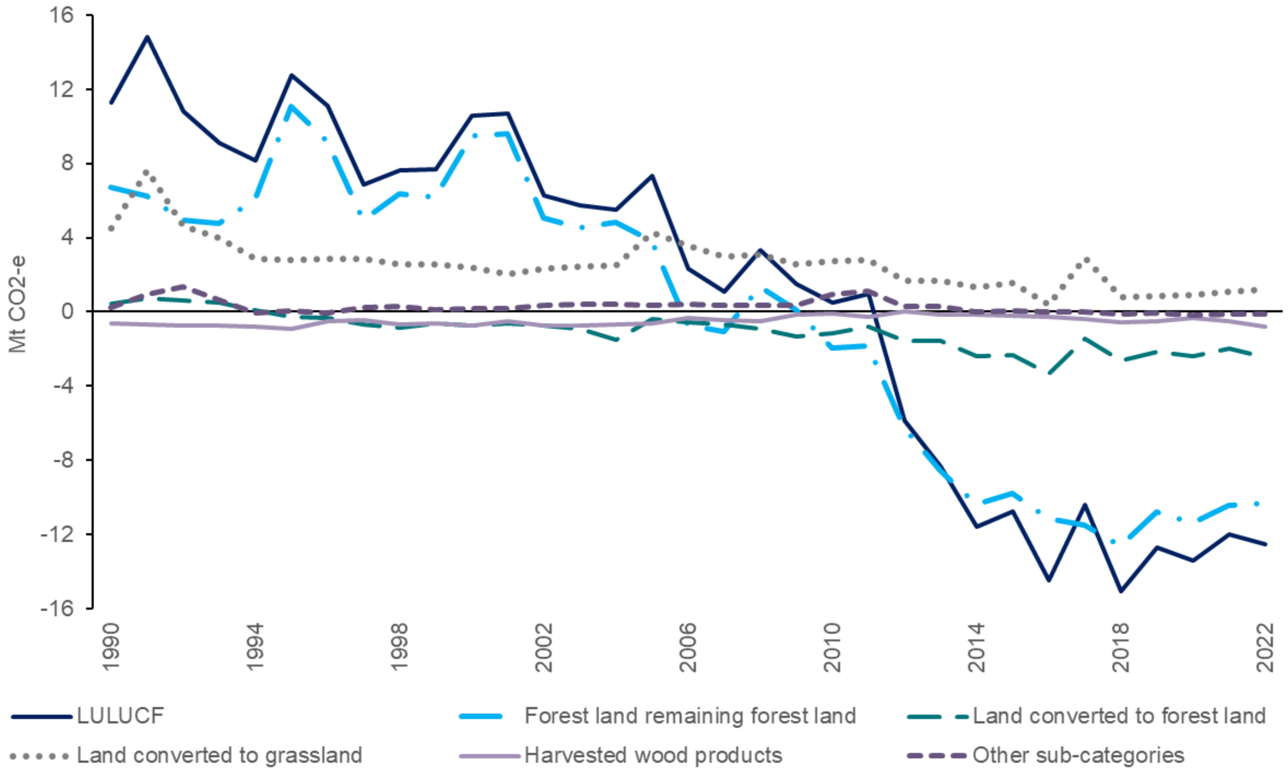
In 2022, emissions from Tasmania's LULUCF sector were a sink of minus 12.51 Mt CO_2-e, which is a reduction of 211 per cent on 1990 levels.

The reduction in Tasmania's LULUCF emissions since 1990 has been largely driven by:

- changes in forest land remaining forest land (4.A.1) and in particular changes in levels of timber harvesting in Tasmania's native forests on private land (4.A.1.i.d) and in public multiple use forests (4.A.1.i.e)
- a reduction in emissions from the forest land converted to grassland sub-category (4.C.2.1) largely associated with lower rates of clearing of forested lands
- an increase in the carbon sink of land converted to forest land (4.A.2) from hardwood and softwood plantations, environmental plantings and natural regeneration and regrowth.

Figure 19 below provides a graphical representation of the changes in emissions and contributions of the major sub-sectors to Tasmania's LULUCF sector for the time series 1990 to 2022.

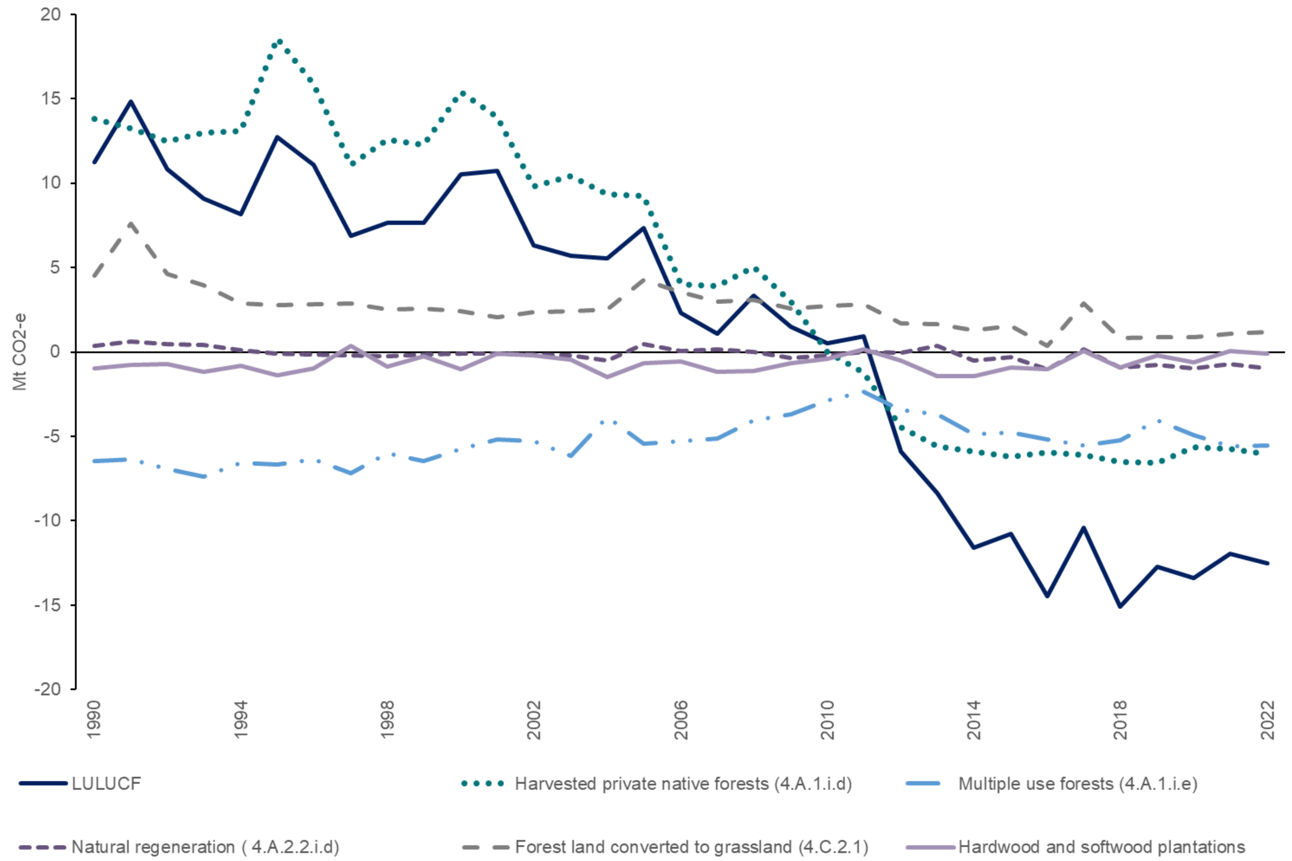
Figure 19: Tasmanian LULUCF and sub-sector emissions - 1990 to 2022



Source: Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2024, State and Territory Greenhouse Gas Inventories 2022

Figure 20 below provides a graphical representation of the changes in emissions and contributions of the major sub-categories in forest land remaining forest land (4.A.1), land converted to forest land (4.A.2), land converted to grassland (4.C.2), and all hardwood and softwood plantations for the time series 1990 to 2022.

Figure 20: Tasmanian LULUCF and sub-category emissions - 1990 to 2022



Source: Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2024, State and Territory Greenhouse Gas Inventories 2022.

Table 8 below provides the change in emissions for key LULUCF sub-sectors and sub-categories from 1990 to 2022.

Table 8: Tasmania's LULUCF emissions by sub-sector and sub-category from 1990 to 2022

Sub-sector/Sub-category	Emissions (Mt CO_2-e)[1]			Change (%)
	1990	2022	Change	
Forest land (4.A)	7.13	-12.78	-19.91	-279.3
Forest land remaining forest land (4.A.1)	6.69	-10.33	-17.01	-254.4
Fuelwood (4.A.1.i.a)	*0.05*	*-0.06*	*-0.12*	*-222.8*
Harvested private native forests (4.A.1.i.d)	*13.81*	*-6.06*	*-19.86*	*-143.9*
Multiple use forests (4.A.1.i.e)	*-6.45*	*-5.54*	*0.90*	*14.0*
Pre 1990 plantations (4.A.1.i.f)	*-0.97*	*0.33*	*1.30*	*134.0*
Biomass burning (4.A.1.ii)	*0.21*	*0.98*	*0.78*	*373.1*
Land converted to forest land (4.A.2)	0.44	-2.45	-2.89	-659.1
Grassland converted to forest land (4.A.2.2)	*0.44*	*-2.45*	*-2.89*	*-658.2*
Post 1990 hardwood plantations (4.A.2.2.i.a)	*0.01*	*-0.29*	*-0.28*	*-2,441.5*
Post 1990 softwood plantations (4.A.2.2.i.b)	*0.00*	*-0.17*	*-0.17*	*-4,914.3*

Sub-sector/Sub-category	Emissions (Mt CO_2-e)[1]			Change (%)
	1990	2022	Change	
Environmental plantings (4.A.2.2.i.c)	*0.02*	*-0.48*	*-0.49*	*-3,032.1*
Natural regeneration (4.A.2.2.i.d)	*0.37*	*-0.98*	*-1.35*	*-361.5*
Regrowth on cleared lands (4.A.2.2.i.e)	*0.01*	*-0.61*	*-0.62*	*-4,645.5*
Cropland (4.B)	0.16	0.04	-0.12	-76.3
Cropland remaining cropland (4.B.1)	0.12	0.03	-0.09	-72.6
Cropland soils (4.B.1.1)	*0.12*	*0.05*	*-0.07*	*-60.2*
Perennial woody crops (4.B.1.2)	*0.00*	*-0.02*	*-0.02*	*-1,858.6*
Land converted to cropland (4.B.2)	0.04	0.00	-0.03	-88.4
Grassland (4.C)	3.91	0.82	-3.09	-79.1
Grassland remaining grassland (4.C.1)	-0.60	-0.36	0.24	39.5
Land converted to grassland (4.C.2)	4.51	1.18	-3.33	-73.8
Forest land converted to grassland (4.C.2.1)	*4.50*	*1.17*	*-3.33*	*-73.9*
Wetland converted to grassland (4.C.2.3)	*0.01*	*0.01*	*0.00*	*0.0*
Wetland (4.D)	0.55	0.21	-0.34	-62.3
Wetland remaining wetland (4.D.1)	0.06	0.21	0.15	249.5
Flooded land remaining flooded land (4.D.1.2)	*0.06*	*0.15*	*0.09*	*158.4*
Other wetland remaining other wetland (4.D.1.3)	*0.00*	*0.06*	*0.06*	*3,329.4*
Land converted to wetland (4.D.2)	0.49	0.00	-0.49	-100.0
Land converted to flooded lands (4.D.2.2)	*0.49*	*0.00*	*-0.49*	*-100.0*
Settlements (4.E)	0.13	-0.01	-0.15	-109.7
Settlements remaining settlements (4.E.1)	0.00	0.00	0.00	160.0
Land converted to settlements (4.E.2)	0.13	-0.01	-0.15	-108.6
Forest land converted to settlements (4.E.2.1)	*0.13*	*-0.01*	*-0.15*	*-108.6*
Other land (4.F)	NR[1]	NR[1]	NR[1]	NR[1]
Harvested wood products (4.G)	-0.61	-0.78	-0.16	27.4[2]
LULUCF Total	**11.26**	**-12.51**	**-23.78**	**-211.1**

[1] Sub-sector not reported

[2] The percentage change for 1990 to 2022 for the harvested wood products sub-sector reflects an increase in the size of the carbon sink, that is, a larger negative outcome.

Source: Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2024, State and Territory Greenhouse Gas Inventories 2022.

Glossary and acronyms

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.
Methane	A greenhouse gas with a chemical symbol of CH_4
Carbon dioxide	A greenhouse gas with a chemical symbol of CO_2
CO_2-e	Carbon dioxide equivalent, a measure used to compare different greenhouse gases.
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	Substances released into the air. In this report, emissions refer to greenhouse gas emissions such as carbon dioxide or methane.
fugitive emissions	Loss or leaks of gases into the atmosphere that are associated with natural gas, oil and coal industries.
FullCAM	Full Carbon Accounting Model
GSP	Gross State Product
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change

Term	Description
IPPU	Industrial Processes and Product Use
Legislation	Written laws enacted by parliament
LPG	Liquefied petroleum gas
LULUCF	Land Use, Land Use Change and Forestry
Mt	Megatonnes
N_2O	Nitrous oxide, a greenhouse gas
Net zero emissions	When greenhouse gas emissions and sequestration are balanced over a year
NGER Scheme	National Greenhouse and Energy Reporting Scheme
NIR	National Inventory Report
ReCFIT	Renewables, Climate and Future Industries Tasmania
Scope 1	Emissions from goods and services that are produced in a location. These are sometimes called ‘direct emissions’.
Sequestration	The process by which carbon is removed from the atmosphere and stored.
Silviculture	The science and practice of managing the growth, productivity, health and diversity of forest ecosystems.
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
Mt	Megatonnes. 1 megatonne is equal to 1 million tonnes
Tier	The methods for estimating emissions and removals are divided into ‘tiers’ by the IPCC, which encompass different levels of methodological complexity and technological detail. Tier 1 methods are generally very simple and require less data and expertise. Tier 2 is more complex and Tier 3 methods are the most complex, generally requiring more detailed country-specific information.
Time series	A sequence of data taken at successive equally-spaced points in time.
UNFCCC	United Nations Framework Convention on Climate Change

References

Australian Bureau of Statistics (ABS) 2024, National, State and Territory Population Reference period September 2023, Cat. No. 3101.0, Table 4, Canberra, viewed 26 April 2024. www.abs.gov.au/statistics/people/population/national-state-and-territory-population/latest-release

Australian Bureau of Statistics (ABS) 2023, Australian National Accounts: State Accounts, 2022-23, Cat. No. 5220.0, Table 7, viewed 26 April 2024. www.abs.gov.au/statistics/economy/national-accounts/australian-national-accounts-state-accounts/latest-release

Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2024, *National Inventory Report Volume I*, viewed 30 April 2024. www.dcceew.gov.au/sites/default/files/documents/national-inventory-report-2022-volume-1.pdf

Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2024, *State and Territory Greenhouse Gas Inventories 2022*, viewed 15 April 2024. www.greenhouseaccounts.climatechange.gov.au/

RECFIT
Renewables, Climate and
Future Industries Tasmania

Department of State Growth

GPO Box 536 Hobart
TAS 7001 Australia

Phone: 03 6166 4466

Email: climatechange@recfit.tas.gov.au

Web: recfit.tas.gov.au