Australian Government
Department of the Environment and Energy

Quarterly Update of Australia's National Greenhouse Gas Inventory: March 2019

Incorporating emissions from the NEM up to June 2019

Australia's National Greenhouse Accounts

Preface

The *Quarterly Update* reports on the latest estimates of Australia's National Greenhouse Gas Inventory. This update provides estimates of Australia's national inventory of greenhouse gas emissions up to the March quarter of 2019, and emissions from the National Electricity Market (NEM)[1] up to the June quarter 2019.

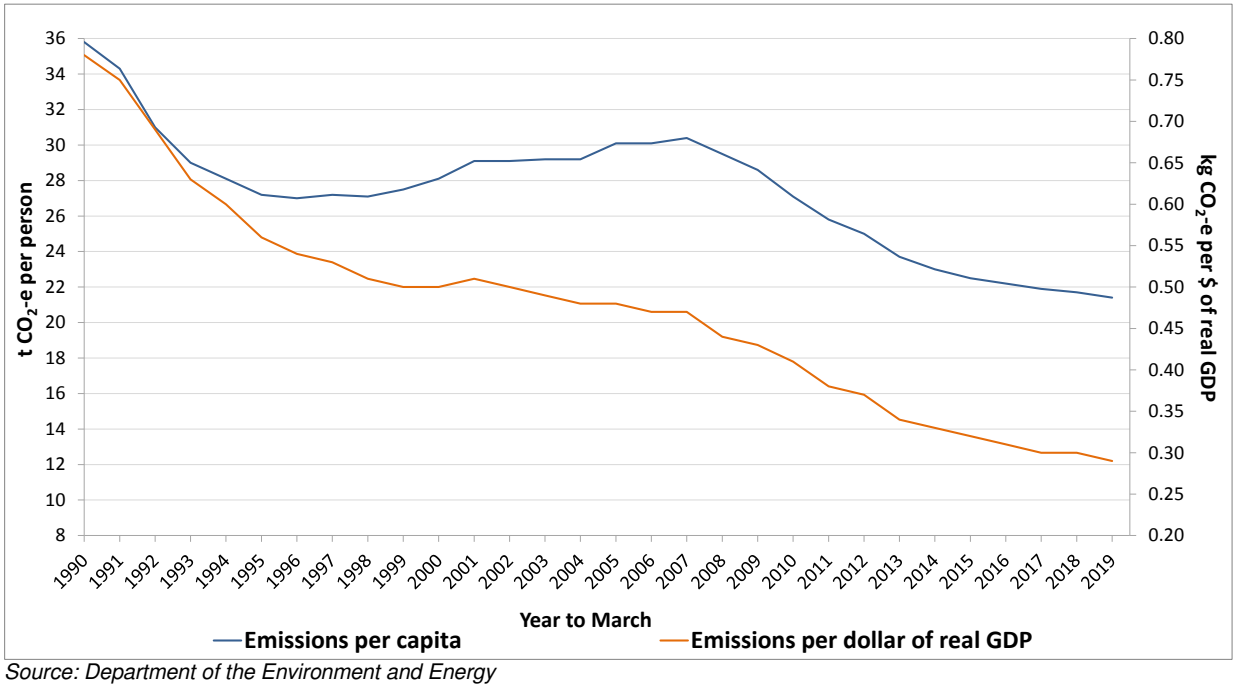
National emission levels[2] for the March quarter 2019 decreased by 0.4 per cent relative to the previous quarter, on a seasonally adjusted and weather normalised basis, primarily due to decreased emissions from diesel and petrol consumption and livestock. In trend terms, emissions have also decreased by 0.1 per cent.

Emissions for the year to March 2019 are estimated to be 538.9 Mt CO_2-e, up 0.6 per cent or 3.1 Mt CO_2-e on the previous year primarily due to increased LNG exports (18.8 per cent).

Australia's emissions for the year to March 2019 have declined 14.0 per cent since the peak in the year to June 2007 and were 0.5 per cent above emissions in 2000 and 11.7 per cent below emissions in 2005.

In the year to March 2019 emissions per capita, and the emissions intensity of the economy are at their lowest levels in 29 years. Emissions per capita in the year to March 2019 have fallen 40.1 per cent since 1990, while the emissions intensity of the economy has fallen 62.4 per cent (Figure P1).

Figure P1: Emissions per capita and per dollar of real GDP, year to March 1990 to 2019



Source: Department of the Environment and Energy

Electricity sector emissions decreased by 2.1 per cent in the year to March 2019 and 15.7 per cent from the peak recorded in the year to June 2009. Emissions in the NEM for the June quarter 2019 decreased by 2.8 per cent on a seasonally adjusted and weather normalised basis compared with the previous quarter.[3] For the June 2019 quarter, generation from renewables increased 6.0 per cent primarily due to increases in wind generation (14.8 per cent) and hydro generation (42.0 per cent).

[1] The NEM includes grid electricity in the Eastern and South Eastern states and accounts for approximately 85 per cent of total electricity estimates in the year to March 2019.

[2] National emissions level are inclusive of all sectors of the economy, including Land Use, Land use Change and Forestry (LULUCF).

[3] 'Unadjusted', 'seasonally adjusted, weather normalised' and 'trend' are defined in Section 7 - Technical notes

Contents

1. Overview

Table 1: National Greenhouse Gas Inventory[4], March quarter 2019, emissions growth rates

	March quarter 2019	Year to March 2019
Quarterly change – seasonally adjusted and weather normalised[5]	-0.4%	
Quarterly change – seasonally adjusted and weather normalised – trend[5]	-0.1%	
Annual Change		0.6%

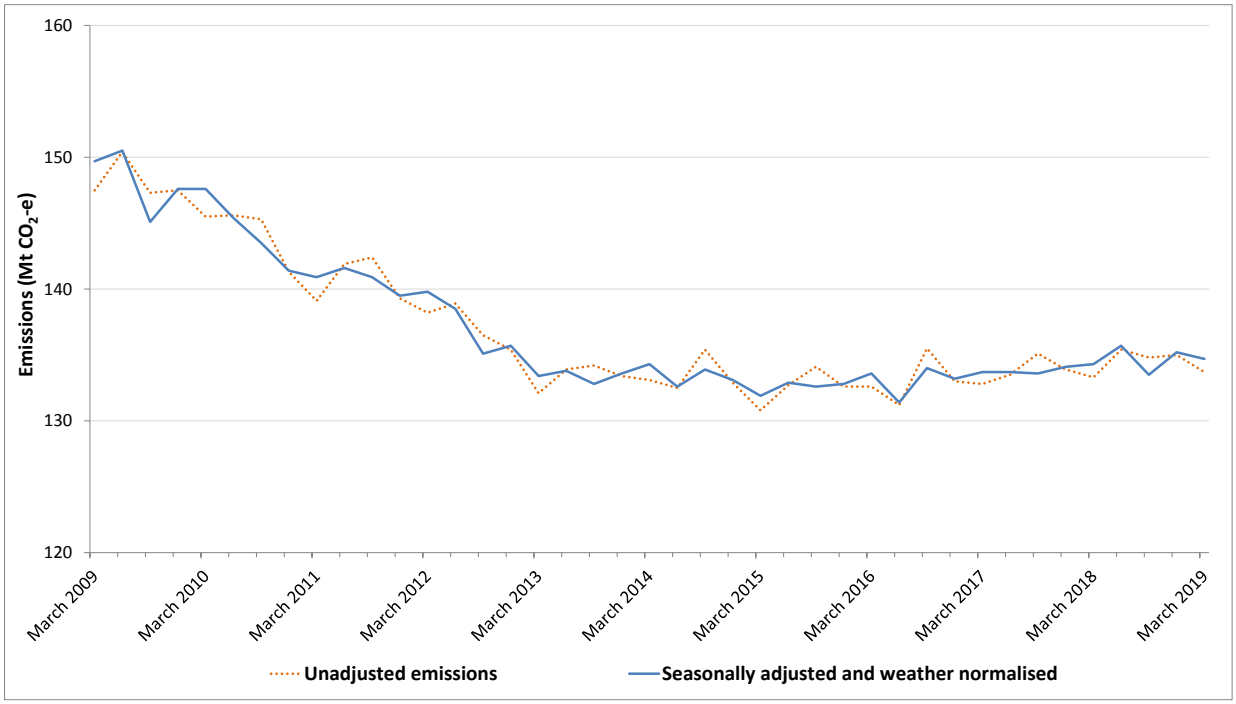
Table 2: National Electricity Market (NEM)[6], June quarter 2019, emissions growth rates

	June quarter 2019	Year to June 2019
Quarterly change – seasonally adjusted and weather normalised[5]	-2.8%	
Quarterly change – seasonally adjusted and weather normalised – trend[5]	-0.9%	
Annual Change		-2.6%

Summary of emissions in the March quarter 2019

In the March quarter of 2019, seasonally adjusted emissions decreased by 0.4 per cent (Figure 1 and Figure 2).

Figure 1: Emissions[2], by quarter, March 2009 to March 2019



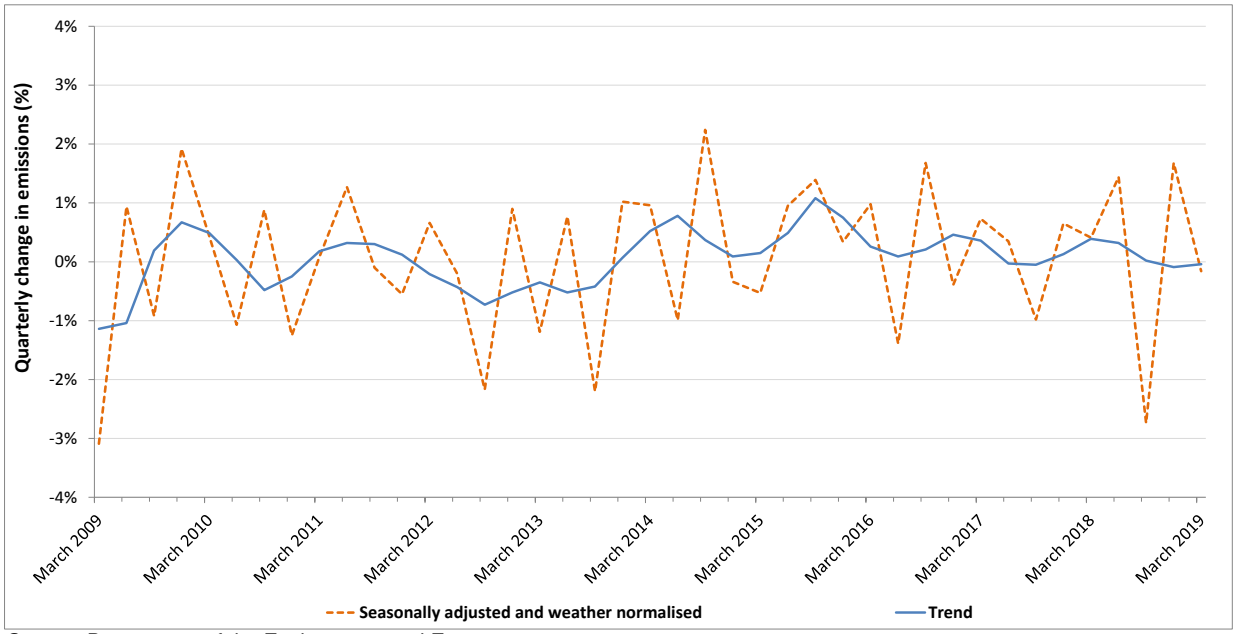
Source: Department of the Environment and Energy

[4] National emissions level are inclusive of all sectors of the economy, including *Land Use, Land use Change and Forestry* (LULUCF).

[5] 'Unadjusted', 'seasonally adjusted, weather normalised' and 'trend' are defined in Section 7: Technical notes

[6] The NEM includes grid electricity in the Eastern and South Eastern states and accounts for approximately 85 per cent of total *electricity* estimates in the year to March 2019.

Figure 2: Emissions growth rates, by quarter, March 2009 to March 2019

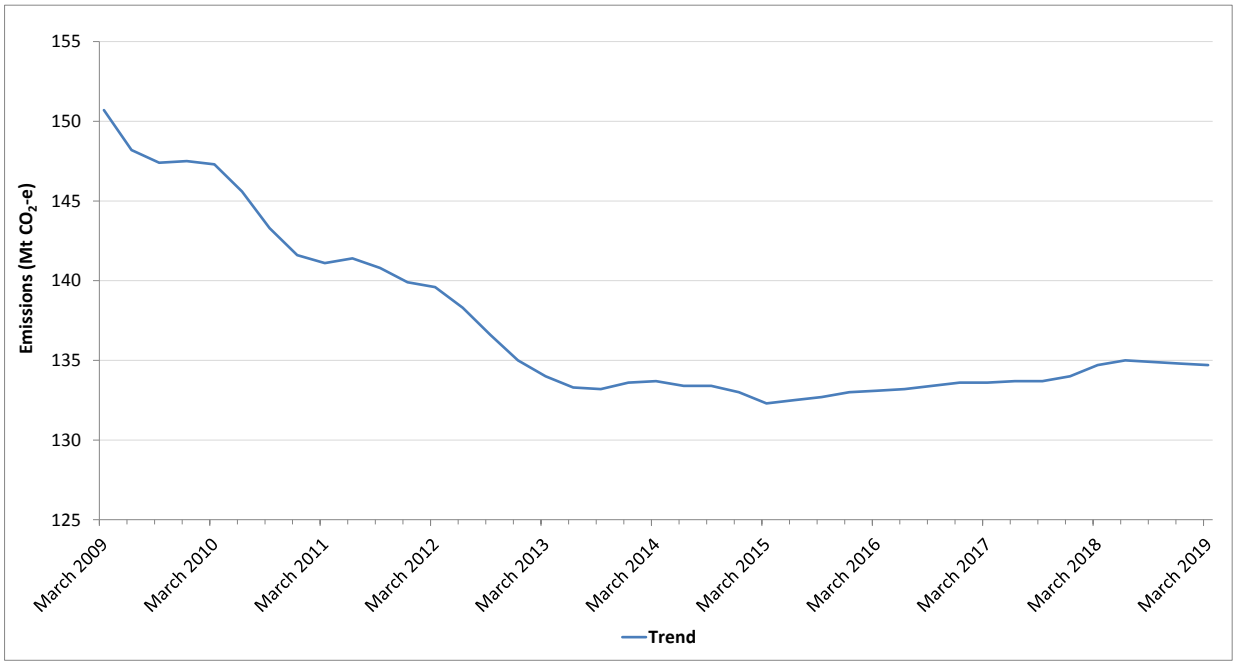


Source: Department of the Environment and Energy

This decrease in total emissions is driven in part by seasonally adjusted decreases in emissions from *fugitives* (1.1 per cent), and *transport* (1.1 per cent). These decreases reflect quarterly declines in LNG for export (7.7 per cent) and petrol and diesel consumption (6.5 and 6.6 per cent).

Trend emissions (Figure 3) decreased by 0.1 per cent, reflecting decreases in emissions from *transport* and *agriculture*.

Figure 3: Trend emissions, by quarter, March 2009 to March 2019



Source: Department of the Environment and Energy

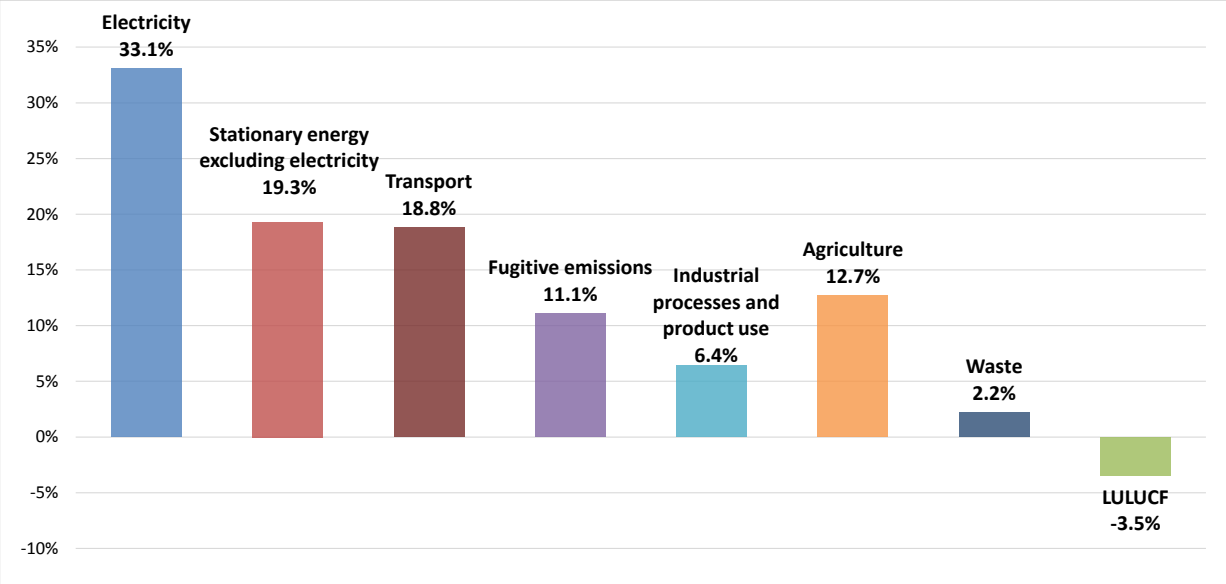
Summary of annual emissions

Emissions for the year to March 2019 are estimated to be 538.9 Mt CO_2-e. The 0.6 per cent or 3.1 Mt CO_2-e increase in emissions over the year to March reflects annual increases in emissions from the *stationary energy*, *transport*, *fugitive*, *industrial processes and product use* and *waste* sectors (Table 3). These increases in emissions were partially offset by decreases in emissions from *agriculture* and *electricity* sectors.

Table 3: 'Unadjusted' annual emissions, by sector, for the year to March 2018 and 2019

Sector	Annual emissions (Mt CO_2-e)		Change (%)
	Year to March 2018	Year to March 2019	
Energy – Electricity	182.4	178.5	-2.1
Energy – Stationary energy excluding electricity	98.7	103.8	5.1
Energy – Transport	99.9	101.2	1.3
Energy – Fugitive emissions	56.3	59.6	5.9
Industrial processes and product use	34.1	34.6	1.3
Agriculture	72.0	68.6	-4.8
Waste	12.0	12.1	0.6
Land Use, Land Use Change and Forestry	-19.6	-19.4	1.2
National Inventory Total	**535.8**	**538.9**	**0.6**

Figure 4: Share of total emissions, by sector, for the year to March 2019



Source: Department of the Environment and Energy

The increases in *stationary energy* emissions reflect strong growth over the year in LNG exports (up 18.8 per cent), steel production (up 6.2 per cent) and aluminium production (up 2.9 per cent). Growth in LNG also strongly impacted *fugitive* emissions due to flaring and the venting of methane and carbon dioxide. The increase of 6.2 per cent in steel production also affected *industrial processes and product use* emissions.

Transport emissions increased 1.3 per cent over the year to March reflecting a 7.5 per cent increase in diesel consumption.

Over the year to March 2019 there were decreases in emissions from the *electricity* and *agriculture* sectors. The 2.1 per cent decrease in emissions from the *electricity* sector is mainly due to a 0.7 per cent reduction in brown coal consumption, a 23.1 per cent reduction in gas consumption, and a corresponding 28.0 per cent increase in supply from renewable sources. The 4.8 per cent decline in emissions from the *agriculture* sector reflects a decline in livestock populations.[7]

Sectoral trends since 1990

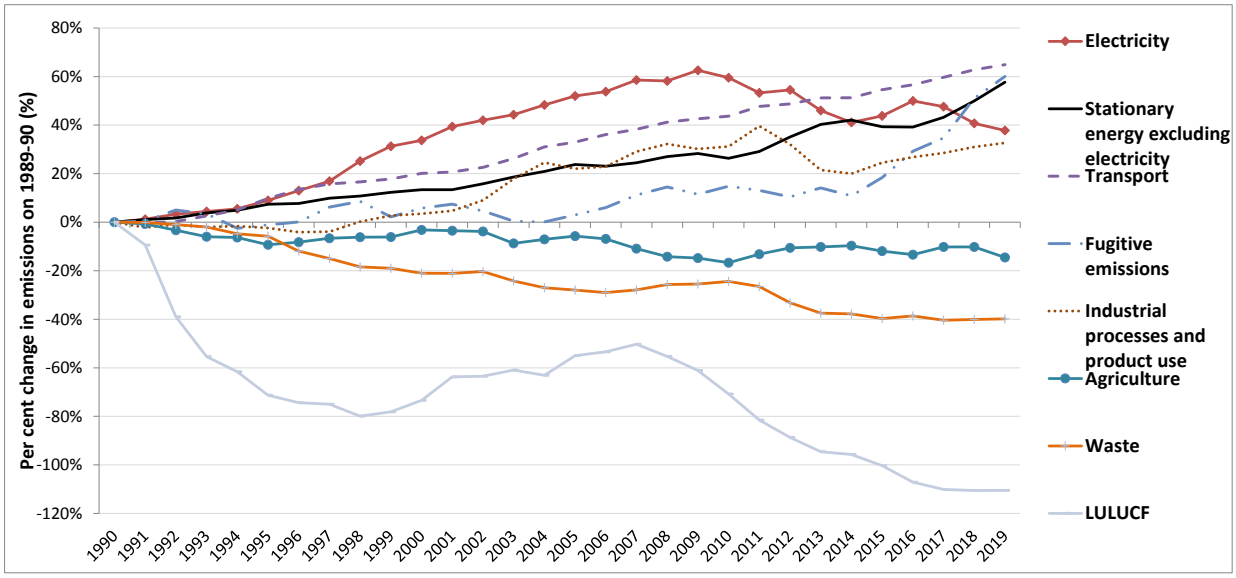
Australia's emissions have decreased by 10.9 per cent (66.0 Mt CO_2-e) since 1990, reaching 538.9 Mt CO_2-e in the year to March 2019.

In percentage terms, the *transport* sector has experienced the largest growth, increasing 64.9 per cent (39.8 Mt CO_2-e) between 1990 and the year to March 2019. Other sectors which have increased in emissions since 1990 include *fugitive emissions* (60.1 per cent or 22.4 Mt CO_2-e), *stationary energy excluding electricity* (57.7 per cent or 38 Mt CO_2-e), *electricity* (37.8 per cent or48.9 Mt CO_2-e) and *industrial processes and product use* (32.7 per cent or 8.5 Mt CO_2-e).

In contrast, the *waste* and *agriculture* sectors have each decreased in emissions since 1990. *Land Use, Land Use Change and Forestry (LULUCF)* emissions have decreased by the largest margin of any sector since 1990 (110.5 per cent or 204.0 Mt CO_2-e).

The change in emissions from each sector from the year to March 1990 to 2019 in percentage terms is presented in Figure 5.

Figure 5: Percentage change in emissions, by sector, since year to March 1990



Source: Department of the Environment and Energy

[7] Australian Bureau of Agricultural and Resource Economics and Sciences (2019). *Agricultural Commodities, June Quarter 2019.*

2. Sectoral Analysis

2.1 Energy – Electricity

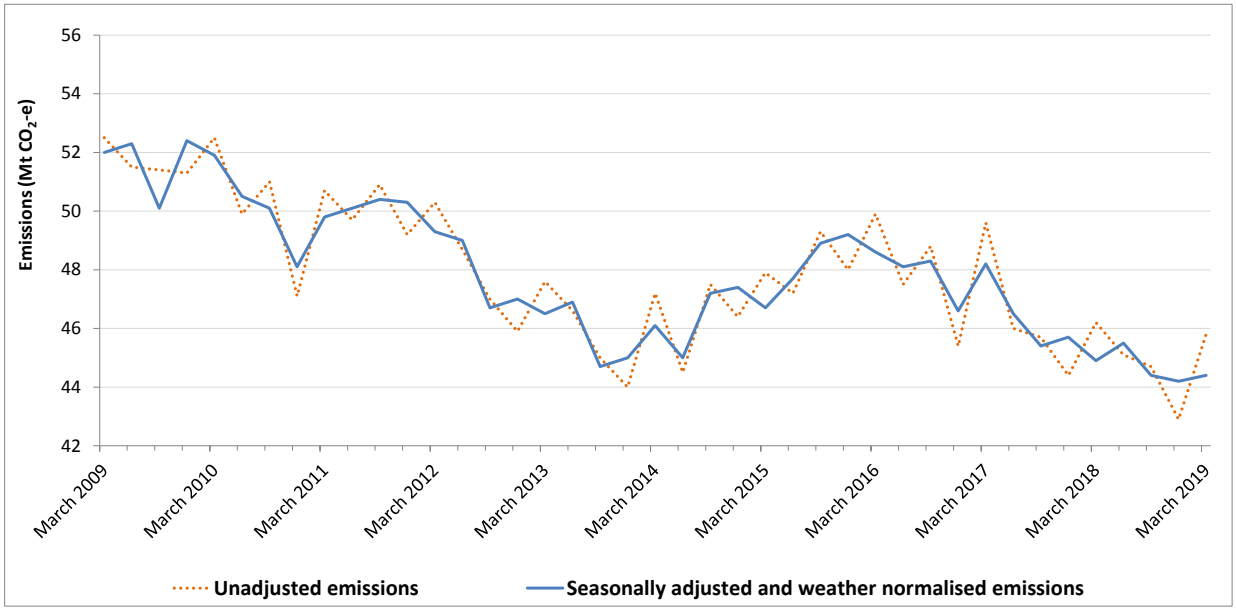
Electricity generation is the largest source of emissions in the national inventory, accounting for 33.1 per cent of emissions in the year to March 2019 (Figure 4).

Electricity sector emissions in the year to March 2019 have declined by 15.7 per cent (32.8 Mt CO_2-e) from the peak recorded in the year to June 2009 (Data Table 1A).

Electricity sector emissions increased 0.7 per cent in the March quarter of 2019 on a 'seasonally adjusted and weather normalised'[8] basis (Figure 6). This reflected a strong increase in gas generation (67.9 per cent) and decreases in wind and hydro generation (3.1 and 21.4 per cent) in the National Electricity Market (NEM).

Over the year to March 2019, emissions from *electricity* decreased by 2.1 per cent compared with the year to March 2018.

Figure 6: *Electricity* sector emissions, by quarter, March 2009 to March 2019



Source: Department of the Environment and Energy

National Electricity Market (NEM) emissions

Emissions in the NEM for the June quarter 2019 decreased by 2.8 per cent on a seasonally adjusted and weather normalised basis compared with the previous quarter (Figure 7). Emissions from the NEM account for around 85 per cent of national electricity emissions.

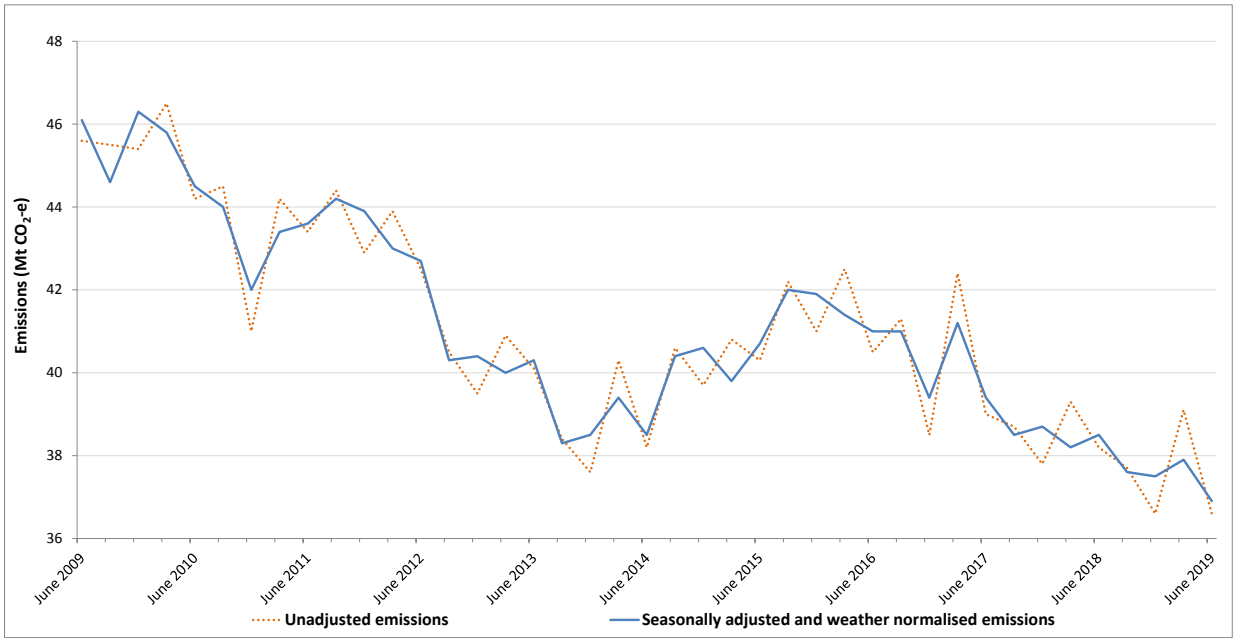
[8] Two adjustments are made:

a) Seasonal adjustment is a first-order adjustment using Eurostat software that systematically corrects emissions data for average fluctuations in seasonal conditions which, for example, controls for the effects of two seasonal peaks in electricity demand: one in winter (associated with demand for heating) and one in summer (associated with demand for cooling); and

b) Weather normalisation is a second-order adjustment that systematically corrects emissions data for atypical temperature effects on electricity demand within the year which, for example, controls for the effects of unusually cold winters or unusually hot summers.

The weather normalisation methodology is described in detail in 'Section 7: Special Topic' of the December 2011 *Quarterly Update*

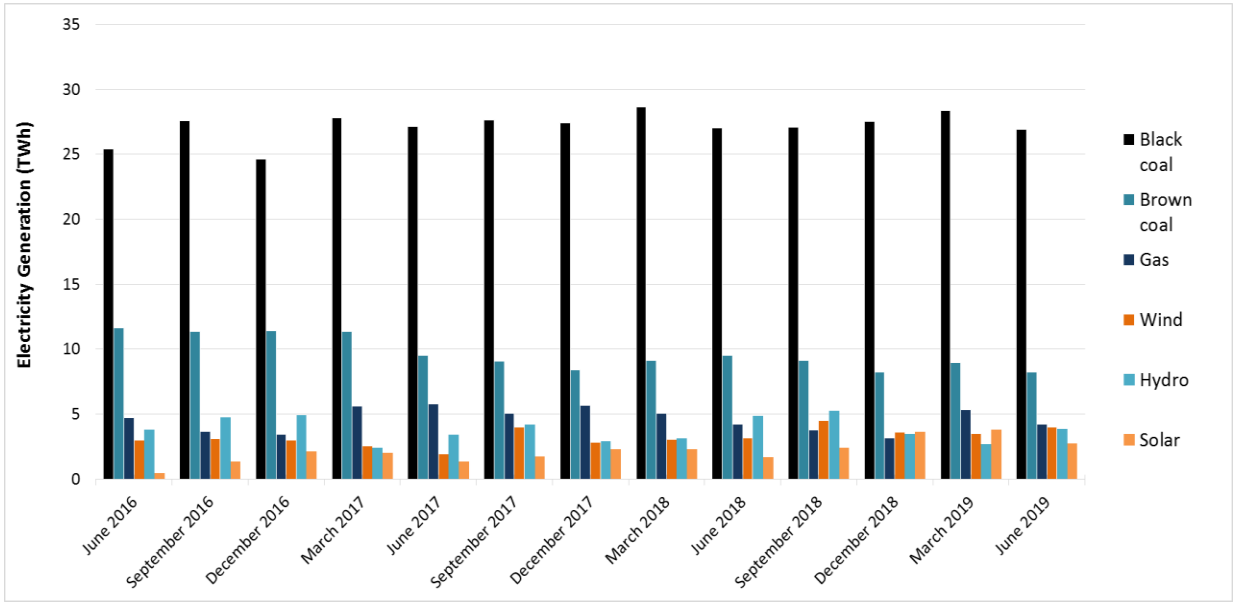
Figure 7: NEM *electricity* emissions, by quarter, June 2009 to June 2019



Source: Department of the Environment and Energy, Australian Energy Market Operator (AEMO, 2018), obtained using NEM-Review software

For the June 2019 quarter, generation from renewables increased 6.0 per cent, in contrast to the 6.4 per cent decrease for the March 2019 quarter (Figure 8). This was primarily due to increases in wind generation (14.8 per cent) and hydro generation (42.0 per cent).

Figure 8: Electricity generation in the NEM, by fuel, by quarter, June 2016 to June 2019



Source: Australian Energy Market Operator (AEMO, 2018), obtained using NEM-Review software

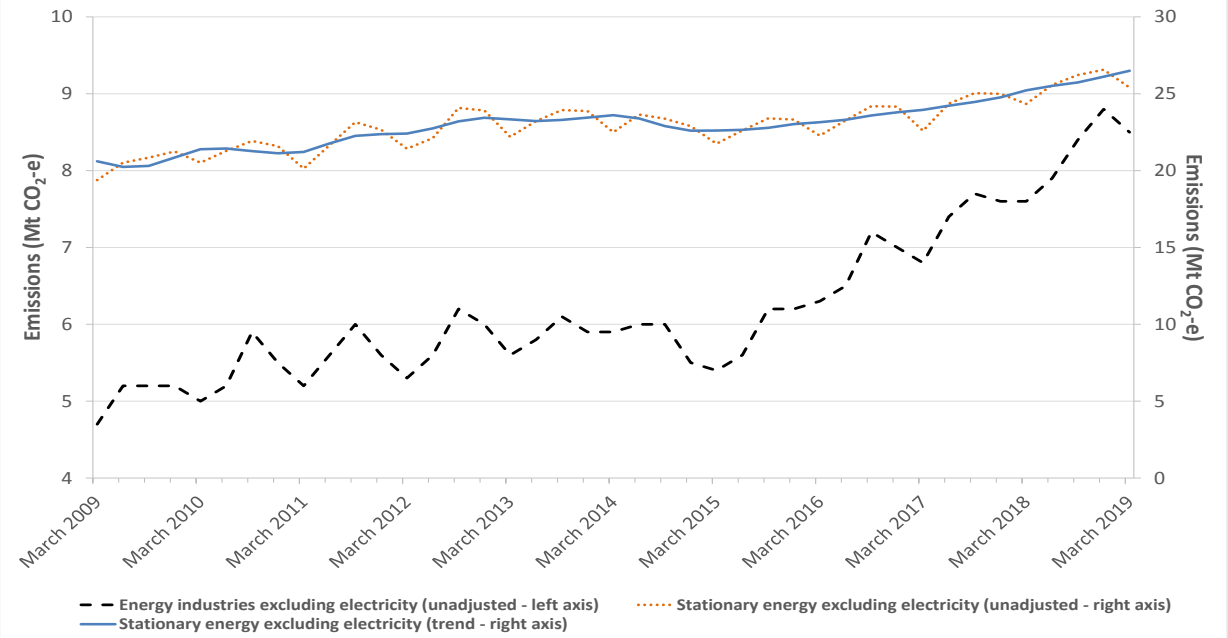
2.2 Energy – Stationary energy excluding electricity

Stationary energy excluding electricity includes emissions from direct combustion of fuels, predominantly from the manufacturing, mining, residential and commercial sectors.

In the year to March 2019, *stationary energy excluding electricity* accounted for 19.3 per cent of Australia's national inventory (Figure 4).

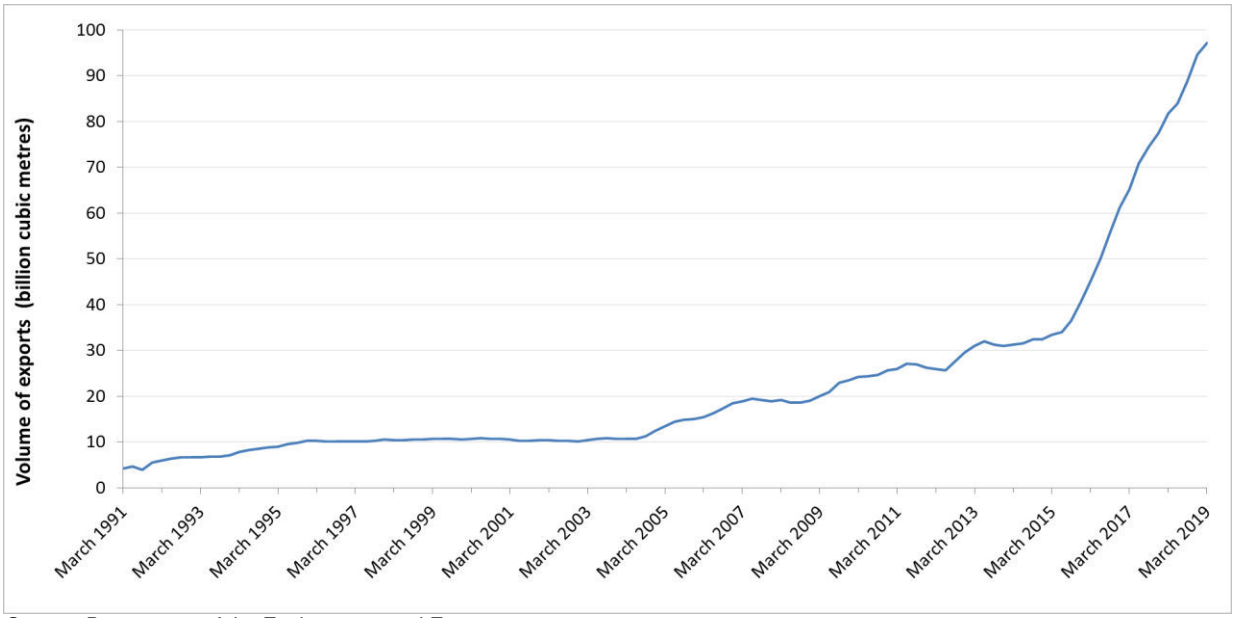
Emissions from *stationary energy excluding electricity* in the March quarter of 2019 increased 1.5 per cent in trend terms compared with the December quarter of 2018. Emissions over the year to March 2019, increased by 5.1 per cent when compared with the previous year (Figure 9).

Figure 9: *Stationary energy excluding electricity* emissions 'unadjusted' and 'trend' by quarter, March 2009 to March 2019



Source: Department of the Environment and Energy

Figure 10: LNG exports, year to the quarter, March 1991 to March 2019



Source: Department of the Environment and Energy

Unadjusted emissions from energy industries excluding electricity increased by 5.0 Mt CO_2-e in the year to March 2019 compared with the year to March 2018. This was driven primarily by an increase of 18.8 per cent in LNG exports in the year to March 2019 (Figure 10).

2.3 Energy – Transport

The *transport* sector includes emissions from the direct combustion of fuels in transportation by road, rail, domestic aviation and domestic shipping. The main fuels used for transport are automotive gasoline (petrol), diesel oil, liquefied petroleum gas (LPG) and aviation turbine fuel.

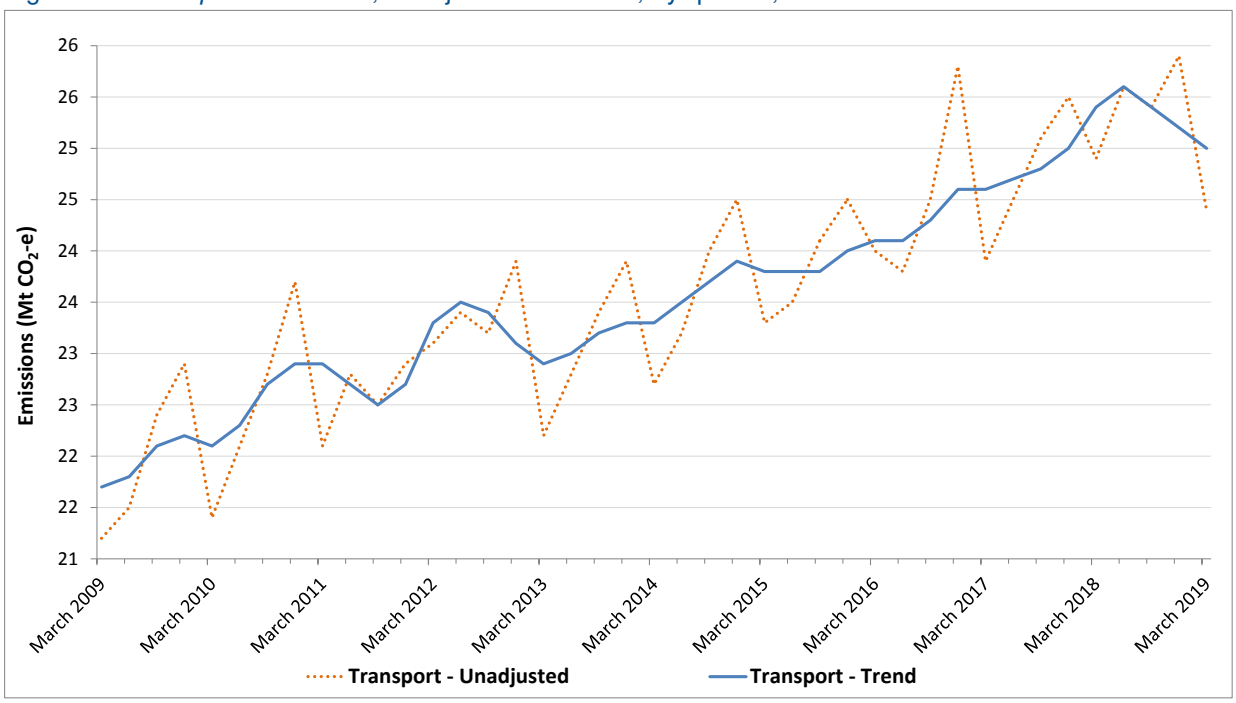
In the year to March 2019, transport accounted for 18.8 per cent of Australia's national inventory (Figure 4).

The domestic transport sector accounts for over 70 per cent[9] of liquid fuels consumed in Australia. The past six years have seen a decrease in the consumption of petrol (including ethanol-blended) of 4.7 per cent and a strong increase in diesel consumption of 19.8 per cent.

Emissions in the March 2019 quarter decreased 0.5 per cent in trend terms, while 'unadjusted' emissions decreased 5.9 per cent (Figure 11). This is attributed to lower than usual diesel sales for the March 2019 quarter. A return to long term diesel consumption growth is however expected in the future.

Emissions from *transport* over the year to March 2019 increased by 1.3 per cent when compared with the previous year. This growth in transport emissions reflected a 7.5 per cent annual growth in diesel consumption. This is attributed to increased diesel passenger vehicle sales and freight activity, supported by steady economic and population growth, and switching to diesel vehicles, which is associated with a 4.6 per cent fall in annual petrol consumption for the year to March 2019.

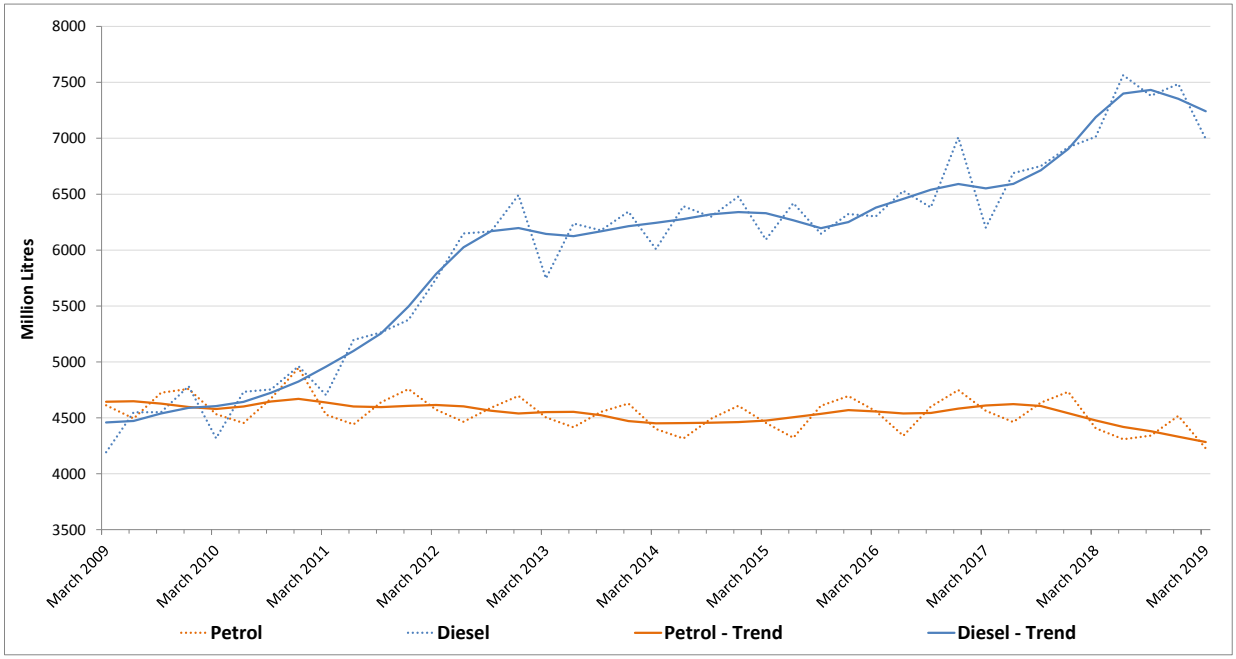
Figure 11: *Transport* emissions, unadjusted and trend, by quarter, March 2009 to March 2019



Source: Department of the Environment and Energy

[9] Department of the Environment and Energy (2018). Australian Energy Statistics: Table F. https://www.energy.gov.au/publications/australian-energy-update-2018

Figure 12: Consumption of primary liquid fuels, unadjusted and trend, by quarter, March 2009 to March 2019

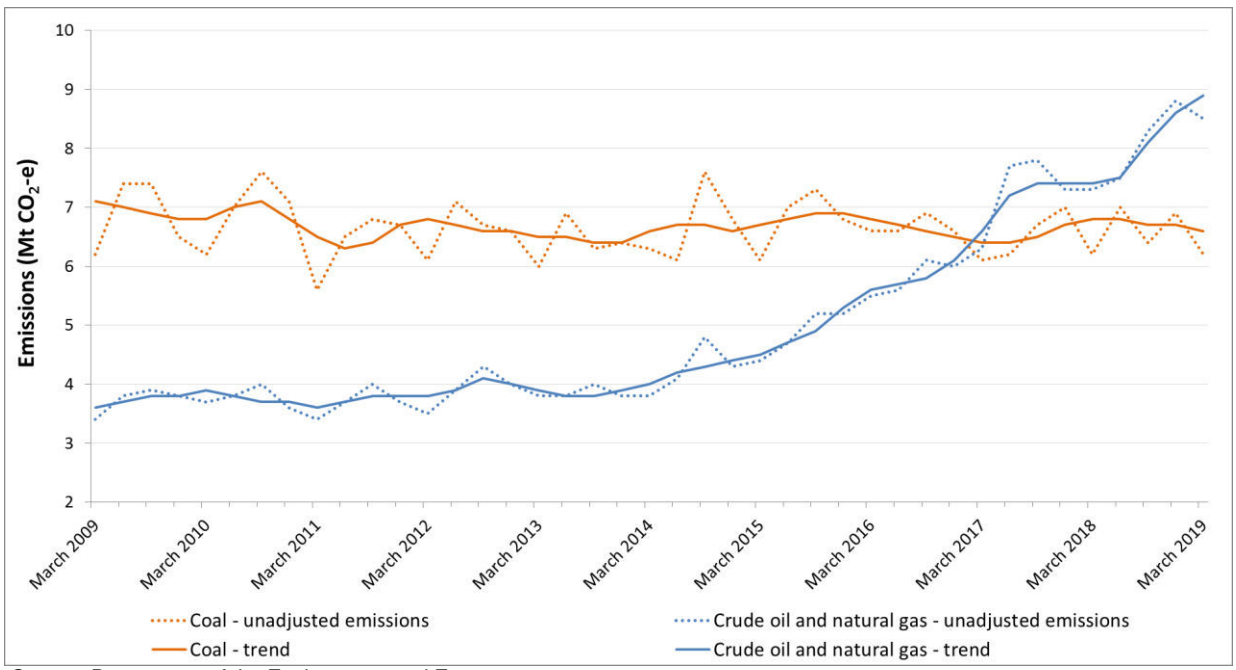


Source: Department of the Environment and Energy

2.4 Energy – Fugitive emissions

Fugitive emissions occur during the production, processing, transport, storage, transmission and distribution of fossil fuels. These include coal, crude oil and natural gas. Emissions from decommissioned underground coal mines are also included in this sector.

Figure 13: *Fugitive emissions*, unadjusted and trend, by sub-sector, by quarter March 2009 to March 2019



Source: Department of the Environment and Energy

Fugitive emissions in the March quarter decreased 1.1 per cent on a seasonally adjusted basis. Emissions increased in trend terms by 2.9 per cent.

The decrease in emissions is driven by total gas production decreasing 3.5 per cent in the March 2019 quarter. This corresponds to a 7.7 per cent decrease in LNG exports. A 6.8 per cent decrease in underground coal production also contributed to the decrease in *fugitive* emissions.

Annual unadjusted emissions in this sector increased by 5.9 per cent over the year to March 2019 (Figure 13). This increase in *fugitive* emissions was driven by an increase of 15.4 per cent[10] in natural gas production.

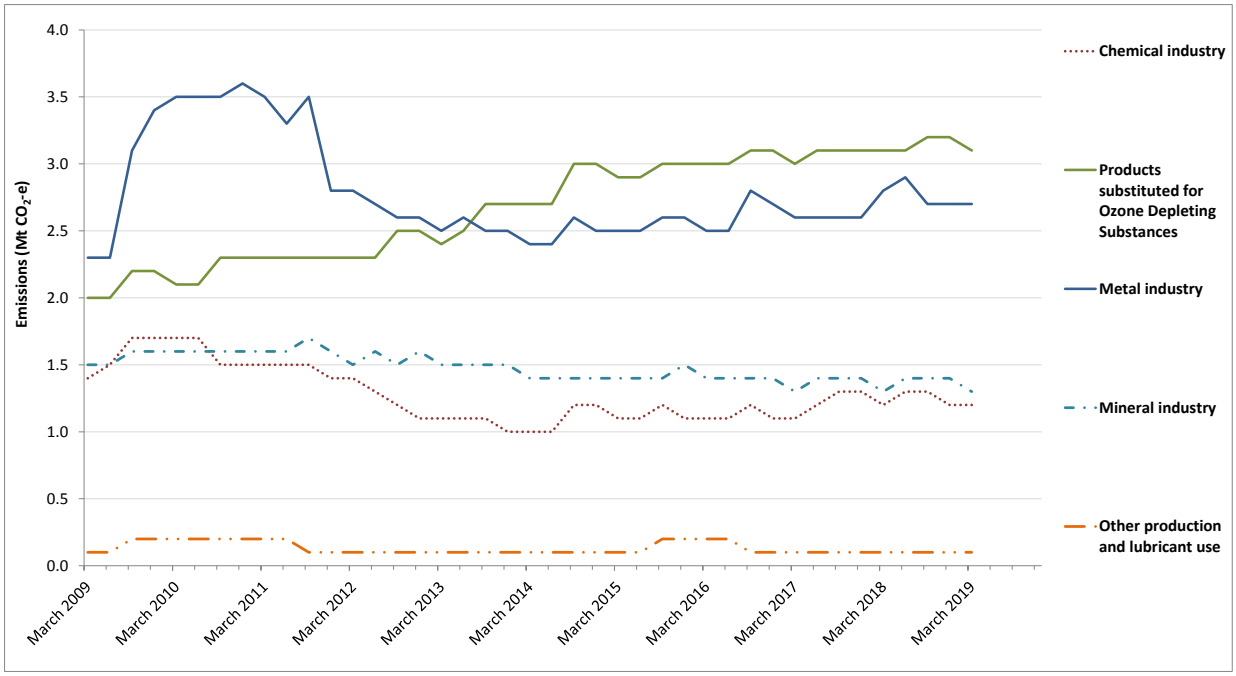
2.5 Industrial processes and product use

Emissions from *industrial processes and product use* occur as the result of by-products of materials and reactions used in production processes. This sector includes emissions from processes used to produce chemical, metal, and mineral products. It also includes emissions from the consumption of synthetic gases.

In the year to March 2019, *industrial processes and product use* accounted for 6.4 per cent of Australia's national inventory (Figure 4).

Trend emissions for industrial processes and product use increased by 0.3 per cent in the March quarter on the previous quarter. Over the year to March 2019, the increase of 1.8 per cent was largely due to increasing iron and steel production of 6.2 per cent, and a 1.5 per cent increase in emissions from products used as substitutes for ozone depleting substances (Figure 14). The increase in iron and steel production has been driven by strong global demand for steel and the resulting increase in commodity prices together with strong domestic building and construction sector activity.

Figure 14: Industrial processes and product use emissions, unadjusted, by sub-sector, by quarter, March 2009 to March 2019



Source: Department of the Environment and Energy

[10] Department of Industry, Innovation and Science (2019). *Resources and Energy Quarterly, June 2019*

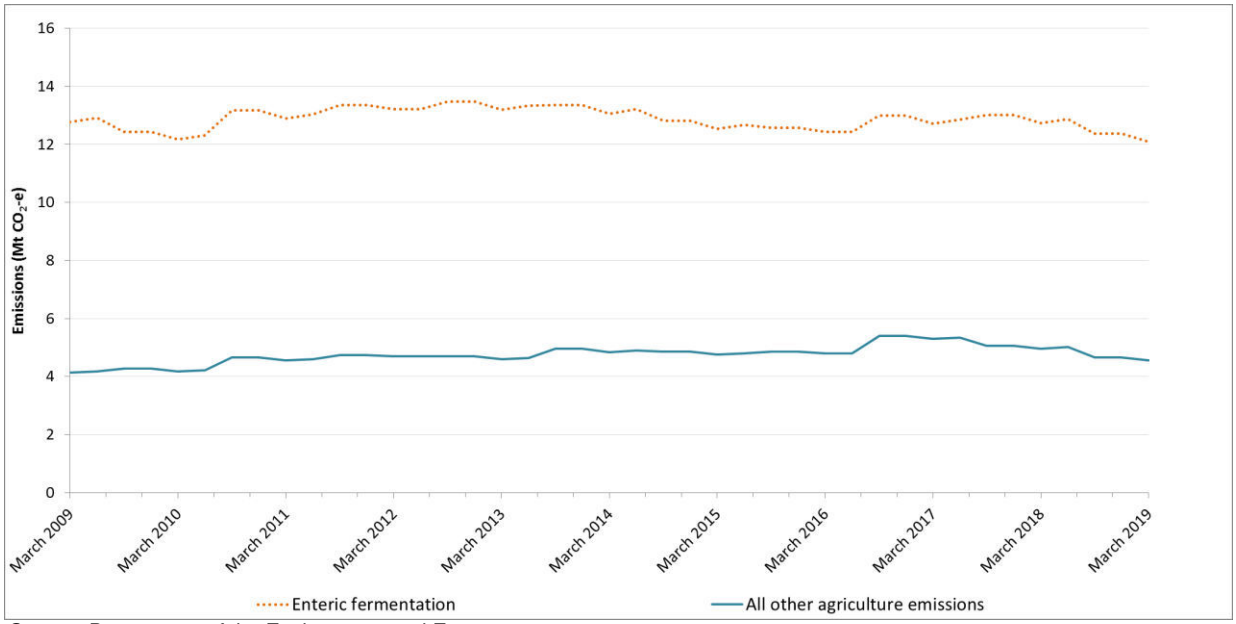
2.6 Agriculture

Emissions from *agriculture* include methane, nitrous oxide and carbon dioxide. Methane and nitrous oxide emissions are estimated for enteric fermentation and manure management in livestock. They are also estimated for rice cultivation, agricultural soils and field burning of agricultural residues. Carbon dioxide emissions are reported from the application of urea and lime (Figure 15).

In the year to March 2019, *agriculture* accounted for 12.7 per cent of Australia's national inventory (Figure 4).

Emissions from Agriculture have decreased by 4.8 per cent over the year to March 2019.

Figure 15: *Agriculture* emissions, unadjusted, by sub- sector, by quarter, March 2009 to March 2019



Source: Department of the Environment and Energy

Climate as well as economic forces such as national and international markets, directly impact emissions from the agricultural sector.

Drought conditions have impacted the cattle industry due to poor grazing conditions and the high cost and availability of grain. The lack of feed available led to elevated levels of turn-off of both sheep and cattle resulting in a contraction in the Australian national herd and flock. Floods in Queensland in early 2019 led to a significant loss of cattle (approximately 600,000).[11]

During 2018-19, drought conditions impacted crop yields throughout Australia as planting decisions are primarily driven by water availability and market demand. Drier than average seasonal conditions during the planting window and reduced supplies of irrigation water have reduced the cotton harvest by almost 50 per cent. In New South Wales the area of rice planted declined by close to 90 per cent in 2018–19 and production is estimated to have declined to 59,000 tonnes.[12]

[11] Australian Bureau of Agricultural and Resource Economics and Sciences (2019). *Agricultural Commodities, June Quarter 2019*

[12] Australian Bureau of Agricultural and Resource Economics and Sciences (2019). Australian Crop Report: June Edition. http://www.agriculture.gov.au/abares/research-topics/agricultural-commodities/australian-crop-report/overview

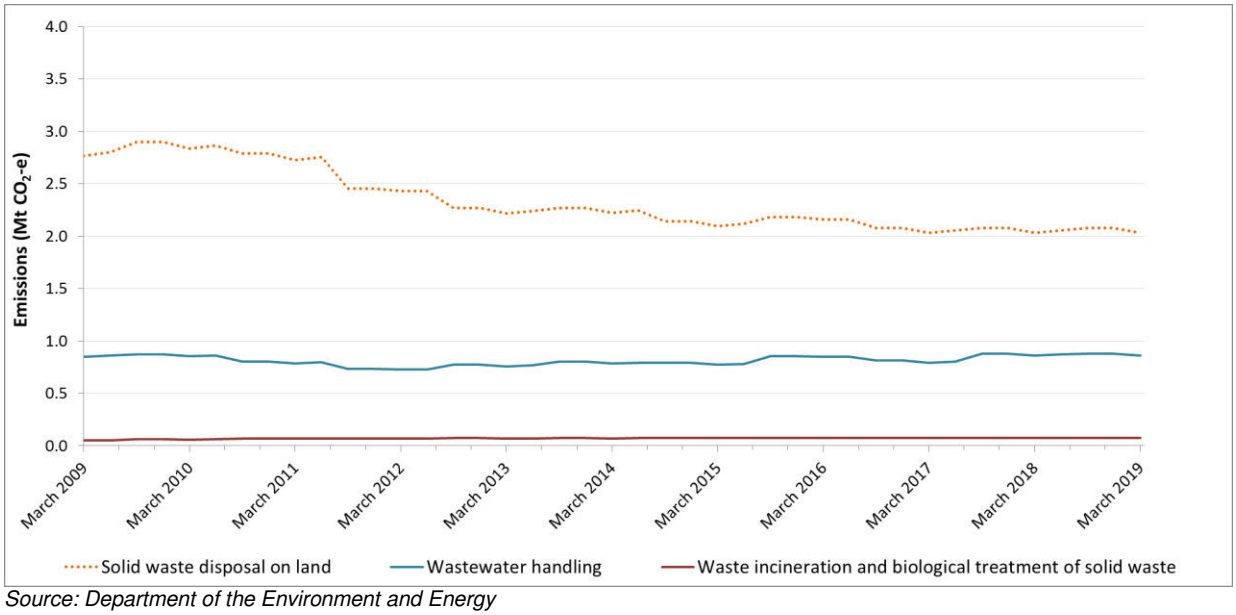
2.7 Waste

The *waste* sector includes emissions from landfills, wastewater treatment, waste incineration and the biological treatment of solid waste. Emissions largely consist of methane, which is generated when organic matter decays under anaerobic conditions.

In the year to March 2019, *waste* accounted for 2.2 per cent of Australia's national inventory (Figure 4).

Emissions from *waste* increased 0.6 per cent over the year to March 2019 due to a 2.0 per cent increase in emissions from wastewater treatment and discharge (Figure 16). This reflects lower rates of methane capture from wastewater treatment and discharge.

Figure 16: *Waste* emissions, unadjusted, by sub-sector, by quarter, March 2009 to March 2019



Source: Department of the Environment and Energy

2.8 Land Use, Land Use Change and Forestry

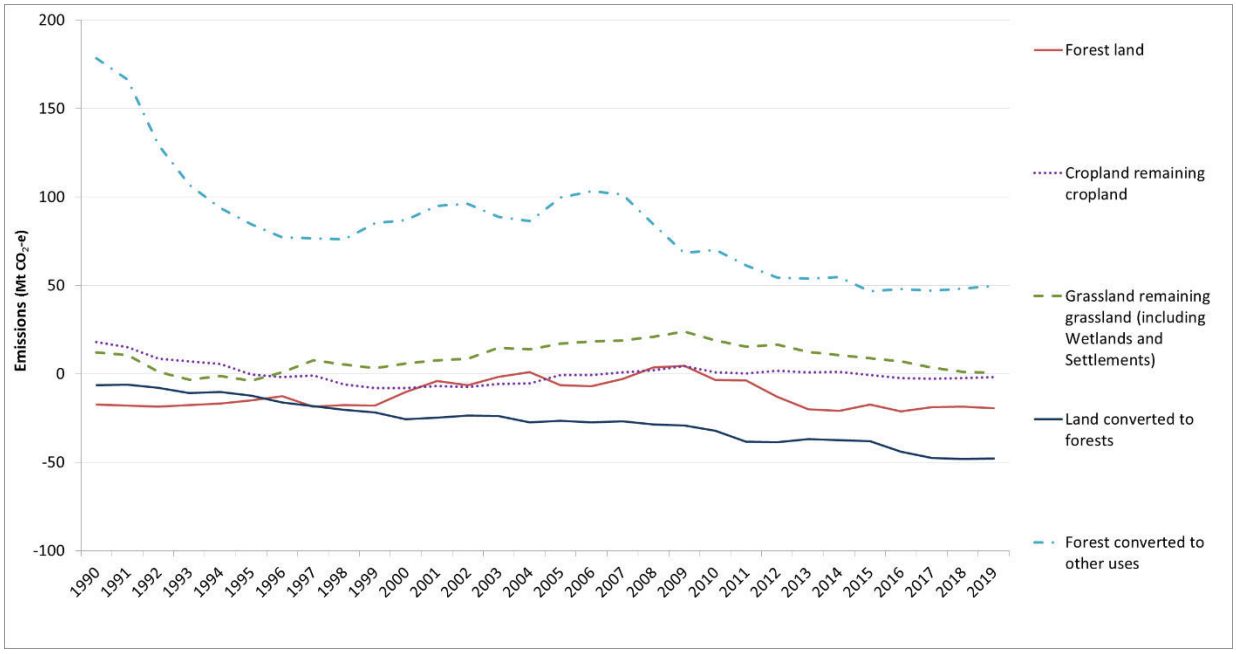
The *Land Use, Land Use Change and Forestry (LULUCF)* sector of the national inventory includes estimates of net anthropogenic emissions for forests and agricultural lands and changes in land use.

In the year to March 2019, the *LULUCF* sector[13] accounted for a net sink equivalent to 3.5 per cent of Australia's national inventory (Figure 4).

Net emissions for the *LULUCF* sector in the year to March 2019 are estimated to be a sink of 19.4 Mt CO_2-e (Figure 17). The sink of emissions remains generally flat, with a small decrease of 1.2 per cent (0.2 Mt CO_2-e) on the previous twelve months (Table 3).

[13] *LULUCF* includes Forest conversion, Forest land remaining forest land, Land converted to forest land, Grasslands (including Wetlands and Settlements) and Croplands

Figure 17: *LULUCF* net anthropogenic emissions, by sub-sector, year to March, 1990 to 2019



Source: Department of the Environment and Energy

3. Emissions per capita and per dollar of GDP

In the year to March 2019 emissions per capita, and the emissions intensity of the economy are at their lowest levels in 29 years.[14]

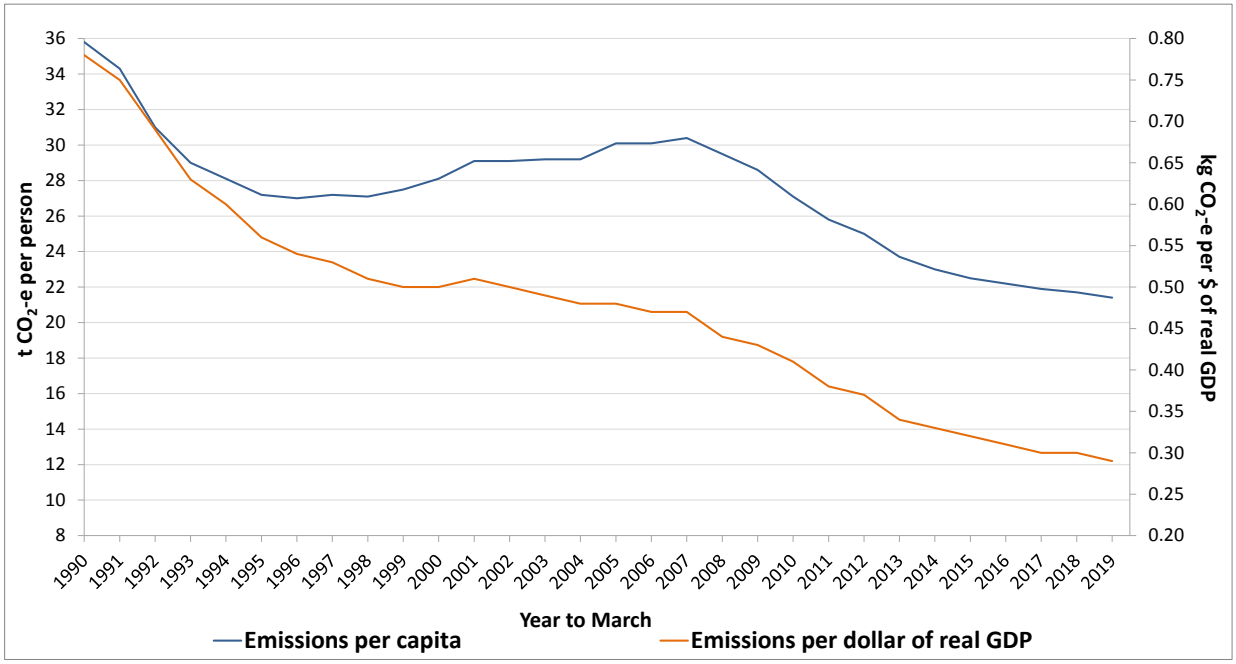
National inventory emissions per capita were 21.4 t CO_2-e per person in the year to March 2019. This represents a 40.1 per cent decline in national inventory emissions per capita from 35.8 t CO_2-e in the year to March 1990.

Over the period from 1989-90 to March 2019, Australia's population grew strongly from 17.0 million to around 25.3 million.[15,16] This reflects growth of 48.7 per cent.

Australia's GDP (2016-17 prices) also experienced significant growth over this period, expanding from $0.8 trillion in 1989-90 to around $1.8 trillion in the year to March 2019.[17] This represents a growth of 136.8 per cent.

National inventory emissions per dollar of real GDP fell from 0.78 kg CO_2-e per dollar in the year to March 1990 to 0.29 kg CO_2-e per dollar in the year to March 2019 (Figure 18). This represents a decline of 62.4 per cent from the year to March 1990.

Figure 18: Emissions per capita and per dollar of real GDP (2016-17 prices), unadjusted, year to March 1990 to 2019



Source: Department of the Environment and Energy

[14] Emissions per capita and per dollar of real GDP levels are inclusive of all sectors of the economy, including *Land Use, Land Use Change and Forestry* (LULUCF)

[15] Australian Bureau of Statistics (2019), *Australian Demographic Statistics*, pub. no. 3101 http://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0

[16] Australian Bureau of Statistics (2019), *Population Clock*. http://www.abs.gov.au/AUSSTATS/abs@.nsf/Web+Pages/Population+Clock

[17] 2016-17 prices, Australian Bureau of Statistics (2019), *National Accounts: National Income, Expenditure and Product*, Cat. No. 5206.0 http://www.abs.gov.au/ausstats/abs@.nsf/mf/5206.0

4. Short Lived Climate Forcers

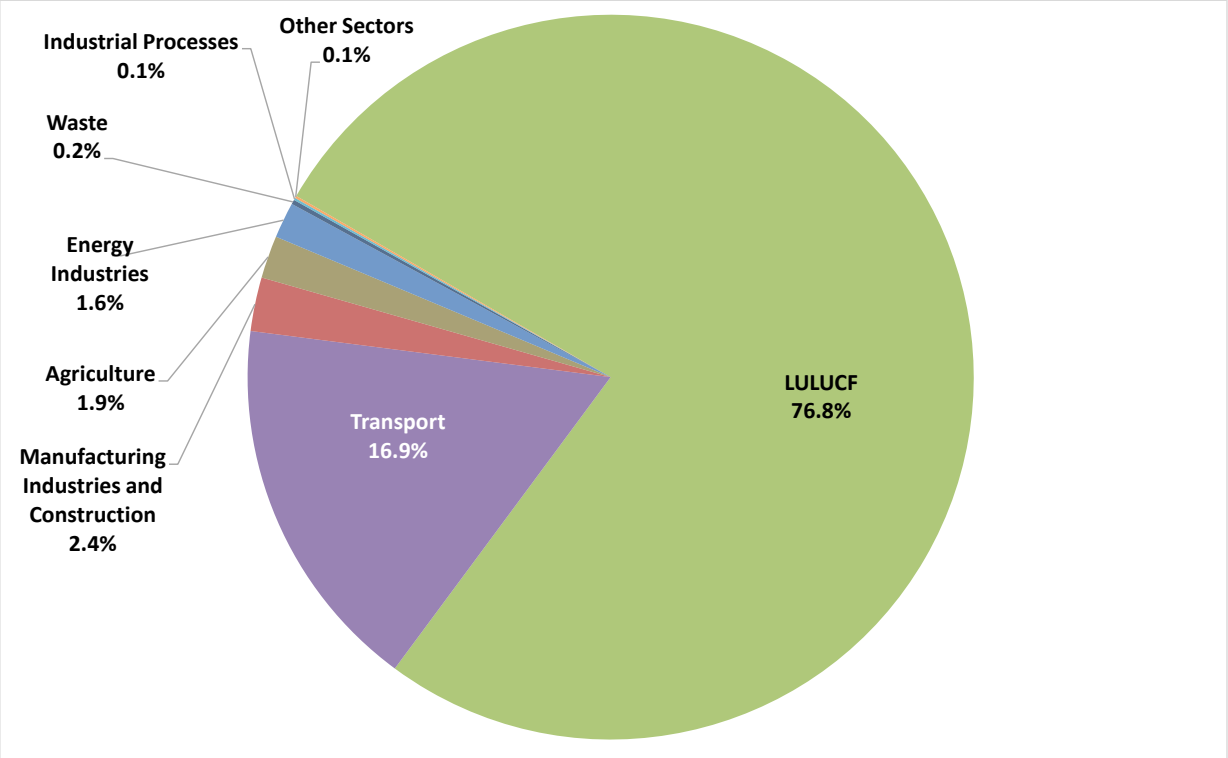
Black carbon emissions from combustion processes have been included in this report along with other aerosols ($PM_{2.5}$) and ozone and aerosol precursors (sulphur dioxide and PM_{10}). These substances are included in Australia's National Greenhouse Gas Inventory submission to the United Nations Framework Convention on Climate Change.

4.1 Aerosols – Black Carbon, $PM_{2.5}$

Black carbon, an aerosol (airborne particle) emitted from combustion processes is emitted as a component of particulate matter less than or equal to 2.5 micrometres (≤ 2.5 μm) in diameter ($PM_{2.5}$). Data from the National Pollutant Inventory (NPI)[18] has been used in conjunction with greenhouse gas data to derive national black carbon estimates.

In the year to March 2019, *LULUCF* accounted for 76.8 per cent of Australia's national black carbon inventory (Figure 19) due to bushfires, along with land management operations such as land clearing and post-harvest fires and hazard reduction burns. The *transport* sector is the second largest contributor (16.9 per cent) to Australia's black carbon emissions due to combustion of diesel fuel in heavy vehicles and kerosene in aviation.

Figure 19: *Black carbon* emissions contribution, by sector, for the year to March 2019



The 1.9 per cent or 6.2 kt increase in black carbon emissions over the year to March 2019 reflects increases in emissions from the *energy industries* (electricity generation) and *transport* (diesel use) sectors. This was partially offset by decreases in emissions from the *agriculture* sector (Table 4).

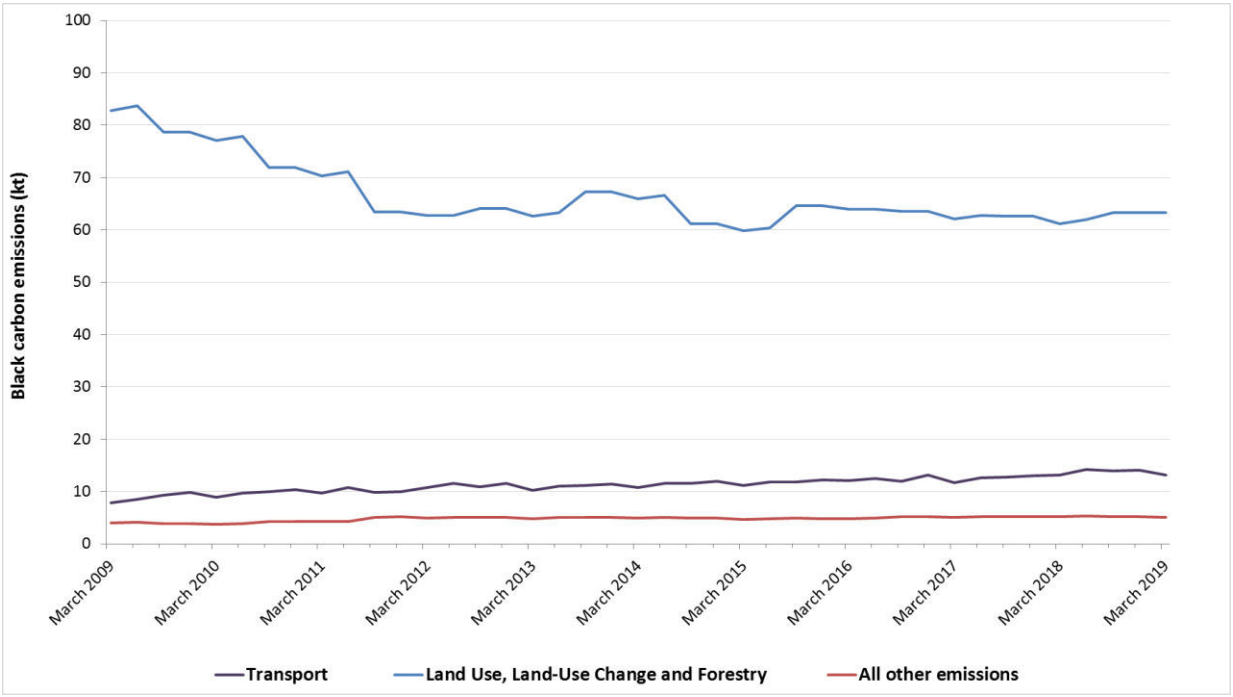
[18] http://www.npi.gov.au/

Table 4: *Black carbon* emissions, by sector, for the years to March 2018 and 2019

Sector	Annual emissions (kt)		Change (%)
	Year to March 2018	Year to March 2019	
Energy – Fuel Combustion	64.7	68.9	6.4
Energy Industries	5.1	5.4	5.5
Energy – Manufacturing Industries and Construction	7.7	7.7	0.5
Energy – Other Sectors	0.4	0.4	0.5
Energy – Transport	51.5	55.4	7.4
Industrial processes and product use	0.4	0.4	2.9
Agriculture	6.4	6.1	-4.8
Waste	0.8	0.8	0.8
Land Use, Land Use Change and Forestry	249.2	251.5	0.9
Black Carbon Total	**321.5**	**327.6**	**1.9**

The increase in black carbon emissions for *transport* is attributed to increased diesel consumption driven by passenger vehicle sales and freight activity, supported by steady economic and population growth, and switching to diesel vehicles.

Figure 20: *Black carbon* emissions, by sector, by quarter, March 2009 to March 2019



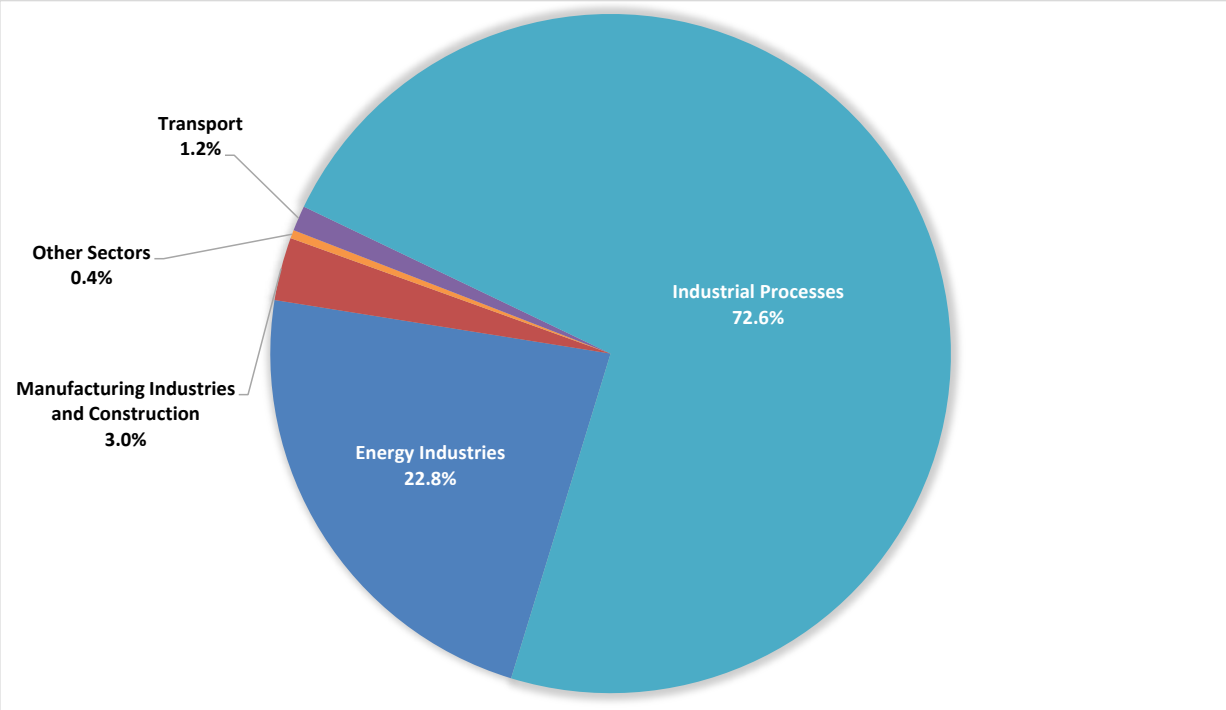
Source: Department of the Environment and Energy

4.2 Ozone and aerosol precursors – Sulphur dioxide, PM_{10}

Measured data from the NPI for sulphur dioxide (SO_2) and the aerosol particulate matter less than or equal to 10 micrometres (≤ 10 µm) in diameter (PM_{10}) has also been published in this report for *energy*, *waste* and *industrial processes and product use* from the year to March 2010.

For SO_2, in the year to March 2019, *metal production* (copper and zinc) accounted for 72.6 per cent of Australia's national inventory (Figure 21). *Energy industries* comprises electricity generation, petroleum refining and coal production is the second largest contributor (22.8 per cent) to Australia's SO_2, emissions. These emissions are primarily associated with *electricity production*.

Figure 21: Sulphur dioxide emissions contribution, by sector, for the year to March 2019



Source: Department of the Environment and Energy

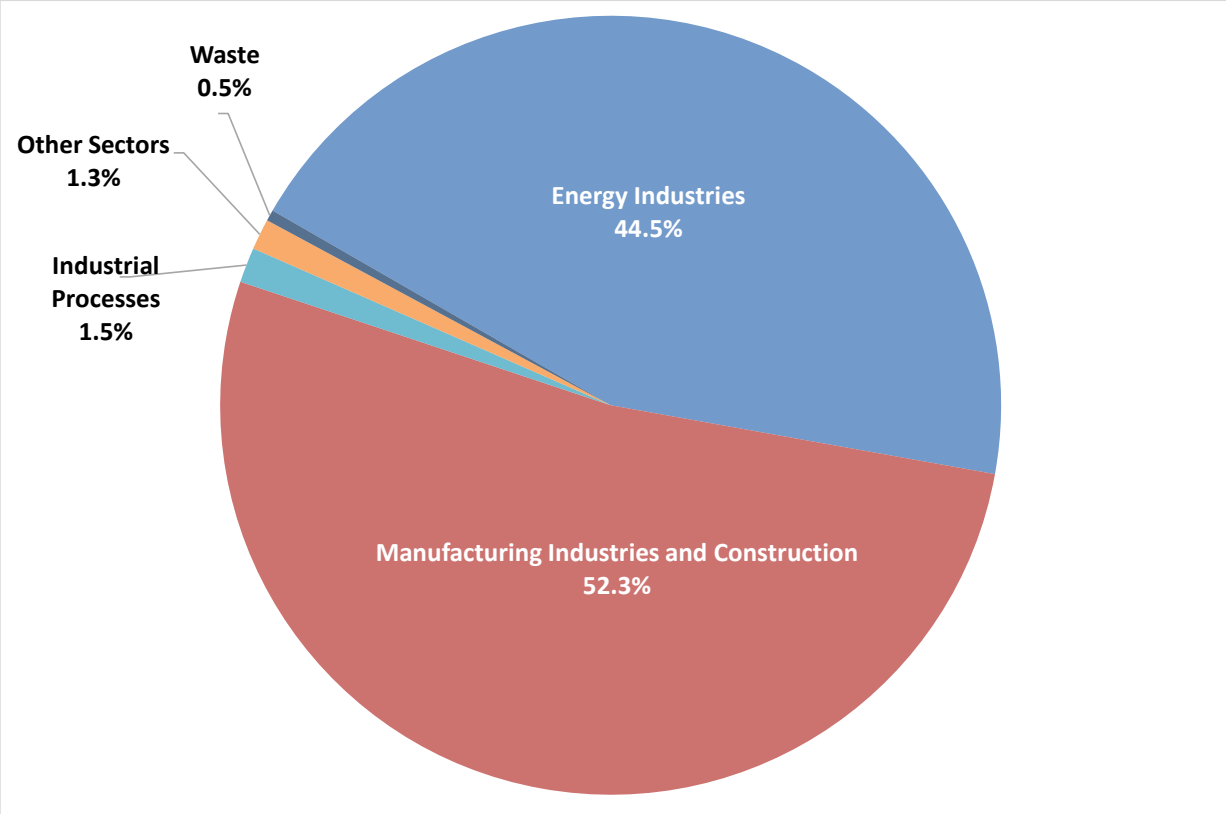
The 1.5 per cent or 32.8 kt increase in emissions over the year to March 2019 mainly reflects increases in emissions from *metal production* (Table 5). These increases in emissions were partially offset by decreases in emissions from the *electricity generation* sector.

Table 5: Sulphur dioxide emissions, by sector, for the years to March 2018 and 2019

Sector	Annual emissions (kt)		Change (%)
	Year to March 2018	Year to March 2019	
Energy – Fuel Combustion	627.3	624.8	-0.4
Energy Industries	528.6	519.9	-1.6
Energy – Manufacturing Industries and Construction	64.5	69.3	7.4
Energy – Other Sectors	9.3	9.4	0.5
Energy – Transport	24.9	26.3	5.5
Industrial processes and product use	1621.0	1656.3	2.2
Sulphur Dioxide Total	**2248.2**	**2281.1**	**1.5**

For the aerosol PM_{10}, in the year to December 2018, *manufacturing industries and construction* (including *mining and quarrying*) accounted for 52.3 per cent of Australia's national inventory (Figure 22). The *manufacture of solid fuels and other energy* (the primary component of *Energy Industries*) is the second largest contributor (44.5 per cent) to Australia's SO_2 emissions due to *coal mining*.

Figure 22: PM_{10} emissions contribution, by sector, for the year to March 2019



Source: Department of the Environment and Energy

The 2.5 per cent or 23.4 kt increase in emissions over the year to March 2019 reflects increases in emissions from the *energy* and *metal production* sectors (Table 6).

Table 6: PM_{10} emissions, by sector, for the years to March 2018 and 2019

Sector	Annual emissions (kt)		Change (%)
	Year to March 2018	Year to March 2019	
Energy – Fuel Combustion	905.1	928.1	2.5
Energy Industries	400.8	421.0	5.1
Energy – Manufacturing Industries and Construction	492.2	494.9	0.5
Energy – Other Sectors	12.1	12.2	0.5
Industrial processes and product use	13.4	13.8	2.9
Waste	4.3	4.3	0.8
PM_{10} Total	**922.7**	**946.2**	**2.5**

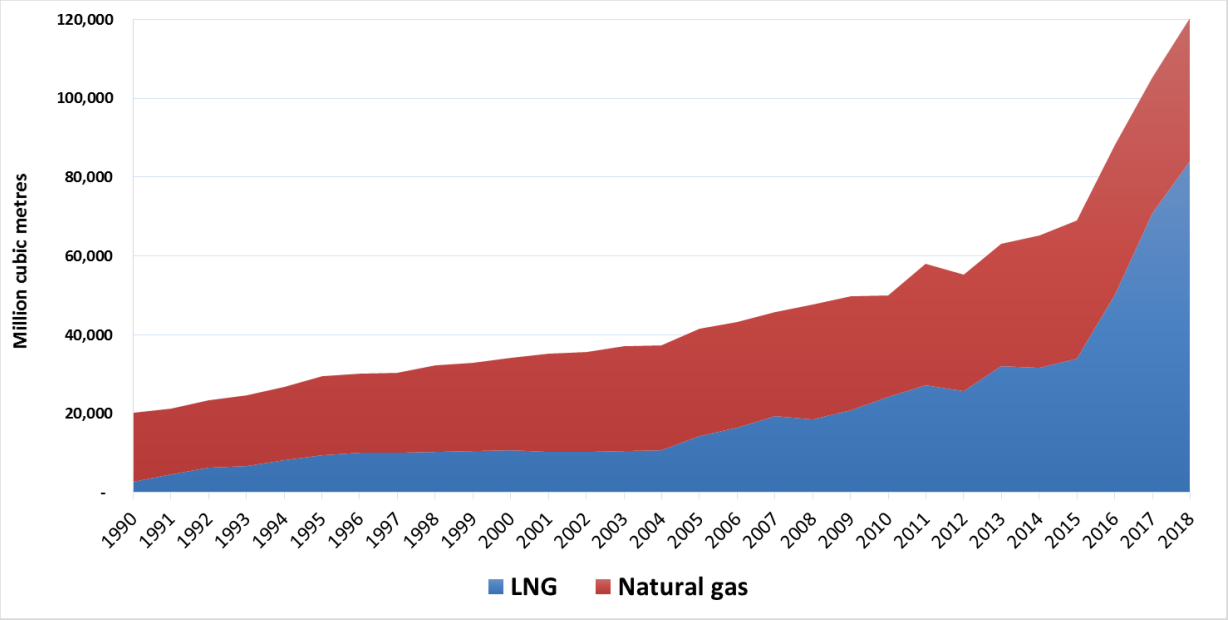
5. Special Topic – Natural gas

Underlying recent trends in national emissions are trends in emissions from natural gas supply. Emissions occur during exploration, extraction, production, processing, and pipeline transmission and distribution. Emissions also occur from the final conversion of gas to LNG at liquefaction plants where gas is cooled to -161^{O}C to become a liquid for export.

Australia's annual gas production has increased over 100 billion cubic metres or nearly 500 per cent in the period 1990 to 2018. When compared to Australia's other primary fuel production, gas has outpaced oil, metallurgical coal and thermal coal.

The underlying driver of Australia's gas growth in recent years has been the rapid expansion of the liquefied natural gas (LNG) export industry (Figure ST1). Australia is the world's second largest exporter of LNG and is forecast to overtake Qatar in 2020 to be become the largest.

Figure ST1: Natural gas and LNG production

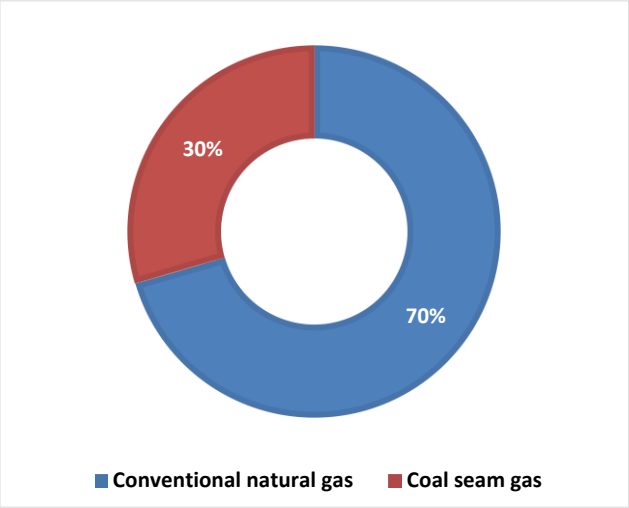


Source: Department of Industry, Innovation and Science (2019), Resources and Energy Quarterly, June 2019

In recent years Australia's natural gas has been increasingly sourced from coal seam gas. Since 2012 the share of coal seam gas has increased from 12 per cent to 30 per cent of total natural gas production (Figure ST2). Coal seam gas has now become an integral part of the gas industry in eastern Australia, particularly in Queensland. A major driver for this was a decision in 2000 by the Queensland Government that required 13 per cent of all power supplied to the state electricity grid to be generated by gas by 2005. That requirement has been increased to 15 per cent by 2010 and 18 per cent by 2020.[19].

[19] http://www.ga.gov.au/scientific-topics/energy/resources/petroleum-resources/coal-seam-gas

Figure ST2: Gas production types in 2018



Source: Department of the Environment and Energy

Greenhouse gas emissions from Australia's natural gas production system

Production of conventional and coal seam gas gives rise to two types of emissions; fugitive emissions and emissions from fuel combustion.

Fugitive emissions

Fugitive emissions can occur at all stages of the gas production chain including delivery for final consumption, or at the point of export in the case of LNG. Fugitive emissions comprise venting, flaring, and leaks.

Venting is the intentional release of gas (including carbon dioxide and methane) from routine operations, or accidental discharges and system disruptions.

Flaring is the burning of excess gases that cannot be recovered or reused during plant operations and is important in managing the pressure, flow and composition of the gas in production and processing. Flaring reduces the greenhouse gas emissions by burning methane to produce carbon dioxide[20].

Leaks of methane and carbon dioxide are a non-intentional release from sources such as connections, flanges, gas gathering pipes, tanks and pressurised equipment.

Fuel combustion

Emissions from direct combustion of fuels are mostly due to the use of raw natural gas for driving compressors, onsite electricity generation or other energy-related purposes.

Indirect electricity generation emissions are associated with the generation of electricity that is consumed from the electricity grid.

Emissions from the gas industry in Australia's National Greenhouse Gas Inventory

Companies are required to report greenhouse gas emissions from fugitive sources and fuel combustion annually to the Clean Energy Regulator under the National Greenhouse and Energy Reporting (NGER) system. The energy production facility threshold of 100 tera joules per year ensures comprehensive reporting of emissions within the sector.

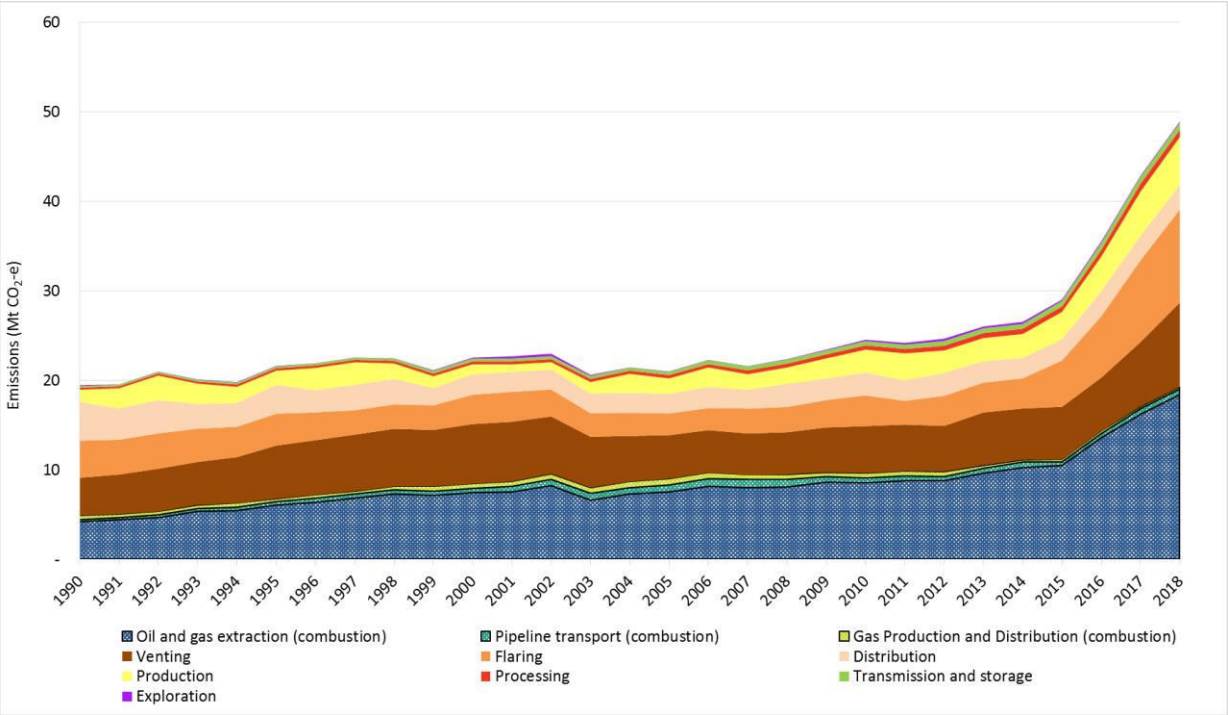
[20] Methane has a greenhouse warming potential 25 times greater than carbon dioxide

Data acquired from NGER are used to inform Australia's national greenhouse gas accounts including the *Quarterly Update* and the National Inventory Report to the United Nations Framework Convention on Climate Change (UNFCCC).

Trends in emissions

Emissions associated with Australian natural gas production have increased by 29.4 Mt CO_2-e or 151 per cent since 1990 (Figure ST3).

Figure ST3: Emissions from Australia's natural gas production system, financial years, 1990-2018



Source: Department of the Environment and Energy

Since 2009 seven new LNG projects have come online adding 64 million tonnes of annual production capacity. This has resulted in emissions from natural gas increasing by 109 per cent or 25.5 Mt CO_2-e over this period.

Role of gas in the transition to cleaner, more efficient energy systems

Natural gas has a clear greenhouse gas benefit over coal when combusted. Natural gas produces around 52 kg CO_2-e per gigajoule compared to around 90 kg CO_2-e per gigajoule from black coal.[21]

There has been debate about whether the greenhouse gas emission benefit of gas over coal still holds when all emissions associated with gas production (for example fugitive emissions) are included. The CSIRO has recently released a report looking at this issue.[22] The CSIRO undertook a comprehensive life cycle assessment of all greenhouse gas emissions associated with coal seam gas-LNG production, from those associated with upstream production at the well head through to liquefaction, including external emissions such as construction.

The CSIRO report found that the use of coal seam gas from the Surat Basin to displace Queensland thermal coal for electricity generation produces a substantial greenhouse gas emission saving.

[21] *National Greenhouse and Energy Reporting (Measurement) Determination 2008*

[22] Whole of life greenhouse gas emissions assessment of a coal seam gas to liquefied natural gas project in the Surat Basin, Queensland, Australia https://gisera.csiro.au/wp-content/uploads/2019/07/GISERA_G2_Final_Report-whole-of-life-GHG-assessment.pdf

Use of coal seam gas from the Surat Basin in an open cycle gas turbine would give a reduction in emissions of 31 per cent and a reduction of 50 per cent for gas used in a closed cycle gas turbine when compared to generation from the use of Queensland thermal coal.

The report also concludes that ensuring high efficiency electricity generation (for example via closed cycle gas turbine technology) is important in realising the potential climate benefits of natural gas where it replaces coal fired electricity generation.

Another CSIRO study[23] using 'top down' atmospheric inversion of methane concentration data in the central Surat Basin coupled with a 'bottom-up' inventory of methane sources for the same region suggested that fugitive methane emissions from upstream gas production infrastructure is less than 0.5 per cent of coal seam gas production. This finding is consistent with a leakage rate estimated from data in the national inventory of around 0.4 per cent of gas supply.

The greenhouse gas emissions benefit of gas over coal is improved if carbon capture and storage (CCS) is used in gas production and processing.The relevance of CCS will increase as more gas reserves with higher levels of carbon dioxide composition are developed.

An example of the deployment of CCS technology is the start-up of a carbon dioxide injection system at the Gorgon natural gas facility on 8 August 2019. Once fully operational, the system will inject between 3.4 and 4 million tonnes of greenhouse gas emissions each year, equivalent of removing 680,000 cars from the roads annually.

[23] *Characterisation of Regional Fluxes of Methane in the Surat Basin*, Queensland; https://gisera.csiro.au/wp-content/uploads/2018/10/GHG-1-Final-Report.pdf

6. Technical notes

6.1 Quarterly coverage

The *Quarterly Update* uses emissions estimates based on our United Nations Framework Convention on Climate Change (UNFCCC) inventory time series to better support implementation of Australia's 2030 target. The UNFCCC inventory will be used to track progress towards Australia's commitment to reduce emissions levels by 2030 under the Paris Agreement.

6.2 International guidelines

The *Quarterly Update* has been prepared in accordance with the international guidelines agreed for use at the Conference of the Parties (COP) of the UNFCCC in Warsaw 2013 including the *Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* (2006).

6.3 Greenhouse gases and short lived climate forcers

This report covers sources of greenhouse gas emissions and removals by sinks resulting from human (anthropogenic) activities for the major greenhouse gases listed in Table 7 below.

This report also reports on some select aerosols and ozone and aerosol precursors known as short lived climate forcers (Table 7).

Table 7: Major greenhouse gases and short lived climate forcers covered by the Quarterly Update

Major greenhouse gases	Short lived climate forcers
Carbon dioxide (CO_2)	particulate matter less than or equal to 2.5 micrometres ($PM_{2.5}$)
Methane (CH_4)	Black carbon (BC)
Nitrous oxide (N_2O)	particulate matter less than or equal to 10 micrometres (PM_{10})
Perfluorocarbons (PFCs)	Sulphur dioxide (SO_2)
Hydrofluorocarbons (HFCs)	
Sulphur hexafluoride (SF_6)	

Australia's emissions of the greenhouse gas nitrogen trifluoride (NF_3) are considered negligible and are not estimated.

Global warming potentials (GWPs) have been used for each of the major greenhouse gases to convert them to carbon dioxide equivalents (CO_2-e). 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. The GWPs used in this Report were the 100-year GWPs contained in the 2007 IPCC Fourth Assessment Report (IPCC 2007), by international agreement.

Short lived climate forcers are gases and particles that affect the climate. They have lifetimes in the atmosphere of a few days to a decade, and many of them are also air pollutants. They are referred to as near-term climate forcers (NTCF) in the IPCC Fifth Assessment Report (AR5), which are a set of compounds whose impact on climate occurs primarily within the first decade after their emission. This set of compounds includes ozone and aerosols, or their precursors, and some halogenated species that are not well-mixed greenhouse gases (Annex 3 Glossary, Working Group I contribution to AR5).

GWPs are not applied to the short lived climate forcers; they are therefore reported in mass units.

6.4 Quarterly methodology and growth rates

Emission estimates have been compiled by the Department using the estimation methodologies incorporated in the Australian Greenhouse Emissions Information System (AGEIS) and documented in the National Inventory Report.

The estimates are calculated using the latest national inventory data and indicators from external data sources (listed in Section 7.6). These data are used to determine growth rates, which are applied to estimate quarterly emissions growth.

Quarterly growth rates are calculated as the percentage change between the estimates for the previous quarter and the current quarter. Annual growth rates are calculated as the percentage change between the estimates for the twelve months to the end of the equivalent quarter in the previous year, and the twelve months to the end of the current quarter.

6.5 Recalculations

Periodic recalculations of the quarterly emission estimates are undertaken as more complete and accurate information becomes available, and in response to changes in international reporting requirements.

Recalculations comply with international guidelines, are estimated on a time series consistent basis and are subject to annual international expert review.

Recalculations since the December Quarter 2018

The recalculations since the December 2018 edition of the *Quarterly Update* for the financial years 2005 and 2016 to 2018), by sector in Mt CO_2-e, are shown in Table 8.

Table 8: Recalculations (Mt CO_2-e) since the December 2018 *Quarterly Update*, by sector, 2005 and 2016 to 2018

Sector	Financial Years and Quarters															
	2005				2016				2017				2018			
	Mar	Jun	Sep	Dec	Mar	Jun	Sep	Dec	Mar	Jun	Sep	Dec	Mar	Jun	Sep	Dec
Agriculture	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	-0.2	-0.2
Electricity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stationary energy (excluding electricity)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	-0.3	0.2
Transport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fugitive emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	-0.2	0.2	0.1	-0.1	0.0
Industrial processes and product use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Waste	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LULUCF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.6**	**0.4**	**-0.6**	**0.0**

Revisions to Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) livestock, crop and rice data resulted in recalculations to *agriculture*.

Revisions to Department of Industry, Innovation and Science (DIIS) commodities production data resulted in recalculations to *stationary energy (excluding electricity)*, *fugitive emissions*, and *industrial processes and product use*.

Routine recalculations

The national inventory is subject to continuous improvement in line with the national inventory improvement plan. All methods and data sources are kept under review to ensure that the inventory is consistent with international guidelines, is able to use the best data available, including new National Greenhouse and Energy Reporting (NGER) data, and takes account of the latest empirical science.

6.6 Source data

Preliminary activity data are obtained under the NGERs and from a range of publicly available sources, principally:

- Australian Bureau of Statistics (2019), Australian Demographic Statistics, pub. no. 3101 http://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0
- Australian Bureau of Statistics (2019), Population Clock. http://www.abs.gov.au/AUSSTATS/abs@.nsf/Web+Pages/Population+Clock
- Australian Bureau of Agricultural and Resource Economics and Sciences (2019*). Agricultural Commodities, June Quarter 2019.*
- Australian Bureau of Statistics (2019), *National Accounts: National Income, Expenditure and Product*, Cat. No. 5206.0 http://www.abs.gov.au/ausstats/abs@.nsf/mf/5206.0
- Australian Energy Market Operator (2019), Market data extracted using NEM-Review software: http://www.aemo.com.au/Electricity/Data
- Bureau of Infrastructure, Transport and Regional Economics (2019), Domestic Totals & Top Routes: http://www.bitre.gov.au/publications/ongoing/domestic_airline_activity-time_series.aspx
- Bureau of Meteorology (2019), Monthly climate summaries: http://www.bom.gov.au/
- Department of Industry, Innovation and Science (2019). *Resources and Energy Quarterly, March 2019*
- Department of the Environment and Energy (2018). Australian Energy Statistics: Table F. https://www.energy.gov.au/publications/australian-energy-update-2018
- Department of the Environment and Energy (2019), Australian Greenhouse Emissions Information System: http://ageis.climatechange.gov.au/

6.7 Unadjusted time series

The ABS defines an original time series as showing 'the actual movements in the data over time'. The unadjusted time series' in this report are equivalent to an original time series.

6.8 Seasonal adjustment analysis

The ABS defines seasonal adjustment as follows: 'A seasonally adjusted time-series is a time-series with seasonal component removed. This component shows a pattern over one year or less and is systemic or calendar related.'

The unadjusted quarterly data have been adjusted using Demetra to remove the effects of seasonal factors. Demetra is a standard seasonal adjustment tool, consistent with methods applied by the ABS.

6.9 Trend analysis

The trend series provides the best indication of underlying movements in the inventory by smoothing short term fluctuations in the seasonally adjusted series, caused for example, by extreme weather events such as floods or fires. The trend time series is estimated using the Demetra tool. More information on trend analysis is available on the ABS website http://www.abs.gov.au/websitedbs/D3310114.nsf/home/Time+Series+Analysis:+The+Basics.

6.10 Weather normalisation

The seasonally adjusted and trend estimates are further adjusted to correct for the effects of variations around average seasonal temperatures. This process is termed 'weather normalisation' and is designed to provide a clearer indication of the underlying trends in the emissions data.

Seasonal temperatures are an important predictor of emissions in Australia due to their influence on demand for electricity for heating and cooling (air conditioning). The seasonally adjusted series corrects for the regular effects of differences in average temperatures between seasons. The weather normalised series further corrects for fluctuations in average seasonal conditions.

The weather normalisation methodology is based on the Bureau of Meteorology concept of 'heating and cooling degree days,' and is applied to total emissions (excluding *LULUCF*) and the *electricity* sector. The methodology is described in detail in 'Section 7: Special Topic' of the December 2011 edition of the *Quarterly Update*.

6.11 Quarterly uncertainty

For all sectors the Department's assessment is that the 90 per cent confidence interval for the national inventory is ± 6.5 per cent (i.e. there is a 90 per cent probability that future revisions will be limited to ± 6.5 per cent of the current estimate).

6.12 Sectoral emissions sources and sinks

Energy:

Electricity:

- Emissions from the combustion of fuel used to generate electricity for public use.

Stationary energy excluding electricity:

- Energy industries: petroleum refining, gas processing and solid fuel manufacturing (including coal mining and oil/gas extraction and processing).
- Manufacturing industries and construction: direct emissions from the combustion of fuel to provide energy used in manufacturing such as steel, non-ferrous metals, chemicals, food processing, non-energy mining and pulp and paper.
- Other sectors: energy used by the commercial, institutional, residential sectors as well as fuel used by the agricultural, fishery and forestry equipment. This also includes all remaining fuel combustion emissions associated with military fuel use.

Transport:

- Road transport: passenger vehicles, light commercial vehicles, trucks, buses and motorcycles.
- Domestic air transport: commercial passenger and light aircraft on domestic routes using either aviation gasoline or jet kerosene. International air transport is reported but not included in Australia's total emissions (in line with international guidelines).
- Coastal shipping: domestic shipping and small craft. International shipping is reported but not included in Australia's total emissions (in line with international guidelines).
- Rail transport: railways, but not electric rail, where fuel combustion is covered under the electricity sector.
- Transmission of natural gas.

Fugitive emissions:

Emissions, other than those attributable to energy use, from:

- Solid fuels: CO_2 and CH_4 from coal mining activities, post-mining and decommissioned mines and CO_2, CH_4 and N_2O from flaring associated with coal mining.
- Oil and natural gas: exploration, extraction, production, processing and transportation of natural gas and oil. Includes leakage, evaporation and storage losses, flaring and venting of CO_2, CH_4 and N_2O.

Industrial processes and product use:

- Mineral industry: CO_2 from cement clinker and lime production; the use of limestone and dolomite and other carbonates in industrial smelting and other processes; soda ash production and use; and magnesia production.
- Metal industry: CO_2 and PFCs from aluminium smelting; CO_2, CH_4 and N_2O from iron and steel production; and CO_2 from the production of ferroalloys and other metals.

- Chemical Industry: includes N_2O from the production of nitric acid; CO_2, from ammonia production, acetylene use and the production of synthetic rutile and titanium dioxide; and CH_4 from polymers and other chemicals.
- Other product manufacture and use: CO_2 from the consumption of CO_2 in the food and drink industry and the use of sodium bicarbonate, SF_6 from electrical equipment.
- Product uses as substitutes for Ozone Depleting Substances: HFC and refrigeration and air conditioning equipment, foam blowing, metered dose inhalers, fire extinguishers, solvent use.
- Non-energy products from fuel and solvent use: CO_2 produced by oxidation of lubricating oils and greases.

Agriculture:

CH_4 and N_2O emissions from the consumption, decay or combustion of living and dead biomass, including:

- Enteric fermentation in livestock: emissions associated with microbial fermentation during digestion of feed by ruminant (mostly cattle and sheep) and some non-ruminant domestic livestock.
- Manure management: emissions associated with the decomposition of animal wastes while held in manure management systems.
- Rice cultivation: CH_4 emissions from anaerobic decay of organic material when rice fields are flooded.
- Agricultural soils: emissions associated with the application of fertilisers, crop residues and animal wastes to agricultural lands and the use of biological nitrogen fixing crops and pastures.
- Field burning of agricultural residues: emissions from field burning of cereal and other crop stubble, and the emissions from burning sugar cane prior to harvest.
- Carbon dioxide emissions from the application of urea and lime.

Waste:

Emissions are predominantly CH_4. Small amounts of CO_2 and N_2O are generated through incineration and the decomposition of human wastes respectively. The main sources are:

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

Land Use, Land Use Change and Forestry:

The *LULUCF* sector includes:

- Forest converted to other land uses: emissions and removals from the direct human-induced removal of forest and replacement with pasture, crops or other uses since 1972. Emissions arise from the burning and decay of cleared vegetation, and changes in soil carbon from current and past events.
- Land converted to forest: emissions and removals (i.e. sinks) from forests established on agricultural land. Growth of the forests and regrowth on cleared lands provides a carbon sink, while emissions can arise from soil disturbance on the cleared lands (N_2O). Both new plantings and the regeneration of forest from natural seed sources contribute to this classification as well as sequestration projects under the Emission Reduction Fund.
- Forest land remaining forest land: emissions and removals in forests managed under a system of practices designed to support commercial timber production such as harvest or silvicultural practices or practices that are designed to implement specific sink enhancement activities. Forest harvesting causes emissions due to the decay of harvest slash and any subsequent prescribed burning. The regrowth of forests following harvesting provides a carbon sink and the harvested wood product pool can be a carbon sink or source depending on the rate of input and the rate of decay. Wildfire emissions on forest management land are reported using the natural disturbances provision.
- Cropland: Anthropogenic emissions and removals on croplands occur as a result of changes in management practices on cropping lands, from changes in crop type (particularly woody crops) and from changes in land use.
- Grazing land: Anthropogenic emissions and removals on grasslands result from changes in management practices on grass lands, particularly from changes in pasture, grazing and fire management; changes in woody biomass elements and from changes in land use.
- Wetlands: Net emissions from the coastal lands including dredging of seagrass, aquaculture, and loss of tidal marsh areas. Changes in mangroves are reported under forest classifications.

6.13 Measurements

The units used in this quarterly update inventory are:

grams (g)

tonnes (t)

metres (m)

litres (L)

Standard metric prefixes used in this inventory are:

kilo (k) = 10^3 (thousand)

mega (M) = 10^6 (million)

giga (G) = 10^9

tera (T) = 10^{12}

peta (P) = 10^{15}

In this report, emissions are expressed in Mt CO_2-e, which represents millions of tonnes of carbon dioxide equivalent gas.

Short lived climate forcers are expressed in kt which represents thousands of tonnes of the respective gas or particle.

6.14 Future publications

The June 2019 Quarterly Update of Australia's National Greenhouse Gas Inventory will be published by 30 November 2019.

7. Data tables

Data Table 1A: Unadjusted emissions (Mt), by sector, by quarter, since 2001-02[24]

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	Total excluding LULUCF	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions						
2001-2002	September	47.5	19.4	18.9	10.2	7.3	19.5	4.0	126.8	16.6	143.4
	December	44.3	19.4	19.6	9.6	7.1	19.5	4.0	123.4	16.6	139.9
	March	45.4	18.6	18.5	8.9	6.9	19.0	3.9	121.2	16.2	137.4
	June	46.8	19.2	18.7	9.8	7.3	19.2	4.0	125.0	16.4	141.3
2002-2003	September	48.6	19.9	19.6	9.9	7.8	18.1	3.8	127.6	18.7	146.4
	December	46.2	19.9	20.2	9.1	7.8	18.1	3.8	125.1	18.7	143.8
	March	45.4	19.1	19.1	8.5	7.8	17.7	3.7	121.3	18.3	139.7
	June	46.4	19.5	19.3	9.5	7.7	17.9	3.7	124.1	18.5	142.6
2003-2004	September	49.0	20.3	20.3	10.0	8.3	18.9	3.6	130.5	16.6	147.1
	December	46.8	20.3	21.0	9.2	8.3	18.9	3.6	128.2	16.6	144.8
	March	50.0	19.4	19.8	8.6	8.1	18.7	3.6	128.2	16.4	144.7
	June	49.1	19.9	20.0	9.7	7.9	18.7	3.6	129.0	16.4	145.4
2004-2005	September	50.9	20.8	20.8	10.2	8.0	19.1	3.6	133.5	22.4	155.9
	December	48.2	20.9	21.1	9.6	8.0	19.1	3.6	130.5	22.4	152.9
	March	48.8	19.8	19.7	8.9	7.9	18.7	3.5	127.4	21.9	149.3
	June	48.9	20.4	20.6	10.0	8.0	18.9	3.6	130.4	22.1	152.6
2005-2006	September	50.9	20.7	20.6	10.5	8.2	18.7	3.6	133.1	21.4	154.6
	December	48.9	20.5	21.9	9.8	8.0	18.7	3.6	131.4	21.4	152.8
	March	50.6	19.4	20.5	9.2	7.8	18.3	3.5	129.3	21.0	150.3
	June	50.9	20.6	20.5	10.5	8.0	18.5	3.5	132.6	21.2	153.8

[24] This table presents estimates of quarterly emissions by sector since 2001-02, in unadjusted terms. As numbers are rounded, the sum of the sectors may not exactly equal the totals.

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	Total excluding LULUCF	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions						
2006-2007	September	52.2	20.5	21.2	10.9	8.5	17.8	3.7	134.9	23.7	158.5
	December	50.8	21.0	22.0	10.3	8.6	17.8	3.7	134.2	23.7	157.9
	March	51.6	19.8	21.2	9.7	8.4	17.4	3.6	131.7	23.2	154.8
	June	49.5	20.6	21.4	11.0	8.6	17.6	3.6	132.4	23.4	155.8
2007-2008	September	53.5	21.4	21.7	11.8	8.7	17.1	3.8	138.0	19.8	157.7
	December	50.3	21.3	22.3	9.9	8.6	17.1	3.8	133.2	19.8	153.0
	March	51.7	20.3	21.3	9.9	8.5	16.9	3.7	132.3	19.6	151.9
	June	50.5	21.4	21.7	10.6	8.6	16.9	3.7	133.5	19.6	153.1
2008-2009	September	55.4	22.1	22.1	10.7	9.3	17.3	3.8	140.7	17.6	158.3
	December	52.3	21.6	22.6	10.7	8.7	17.3	3.8	136.9	17.6	154.5
	March	52.5	19.4	21.2	9.5	7.3	16.9	3.7	130.3	17.2	147.5
	June	51.5	20.5	21.5	11.2	7.5	17.1	3.7	133.0	17.4	150.4
2009-2010	September	51.4	20.8	22.4	11.3	8.6	16.7	3.8	135.1	12.3	147.3
	December	51.3	21.3	22.9	10.3	9.0	16.7	3.8	135.3	12.3	147.5
	March	52.5	20.5	21.4	9.9	9.1	16.3	3.8	133.5	12.0	145.5
	June	49.9	21.3	22.1	10.8	9.0	16.5	3.8	133.4	12.1	145.6
2010-2011	September	51.0	21.9	22.8	11.6	9.1	17.8	3.7	137.9	7.4	145.3
	December	47.1	21.6	23.7	10.8	9.2	17.8	3.7	133.9	7.4	141.3
	March	50.7	20.1	22.1	9.0	9.0	17.4	3.6	131.9	7.2	139.1
	June	49.7	21.6	22.8	10.2	8.9	17.6	3.6	134.6	7.3	141.9
2011-2012	September	50.9	23.2	22.5	10.8	9.2	18.1	3.3	137.9	4.6	142.4
	December	49.2	22.7	22.9	10.5	8.2	18.1	3.3	134.8	4.6	139.3
	March	50.3	21.4	23.1	9.6	8.1	17.9	3.2	133.7	4.5	138.2
	June	48.7	22.1	23.4	11.1	7.9	17.9	3.2	134.4	4.5	138.9

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	Total excluding LULUCF	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions						
2012-2013	September	47.0	24.1	23.2	11.0	8.0	18.2	3.1	134.6	1.8	136.5
	December	45.9	23.9	23.9	10.6	8.0	18.2	3.1	133.6	1.8	135.4
	March	47.6	22.2	22.2	9.8	7.7	17.8	3.0	130.3	1.8	132.1
	June	46.6	23.2	22.8	10.6	7.8	18.0	3.1	132.1	1.8	133.9
2013-2014	September	45.0	23.9	23.4	10.3	7.9	18.3	3.1	132.1	2.0	134.2
	December	44.0	23.9	23.9	10.2	7.9	18.3	3.1	131.4	2.0	133.4
	March	47.2	22.5	22.7	10.1	7.6	17.9	3.1	131.1	2.0	133.1
	June	44.5	23.7	23.2	10.2	7.7	18.1	3.1	130.5	2.0	132.5
2014-2015	September	47.5	23.4	24.0	12.4	8.3	17.7	3.0	136.3	-0.9	135.4
	December	46.4	22.9	24.5	11.1	8.3	17.7	3.0	133.8	-0.9	132.9
	March	47.9	21.8	23.3	10.4	8.0	17.3	2.9	131.7	-0.9	130.8
	June	47.2	22.6	23.5	11.6	8.2	17.5	3.0	133.5	-0.9	132.7
2015-2016	September	49.3	23.4	24.1	12.5	8.4	17.4	3.1	138.2	-4.1	134.1
	December	48.0	23.3	24.5	11.9	8.4	17.4	3.1	136.7	-4.1	132.6
	March	49.9	22.3	24.0	12.1	8.1	17.2	3.1	136.7	-4.1	132.6
	June	47.5	23.3	23.8	12.2	8.2	17.2	3.1	135.2	-4.1	131.2
2016-2017	September	48.8	24.2	24.5	12.9	8.6	18.4	3.0	140.4	-4.9	135.5
	December	45.4	24.2	25.8	12.6	8.5	18.4	3.0	137.9	-4.9	133.0
	March	49.6	22.6	23.9	12.4	8.2	18.0	2.9	137.6	-4.8	132.8
	June	46.0	24.4	24.5	13.9	8.4	18.2	2.9	138.3	-4.8	133.5
2017-2018	September	45.7	25.0	25.1	14.5	8.5	18.1	3.0	140.0	-5.0	135.1
	December	44.4	25.0	25.5	14.3	8.6	18.1	3.0	138.9	-5.0	133.9
	March	46.2	24.3	24.9	13.5	8.6	17.7	3.0	138.2	-4.8	133.3
	June	45.1	25.6	25.6	14.5	8.7	17.9	3.0	140.3	-4.9	135.4

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	Total excluding LULUCF	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions						
2018-2019	September	44.7	26.2	25.4	14.7	8.7	17.0	3.0	139.7	-4.9	134.8
	December	42.9	26.6	25.9	15.8	8.7	17.0	3.0	139.8	-4.9	135.0
	March	45.8	25.4	24.4	14.7	8.5	16.7	3.0	138.4	-4.7	133.7
	June	-	-	-	-	-	-	-		-	-

Data Table 1B: Seasonally adjusted emissions (Mt), by sector, by quarter, since 2001-02[25]

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	Total excluding LULUCF	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions						
2001-2002	September	45.9	18.9	18.7	9.6	7.1	19.3	4.0	123.8	16.2	140.2
	December	45.3	19.1	18.9	9.7	7.0	19.3	4.0	123.3	16.4	139.6
	March	45.7	19.2	19.0	9.6	7.1	19.2	4.0	123.8	16.5	140.4
	June	47.0	19.4	19.1	9.6	7.3	19.3	4.0	125.5	16.5	141.8
2002-2003	September	47.0	19.4	19.3	9.3	7.6	18.0	3.8	124.7	18.4	143.2
	December	47.3	19.5	19.5	9.2	7.8	18.0	3.7	125.0	18.6	143.5
	March	45.7	19.7	19.6	9.3	8.0	17.9	3.7	123.9	18.7	142.7
	June	46.6	19.7	19.7	9.2	7.8	18.0	3.7	124.6	18.6	143.0
2003-2004	September	47.5	19.9	20.0	9.4	8.1	18.8	3.6	127.4	16.4	144.1
	December	47.9	19.9	20.3	9.3	8.2	18.8	3.6	128.1	16.3	144.4
	March	50.2	20.1	20.4	9.3	8.3	18.9	3.6	130.8	16.8	147.7
	June	49.4	20.1	20.5	9.4	8.0	18.8	3.6	129.7	16.4	145.8
2004-2005	September	49.4	20.4	20.6	9.5	7.8	19.0	3.6	130.4	22.3	152.9
	December	49.2	20.5	20.4	9.7	7.9	19.0	3.6	130.3	22.1	152.5
	March	48.9	20.6	20.2	9.7	8.0	18.9	3.6	129.9	22.3	152.2
	June	49.4	20.6	21.0	9.7	8.2	18.9	3.6	131.2	21.9	153.0
2005-2006	September	49.3	20.2	20.4	9.8	8.0	18.7	3.6	130.1	21.5	151.7
	December	49.9	20.1	21.2	9.9	7.9	18.6	3.5	131.2	21.3	152.5
	March	50.6	20.1	21.1	10.0	7.9	18.5	3.5	131.8	21.3	153.0
	June	51.6	20.7	20.9	10.2	8.1	18.5	3.6	133.4	20.8	154.2

[25] This table presents estimates of quarterly emissions by sector since 2001-02, in seasonally adjusted terms. Estimates for the national inventory total and the electricity sector include weather normalisation, as described in Section 5: Technical Notes. Seasonally adjusted estimates for all other sectors are presented without weather normalisation. As a result, the national inventory total may differ from the sum of the rows.

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	Total excluding LULUCF	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions						
2006-2007	September	50.6	20.0	21.0	10.3	8.3	17.8	3.6	131.8	23.9	155.7
	December	51.8	20.6	21.3	10.3	8.5	17.7	3.6	134.0	23.7	157.6
	March	51.5	20.6	21.7	10.6	8.6	17.6	3.6	134.1	23.3	157.4
	June	50.3	20.7	21.8	10.7	8.8	17.6	3.6	133.2	22.7	156.2
2007-2008	September	51.9	20.8	21.5	11.1	8.5	17.1	3.7	135.0	20.3	155.0
	December	51.2	20.9	21.5	10.0	8.5	17.0	3.7	133.1	20.0	152.8
	March	51.4	21.2	21.9	10.8	8.7	17.1	3.8	134.6	19.5	154.3
	June	51.4	21.5	22.0	10.3	8.8	16.9	3.7	134.3	18.6	153.3
2008-2009	September	53.9	21.5	22.0	10.1	9.1	17.2	3.7	137.8	18.4	155.7
	December	53.4	21.2	21.8	10.8	8.6	17.1	3.7	136.7	17.9	154.5
	March	52.0	20.3	21.8	10.4	7.4	17.1	3.7	132.5	17.0	149.7
	June	52.3	20.6	21.7	10.9	7.6	17.1	3.7	133.7	16.2	150.5
2009-2010	September	50.1	20.2	22.3	10.7	8.4	16.6	3.8	132.5	13.3	145.1
	December	52.4	20.8	22.2	10.3	8.8	16.6	3.8	135.0	12.7	147.6
	March	51.9	21.5	22.1	10.8	9.3	16.5	3.8	135.6	11.7	147.6
	June	50.5	21.4	22.3	10.5	9.2	16.6	3.8	134.2	11.0	145.4
2010-2011	September	50.1	21.2	22.6	11.0	8.9	17.7	3.7	135.4	8.4	143.5
	December	48.1	21.2	23.0	10.7	9.1	17.7	3.7	133.7	7.8	141.4
	March	49.8	21.1	22.8	9.8	9.2	17.7	3.6	133.8	7.0	140.9
	June	50.1	21.7	23.0	10.0	9.1	17.7	3.6	135.5	6.2	141.6
2011-2012	September	50.4	22.4	22.4	10.3	9.0	18.0	3.3	135.3	5.6	140.9
	December	50.3	22.3	22.2	10.4	8.1	17.9	3.3	134.6	4.9	139.5
	March	49.3	22.5	23.8	10.5	8.3	18.1	3.3	135.5	4.2	139.8
	June	49.0	22.2	23.6	10.8	8.1	17.9	3.2	135.2	3.5	138.5

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	Total excluding LULUCF	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions						
2012-2013	September	46.7	23.3	23.1	10.5	7.8	18.1	3.1	132.3	2.8	135.1
	December	47.0	23.5	23.2	10.6	7.9	18.0	3.1	133.5	2.1	135.7
	March	46.5	23.3	22.9	10.5	7.9	18.0	3.1	131.9	1.6	133.4
	June	46.9	23.3	23.0	10.4	7.9	18.0	3.1	132.9	0.9	133.8
2013-2014	September	44.7	23.2	23.3	9.9	7.8	18.2	3.2	130.0	3.0	132.8
	December	45.0	23.5	23.2	10.3	7.8	18.2	3.1	131.3	2.3	133.6
	March	46.1	23.5	23.4	10.7	7.8	18.1	3.1	132.6	1.8	134.3
	June	45.0	23.7	23.4	10.0	7.8	18.1	3.1	131.2	1.2	132.6
2014-2015	September	47.2	22.8	23.8	11.9	8.2	17.6	3.0	134.2	-0.1	133.9
	December	47.4	22.6	23.8	11.1	8.2	17.5	3.0	133.7	-0.7	133.1
	March	46.7	22.7	23.9	11.0	8.2	17.5	3.0	133.0	-1.1	131.9
	June	47.7	22.6	23.8	11.4	8.2	17.4	3.0	134.3	-1.5	132.9
2015-2016	September	48.9	22.8	23.9	12.0	8.3	17.4	3.1	136.2	-3.4	132.6
	December	49.2	23.0	23.9	12.0	8.3	17.3	3.1	136.6	-3.9	132.8
	March	48.6	23.2	24.6	12.7	8.2	17.4	3.1	138.0	-4.3	133.6
	June	48.1	23.2	24.0	12.1	8.2	17.2	3.1	136.0	-4.5	131.4
2016-2017	September	48.3	23.6	24.3	12.5	8.4	18.4	3.0	138.3	-4.4	134.0
	December	46.6	23.8	25.2	12.6	8.4	18.3	2.9	137.8	-4.8	133.2
	March	48.2	23.5	24.5	13.0	8.4	18.2	2.9	138.8	-5.0	133.7
	June	46.5	24.3	24.7	13.8	8.5	18.1	2.9	139.3	-5.1	133.7
2017-2018	September	45.4	24.5	24.9	14.0	8.4	18.1	3.0	137.9	-4.7	133.6
	December	45.7	24.7	24.9	14.3	8.5	18.0	3.0	138.8	-4.8	134.1
	March	44.9	25.3	25.5	14.2	8.8	17.9	3.0	139.4	-5.0	134.3
	June	45.5	25.5	25.8	14.3	8.8	17.8	3.0	141.4	-5.0	135.7

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	Total excluding LULUCF	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions						
2018-2019	September	44.4	25.6	25.2	14.2	8.5	17.0	3.0	137.5	-4.7	133.5
	December	44.2	26.2	25.3	15.7	8.6	16.9	3.0	139.8	-4.8	135.2
	March	44.4	26.4	25.0	15.5	8.6	16.8	3.0	139.6	-4.9	134.7
	June	-	-	-	-	-	-	-		-	-

Data Table 1C: Trend emissions (Mt), by sector, by quarter, since 2001-02[26]

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	Total excluding LULUCF	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions						
2001-2002	September	45.6	18.9	18.7	9.6	7.1	19.3	4.0	123.5	16.2	139.9
	December	45.6	19.1	18.8	9.7	7.1	19.3	4.0	123.6	16.4	139.9
	March	46.0	19.2	19.0	9.7	7.1	19.2	4.0	124.1	16.4	140.4
	June	46.7	19.3	19.1	9.5	7.3	18.9	3.9	124.8	16.9	141.9
2002-2003	September	47.1	19.4	19.3	9.3	7.6	18.4	3.8	125.0	18.0	143.1
	December	46.8	19.6	19.5	9.2	7.8	18.0	3.7	124.5	18.7	143.3
	March	46.5	19.7	19.6	9.2	7.9	17.9	3.7	124.3	18.8	142.9
	June	46.6	19.8	19.8	9.3	8.0	18.1	3.7	125.1	18.1	143.0
2003-2004	September	47.3	19.8	20.0	9.3	8.1	18.6	3.6	126.8	16.8	144.1
	December	48.4	20.0	20.3	9.3	8.2	18.9	3.6	128.7	16.2	145.4
	March	49.2	20.0	20.4	9.3	8.2	18.8	3.6	129.8	16.8	146.1
	June	49.6	20.1	20.5	9.4	8.0	18.9	3.6	130.2	18.4	145.9
2004-2005	September	49.4	20.3	20.5	9.6	7.8	19.0	3.6	130.2	20.5	152.9
	December	49.1	20.5	20.4	9.7	7.9	19.0	3.6	130.2	22.0	152.4
	March	49.1	20.6	20.4	9.7	8.0	19.0	3.6	130.4	22.3	152.5
	June	49.2	20.5	20.6	9.7	8.1	18.9	3.6	130.5	21.9	152.4
2005-2006	September	49.4	20.3	20.8	9.8	8.0	18.7	3.6	130.6	21.5	152.2
	December	50.0	20.1	21.0	9.9	7.9	18.6	3.5	131.2	21.3	152.2
	March	50.6	20.2	21.0	10.0	7.9	18.5	3.5	131.9	21.2	153.1
	June	51.1	20.3	20.9	10.2	8.1	18.3	3.6	132.6	22.0	154.2

[26] This table presents estimates of quarterly emissions by sector since 2001-02, in trend terms. Estimates for the national inventory total and the electricity sector include weather normalisation, as described in Section 5: Technical Notes.' Trend estimates for all other sectors are presented without weather normalisation. As a result, the national inventory total may differ from the sum of the rows.

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	Total excluding LULUCF	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions						
2006-2007	September	51.3	20.4	21.0	10.3	8.3	17.9	3.6	133.0	23.3	155.9
	December	51.3	20.5	21.3	10.4	8.5	17.7	3.6	133.4	23.8	157.3
	March	51.2	20.6	21.7	10.5	8.7	17.6	3.6	133.8	23.4	157.4
	June	51.2	20.7	21.7	10.8	8.7	17.5	3.6	134.0	22.4	156.4
2007-2008	September	51.2	20.8	21.6	10.8	8.5	17.2	3.7	133.9	20.8	154.6
	December	51.3	20.9	21.6	10.8	8.5	17.1	3.7	133.8	19.9	153.6
	March	51.4	21.2	21.8	10.6	8.6	17.0	3.8	134.2	19.4	153.4
	June	52.2	21.5	22.0	10.3	8.9	17.0	3.7	135.5	18.8	154.3
2008-2009	September	53.0	21.5	22.0	10.2	8.9	17.1	3.7	136.5	18.3	155.2
	December	53.2	21.1	21.8	10.4	8.5	17.2	3.7	136.2	17.9	154.0
	March	52.6	20.6	21.7	10.6	7.8	17.1	3.7	134.6	17.0	150.7
	June	51.9	20.2	21.8	10.8	7.7	17.0	3.7	133.2	15.8	148.2
2009-2010	September	51.9	20.3	22.1	10.7	8.3	16.7	3.8	133.5	14.2	147.4
	December	51.9	20.9	22.2	10.5	8.9	16.5	3.8	134.4	12.8	147.5
	March	51.6	21.4	22.1	10.6	9.2	16.6	3.8	135.1	11.7	147.3
	June	50.8	21.4	22.3	10.8	9.2	16.9	3.8	135.1	10.5	145.6
2010-2011	September	49.7	21.3	22.7	10.9	9.0	17.4	3.7	134.4	9.0	143.3
	December	49.3	21.1	22.9	10.6	9.1	17.6	3.7	134.1	7.8	141.6
	March	49.5	21.2	22.9	10.1	9.2	17.7	3.6	134.4	6.9	141.1
	June	50.1	21.8	22.7	10.0	9.1	17.7	3.5	134.8	6.2	141.4
2011-2012	September	50.4	22.3	22.5	10.2	8.8	17.9	3.4	135.2	5.6	140.8
	December	50.2	22.4	22.7	10.4	8.5	18.0	3.3	135.4	4.9	139.9
	March	49.5	22.4	23.3	10.6	8.3	18.0	3.2	135.1	4.2	139.6
	June	48.4	22.7	23.5	10.6	8.0	18.0	3.2	134.5	3.5	138.3

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	Total excluding LULUCF	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions						
2012-2013	September	47.4	23.2	23.4	10.6	7.9	18.0	3.1	133.5	2.8	136.6
	December	46.8	23.4	23.1	10.6	7.8	18.0	3.1	132.8	2.1	135.0
	March	46.5	23.3	22.9	10.5	7.9	18.0	3.1	132.3	1.6	134.0
	June	45.9	23.2	23.0	10.3	7.9	18.0	3.1	131.7	1.7	133.3
2013-2014	September	45.3	23.3	23.2	10.1	7.8	18.2	3.1	131.1	2.2	133.2
	December	45.1	23.5	23.3	10.2	7.8	18.2	3.1	131.2	2.2	133.6
	March	45.4	23.6	23.3	10.6	7.8	18.2	3.1	131.9	1.8	133.7
	June	46.1	23.4	23.5	10.9	7.9	18.0	3.1	132.9	1.1	133.4
2014-2015	September	46.7	22.9	23.7	11.1	8.1	17.7	3.0	133.4	0.1	133.4
	December	47.0	22.6	23.9	11.1	8.2	17.5	3.0	133.5	-0.7	133.0
	March	47.3	22.6	23.8	11.1	8.2	17.5	3.0	133.7	-1.2	132.3
	June	47.8	22.7	23.8	11.5	8.2	17.4	3.0	134.4	-2.0	132.5
2015-2016	September	48.6	22.8	23.8	11.9	8.3	17.4	3.1	135.8	-3.1	132.7
	December	49.0	23.0	24.0	12.2	8.3	17.3	3.1	136.8	-3.9	133.0
	March	48.8	23.1	24.1	12.3	8.2	17.4	3.1	137.2	-4.3	133.1
	June	48.3	23.3	24.1	12.3	8.3	17.6	3.1	137.3	-4.4	133.2
2016-2017	September	47.9	23.6	24.3	12.3	8.4	18.0	3.0	137.6	-4.5	133.4
	December	47.6	23.8	24.6	12.6	8.4	18.2	2.9	138.2	-4.7	133.6
	March	47.1	23.9	24.6	13.1	8.4	18.2	2.9	138.7	-5.0	133.6
	June	46.5	24.2	24.7	13.7	8.4	18.1	3.0	138.7	-5.0	133.7
2017-2018	September	45.8	24.5	24.8	14.1	8.4	18.1	3.0	138.6	-4.8	133.7
	December	45.3	24.8	25.0	14.2	8.5	18.0	3.0	138.8	-4.8	134.0
	March	45.2	25.2	25.4	14.3	8.7	17.9	3.0	139.3	-5.0	134.7
	June	45.0	25.5	25.6	14.2	8.8	17.7	3.0	139.8	-5.0	135.0

Year	Quarter	Energy				Industrial processes and product use	Agriculture	Waste	Total excluding LULUCF	LULUCF	National Inventory Total
		Electricity	Stationary energy excl. electricity	Transport	Fugitive emissions						
2018-2019	September	44.6	25.7	25.4	14.7	8.7	17.2	3.0	139.8	-4.8	134.9
	December	44.3	26.1	25.2	15.3	8.6	16.9	3.0	139.7	-4.7	134.8
	March	44.1	26.5	25.0	15.7	8.6	16.8	3.0	139.6	-4.8	134.7
	June	-	-	-	-	-	-	-		-	-

Data Table 1D: Black carbon trend emissions (kt), by sector, by quarter, since 2008-2009

Year	Quarter	Fuel Combustion				Industrial processes and product use	Agriculture	Waste	LULUCF	Black Carbon Inventory Total
		Energy Industries	Manufacturing industries and construction[27]	Transport	Other sectors					
2008-2009	September	1.3	1.6	8.6	0.0	0.1	1.0	0.0	84.6	97.3
	December	1.3	1.6	8.7	0.0	0.1	1.0	0.0	84.6	97.4
	March	1.2	1.6	7.8	0.0	0.1	1.0	0.0	82.8	94.6
	June	1.3	1.6	8.5	0.0	0.1	1.0	0.0	83.7	96.3
2009-2010	September	1.3	1.5	9.3	0.0	0.1	0.9	0.0	78.7	91.9
	December	1.3	1.5	9.8	0.0	0.1	0.9	0.0	78.7	92.4
	March	1.2	1.5	8.9	0.0	0.1	0.9	0.0	77.0	89.6
	June	1.4	1.5	9.7	0.0	0.1	0.9	0.0	77.8	91.4
2010-2011	September	1.3	1.5	9.9	0.1	0.1	1.3	0.0	71.9	86.1
	December	1.3	1.5	10.3	0.1	0.1	1.3	0.0	71.9	86.5
	March	1.2	1.5	9.7	0.1	0.1	1.3	0.0	70.3	84.2
	June	1.3	1.5	10.8	0.1	0.1	1.3	0.0	71.1	86.2
2011-2012	September	1.7	1.8	9.8	0.1	0.1	1.3	0.0	63.4	78.3
	December	1.8	1.8	10.0	0.1	0.1	1.3	0.0	63.4	78.6
	March	1.6	1.8	10.7	0.1	0.1	1.3	0.0	62.7	78.3
	June	1.8	1.8	11.5	0.1	0.1	1.3	0.0	62.7	79.3
2012-2013	September	1.7	1.9	10.9	0.1	0.1	1.2	0.0	64.0	79.9
	December	1.8	1.9	11.5	0.1	0.1	1.2	0.0	64.0	80.5
	March	1.6	1.8	10.2	0.1	0.1	1.2	0.0	62.6	77.6
	June	1.8	1.9	11.0	0.1	0.1	1.2	0.0	63.3	79.4
2013-2014	September	1.8	1.9	11.1	0.1	0.1	1.2	0.0	67.3	83.5
	December	1.8	1.9	11.4	0.1	0.1	1.2	0.0	67.3	83.8
	March	1.8	1.9	10.8	0.1	0.1	1.1	0.0	65.9	81.6
	June	1.9	1.9	11.5	0.1	0.1	1.1	0.0	66.6	83.2

[27] Manufacturing Industries and Construction includes metal manufacturing, mining, chemical production and food processing.

Year	Quarter	Fuel Combustion				Industrial processes and product use	Agriculture	Waste	LULUCF	Black Carbon Inventory Total
		Energy Industries	Manufacturing industries and construction[27]	Transport	Other sectors					
2014-2015	September	1.7	1.9	11.6	0.1	0.1	1.1	0.0	61.1	77.6
	December	1.7	1.9	11.9	0.1	0.1	1.1	0.0	61.1	77.9
	March	1.6	1.8	11.2	0.1	0.1	1.1	0.0	59.8	75.7
	June	1.7	1.8	11.8	0.1	0.1	1.1	0.0	60.4	77.0
2015-2016	September	1.8	1.9	11.8	0.1	0.1	1.0	0.0	64.6	81.3
	December	1.8	1.9	12.2	0.1	0.1	1.0	0.0	64.6	81.6
	March	1.7	1.8	12.1	0.1	0.1	1.0	0.0	63.9	80.8
	June	1.8	1.8	12.5	0.1	0.1	1.0	0.0	63.9	81.3
2016-2017	September	1.3	1.9	12.0	0.1	0.1	1.6	0.2	63.5	80.7
	December	1.3	1.9	13.2	0.1	0.1	1.6	0.2	63.5	81.9
	March	1.2	1.9	11.7	0.1	0.1	1.6	0.2	62.1	78.9
	June	1.3	1.9	12.6	0.1	0.1	1.6	0.2	62.8	80.6
2017-2018	September	1.3	1.9	12.7	0.1	0.1	1.6	0.2	62.6	80.5
	December	1.3	1.9	13.0	0.1	0.1	1.6	0.2	62.6	80.8
	March	1.3	1.9	13.2	0.1	0.1	1.6	0.2	61.2	79.6
	June	1.3	1.9	14.2	0.1	0.1	1.6	0.2	61.9	81.4
2018-2019	September	1.4	1.9	13.9	0.1	0.1	1.5	0.2	63.2	82.3
	December	1.4	1.9	14.1	0.1	0.1	1.5	0.2	63.2	82.5
	March	1.3	1.9	13.2	0.1	0.1	1.5	0.2	63.2	81.5
	June	-	-	-	-	-	-	-	-	-

Data Table 1E: $PM_{2.5}$ trend emissions (kt), by sector, by quarter since 2008-2009

Year	Quarter	Fuel Combustion				Industrial processes and product use	Agriculture	Waste	LULUCF	$PM_{2.5}$ Inventory Total
		Energy Industries	Manufacturing industries and construction[28]	Transport	Other sectors					
2008-2009	September	5.4	2.6	11.6	0.1	0.4	6.1	0.0	221.0	247.2
	December	5.1	2.6	11.7	0.1	0.4	6.1	0.0	221.0	247.0
	March	5.1	2.5	10.6	0.1	0.4	6.0	0.0	216.2	240.8
	June	5.0	2.5	11.5	0.1	0.4	6.0	0.0	218.6	244.1
2009-2010	September	4.1	2.6	12.6	0.1	0.4	5.3	0.0	216.2	241.4
	December	4.1	2.6	13.2	0.1	0.4	5.3	0.0	216.2	242.0
	March	4.2	2.6	12.0	0.1	0.4	5.2	0.0	211.5	235.9
	June	4.0	2.6	13.1	0.1	0.4	5.2	0.0	213.9	239.3
2010-2011	September	4.8	2.5	13.3	0.1	0.5	7.7	0.0	217.0	245.8
	December	4.4	2.5	13.8	0.1	0.5	7.7	0.0	217.0	246.0
	March	4.7	2.5	13.1	0.1	0.4	7.5	0.0	212.3	240.7
	June	4.6	2.5	14.5	0.1	0.4	7.6	0.0	214.6	244.4
2011-2012	September	5.3	2.8	13.2	0.1	0.3	7.7	0.0	202.0	231.4
	December	5.1	2.8	13.5	0.1	0.3	7.7	0.0	202.0	231.5
	March	5.2	2.8	14.4	0.1	0.3	7.6	0.0	199.8	230.2
	June	5.0	2.8	15.4	0.1	0.3	7.6	0.0	199.8	231.1
2012-2013	September	4.8	2.9	14.6	0.1	0.3	7.2	0.0	203.6	233.6
	December	4.7	2.9	15.4	0.1	0.3	7.2	0.0	203.6	234.2
	March	4.9	2.8	13.7	0.1	0.3	7.0	0.0	199.2	228.0
	June	4.8	2.9	14.8	0.1	0.3	7.1	0.0	201.4	231.4
2013-2014	September	4.7	2.9	14.9	0.1	0.3	6.8	0.0	208.5	238.3
	December	4.6	2.9	15.3	0.1	0.3	6.8	0.0	208.5	238.6
	March	4.9	2.8	14.5	0.1	0.3	6.6	0.0	204.0	233.3
	June	4.7	2.9	15.4	0.1	0.3	6.7	0.0	206.3	236.4

[28] Manufacturing Industries and Construction includes metal manufacturing, mining, chemical production and food processing.

Year	Quarter	Fuel Combustion				Industrial processes and product use	Agriculture	Waste	LULUCF	$PM_{2.5}$ Inventory Total
		Energy Industries	Manufacturing industries and construction[28]	Transport	Other sectors					
2014-2015	September	4.7	2.8	15.6	0.1	0.4	6.5	0.0	201.8	231.9
	December	4.6	2.8	16.0	0.1	0.4	6.5	0.0	201.8	232.2
	March	4.7	2.8	15.1	0.1	0.3	6.3	0.0	197.4	226.8
	June	4.7	2.8	15.9	0.1	0.4	6.4	0.0	199.6	229.8
2015-2016	September	4.5	2.9	15.9	0.1	0.5	5.9	0.1	186.3	216.1
	December	4.4	2.9	16.4	0.1	0.5	5.9	0.1	186.3	216.5
	March	4.5	2.8	16.3	0.1	0.5	5.9	0.1	184.2	214.4
	June	4.3	2.8	16.9	0.1	0.5	5.9	0.1	184.2	214.8
2016-2017	September	3.8	3.0	16.1	0.1	0.6	9.5	0.5	196.8	230.4
	December	3.6	3.0	17.7	0.1	0.6	9.5	0.5	196.8	231.7
	March	3.9	2.9	15.7	0.1	0.5	9.3	0.5	192.5	225.4
	June	3.6	2.9	16.9	0.1	0.5	9.4	0.5	194.7	228.6
2017-2018	September	3.6	3.0	17.1	0.1	0.6	9.4	0.5	184.1	218.2
	December	3.5	3.0	17.5	0.1	0.6	9.4	0.5	184.1	218.6
	March	3.6	2.9	17.7	0.1	0.6	9.2	0.5	180.1	214.7
	June	3.5	2.9	19.1	0.1	0.6	9.3	0.5	182.1	218.1
2018-2019	September	3.5	3.0	18.6	0.1	0.6	8.8	0.5	180.4	222.7
	December	3.4	3.0	18.9	0.1	0.6	8.8	0.5	180.4	222.8
	March	3.6	3.0	17.7	0.1	0.5	8.6	0.5	176.4	220.7
	June	-	-		-	-	-	-	-	-

Data Table 1F: PM_{10} trend emissions (kt), by sector, by quarter, since 2008-2009

Year	Quarter	Energy	Industrial processes and product use	Waste	PM_{10} Inventory Total
2008-2009	September	131.2	2.9	0.1	134.2
	December	131.6	2.9	0.1	134.6
	March	125.4	2.8	0.1	128.2
	June	130.4	2.8	0.1	133.3
2009-2010	September	130.8	2.9	0.1	133.9
	December	131.5	3.0	0.1	134.6
	March	126.5	2.9	0.1	129.5
	June	132.8	2.9	0.1	135.8
2010-2011	September	159.9	3.0	0.1	163.0
	December	158.1	3.0	0.1	161.2
	March	148.2	3.0	0.1	151.2
	June	157.1	3.0	0.1	160.2
2011-2012	September	181.0	2.8	0.0	183.9
	December	184.3	2.8	0.0	187.2
	March	175.8	2.8	0.0	178.6
	June	183.7	2.7	0.0	186.5
2012-2013	September	202.6	3.0	0.1	205.7
	December	205.8	3.0	0.1	208.8
	March	196.3	2.9	0.1	199.2
	June	207.4	3.0	0.1	210.4
2013-2014	September	222.3	3.5	0.1	225.9
	December	223.6	3.5	0.1	227.2
	March	218.9	3.3	0.1	222.4
	June	227.9	3.4	0.1	231.4

Year	Quarter	Energy	Industrial processes and product use	Waste	PM_{10} Inventory Total
2014-2015	September	235.8	3.2	0.4	239.4
	December	235.6	3.2	0.4	239.1
	March	227.3	3.1	0.4	230.7
	June	232.1	3.2	0.4	235.7
2015-2016	September	238.6	3.4	0.3	242.3
	December	237.2	3.4	0.3	240.9
	March	233.0	3.3	0.3	236.6
	June	235.3	3.4	0.3	239.0
2016-2017	September	226.4	3.7	1.1	231.1
	December	227.6	3.5	1.1	232.2
	March	219.7	3.1	1.1	223.9
	June	225.3	3.1	1.1	229.4
2017-2018	September	228.1	3.4	1.1	232.6
	December	227.7	3.5	1.1	232.3
	March	224.0	3.4	1.1	228.4
	June	230.7	3.4	1.1	235.2
2018-2019	September	233.6	3.5	1.1	238.2
	December	234.1	3.5	1.1	238.6
	March	229.7	3.4	1.1	234.1
	June	-	-	-	-

Data Table 1G: SO_2 trend emissions (kt), by sector, by quarter since 2001-2002

Year	Quarter	Fuel Combustion				Industrial Processes and Product Use	SO_2 Inventory Total
		Energy Industries	Manufacturing Industries and Construction	Transport	Other Sectors		
2001-2002	September	154.9	23.7	6.3	1.8	514.7	701.5
	December	144.3	25.5	6.7	1.8	510.8	689.1
	March	147.9	24.2	6.2	1.8	503.5	683.5
	June	152.6	23.8	6.6	1.8	516.5	701.4
2002-2003	September	168.4	22.7	6.4	2.0	502.6	702.0
	December	160.0	23.9	6.8	2.0	505.3	698.0
	March	157.3	22.3	6.2	1.9	494.1	681.9
	June	160.7	24.7	6.7	1.9	499.1	693.2
2003-2004	September	158.0	24.6	6.8	1.9	433.9	625.2
	December	151.1	23.9	7.2	1.9	441.3	625.4
	March	161.3	22.9	6.6	1.9	436.7	629.4
	June	158.4	23.7	7.1	1.9	441.4	632.6
2004-2005	September	157.5	25.1	6.8	2.0	448.7	640.1
	December	149.0	25.7	7.2	2.0	447.6	631.6
	March	151.0	25.2	6.7	2.0	433.3	618.2
	June	151.2	23.7	7.2	2.0	446.4	630.5
2005-2006	September	164.9	24.5	6.6	1.9	430.2	628.2
	December	158.7	24.3	7.2	1.9	427.2	619.4
	March	164.1	24.0	6.6	1.9	415.8	612.4
	June	164.9	26.4	7.0	1.9	422.4	622.6
2006-2007	September	161.2	24.2	7.3	1.9	421.9	616.5
	December	157.1	25.3	7.9	1.9	423.2	615.4
	March	159.5	23.0	7.4	1.9	415.4	607.0
	June	152.8	23.0	7.7	1.9	420.5	606.0

Year	Quarter	Fuel Combustion				Industrial Processes and Product Use	SO_2 Inventory Total
		Energy Industries	Manufacturing Industries and Construction	Transport	Other Sectors		
2007-2008	September	170.2	24.4	6.6	1.9	431.6	634.8
	December	159.9	25.7	7.0	1.9	432.3	626.9
	March	164.3	26.1	6.6	1.9	425.0	623.9
	June	160.6	27.4	7.2	1.9	429.9	626.9
2008-2009	September	170.0	26.6	7.2	1.9	459.0	664.7
	December	160.5	24.8	7.3	1.9	460.3	654.7
	March	160.8	21.9	6.6	1.8	447.1	638.2
	June	157.8	21.8	7.1	1.8	453.8	642.4
2009-2010	September	157.9	23.2	7.0	1.9	406.9	596.8
	December	157.6	23.6	7.3	1.9	408.5	599.0
	March	161.4	23.7	6.6	1.8	398.0	591.5
	June	153.4	25.0	7.3	1.9	405.4	592.8
2010-2011	September	156.6	23.4	6.7	1.9	447.1	635.7
	December	144.3	22.5	7.0	1.9	446.5	622.2
	March	155.4	20.2	6.7	1.8	435.8	620.0
	June	152.6	23.6	7.4	1.8	444.6	630.0
2011-2012	September	153.9	23.5	6.2	1.9	453.0	638.4
	December	148.6	24.6	6.3	1.9	456.1	637.5
	March	152.1	21.7	6.7	1.9	443.7	626.2
	June	147.1	22.1	7.2	1.9	438.6	616.9
2012-2013	September	144.8	25.4	5.8	2.0	435.9	613.9
	December	141.4	24.2	6.1	2.0	433.5	607.1
	March	146.4	21.3	5.4	1.9	419.6	594.6
	June	143.4	22.8	5.8	1.9	424.5	598.5

Year	Quarter	Fuel Combustion				Industrial Processes and Product Use	SO_2 Inventory Total
		Energy Industries	Manufacturing Industries and Construction	Transport	Other Sectors		
2013-2014	September	139.5	23.2	5.9	2.0	461.7	632.3
	December	136.2	23.3	6.1	2.0	461.0	628.7
	March	146.2	19.8	5.8	2.0	441.6	615.3
	June	137.9	22.0	6.1	2.0	455.1	623.1
2014-2015	September	140.8	18.0	6.1	2.1	438.2	605.2
	December	137.4	17.8	6.2	2.1	430.6	594.1
	March	142.0	16.6	5.9	2.0	422.1	588.7
	June	139.7	17.4	6.2	2.1	432.4	597.9
2015-2016	September	138.4	17.1	6.0	2.2	458.9	622.5
	December	134.8	16.6	6.2	2.2	456.5	616.4
	March	140.0	14.2	6.2	2.2	450.6	613.3
	June	133.2	16.3	6.4	2.2	454.7	612.7
2016-2017	September	139.2	17.0	6.1	2.3	452.4	617.1
	December	129.6	16.6	6.7	2.3	432.4	587.7
	March	141.6	14.3	6.0	2.3	377.7	541.9
	June	131.5	16.5	6.4	2.3	385.2	541.9
2017-2018	September	133.2	16.3	6.0	2.3	410.5	568.4
	December	129.3	16.5	6.2	2.3	416.7	571.0
	March	134.6	15.2	6.3	2.3	408.6	566.9
	June	131.4	17.1	6.7	2.3	413.6	571.3
2018-2019	September	130.1	18.2	6.6	2.3	420.0	577.3
	December	124.9	17.7	6.7	2.3	417.9	569.6
	March	133.4	16.3	6.2	2.3	404.7	563.0
	June	-	-		-	-	-

Tracking Australia's emissions

The data presented in Table 9 and Figure 23 include Australia's annual emissions for 2000 to 2019.

Australia's annual emissions for the year to March 2019 are estimated to be 538.9 Mt CO_2-e. This figure is 0.5 per cent above emissions in 2000 (536.2 Mt CO_2-e) and 11.7 per cent below emissions in 2005 (610.6 Mt CO_2-e).

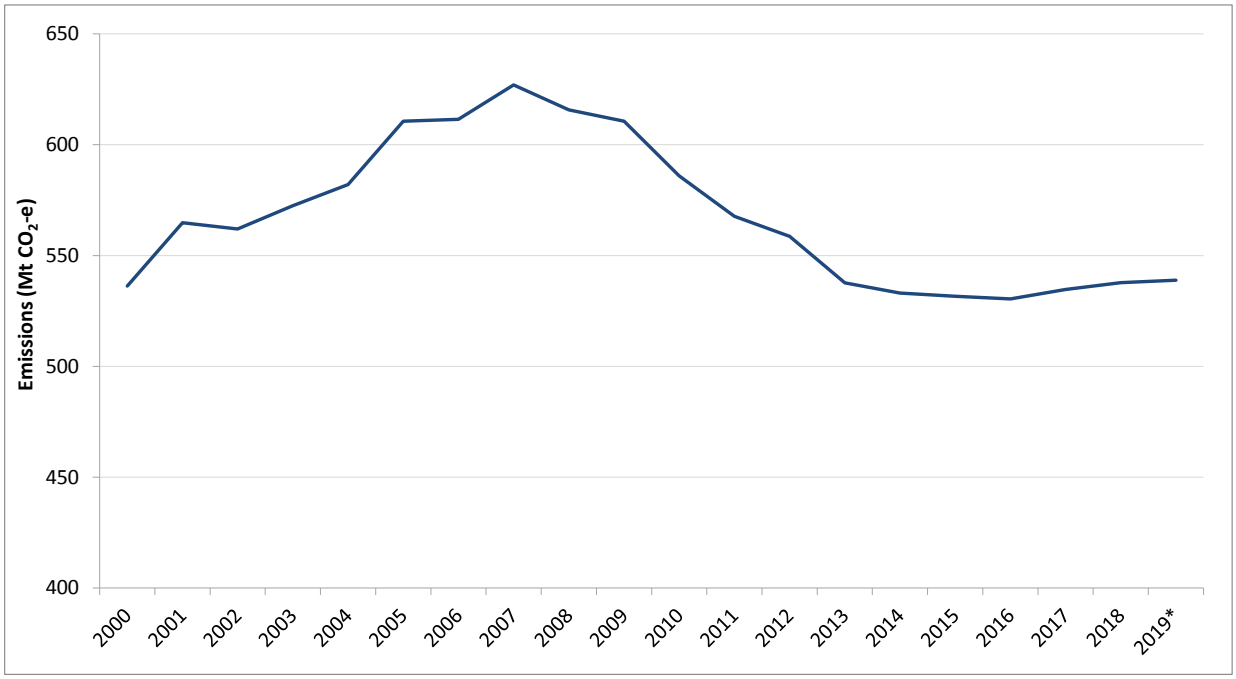
Table 9: National inventory total from 2000 to 2019, by financial year

Financial Year[29]	Emissions (Mt CO_2-e)
2000	536.2
2001	564.8
2002	562.0
2003	572.5
2004	582.0
2005	610.6
2006	611.5
2007	627.0
2008	615.7
2009	610.6
2010	586.0
2011	567.7
2012	558.7
2013	537.7
2014	533.1
2015	531.6
2016	530.4
2017	534.7
2018	537.8
2019[30]	538.9

[29] 2000 to 2017, National Inventory Report 2017 (Department of the Environment and Energy (2019), *National Inventory Report*, Australian Government submission under the UN Framework Convention on Climate Change http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/progress-inventory; 2018,) *Quarterly Update:* March 2019.

[30] Year to March 2019

Figure 23: National inventory total, year to June 2000 to 2019[31]



Source: Department of the Environment and Energy

[31] Year to March 2019

8. Related publications and resources

Australia's National Greenhouse Accounts

The following Department of the Environment and Energy (DoEE) publications are all available on the departmental website:

http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/progress-inventory

National Inventory Report 2017

The three volumes comprising Australia's forthcoming National Inventory Report 2017 were submitted under the UNFCCC and the Kyoto Protocol in May 2019. These reports contains national greenhouse gas emission estimates for the period 1990-2017 and preliminary estimates for 2018 compiled under the rules for reporting applicable to the UNFCCC.

- Volume 1: Includes Australia's data for energy (*stationary energy, transport and fugitive emissions*), *industrial processes and product use*, and *agriculture*.
- Volume 2: Australia's data for the *Land Use, Land Use Change and Forestry* (LULUCF) and *waste* sectors, recalculations and improvements.
- Volume 3: Australia's data for Kyoto Protocol LULUCF, Kyoto Protocol accounting requirements, annexes, glossary and references.

State and Territory Greenhouse Gas Inventories 2017

This document provides an overview of the latest available estimates of annual greenhouse gas emissions for Australia's States and Territories. It complements Australia's *National Inventory Report 2017* and the *National Inventory by Economic Sector 2017*.

National Inventory by Economic Sector 2017

This document provides an overview of the latest available estimates of annual greenhouse gas emissions, disaggregated by Australia-New Zealand Standard Industrial Classifications (ANZSIC). It complements Australia's *National Inventory Report 2017* and the *State and Territory Greenhouse Gas Inventories 2017*.

Australian Greenhouse Emissions Information System (AGEIS)

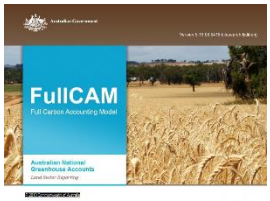
The AGEIS centralises the Department's emissions estimation, emissions data management and reporting systems. AGEIS is being used to compile national and State and Territory inventories. The interactive web interface provides enhanced accessibility and transparency to Australia's greenhouse emissions data: http://www.environment.gov.au/climate-change/climate-science-data/greenhouse-gas-measurement/ageis

Australia's Emissions Projections: 2018

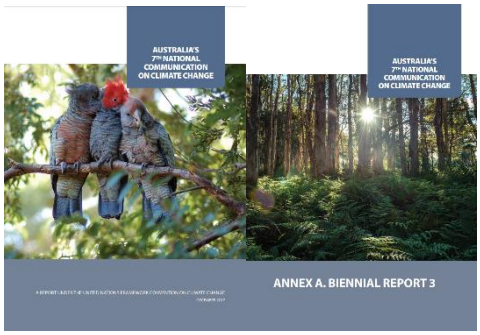
The report provides detail on emissions trends, including sector specific analysis of factors driving emissions. The report estimates the emissions reduction effort required to meet Australia's emissions reduction targets. The projections include sensitivity analyses to illustrate how emissions may differ under changes in economic growth.
http://www.environment.gov.au/climate-change/publications/emissions-projections-2018

Full Carbon Accounting Model

The Full Carbon Accounting Model (FullCAM) is the calculation engine which supports the estimation of carbon stock change on forest and agricultural systems. FullCAM can be downloaded from the Department's webpage: http://www.environment.gov.au/climate-change/climate-science-data/greenhouse-gas-measurement/land-sector



Australia's Seventh National Communication/Third Biennial Report



Australia's Seventh National Communication (2017) summarises information on Australia's implementation of its UNFCCC and Kyoto Protocol obligations including: emissions and removals of greenhouse gases; national circumstances; policies and measures; vulnerability assessment; financial, technology and capacity building cooperation; education, training, and public awareness. Countries such as Australia are required to submit these reports to the UNFCCC every four years. In accordance with international reporting requirements, the 2017 National Communication also incorporates Australia's Third Biennial Report. Biennial Reports must be submitted every two years and outline Australia's progress in achieving emission reductions and the provision of financial, technology, and capacity-building support. More information is available at: http://unfccc.int/national_reports/annex_i_natcom/submitted_natcom/items/10138.php

What the rest of the world is doing

Other developed countries are also required to produce annual greenhouse gas inventories. More information regarding the reporting requirements and various international reports (including reports by Australia) are located online. https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/national-inventory-submissions-2019

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