Australian Government
Department of the Environment and Energy

Australia's emissions projections 2018

December 2018

Further information about projections of greenhouse gas emissions is available on the Department of the Environment and Energy's website: www.environment.gov.au. To contact the Projections team, please email emissions.projections@environment.gov.au

Disclaimer

The views and opinions expressed in this publication are those of the authors and do not necessarily reflect those of the Australian Government or the Minister for the Environment.

Image credit

Copyright Department of the Environment (taken by staff)

Australia's emissions projections 2018

Executive Summary

- The 2018 projections show Australia continues to make good progress to its emissions reduction targets. Australia will surpass its 2020 target and the task to meet the 2030 target has declined.

Australia's 2020 target (5 per cent below 2000 levels)

- Australia is on track to overachieve on its 2020 target by 367 million tonnes of carbon dioxide equivalent (Mt CO_2-e), inclusive of carryover, or 240 Mt CO_2-e without carryover.
- This is an improvement of 73 million tonnes since the 2017 projections, which estimated an overachievement of 294 Mt CO_2-e.
- Emissions in 2020 are projected to be 540 Mt CO_2-e, a downward revision of 11 Mt CO_2-e since the 2017 projections. This change is due to:
  - lower projected emissions from land use, land use change and forestry (LULUCF),
  - lower projected emissions from electricity generation, and
  - lower projected emissions from the agriculture sector.
- The major drivers of growth in emissions to 2020 are the continued expansion of Australia's Liquefied Natural Gas (LNG) industry and a declining carbon sink from the land sector. This is mostly offset by a decline in electricity emissions.

Australia's 2030 target (26–28 per cent below 2005 levels)

- The 2018 projections shows a 173 Mt CO_2-e reduction in the task to meet our 2030 targets since our last projection.
- The 2030 target will require 695 to 762 Mt CO_2-e in cumulative emissions reductions between 2021 and 2030 to meet the 26 per cent and 28 per cent targets respectively.
- Emissions in 2030 are projected to be 563 Mt CO_2-e, a downward revision of 7 Mt CO_2-e since the 2017 projections.
- This change is largely due to the decline of emissions in the electricity sector, driven by:
  - higher than expected build for large scale renewables to the early 2020s,
  - an increased forecast of small scale solar PV uptake, and
  - lower than previously forecast electricity demand.
- Agricultural sector emissions are projected to grow to 2030. However, the current drought has constrained production and short-term growth, meaning the starting level of emissions in 2021 are lower. This results in less cumulative emissions from agriculture than in the 2017 projections.

Contents

Introduction

Emissions projections are estimates of Australia's future greenhouse gas emissions. They provide an indicative assessment of how Australia is tracking against its emissions reduction targets. They also provide an understanding of the expected drivers of future emissions.

The projections provide an estimate of the emissions reduction effort required to meet Australia's emissions reduction targets. Australia's targets are tracked against an emissions budget. The cumulative emissions reduction task represents the total emissions that must be avoided or offset for Australia to achieve its targets. If the emissions reduction task is a negative value, this indicates Australia is on track to overachieve on its targets.

The 2018 projections include:

- A projection of emissions from 2018 to 2020[1], which provides an estimate of Australia's emissions reduction task to meet its 2020 emissions reduction target.
- A projection of emissions from 2021 to 2030, which provides an estimate of Australia's emissions reduction task to meet its 2030 emissions reduction target.
- Sensitivity analyses to illustrate how emissions may differ under changes in expected economic growth.

These projections update *Australia's emissions projections 2017*.

This report contains a high level description of projections methods. A detailed description of the methodologies applied and key data inputs to the projections can be found in the *2018 Projections Methodology* paper on the Department's website.

1 All year references refer to Australian financial years unless otherwise stated. For example 2020 refers to the financial year 2019–20.

Projection results

Australia's progress toward meeting the 2020 target

Australia has a target of reducing emissions to 5 per cent below 2000 levels by 2020.

Australia is expected to overachieve on its 2020 target by 367 Mt CO_2-e, inclusive of carryover, or 240 Mt CO_2-e without carryover. These estimates are calculated against an emissions budget for the period 2013 to 2020 using Kyoto categories[2]. They are adjusted for estimates of voluntary action[3] and units voluntarily transferred to the Commonwealth under the Waste Industry Protocol[4].

Australia holds 128 Mt CO_2-e of surplus units from the Kyoto Protocol first commitment period (our 'carryover').

Table 1 Cumulative emissions reduction task, 2013 to 2020

Calculation of 2020 emissions reduction task	Emissions (Mt CO_2-e)
Cumulative emissions 2013–2020	4269
Target trajectory 2013–2020	4488
Unadjusted emissions reduction task	**-219**
Voluntary action	8
Waste Protocol units	-28
Emissions reduction task	**-240**
Carryover from 2008–2012	-128
Emissions reduction task with carryover	**-367**

Note: totals may not sum due to rounding.

2 Description and quantification of the emissions budget is detailed in Appendix A.

3 Voluntary action refers to individuals and companies offsetting their emissions to become 'carbon-neutral' and households buying GreenPower (a government-accredited program for energy retailers to purchase renewable energy on behalf of customers). Voluntary action achieves emissions reductions additional to—that is, above and beyond—national targets.

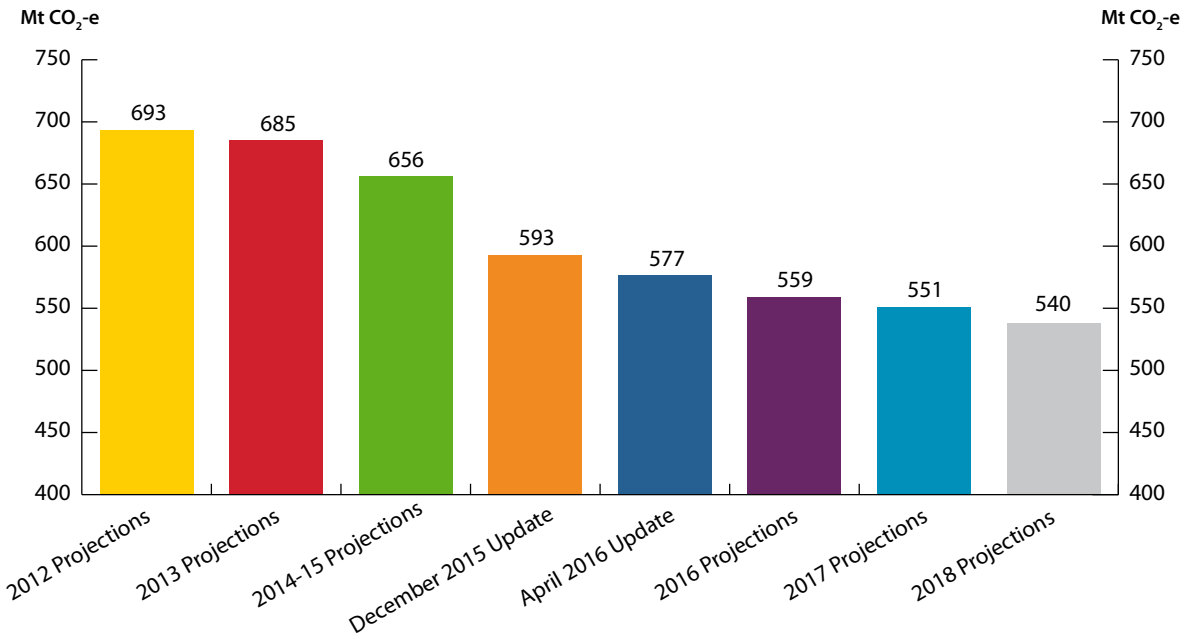
4 Under the carbon tax, many landfill facility operators charged their customers in relation to future carbon liabilities that were expected to accrue as the waste being deposited decayed over many decades. Now that the carbon tax has been repealed, the voluntary Waste Industry Protocol allows these landfill operators to acquit these charges by purchasing carbon abatement credits and voluntarily transferring them to the Commonwealth.

Emissions to 2020

Australia's emissions are projected to grow 1 per cent above current levels to 2020. A major factor in this growth is the increase in LNG production and a declining sink in the land sector. These increases are largely offset by falling emissions in the electricity sector as a result of higher renewable builds and lower than previously forecast demand.

Emissions in 2020 are projected to be 540 Mt CO_2-e. This is a reduction of 11 Mt CO_2-e, or 2 per cent, from the estimate of 551 Mt CO_2-e published in *Australia's emissions projections 2017*.

Figure 1 Projected emissions in 2020 over time



Changes since the 2017 projections

The increase in the overachievement of the 2020 target is primarily due to lower emissions in the land use, land use change and forestry (LULUCF), agriculture and electricity sectors. This is partially offset by increased emissions in the fugitives and transport sectors.[5]

5 Further information is available in the relevant sectorial sections of this report.

Australia's progress toward meeting the 2030 target

Australia has a target of reducing emissions to 26 to 28 per cent below 2005 levels in 2030.

The current estimate is that cumulative emissions reductions of 695 Mt CO_2-e (26 per cent reduction) to 762 Mt CO_2-e (28 per cent reduction) will be needed over the period 2021–2030 to meet Australia's 2030 target.

Table 2 Cumulative emissions reduction task 2021 to 2030

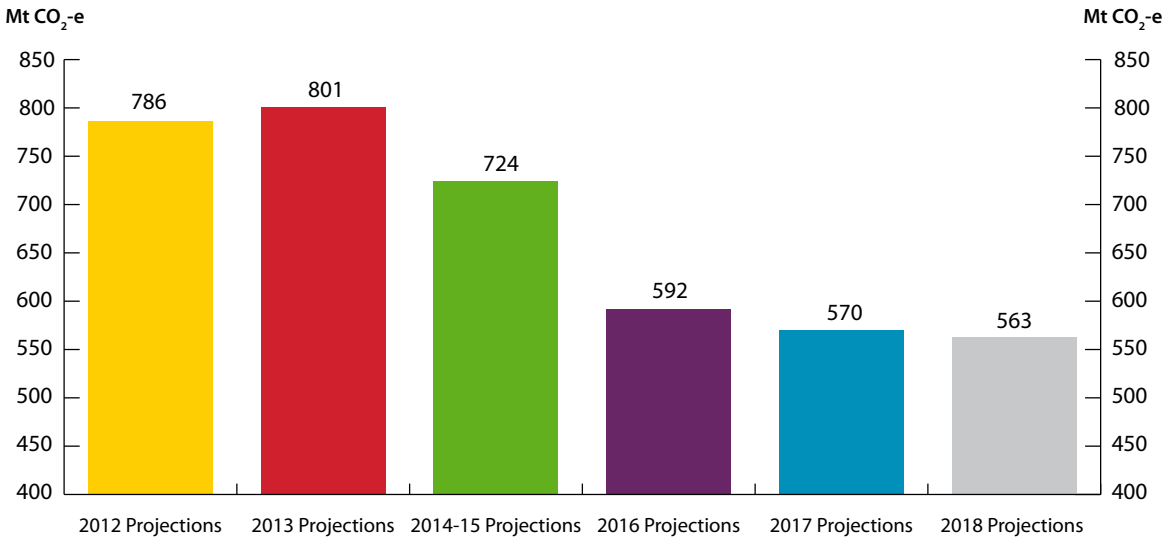
Calculation of 2030 emissions reduction task	26 per cent below 2005 level in 2030 (Mt CO_2-e)	28 per cent below 2005 level in 2030 (Mt CO_2-e)
Cumulative emissions 2021–2030	5487	5487
Target trajectory 2021–2030	4800	4733
Voluntary action	8	8
Emissions reduction task	**695**	**762**
Overachievement of Australia's Kyoto Protocol targets	*-240* (2013–2020, *projection)* *-128 (2008–2012)*	
Total	*-367*	
Emissions reduction task including overachievement	***328***	***395***

Emissions to 2030

Total emissions in 2030 are projected to be 563 Mt CO_2-e, which is 7 per cent below 2005 levels (605 Mt CO_2-e). This is a reduction of 8 Mt CO_2-e from the estimate of 570 Mt CO_2-e published in the 2017 projections.

Emissions to 2030 are projected to grow 4 per cent above 2020 levels, driven by higher emissions from LNG production, increased transport activity, a declining forest sink in the LULUCF sector, and growth in agricultural activity after a return to average seasonal conditions.

Figure 2 Projected emissions in 2030 over time



Changes since the 2017 projections

The decrease in the emissions reduction task for the 2030 target is primarily driven by reductions in projected emissions from the electricity sector. This is due to greater renewable generation and lower electricity demand than previously projected.

Emissions from the LULUCF sector have also been revised down due to improved methods and data for estimating carbon sinks from regrowing forests based on analysis by CSIRO. The drought's impact combined with weaker mid-term agriculture growth rates also restrict the agriculture sector's ability to reach previously projected activity levels, and corresponding emissions levels.

These reductions are partially offset by higher estimated emissions for LNG driven by an improved outlook for exports.

Overall results

Figure 3 Australia's emissions, 1990 to 2030

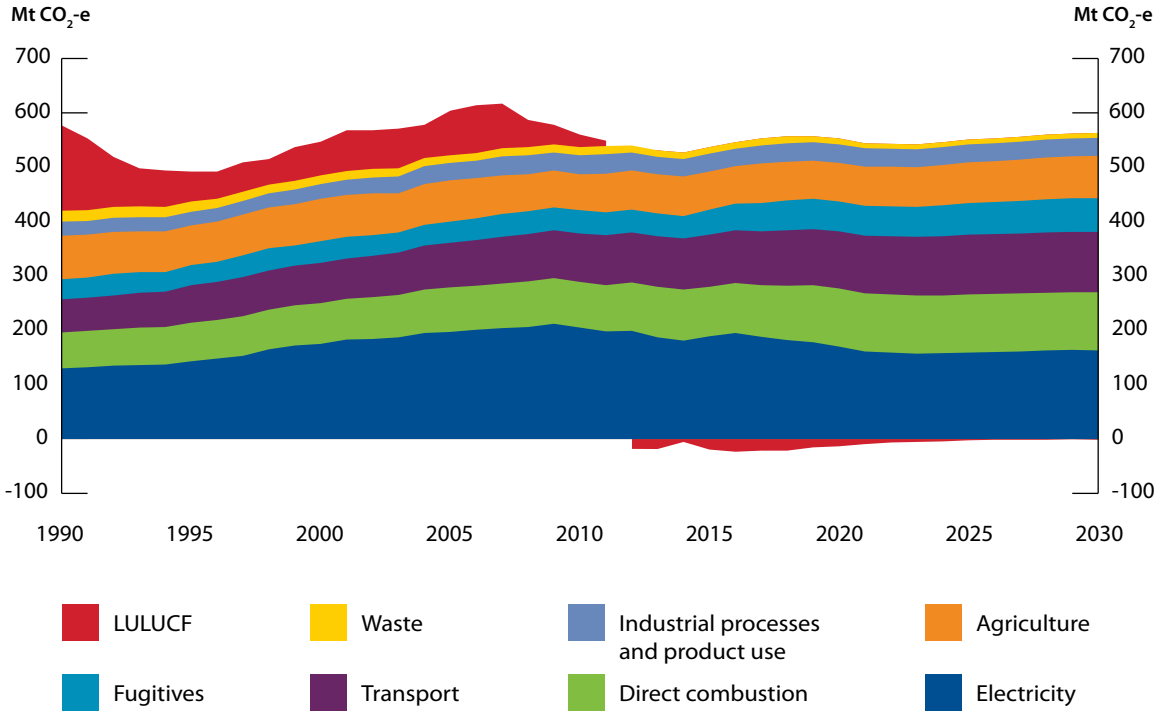


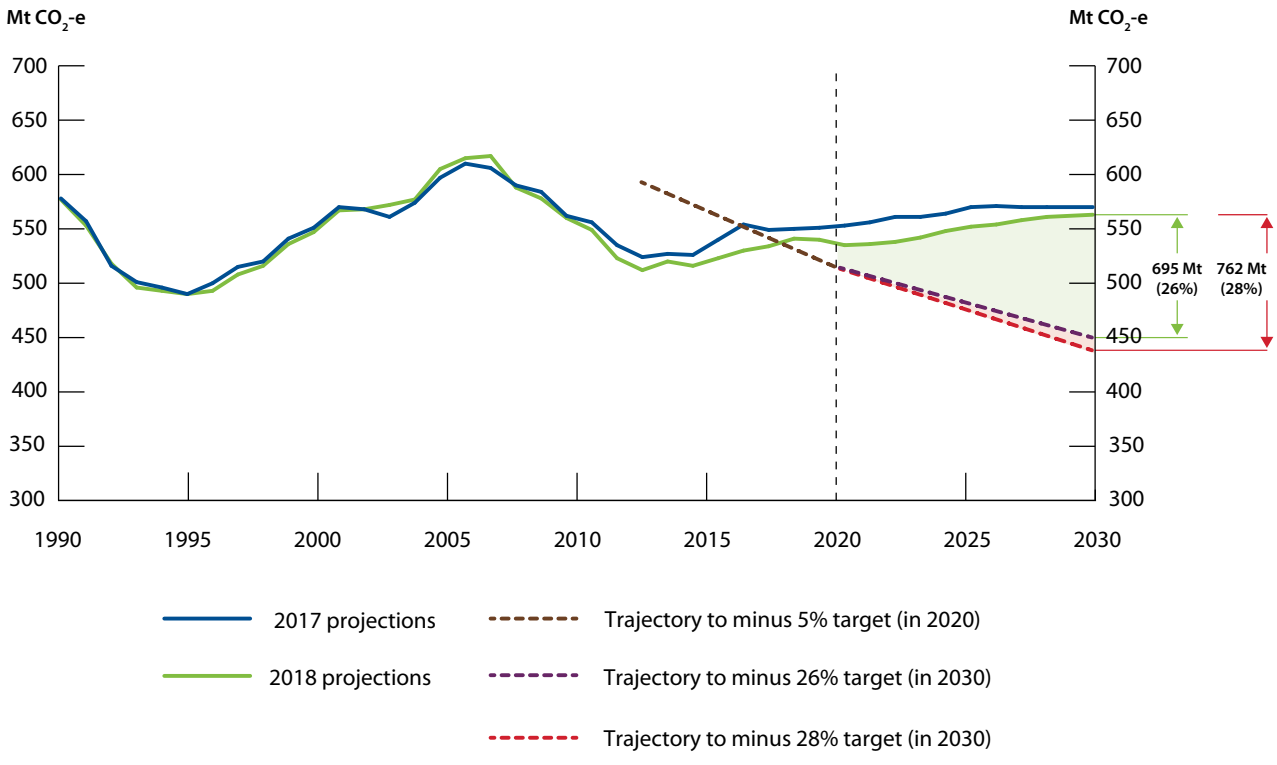
Table 3 Sectoral breakdown of 2018 projections results to 2030

Emissions by sector (Mt CO_2-e)	National Greenhouse Gas Inventory			Projection	
	2000	2005	2018	2020	2030
Electricity	175	197	182	170	163
Direct combustion	75	82	100	107	107
Transport	74	82	102	105	111
Fugitives	40	39	55	55	62
Industrial processes and product use	27	32	34	34	33
Agriculture	78	76	71	71	78
Waste	16	14	13	11	9
Land use, land use change and forestry	62	82	-22	-14	-1
Total	**547**	**605**	**534**	**540**	**563**

Note: totals do not sum due to rounding.

Overall change since the 2017 projections

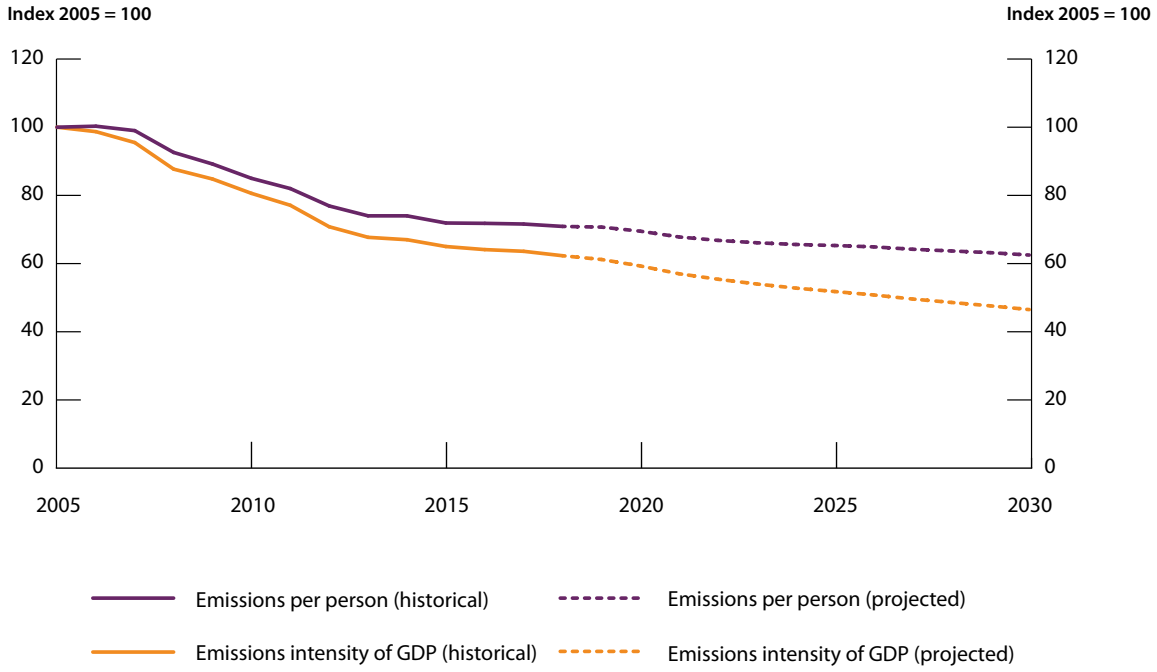
Figure 4 Australia's emissions trends, 1990 to 2030



Other metrics

The emissions intensity of the economy (GDP) has continued to decline and is projected to fall by 54 per cent from 2005 to 2030. Emissions per person are also expected to fall steadily by 38 per cent from 2005 to 2030.

Figure 5 Emissions per person and emissions intensity of GDP, 2005 to 2030



Sectoral trends

This chapter sets out the emissions projections associated with each sector. The sector breakdown is consistent with the international guidelines for reporting under the United Nations Framework Convention on Climate Change (UNFCCC). These sectors are described in Table 4 below:

Table 4 Projections sector coverage

Sector	Coverage
Electricity	Emissions from the combustion of fuels to generate electricity
Direct combustion	Emissions from the combustion of fuels to generate steam, heat or pressure, other than for electricity generation and transport
Transport	Emissions from the combustion of fuels for transportation within Australia
Fugitives	Emissions released during the extraction, processing and delivery of fossil fuels
Industrial processes and product use	Emissions from non-energy related industrial production and processes. Includes emissions from hydrofluorocarbons (HFCs) (used in refrigerants and air conditioning)
Agriculture	Emissions from livestock, manure management and crop residue Emissions from rice cultivation, application of nitrogen to soils, and burning of agricultural residues
Waste	Emissions from the disposal of material to landfill and wastewater
Land use, land use change and forestry	Emissions and sequestration from activities occurring on forest lands, forests converted to other land uses, grasslands, croplands, wetlands and settlements

Electricity

Emissions from electricity generation are the result of fuel combusted for the production of electricity in the National Electricity Market (NEM), Western Australia's Wholesale Electricity Market (WEM), the other small grids and off-grid.

The NEM is the electricity market covering the east coast of Australia. It comprises of five regions – Queensland, New South Wales (including the ACT), Victoria, Tasmania, South Australia – and represents approximately 85 per cent of electricity generation in Australia. The WEM operates in the South West of Australia. The other grids comprise of the small grids (the Darwin Katherine Interconnected System, the North West Interconnected System, and Mt Isa) and off-grid electricity generation.

Emissions to 2020

Electricity emissions are projected to be 170 Mt CO_2-e in 2020, a decrease of 7 per cent on current levels. Emissions are projected to fall as federal and state renewable energy targets drive increased renewable generation. Expanding renewable investment, aided by declining costs, also contributes to emissions reductions. This trend is seen in both the NEM and WEM.

In the other grids, emissions grow strongly to 2020. This is largely because of increased electricity use generated on-site by LNG facilities as they ramp up to full production.

Emissions to 2030

Electricity emissions are projected to be 163 Mt CO_2-e in 2030, 4 per cent below 2020 levels. This is 17 per cent below electricity emissions in 2005. After 2020, emissions in the NEM and WEM are projected to continue to fall to the early 2020s as renewable generation grows as a proportion of the generation mix (Figure 7). By 2023 NEM emissions fall to 28 per cent below 2005 levels.

From the mid-2020s, emissions in the NEM and WEM gradually increase as electricity demand grows with population and economic growth. Much of this increase in demand is met by continued growth in rooftop PV generation and some thermal generation. By 2030, emissions in the NEM are still 26 per cent below 2005 levels and emissions in the WEM are 18 per cent above 2005 levels.

In the other grids there is a small increase in emissions to 2030.

Comparison to previous projections

Compared to the 2017 projections, emissions are lower in 2020 by 6 Mt CO_2-e and lower in 2030 by 10 Mt CO_2-e. This is due to lower electricity demand assumptions compared to the previous projections and greater investment in renewables than previous projected.

Figure 6 Electricity emissions, 1990 to 2030

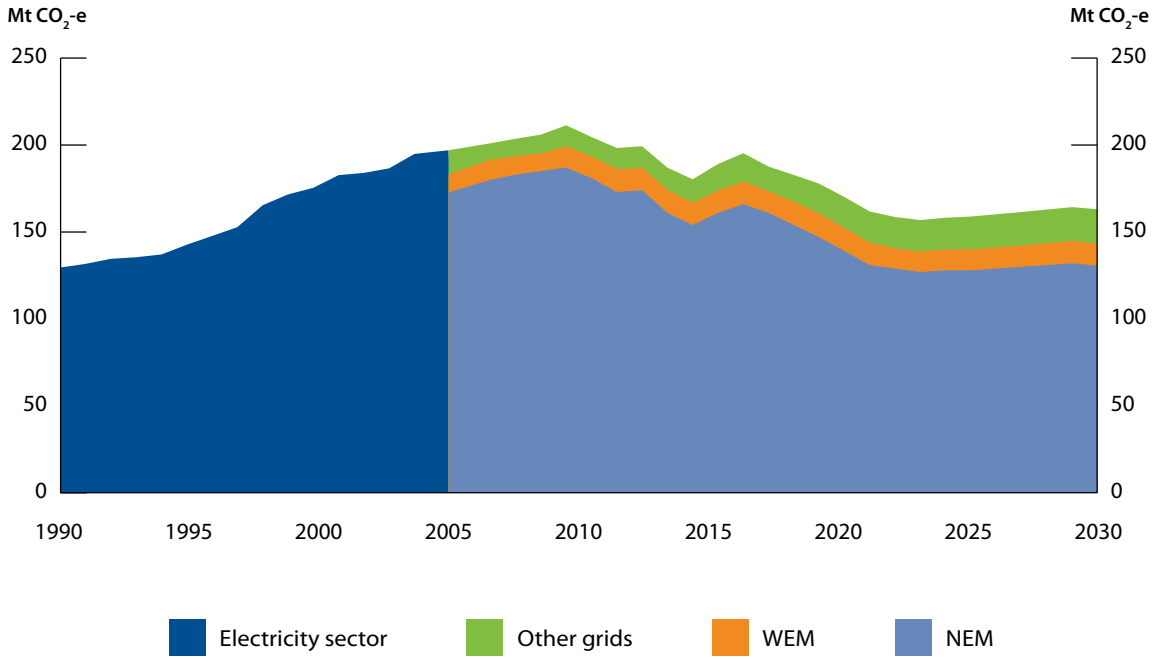


Figure 7 Fuel generation mix, 2018 to 2030

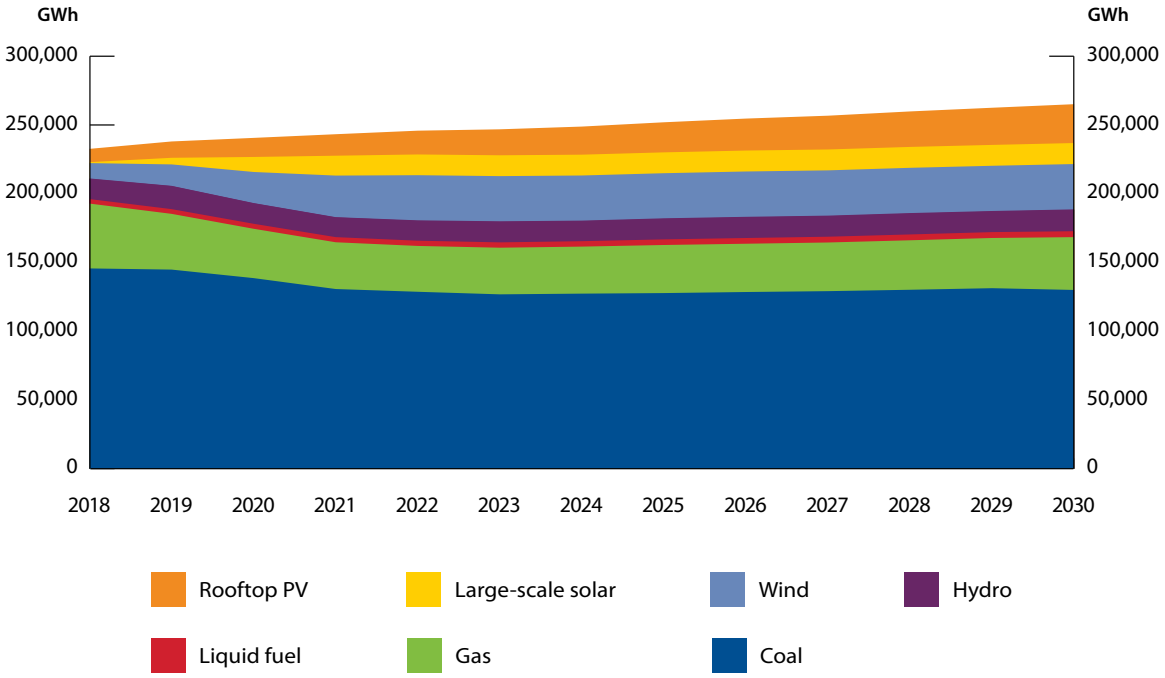


Table 5 Electricity emissions, Mt CO_2-e

Emissions by grid	2018	2020	2025	2030
National Electricity Market	154	139	128	131
Western Australia Wholesale Electricity Market	13	13	12	13
Other grids	15	18	19	20
Total electricity sector	**182**	**170**	**159**	**163**

Note: totals may not sum due to rounding

Direct combustion

Emissions from direct combustion are from the burning of fuels for energy used directly, in the form of heat, steam or pressure (excluding for electricity generation and transport). The direct combustion sector consists of six subsectors: energy, mining, manufacturing, buildings, agriculture, forestry and fishing, and military. Fuel combusted in mobile equipment in mining, manufacturing, buildings, agriculture, forestry and fishing is included in direct combustion.

Emissions to 2020

Direct combustion emissions are projected to be 107 Mt CO_2-e in 2020, 7 per cent above current levels.

Projected increase in gas combustion at LNG facilities and diesel combustion at mine sites are expected to drive higher energy emissions to 2020.

Emissions to 2030

Direct combustion emissions are projected to be 107 Mt CO_2-e in 2030, the same as 2020 levels.

Emissions from the energy subsector are projected to grow due to higher coal mining and LNG activities. In 2013–14 there were three operating LNG plants with capacity to export 24 Mt of LNG per year. Australia is now over halfway through the ramp-up of new LNG capacity. By 2020, Australia will be operating 10 LNG plants with capacity to export more than 80 Mt of LNG per year.

Manufacturing is projected to remain the biggest contributor to sector emissions, with emissions projected to be mostly flat to 2030. Emissions from the agriculture, forestry and fishing subsector are also projected to be stable over the projections period.

Emissions from buildings are expected to decline marginally to 2030 due to emissions reductions from energy efficiency improvements and fuel-switching from gas to electric appliances.

Comparison to previous projections

Compared to the 2017 projections, emissions are projected to be 2 Mt CO_2-e higher in 2020, and 4 Mt CO_2-e higher in 2030. This is due to higher than forecast emissions across multiple subsectors.

Building emissions have increased due to methodology improvements to align with AEMO's assumptions. AEMO assume that effects of fuel switching and energy efficiency on gas consumption in residential and commercial buildings will diminish in the long term.

Emissions from the agriculture, forestry and fishing subsector are higher than the previous forecast due to a higher inventory starting point. This reflects higher diesel demand for cropping in response to a record winter harvest in 2016–17.

Figure 8 Direct combustion emissions, 1990 to 2030

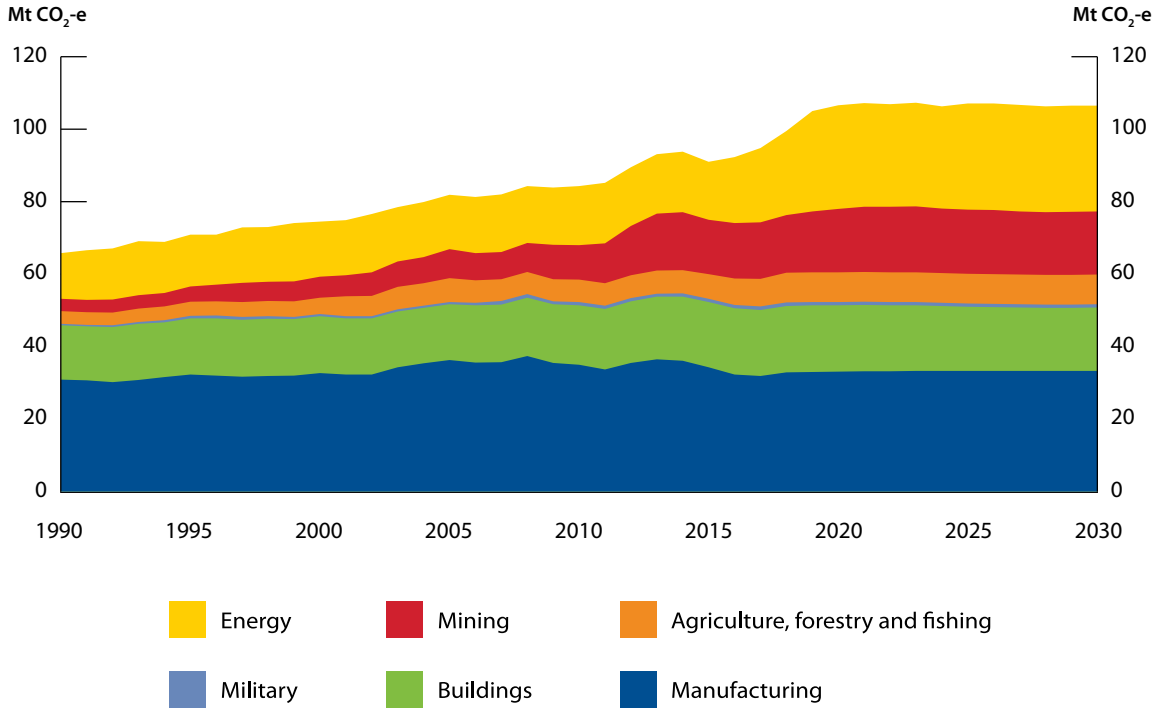


Table 6 Direct combustion emissions, Mt CO_2-e

Emissions by subsector	2018	2020	2025	2030
Energy	23	29	29	29
Mining	16	18	18	17
Agriculture, Forestry and Fishing	8	8	8	8
Military	1	1	1	1
Buildings	18	18	18	18
Manufacturing	33	33	33	33
Total	**100**	**107**	**107**	**107**

Note: totals may not sum due to rounding

Transport

Emissions in the transport sector are the result of the combustion of fuels for transportation. This includes road, domestic aviation, rail, domestic shipping, off-road recreational vehicle activity and gas pipeline transport. Road transport includes cars, light commercial vehicles, motorcycles, rigid trucks, articulated trucks and buses.

Emissions from electricity used in electric vehicles and rail are accounted for in the electricity sector.

Emissions to 2020

Transport emissions are projected to be 105 Mt CO_2-e in 2020, 3 per cent above current levels. Emissions are projected to increase as activity from all modes of transport increase due to population and economic growth.

Emissions to 2030

Transport emissions are projected to be 111 Mt CO_2-e in 2030, 6 per cent above 2020 levels.

The biggest contributor to emissions is road transport. Emissions from cars and light commercial vehicles are projected to increase to 2025 due to increased activity, however from 2025 emissions start to decline. Increases in activity to 2030 are more than offset by improvements in vehicle efficiency, fuel switching away from diesel and an increasing share of electric vehicles.

Emissions from heavy vehicles increase to 2030 as fuel consumption increases to meet the increased freight load. Emissions growth slows from 2025 as efficiency improvements and fuel switching slows the growth in emissions.

Emissions from non-road sectors are projected to grow to 2030 with most of the growth occurring in domestic aviation due to increasing demand for air travel. Emissions from domestic shipping and rail are projected to increase as they take on an increased freight load.

Comparison to previous projections

Compared to the 2017 projections, transport sector emissions are projected to be 3 Mt CO_2-e higher in 2020 and 1 Mt CO_2-e lower in 2030.

Road transport emissions are projected to be 3 Mt CO_2-e lower in 2030 due to lower forecast activity, improved heavy vehicle fuel efficiency and fuel switching to electric and hybrid vehicles.

Compared to the previous projections, emissions from domestic aviation and shipping are both projected to be 1 Mt CO_2-e higher in 2030 due to increased projected activity.

Figure 9 Transport emissions, 1990 to 2030

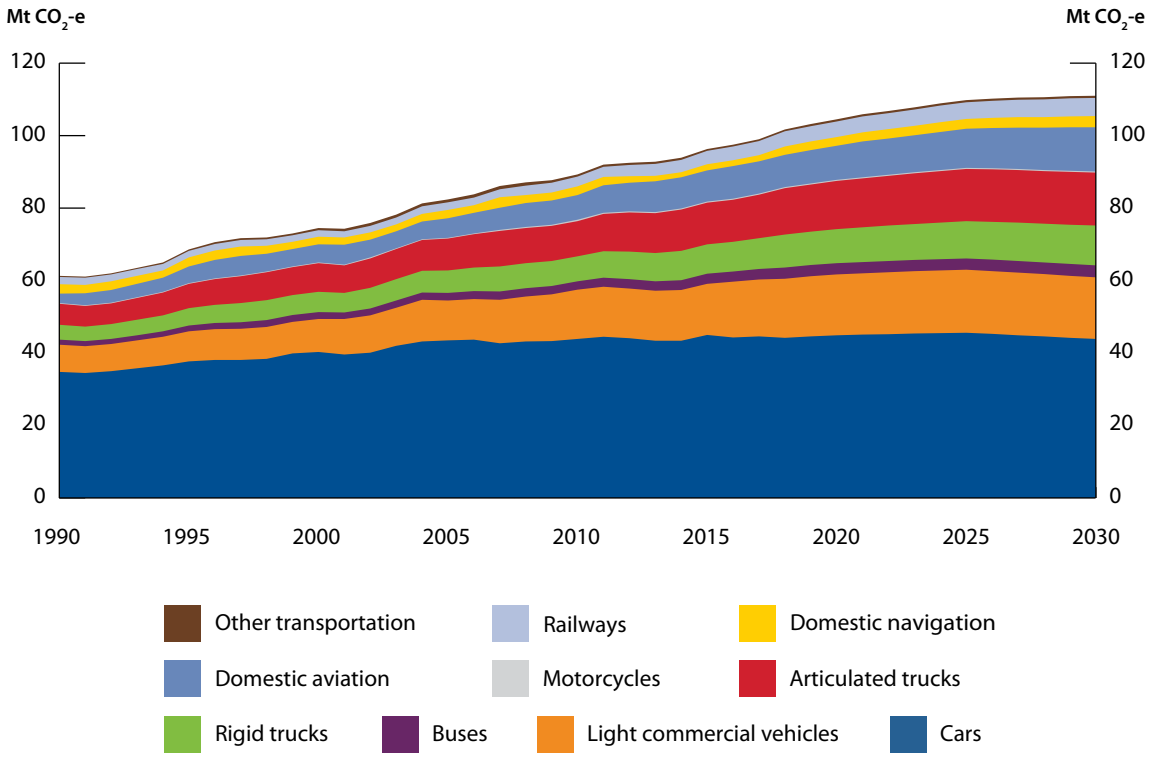


Table 7 Transport emissions, Mt CO_2-e

Emissions by subsector	2018	2020	2025	2030
Cars	44	45	46	44
Light commercial vehicles	16	17	17	17
Buses	3	3	3	3
Rigid trucks	9	9	10	11
Articulated trucks	13	13	14	15
Motorcycles	<1	<1	<1	<1
Domestic aviation	9	9	11	12
Domestic shipping	2	2	3	3
Railways	4	4	5	5
Other transportation[6]	<1	<1	<1	<1
Total	**102**	**105**	**110**	**111**

Note: totals may not sum due to rounding

6 Other transportation includes off-road recreational and pipeline transport

Fugitives

Fugitive emissions are released during the extraction, processing and delivery of fossil fuels. Fugitive emissions do not include emissions from fuel combusted to generate electricity, operate mining plant and equipment, or transport fossil fuels by road, rail or sea.

Emissions to 2020

Fugitive emissions are projected to be 55 Mt CO_2-e in 2020, the same level as emissions in 2018.

Emissions from coal mines are projected to increase as a number of gassy coal mines return to full production after temporary declines. Emissions from LNG plants are projected to increase as Australia's new LNG plants come online and ramp up to full production. Icthys (NT) shipped its first LNG cargo in October this year leaving Prelude LNG (WA) the final announced project to commence production.

These increases are projected to be offset by the commencement of carbon capture and storage at the Gorgon LNG project prior to 2020.

Emissions to 2030

Fugitive emissions are projected to be 62 Mt CO_2-e in 2030, 13 per cent higher than 2020 levels.

Fugitive emissions from oil and gas[7] are projected to increase from 29 Mt CO_2-e in 2020 to 31 Mt CO_2-e in 2030. LNG emissions are projected to increase between 2020 and 2030 as production and the emissions intensity of feed gas increase. The addition of one new LNG train in the mid-2020s adds to the expected LNG production profile for Australia.

Out to 2030, several LNG plants are expected to source gas from new basins as current feed gas sources deplete. As the percentage of CO_2 is higher for some of these new feed gas sources the overall emissions intensity of Australia's LNG projections increases which increases emissions. Gas emissions growth is partially offset by decreasing fugitive emissions from oil production.

Fugitive emissions from coal mines are projected to increase from 27 Mt CO_2-e in 2020 to 31 Mt CO_2-e in 2030. Post 2020, slower growth is projected in coal production and emissions. The International Energy Agency's *World Energy Outlook 2018* New Policy Scenario projects global trade in thermal coal (used for electricity generation) will decline from current levels while trade in coking coal (used in iron and steel production) will increase. In Australia a higher proportion of coking coal is produced from underground coal mines, which have a higher average emissions intensity than open cut mines.

Comparison to previous projections

Compared to the 2017 projections, emissions are projected to be 4 Mt CO_2-e higher in 2020, and 9 Mt CO_2-e higher in 2030. The majority of the growth in fugitive emissions comes from the updated outlook for LNG in Australia, reflecting an increased production profile out to 2030 and industry gas source updates.

The increase in fugitive emissions also reflects updates to natural gas emissions, driven by higher unconventional gas production, and a small increase in coal fugitive emissions due to an improved outlook for Australian coking coal exports.

---

7 Fugitive gas emissions include emissions associated with gas consumed domestically and LNG. LNG is natural gas that has been cooled down to liquid form for ease and safety of non-pressurised storage and transport.

Figure 10 Fugitive emissions, 1990 to 2030

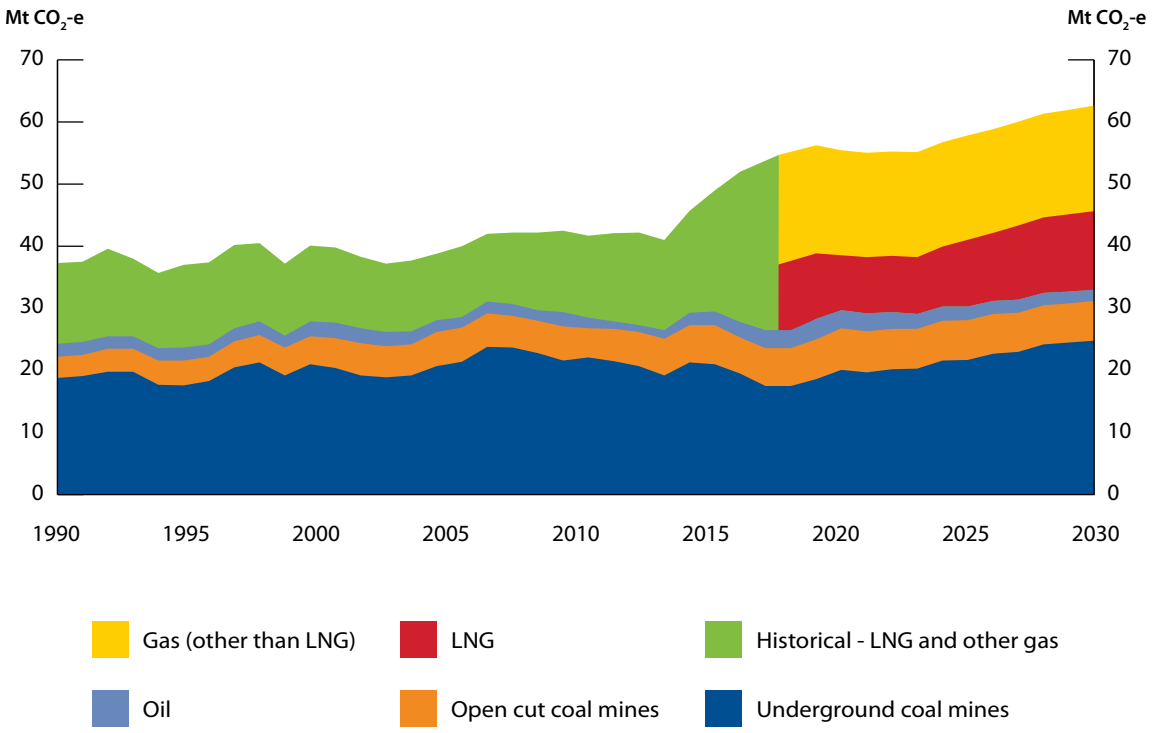


Table 8 Fugitive emissions, Mt CO_2-e

Emissions by subsector	2018	2020	2025	2030
Gas (other than LNG)	17	17	17	17
LNG	11	9	11	13
Oil	3	3	2	2
Open cut mines	6	7	6	6
Underground coal mines	18	20	22	25
Total	**55**	**55**	**58**	**62**

Note: totals may not sum due to rounding

Industrial processes and product use

The industrial processes and product use sector includes emissions from non-energy related production processes. Table 9 below lists the subsectors that comprise the industrial processes and product use sector and the main production processes which drive emissions from these subsectors.

Table 9 Production processes in industrial processes and product use

Subsector	Main production processes
Metal Industry	Iron and steel, and aluminium production
Chemical Industry	Ammonia, nitric acid and titanium dioxide production
Mineral Industry	Cement clinker and lime production
Product uses as substitutes for ozone depleting substances	Hydrofluorocarbons used in refrigeration and air conditioning equipment, foam, fire protection and aerosols
Non-energy products from fuel and solvent use	Emissions from lubricant oils not used for fuel
Other production	Carbon dioxide used in food production
Other product manufacture and use	Sulphur hexafluoride used in electrical switchgear

Emissions to 2020

Industrial processes and product use emissions are projected to be 34 Mt CO_2-e in 2020, 2 per cent above current levels.

Growth in iron ore mining and coal mining, which are drivers for ammonia and nitric acid production, are projected to increase chemical industry emissions. Emissions from the metal industry are projected to be higher in the short term due to higher commodity prices and a lower Australian dollar, leading to greater exports.

Emissions to 2030

Industrial processes and product use emissions are projected to be 33 Mt CO_2-e in 2030, 4 per cent below 2020 levels. Emissions reductions across the projections period are mainly due to reduced emissions from the product uses as substitutes for ozone depleting substances subsector, also known as the hydrofluorocarbon (HFC) subsector. This is because the HFC subsector takes into account the legislated phase-down of bulk HFC gases permitted to be imported into Australia from 2018.

Chemical industry emissions are projected to increase due to continued strength in the iron ore mining and coal mining. Chemical products such as ammonia are used as explosives in the mining industry.

Comparison to previous projections

Compared to the 2017 projections, industrial processes and product use emissions are projected to be less than 1 Mt CO_2-e higher in 2020 and 2030.

Higher emissions in this sector are mainly due to projected increases in emissions from the chemical subsector, driven by higher ammonia and nitric acid production.

Figure 11 Industrial processes and product use emissions, 1990 to 2030

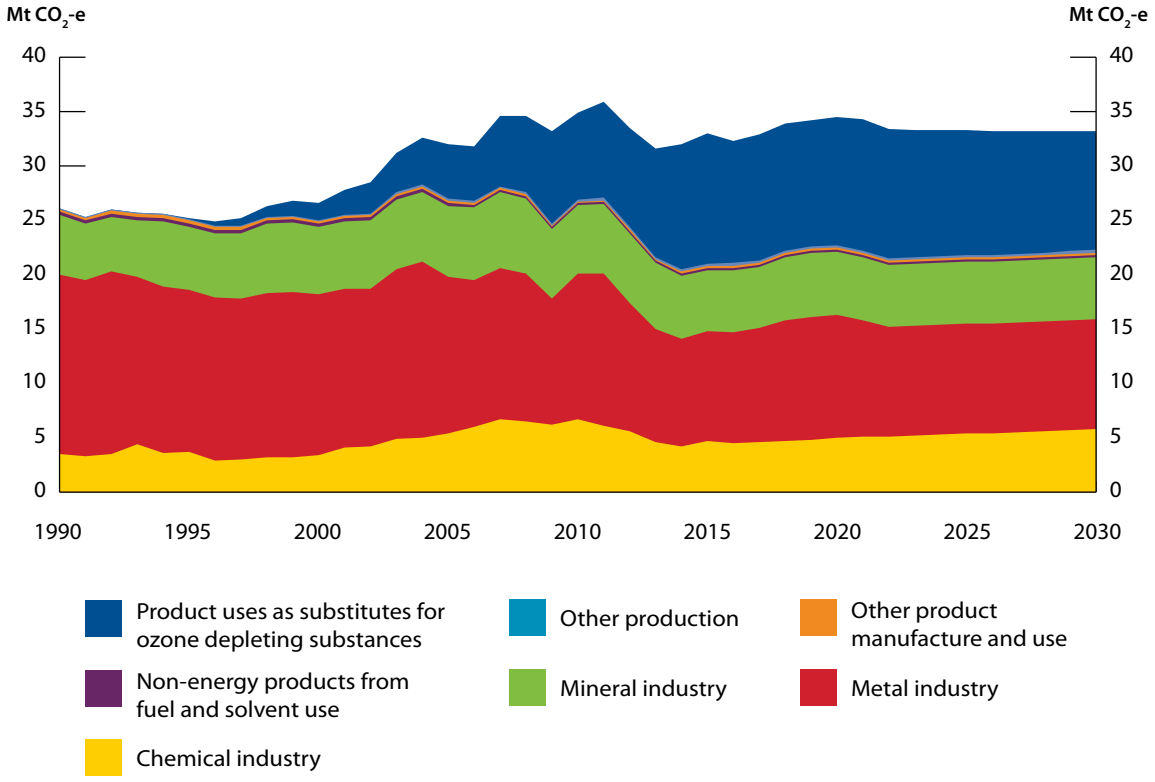


Table 10 Industrial processes and product use emissions, Mt CO_2-e

Emissions by subsector	2018	2020	2025	2030
Product uses as substitutes for ozone depleting substances	12	12	12	11
Other production	<1	<1	<1	<1
Other product manufacture and use	<1	<1	<1	<1
Non-energy products from fuel and solvent use	<1	<1	<1	<1
Mineral industry	6	6	6	6
Metal industry	11	11	10	10
Chemical industry	5	5	5	6
Total	**34**	**34**	**33**	**33**

Note: totals may not sum due to rounding

Agriculture

The agriculture sector includes emissions from enteric fermentation (the digestive process of some animals including cattle and sheep), manure management, rice cultivation, agricultural soils and field burning of agricultural residues. It does not include emissions from electricity use or fuel combustion from operating equipment, which are included in the electricity and direct combustion sectors.

The bulk of agriculture greenhouse gas emissions are methane and nitrous oxide. The emissions projections presented below are expressed as carbon dioxide equivalent.

Emissions to 2020

Agriculture emissions are projected to be 71 Mt CO_2-e in 2020, 1 per cent above current levels.

Emissions are projected to fall by 1 per cent in 2019 as drought conditions restrict agriculture activity. After falling in 2019 agricultural activity is predicted to rise in 2020 on the assumed return to average seasonal conditions.

Emissions to 2030

Agriculture emissions are projected to be 78 Mt CO_2-e in 2030, 9 per cent above 2020 levels.

Emissions to 2030 are projected to slowly rise by approximately 1 per cent a year, driven by productivity improvements, and underpinned by rising food demand internationally.

Beef cattle is projected to continue to be the biggest contributor to sectoral emissions, followed by sheep and dairy cattle. Most emissions come from enteric fermentation from livestock, so fluctuations in these animal numbers have a direct effect on emissions in this sector. While the majority of beef will continue to be fed by grazing on pasture, the projections have accounted for an assumed increase in grain fed beef cattle in feedlots due to these cattle being less susceptible to drought. Grain fed cattle are more emissions intensive, due to increased energy intake and increased concentration of manure in feedlots.

Comparison to previous projections

Compared to the 2017 projections, emissions are lower in 2020 by 3 Mt CO_2-e and lower in 2030 by 5 Mt CO_2-e. Emissions are lower due to drought in the immediate term which acts as a constraint on livestock numbers. This combines with slightly weaker mid-term growth, forecast by ABARES, beyond the drought period, which brings down projected emissions in 2030.

Figure 12 Agriculture emissions, 1990 to 2030

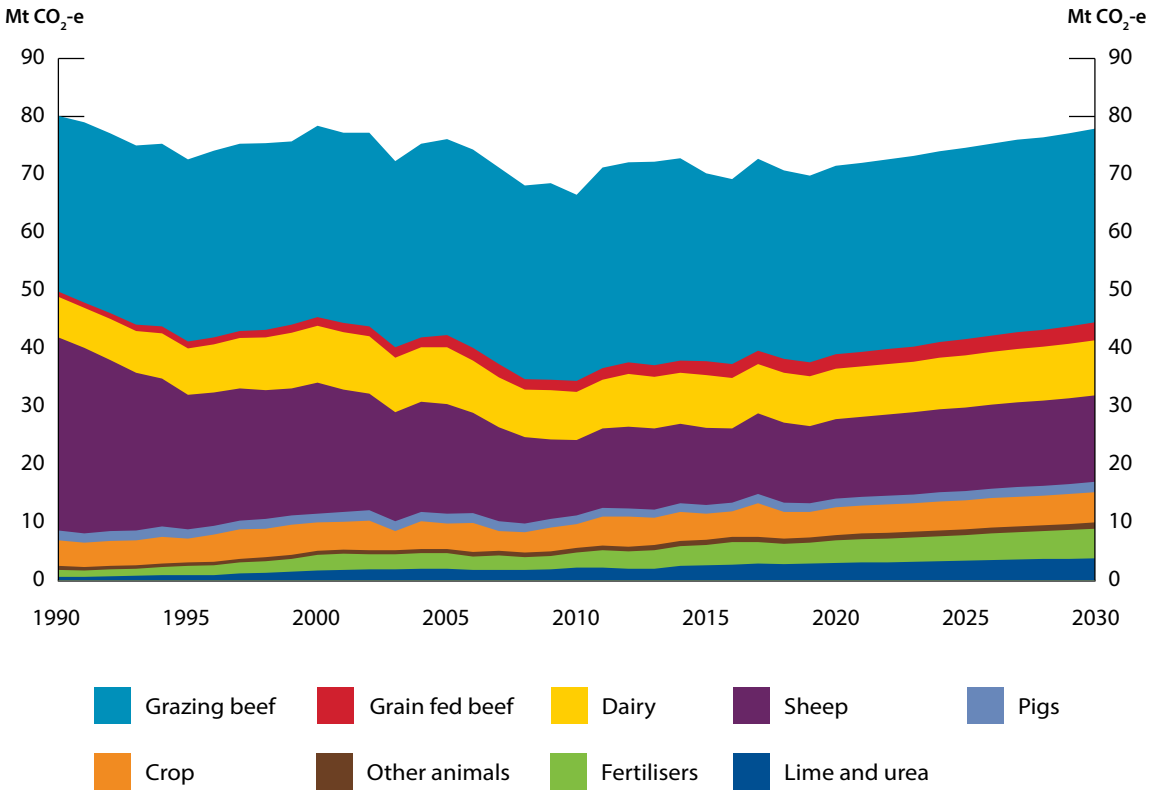


Table 11 Agriculture emissions, Mt CO_2-e

Emissions by subsector	2018	2020	2025	2030
Grazing beef	33	33	33	33
Grain fed beef	2	2	3	3
Dairy	9	9	9	9
Sheep	14	14	14	15
Pigs	2	2	2	2
Crop	5	5	5	5
Other animals	1	1	1	1
Fertilisers	4	4	4	5
Lime and urea	3	3	3	4
Total	**71**	**71**	**75**	**78**

Note: totals may not sum due to rounding

Waste

The waste sector covers emissions from the disposal of organic materials to landfill and wastewater emissions from domestic, commercial and industrial sources. Emissions are predominantly methane, generated from anaerobic decomposition of organic matter.

Emissions to 2020

Emissions in the waste sector are projected to be 11 Mt CO_2-e in 2020, 14 per cent below current levels.

The decrease in emissions reflects the impact of ERF projects as well as efforts to divert waste from landfill.

Emissions to 2030

Emissions in the waste sector are projected to be 9 Mt CO_2-e in 2030, 14 per cent below 2020 levels.

The decrease in waste sector emissions to 2030 is predominately the result of the increase in recycling and methane capture rates over the period. This includes the methane capture and emissions avoidance as a result of ERF projects. It also reflects the impact of policies and projects implemented by state and federal governments to reduce waste, including the National Food Waste Strategy.

Emissions in the waste sector decline to 2022 as ERF abatement increases. Post 2022, waste emissions are projected to remain moderately flat as population and industry production impacts begin to outpace growth in ERF abatement and methane capture rates.

Comparison to previous projections

Compared to the 2017 projections, emissions are projected to be 1 Mt CO_2-e higher in 2020, and 1 Mt CO_2-e lower in 2030.

The increase in emissions out to 2020 reflects an increase in expected short term emissions due to updates to emissions estimation methods in the national greenhouse gas inventory.

The long term decrease out to 2030 reflects an updated outlook of state waste diversion targets, the inclusion of announced national waste diversion policies and the ARENA funded Kwinana energy-from-waste facility project.

Figure 13 Waste emissions, 1990 to 2030

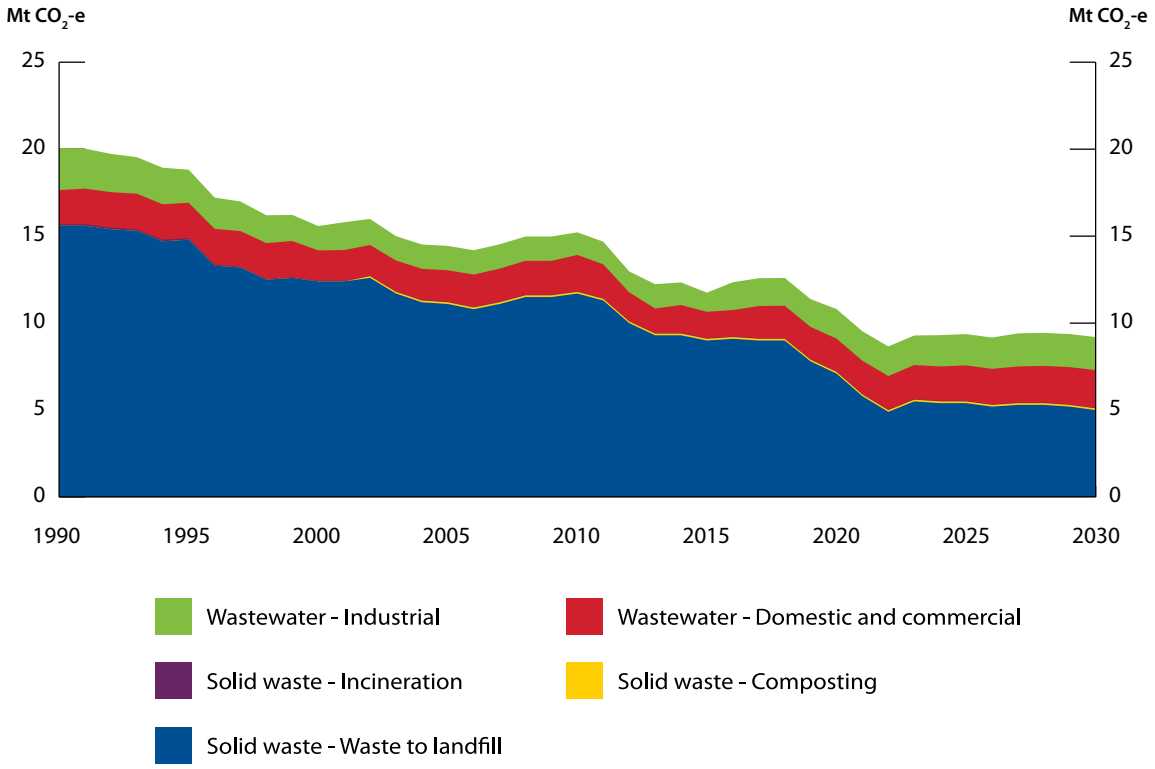


Table 12 Waste emissions, Mt CO_2-e

Emissions by subsector	2018	2020	2025	2030
Solid waste – waste to landfill	9	7	5	5
Solid waste – composting	< 1	< 1	< 1	< 1
Solid waste – incineration	< 1	< 1	< 1	< 1
Wastewater – domestic and commercial	2	2	2	2
Wastewater – industrial	2	2	2	2
Total	**13**	**11**	**9**	**9**

Note: totals may not sum due to rounding

Land use, land use change and forestry

The land use, land use change and forestry (LULUCF) sector includes both sources of greenhouse gas emissions and sinks that remove carbon dioxide from the atmosphere and sequester it as carbon in living biomass, debris and soils. The most influential source of emissions is clearing of forests. Other land sector categories (see below) include the establishment and ongoing management of forests, grazing land, and croplands.

The LULUCF sector projections are based on the UNFCCC inventory structure as described in Australia's *National Inventory Report 2016*. The major categories used include:

- **forest land**, including *forest land remaining forest* and *land converted to forest* (e.g. harvest and regeneration of native forests, establishment and harvest of plantations, wildfires and prescribed burning) and includes sinks from regrowing forest on previously cleared land, and carbon stored in harvested wood products and their disposal in landfill
- **forest clearing**, emissions from the UNFCCC land use classification of *forest converted to other land uses*, includes direct clearing-related emissions and delayed emissions from previous clearing, mainly through the gradual loss of soil carbon over a number of years but excluding sinks from regrowing forests on previously cleared lands
- **cropland**, i.e. woody horticulture and changes in soil carbon under herbaceous crops
- **grasslands**, i.e. changes in soil carbon through pastoral activities, fire management in savanna rangelands and changes in shrubby vegetation extent on grasslands and
- **wetlands and settlements**, gains and losses of woody vegetation that is not already classified as *forest land* (e.g. sparsely planted trees or shrubs) on wetlands and within settlement boundaries (from ABARES' catchment-scale land-use mapping), as well as aquaculture activities, dredging of seagrasses and mangrove and tidal marsh conversions not already reported in *forest land* or *forest conversions*.

Emissions to 2020

Net emissions from the LULUCF sector are projected to represent a sink of -14 Mt CO_2-e in 2020, an increase of 8 Mt CO_2-e above current levels.

Net emissions are projected to rise from the historical lows seen in recent inventory years. These lows reflect a large net sink driven by increasing forest cover across Australia, including from forests that are re-appearing on previously cleared land more rapidly than land managers are able to re-clear that bush encroachment. These strong increases in forest cover are not expected to be maintained over the projections period with the return to normal conditions.

Emissions to 2030

Net emissions from LULUCF are projected to be -1 Mt CO_2-e in 2030, an increase of 13 Mt CO_2-e above 2020 levels.

Net emissions are projected to continue to rise beyond 2020, reflecting a gradual return to long-term average conditions, approaching net zero emissions. The rate of increase is projected to slow by around 2025, reflecting the declining impact of the current forest sink over the medium to longer term.

Land clearing emissions are largely stable over the projections period, reflecting continuing high rates of re-clearing to maintain pastures for grazing, offsetting the declining rate of conversion of primary forests in line with farmers' terms-of-trade forecasts.

High rates of hardwood plantation harvesting are projected to continue over the whole projections period, resulting in a declining net sink from plantations established after 1990 as these mature from a phase of rapid growth and increasingly become available for harvesting. Harvesting of native forests is projected to remain close to historical lows, resulting in an ongoing net sink as regrowth in previously harvested forest lands continues to outweigh harvesting emissions.

Comparison to previous projections

The projections have been revised to reflect updates and improvements in the most recent National Inventory Report, submitted in April 2018. Compared to the 2017 projections, emissions are projected to be 13 Mt CO_2-e lower in 2020 and 5 Mt CO_2-e lower in 2030. There are two main factors driving the revisions to the inventory baseline.

First, in response to recommendations from international expert review of the inventory, coverage of grasslands converted to forest lands has been broadened to include ongoing net emissions (sequestration) from natural regrowth that occurred prior to 1990.

Second, these revisions reflect improvements in modelling and data for land subject to natural regrowth and commercial plantations, as part of ongoing implementation of CSIRO research.

Figure 14 Emissions and removals from land use, land use change and forestry (LULUCF), 1990 to 2030

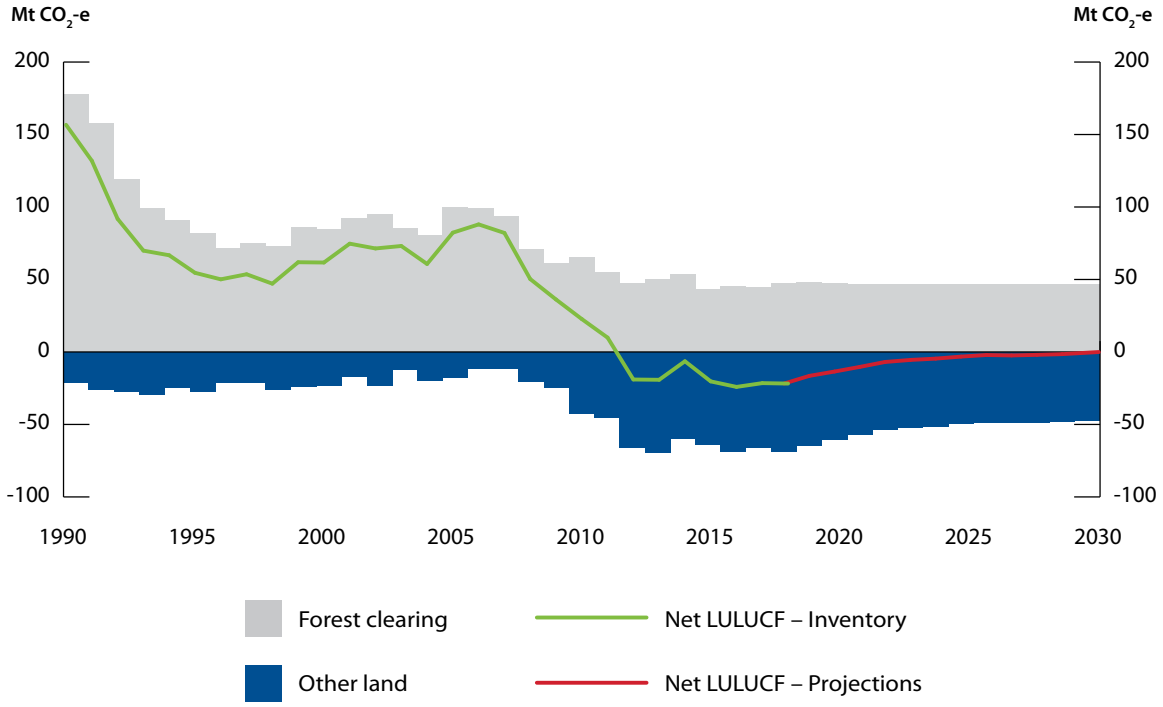


Table 13 Emissions and removals from land use, land use change and forestry (LULUCF), Mt CO_2-e

Emissions by subsector	2018	2020	2025	2030
Forest clearing *	47	47	46	46
Other land +	-69	-61	-50	-47
Net LULUCF emissions	-22	-14	-3	-1

* Emissions from UNFCCC land use classification of forest conversions, excluding sinks from regrowing forest on previously cleared land.

+ Includes the UNFCCC classifications forest land remaining forest land, land converted to forest land, as well as croplands, grasslands, wetlands and settlements that were not previously converted from forest lands.

Sensitivity Analyses

It is not possible to predict future trends in emissions with complete certainty. The 2018 projections include two sensitivities to assess how Australia's emissions are impacted by different assumptions:

- Low demand, which assumes slower economic growth both in Australia and across the globe, tentative consumer confidence and low population growth in Australia.
- High demand, which assumes faster economic growth both in Australia and across the globe, high consumer confidence and strong population growth in Australia.

The sensitivities do not assume any policy changes. When considered with the baseline projections, they present a possible range of emissions trajectories to 2030.

Each sensitivity has been prepared by drawing on published modelling and data.

The sectors modelled for the sensitivity analyses are the electricity, direct combustion, transport, fugitives, industrial processes and product use and waste sectors.

Table 14 Key assumptions under the sensitivities

Sensitivity	Baseline – 2018 projections	High demand	Low demand
Economy	Medium global and domestic demand, broadly consistent with Treasury forecasts for Budget 2018–19	High global and domestic demand	Low global and domestic demand
Population growth	Medium	High	Low
Commodity prices	Medium	High	Low
Electricity demand	Medium	High	Low
Energy efficiency	Medium	High	Low
Electric vehicle uptake	Medium	High	Low
Uptake of rooftop solar	Medium	High	Low

Low demand sensitivity

The low demand sensitivity has been prepared drawing on AEMO's slow change scenario in the 2018 Electricity Statement of Opportunities (ESOO).

Compared to the baseline:

- Slower economic growth is assumed to reduce demand for Australia's products both domestically and internationally.
- Energy demand is lower, with electricity demand 17 per cent lower than the baseline in 2030.
- Energy demand from industry is reduced because of lower production. Household energy demand is lower due to slower population growth as well as consumer responses to prices.
- Manufacturing activity is lower, with activity 20 per cent lower than the baseline in 2030.
- Exports are lower, with global metal prices between 15 and 30 per cent below the baseline in 2030.
- Electric vehicle uptake is slower, with 70 per cent fewer electric vehicles on the road in 2030 compared with the baseline.

Emissions to 2020

Emissions in 2020 are projected to be 534 Mt CO_2-e, equivalent to current levels and 1 per cent lower than the baseline in 2020.

Similar to the baseline, rising LNG production and a declining sink in the land sector increases emissions to 2020. However, compared to the baseline scenario emissions are slightly lower because of lower LNG production in line with the lower export demand assumed.

This emissions growth is offset by falling emissions in the electricity sector, which continues to see growth in large-scale renewable builds lowering the emissions intensity of the grid, as with the baseline.

Emissions to 2030

Emissions in 2030 are projected to be 497 Mt CO_2-e, falling 7 per cent below 2020 emissions levels and 12 per cent lower than the baseline in 2030.

Much of this fall is driven by emission declines in the electricity sector. Electricity demand falls as industrial closures are assumed. Given the lower electricity demand, a number of older power stations are projected to close.

Direct combustion emissions also decline, driven by lower manufacturing and energy activity levels.

Part of this decline is offset by rising transport emissions and a declining sink in the land sector. Transport emissions grow faster than the baseline as lower consumer confidence and slower investment delays the uptake of electric vehicles through the projections period. This results in a more emissions-intensive fleet to 2030.

High demand sensitivity

The high demand sensitivity has been prepared drawing on AEMO's fast change scenario in the 2018 ESOO.

Compared to the baseline:

- Faster economic growth is assumed to increase demand for Australia's products both domestically and internationally.
- Energy demand is higher, with electricity demand 8 per cent higher than the baseline in 2030.
- Manufacturing activity is 5 per cent higher than the baseline in 2030.
- Exports are higher, with global metal prices between 15 to 40 per cent above the baseline in 2030.
- Electric vehicle uptake is higher, with double the number of electric vehicles on the road in 2030 compared to the baseline scenario.

Emissions to 2020

Emissions in 2020 are 547 Mt CO_2-e, 3 per cent above current levels and 1 per cent above baseline levels in 2020.

Similar to the baseline, rising LNG production and a declining sink in the land sector drives emission increases to 2020. However compared to the baseline scenario, emissions are slightly higher due to stronger growth in LNG production to meet higher export demand.

Part of this growth is offset by falling emissions in the electricity sector, which continues to see growth in large-scale renewable builds lowering the emissions intensity of the grid, as with the baseline. In this sensitivity, electricity demand is higher compared to the baseline but is offset by higher rooftop solar generation.

Emissions to 2030

Emissions in 2030 are 582 Mt CO_2-e, growing 6 per cent above 2020 emissions levels and 3 per cent above the baseline in 2030.

Emissions are driven by growing production of LNG and coal. Demand for energy exports is higher than the baseline, which sees production for both of these products grow faster than the baseline.

This growth is offset in part by declines in electricity sector emissions. Although demand for electricity is higher than the baseline, there is stronger uptake of rooftop solar driven by strong economic activity, consumer confidence and growth in new dwellings. Large-scale renewable capacity is added in the late 2020s to meet growing demand and aided by declining renewable costs.

Transport emissions grow slower than the baseline, as higher investment and consumer confidence increase the uptake of electric vehicles. This lowers the emissions-intensity of the fleet.

Figure 15 Sensitivities against baseline, 1990 to 2030

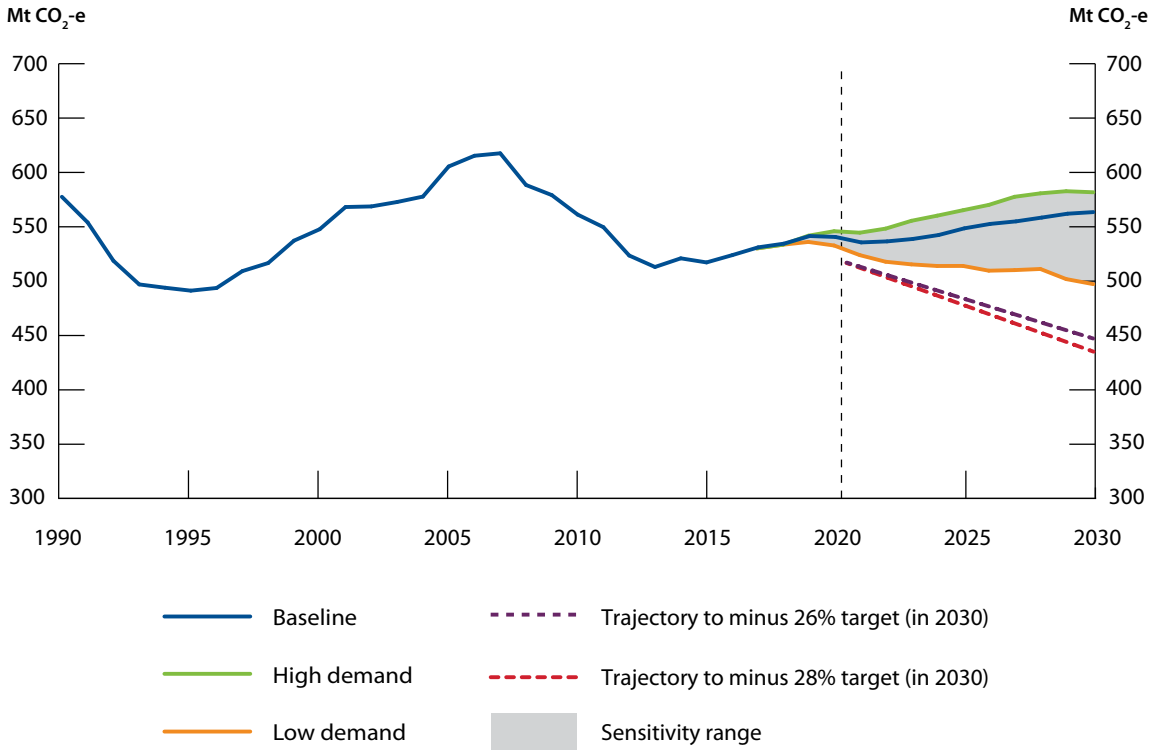


Table 15 Sensitivity results compared to baseline, Mt CO_2-e

	2005	2018	2020	2030
Baseline	605	534	540	563
Low demand	605	534	534	497
High demand	605	534	547	582

Table 16 Cumulative emissions reduction task to 2030 under baseline and sensitivity analyses, Mt CO_2-e

	Cumulative emissions reduction task (26% below 2005)	Cumulative emissions reduction task (28% below 2005)
Baseline	695	762
Low demand	325	392
High demand	877	944

Appendix A – Methodology

An extensive methodology for Australia's emissions projections is provided as a separate document alongside this report. The Methodology report, *Methodology for the 2018 Projections*, can be found on the Department's website.

Accounting approach

The projections are prepared at the sectoral level consistent with international guidelines adopted by the United Nations Framework Convention on Climate Change (UNFCCC). Emissions are expressed in terms of CO_2-e using the 100 year global warming potentials contained in the Intergovernmental Panel on Climate Change's *Fourth Assessment Report* (IPCC 2007). As greenhouse gases vary in their radiative activity and in their atmospheric residence time, converting emissions into CO_2-e allows the aggregate effect of emissions of the various gases to be considered.

Australia's emissions projections are estimated using a UNFCCC reporting framework consistent with Australia's approach to reporting under the 2030 target. The projections are also prepared on a Kyoto Protocol classification basis for tracking under the 2020 target. The sectoral emission estimates in this report use the UNFCCC reporting framework. The difference between the two classification frameworks is the treatment of emission sources and sinks from the land use, land use change and forestry sector. The UNFCCC framework includes more comprehensive coverage of lands and activities, while Kyoto Protocol classifications are more restrictive in their coverage of forests and wetlands, and apply a different set of reporting rules, for example relating to the international trade of harvested wood products and their eventual disposal in landfill.

Unless stated otherwise, all years in this report align with the definition of reporting year used in the national greenhouse gas inventory. Reporting years are reported for financial years as key data sources are published on this basis. For instance, '2030' refers to the financial year 2029–30.

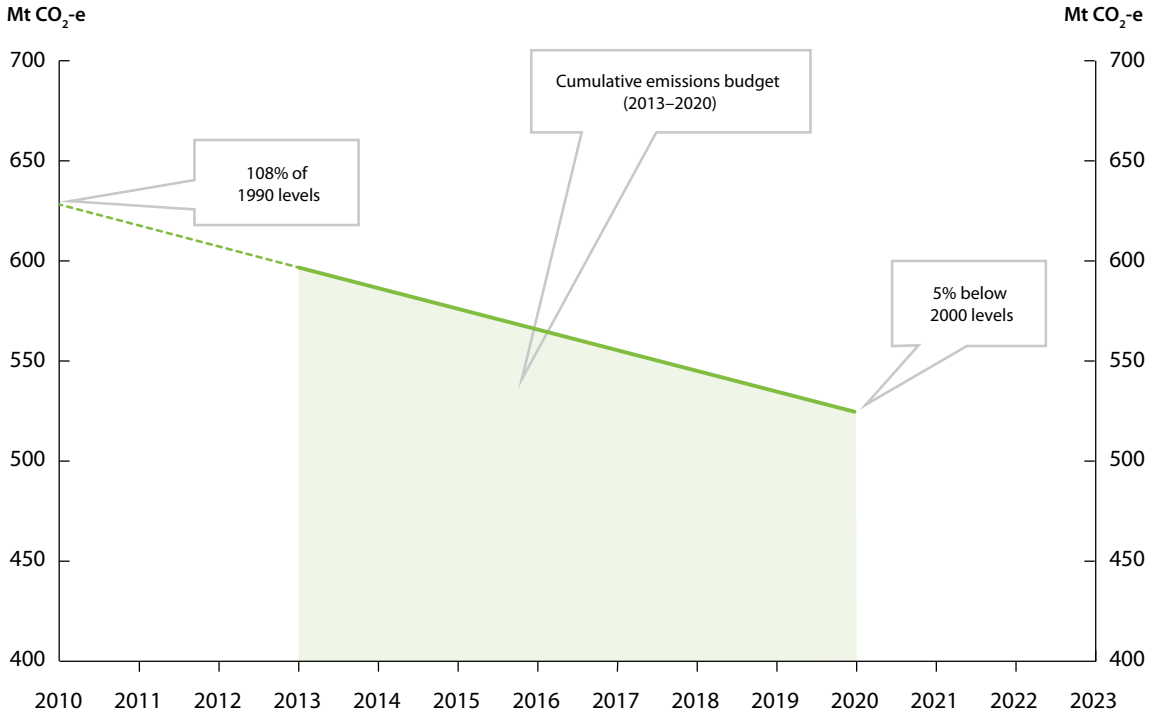
Methodology for calculating Australia's cumulative emissions reduction task to 2020

Australia has a target of reducing emissions to 5 per cent below 2000 levels by 2020. This target has been communicated to the UNFCCC as a pledge under the Cancun Agreement.

Australia's 2020 target is based on the Kyoto Protocol classification system. It includes emissions and removals from the energy (electricity, direct combustion, transport, fugitives), industrial processes and product use, agriculture and waste sectors and the following Kyoto Protocol land use, land use change and forestry sub-classifications: deforestation, afforestation, reforestation, forest management, cropland management, grazing land management and revegetation.

Australia assesses its progress towards its 2020 target using an emissions budget for 2013 to 2020. A trajectory to achieve the emissions budget is calculated by taking a linear decrease from 2010 to 2020, beginning from the Kyoto Protocol first commitment period target level, which was 108 per cent of 1990 levels (583 Mt CO_2-e) as calculated in Australia's latest National Inventory Report submission, and finishing at five per cent below 2000 levels in 2020.

Figure 16 Australia's cumulative emissions reduction task to 2020

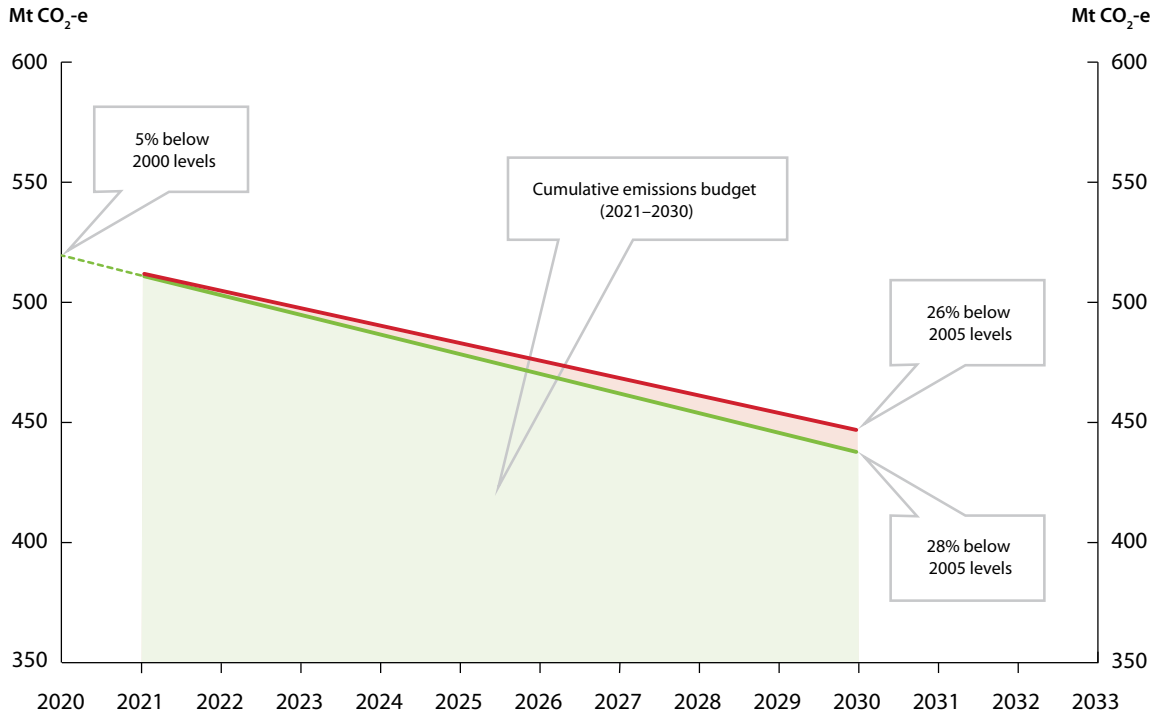


	2013	2014	2015	2016	2017	2018	2019	2020	2013–2020
Budget trajectory Mt CO_2-e	598	587	577	566	556	545	535	524	**~~4488~~**

Methodology for calculating Australia's cumulative emissions reduction task to 2030

Under the Paris Agreement, Australia has a target of reducing emissions by 26–28 per cent below 2005 levels by 2030. Australia stated in its Nationally Determined Contribution that it would develop its target into an emissions budget covering the period 2021–2030. For this report, the calculation of Australia's emissions budget is based on existing UNFCCC guidance developed in the context of the Cancun Agreement.

Figure 17 Australia's cumulative emissions reduction task to 2030



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2021–2030
Budget trajectory (26% target) Mt CO_2-e	512	505	498	491	484	476	469	462	455	447	**4800**
Budget trajectory (28% target) Mt CO_2-e	511	503	494	486	478	469	461	452	444	435	**4733**

Data sources

The projections are developed using a combination of top-down and bottom-up modelling prepared by the Department's analysts and external consultants. The preparation of the projections is based on the following data sources:

- historical emissions data from the *Quarterly Update of Australia's National Greenhouse Gas Inventory: June 2018,*
- macroeconomic assumptions of gross domestic product and exchange rates consistent with the Australian Government's 2018–19 Budget,
- population growth from the Treasury and ABS; and
- commodity forecasts and activity levels informed by a number of publications and data from government agencies and other bodies, including:
  - the Department of Industry, Innovation and Science
  - the Australian Bureau of Agricultural and Resource Economics and Sciences
  - the Australian Energy Market Operator
  - the International Energy Agency
  - announcements by business of investment intentions.

The Department applies consistent assumptions across all sectors of these projections.

Every effort is made to take account of available information and analysis. However, there is inevitably information that becomes available too close to the release of the projections to allow for detailed integration into the projections.

Consideration of policies

The projections are developed on the basis of current policies and measures. These include the:

- ERF, total funding allocated to the ERF is $2.55 billion and is projected to contribute 65 Mt CO_2-e of abatement to 2020, and 240 Mt CO_2-e over the period 2021 to 2030[8]
- Large-scale Renewable Energy Target of 33,000 GWh by 2020 to 2030
- Legislated phase-down of HFCs
- Land Use Land Use Change and Forestry measures including land clearing laws and the 20 Million Trees Programme
- State-based waste policy frameworks and the National Food Waste Strategy
- National Energy Productivity Plan
- State and territory government legislated renewable energy policies.

They do not take account of estimates of abatement from potential future policies and initiatives including proposed state renewable energy targets and plans.

8 Abatement from the ERF includes the results of the first seven auctions, with calculated estimates for future auctions based on set assumptions. Abatement includes contracted emission reductions and the continuation of some projects after the end of the contract period (post contract abatement). Further abatement from ERF projects after 2030 is not included in the projections.

Institutional arrangements and quality assurance

The projections are prepared by the Department of the Environment and Energy using the best available data and independent expertise to analyse Australia's future emissions reduction task. The Department engages with a technical working group comprising of representatives from Commonwealth agencies to test the methodologies, assumptions and projections results. Australia makes formal submissions on its emissions projections to the United Nations and these are subject to UN expert review. The last review was completed in 2018.

The preparation of the emissions projections underwent a performance audit by the Australian National Audit Office (ANAO) in 2016 and 2017. The audit found the arrangements for preparing, calculating and reporting on Australia's greenhouse gas emission projections were largely effective. The audit report, *Accounting and Reporting of Australia's Greenhouse Gas Emissions Estimates and Projections* is published on the ANAO website.

Difference between projections and forecasts

The Department regularly prepares emissions projections using the latest data including production and activity levels, commodity prices and macroeconomic assumptions. The Department makes reasonable assumptions about this data into the future based on the advice of other government agencies and external consultants. These include macroeconomic forecasts by the Australian Treasury; activity forecasts by other government agencies such as the Australian Bureau of Agricultural and Resource Economics and Sciences and the Department of Industry, Innovation and Science; forecasts by other public bodies such as the Australian Energy Market Operator; and announced investment intentions by businesses.

The projections are modelled taking this data into account and indicate what Australia's future emissions could be if the assumptions that underpin the projections continue to occur. For example, the projections presume that assumptions around the current rates of economic and population growth, the take up of certain technologies and the impacts of current government policies will remain valid. The projections do not attempt to account for the inevitable, but as yet unknown, changes that will occur in technology, energy demand and supply and the international and domestic economy.

In contrast, emissions forecasts speculate on the expectations or predictions of what will happen in the future and thus what future emissions will be. In a forecast the assumptions represent expectations of actual future events or changes. For example, this could mean forecasting emissions based on alternative predictions of how technology may evolve, how consumers and businesses will react to these technological changes and subsequently what impacts this would have on emissions. Alternatively this could mean forecasting emissions based on expectations about restructures in the Australian economy. Often a number of different scenarios that reflect different forecast assumptions are undertaken at the same time.

Both projections and forecasts are inherently uncertain, involving judgements about the future growth path of global and domestic economies, policies and measures, technological innovation and human behaviour. This uncertainty increases the further into the future emissions are projected (or forecast).

The distinction between forecasts and projections can also be seen in the Treasury's economic estimates underlying Australian Government fiscal projections. The estimates divide the forecast horizon into two distinct periods: the near–term forecast period which covers the first two years beyond the current financial year; and the longer-term projection period which includes the last two years of the forward estimates, and up to 36 more years for intergenerational analysis. The economic estimates over the forecast period are based on a range of short–run forecasting methodologies, while those over the projection period are based on medium–to long–run rules.

Feedback

The Department of the Environment and Energy welcomes feedback regarding Australia's Emissions Projections at emissions.projections@environment.gov.au.

environment.gov.au

CC227.1118