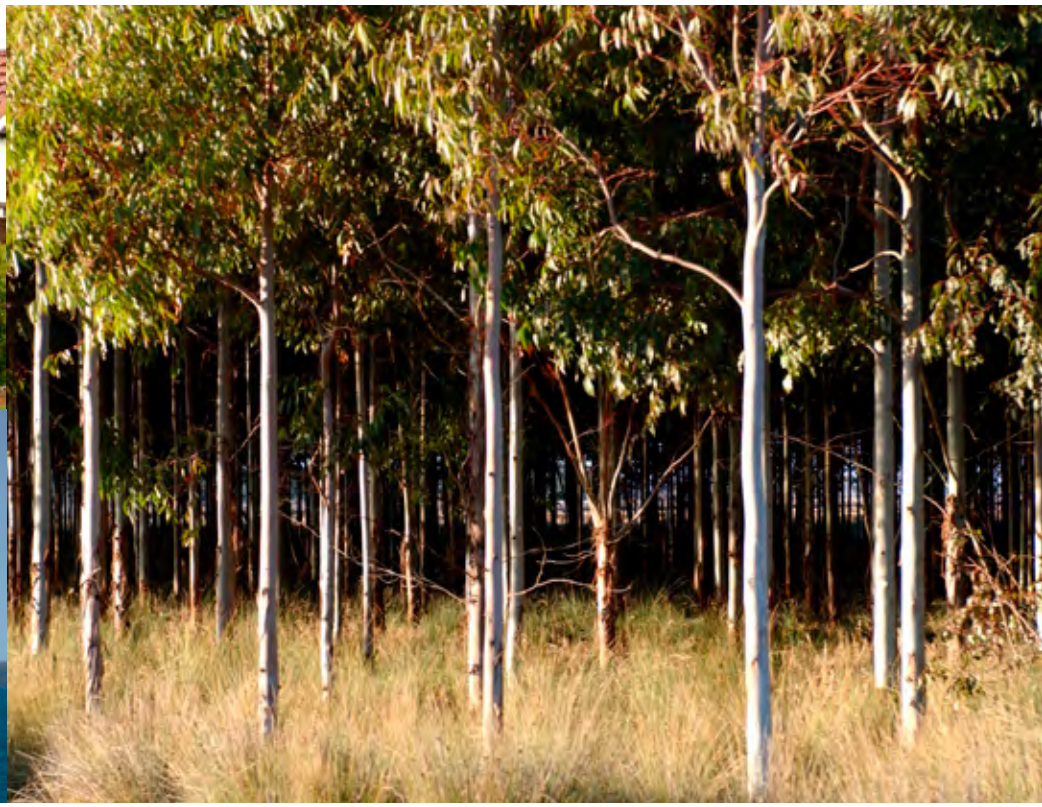
Australian Government

Department of the Environment

Australia's emissions projections 2014–15



March 2015

Corrigenda

The following corrections were made to this report on 1 April 2015:

p. 4 Figure 1 now has a cumulative abatement challenge in the 2012 Projections of 755 Mt CO_2-e.

p. 4 The third dot point now reads:

- Emissions per unit of GDP is projected to fall by 47 per cent between 1999–2000 and 2029–30 and emissions per capita is projected to fall by 18 per cent over this period to 24 t CO_2-e in 2029–30.

Disclaimer

or

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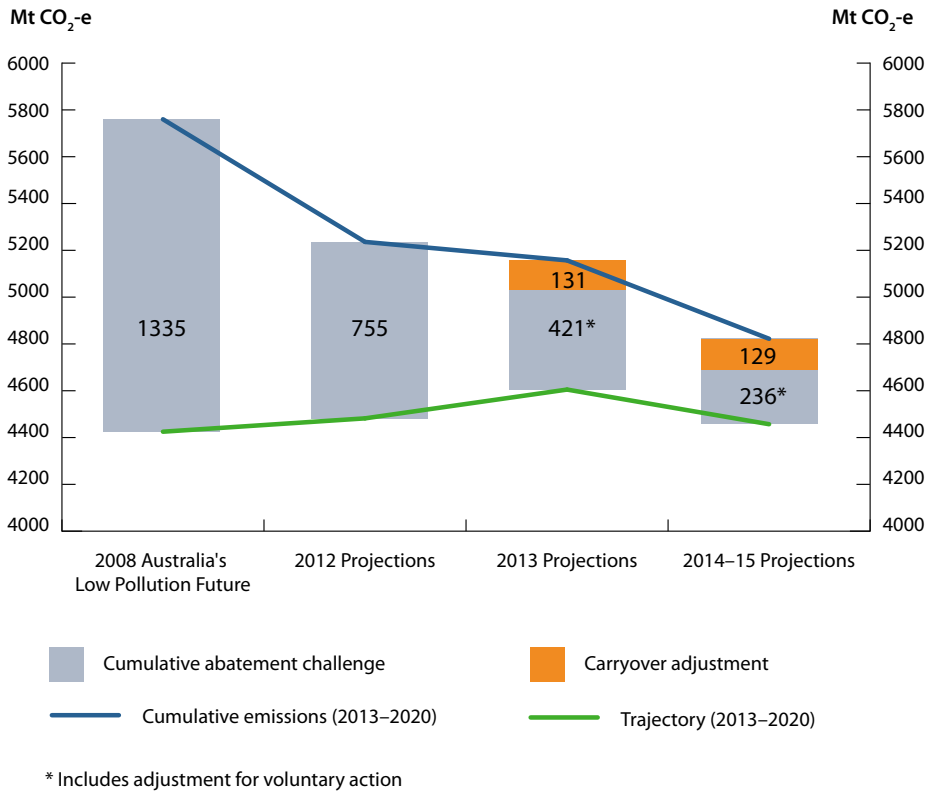
Overview

- The Australian Government is firmly committed to reducing Australia's greenhouse gas emissions to five per cent below 2000 levels by 2020.
- The centrepiece of the Government's emissions reduction efforts is the $2.55 billion Emissions Reduction Fund which will commence purchasing emissions reduction from all sectors of the economy from April 2015.
- **Australia's cumulative abatement task from 2013 to 2020 has steadily fallen by around 1,100 Mt[1] CO_2-e[2], from 1,335 Mt CO_2-e in 2008 to 236 Mt CO_2-e in 2014–15** as the Australian economy became less emissions intensive. (Figure 1)
- This is a reduction of 185 Mt CO_2-e compared to the abatement task of 421 Mt CO_2-e in the 2013 Projections.
- The cumulative abatement task has been revised downwards since the 2013 Projections due to a range of factors.
  - lower electricity demand forecasts due to uptake of household solar, energy efficiency and increased retail prices;
  - worse than expected agricultural conditions due to drought;
  - lower manufacturing output due to industrial closures;
  - weaker growth expectations for local coal production due to a fall in international coal prices; and
  - two additional years of historic data and improved estimation methods that have been applied to the National Greenhouse Gas Inventory and these projections.
- Going forward Australia's gross domestic product (GDP) is projected to outpace projected emissions growth, with emissions per unit of GDP projected to fall 35 per cent between 1999–2000 and 2019–2020. Australia's emissions per capita are projected to fall by 14 per cent over the same period.
- Australia's emissions peaked in 2005–06 at 614 Mt CO_2-e and have declined by 55 Mt CO_2-e to 559 Mt CO_2-e in 2012–13.
- The first auctions to purchase abatement under the Emissions Reduction Fund will commence from April 2015 and the safeguard mechanism will commence from 1 July 2016.
- Emissions Reduction Fund Methodologies are available or under development covering emissions reductions from electricity, direct combustion, transport, fugitives, industrial processes and product use, agriculture, waste and land use land use change and forestry. In addition the Australian Government supports efforts to reduce emissions of high global warming potential synthetic greenhouse gases under the Montreal protocol.
- Without taking account of abatement from the Emissions Reduction Fund, domestic emissions are projected to be **656 Mt CO_2-e higher in 2019–20**.
  - Strong demand for Australian energy exports, primarily coal and liquefied natural gas (LNG), is expected to drive growth in direct combustion and fugitive emissions.
  - Emissions from electricity generation, Australia's largest source of emissions, are projected to increase throughout the projections.

1 Mt is short for million tonnes

2 CO_2-e is short for carbon dioxide equivalent

Figure 1 Change in cumulative abatement task

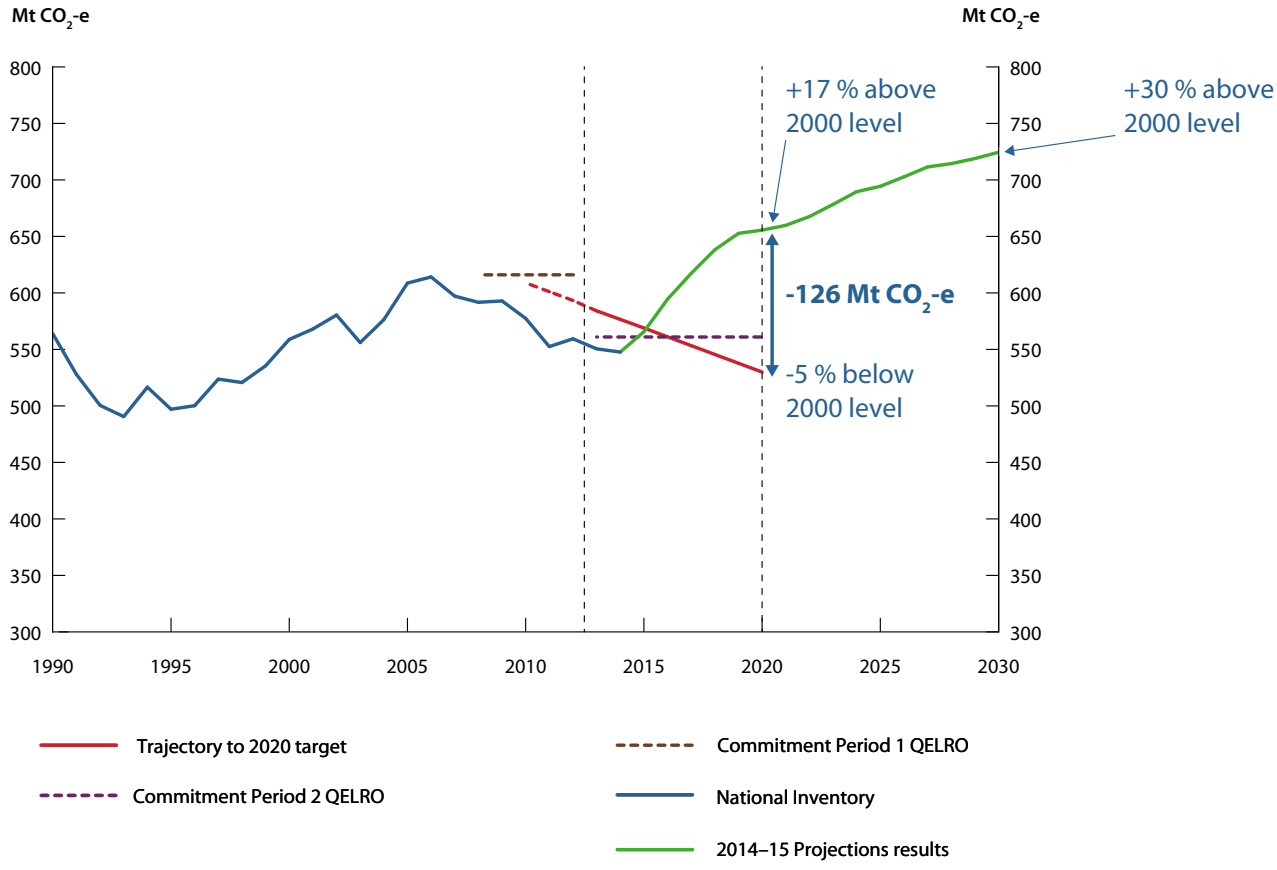


Note: The cumulative abatement task has been derived for the period 2013 to 2020 using the information available in each publication. It is important to note that they are not directly comparable as the underlying assumptions and policy measures differ. Emissions accounting approaches to comply with international reporting standards and target trajectories are also different between projections.

Source: Australian Government 2008; DCCEE 2012; DoE 2013; DoE estimates.

- To meet Australia's five per cent emissions reduction target in 2020, emissions will need to be 126 Mt CO_2-e lower than currently projected (or no more than 530 Mt CO_2-e). That is, Australia's abatement task in 2019–20 is projected to be 126 Mt CO_2-e.
- Without taking account of abatement from the Emissions Reduction Fund, domestic emissions are projected to be **724 Mt CO_2-e** in 2029–30, a 30 per cent increase on 1999–2000 levels.
  - The fugitives sector is projected to continue to be the fastest growing sector during the 2020s, reflecting sustained global demand for Australian LNG and coal.
  - Emissions from the electricity generation sector are projected to increase the most, in absolute terms, during the 2020s due to economic and population growth.
- Emissions per unit of GDP is projected to fall by 47 per cent between 1999–2000 and 2029–30 and emissions per capita is projected to fall by 18 per cent over this period to 24 t CO_2-e in 2029–30.
- Figure 2 displays Australia's historical and projected emissions, along with the 2019–20 abatement task.

Figure 2 Australia's emissions trends, 1990 to 2030[3]



Note: all years in figures refer to the financial year ending in the year shown.
Source: Department of the Environment (DoE) 2015a; DoE estimates.

3 QELRO is the Quantified Emissions Limitation or Reduction Objective (see Box 1, p.14).

Introduction

The 2014–15 Projections are a full update of Australia's domestic emissions projections including:

- A projection of emissions from 2014–15 to 2019–20[4], which provides the basis for estimating the 'abatement task' Australia is required to achieve to meet its 2019–20 targets.
- An indicative projection of Australia's emissions out to 2034–35.

These projections update those provided in *Australia's Abatement Task and 2013 Emissions Projections*, released in December 2013 (Department of the Environment (DoE) 2013; see Appendix A for a comparison). They are based on:

- Historical emissions data from Australia's 2013 National Greenhouse Accounts: National Greenhouse Gas Inventory[5], and Quarterly Update of Australia's National Greenhouse Gas Inventory, September Quarter 2014 released in March 2015 (DoE 2015a, 2015b).
- Economic and population forecasts consistent with the Government's 2014–15 Budget and Mid-year Economic and Fiscal Outlook (MYEFO)[6] (Australian Government 2014a, 2014b; see Appendix B — Key assumptions).
- Commodity forecasts and activity levels from a range of sources, as outlined in Appendix B — Key assumptions.

Emissions projections are inherently uncertain, involving judgments about the growth path of future global and domestic economies, policy actions, technological innovation and human behaviour. This uncertainty increases the further into the future emissions are projected. Therefore the 2034–35 projection should be considered indicative as the projection of underlying variables becomes increasingly more uncertain beyond 2019–20.

Further details on each sectoral projection are provided in a set of technical papers (forthcoming) published on the Department's website www.environment.gov.au.

Outline of methodology

Modelling approach

The projections are prepared at a sectoral level, consistent with international guidelines adopted by the United Nations Framework Convention on Climate Change (UNFCCC) for accounting under the Kyoto Protocol. This includes projecting Australia's emissions for the six Kyoto Protocol greenhouse gases, expressed in terms of carbon dioxide equivalent (CO_2-e) using the 20-year global warming potentials contained in the Intergovernmental Panel on Climate Change's (IPCC) *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.

The 2014–15 Projections presents a baseline scenario that is developed on the basis of current policies and measures in place. The main exception is it does not include projected abatement from the Emissions Reduction Fund. The operation of the Fund is being finalised, including the detailed design of the safeguards mechanism and future funding decisions are still be taken so it is premature at this stage to prepare long term projections inclusive of its impact. Initial auction results from April 2015 and thereafter will provide additional information to inform projections of abatement from the Emissions Reduction Fund. This approach is consistent with previous projections where the abatement task was shown without the impact of the carbon tax included.

4 Financial year. Years which are based on Kyoto Protocol commitments are based on calendar years.
5 To be released in April 2015.
6 The population projection used for this projection is similar to that used in the *2015 Intergenerational Report* (Australian Government 2015).

The 2014–15 Projections include a Renewable Energy Target consistent with the Government's stated policy position of a 'real 20 per cent' Large-scale Renewable Energy Target. The 2014–15 Projections do not separately attribute additional abatement to the activities of the Clean Energy Finance Corporation or the Australian Renewable Energy Agency. Funding provided by these organisations overlaps with other measures, notably the Renewable Energy Target and the former Clean Technology Investment Program, which makes it difficult to attribute any additional abatement to the Clean Energy Finance Corporation and Australian Renewable Energy Agency.

The preparation of the projections is based on assumptions for gross domestic product, the exchange rate and population growth that are consistent with the Government's 2014–15 Budget and Mid-year Economic and Fiscal Outlook (Australian Government 2014a, 2014b). In projecting results, the Department draws on publications from the Department of Industry and Science, the Australian Bureau of Agricultural and Resource Economics and Sciences, and the *Climate Change Mitigation Scenarios* report by the Department of the Treasury and the former Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education (DIICCSRTE; Department of the Treasury and DIICCSRTE 2013).

The projections use a combination of top-down and bottom-up modelling prepared by the Department's analysts and external consultants. Economic modelling was commissioned for the electricity, transport, agriculture and waste sectors. The direct combustion, fugitive, industrial processes and product use, and land use, land use change and forestry (LULUCF) projections were prepared by the Department. The sectoral reports provide further details on the methodology used for each sector.

There have been significant revisions to some emissions factors in agriculture and fugitives. New scientific research has led to the emissions intensity of beef cattle production being revised down since the 2013 Projections. Several coal mines have also commenced more accurate reporting through the National Greenhouse and Energy Reporting scheme (NGERs). Both of these revisions have been applied in the National Greenhouse Gas Inventory and these projections (DoE 2015a, 2015b). Further information of these changes are available in Appendix A — Changes from previous projections.

Calculation of emissions targets

The Government is committed to a target of reducing emissions to five per cent below 2000 levels by 2020. This target has been reported as a commitment under the UNFCCC. A trajectory to achieve the target is calculated by taking a linear decrease from 2009–10 to 2019–20, beginning from the Kyoto Protocol first commitment period (CP1) target level[7] and finishing at five per cent below emissions in 2020.

The cumulative abatement task is defined as the difference in cumulative emissions over the period 2013 to 2020 between projected emissions and the target trajectory. The cumulative abatement task includes the use of surplus units from the Kyoto Protocol CP1. Abatement from voluntary action from GreenPower and the National Carbon Offset Standard is treated as being additional to the abatement task.

The Australian Government has also inscribed a commitment in amendments to the Kyoto Protocol to reduce emissions to 99.5 per cent of 1990 emission levels for the duration of the second commitment period, which extends from 2013 to 2020. This commitment is known as the Kyoto Protocol second commitment period (CP2) Quantified Emissions Limitation or Reduction Objective (QELRO). The Australian Government has not yet ratified these amendments and will consider ratification at an appropriate time. See Box 1 (p.14) for further detail on Australia's QELRO.

7 This target level is the CP1 Quantified Emissions Limitation or Reduction Objective (QELRO). In CP1, which spanned the years 2008 to 2012, annual emissions over the period were required to be on average below 108 per cent of emissions in the 1990 reference year level.

Quality assurance process

The projections undergo an extensive quality assurance process. The methodologies employed and the results are reviewed by a technical working group comprising representatives from Commonwealth agencies. Representatives from industry bodies, independent economic analysts and consultants are also consulted. Australia makes formal submissions on its emissions projections to the United Nations and these are periodically subject to UN expert review.

The Department uses the best available data and expertise to analyse Australia's future emissions and abatement task. However, the projections represent a judgment about the future and it is not possible to predict all factors that may influence Australia's emissions — such as economic shocks, significant shifts in future technology development and changes in consumer preferences.

Recognising these inherent uncertainties about the future, sensitivity analysis has been undertaken for the sectoral projections (and will be included in the forthcoming sectoral technical papers) to illustrate how emissions may differ under alternative scenarios, for example changes to economic growth assumptions.

Recent trends — National Greenhouse Gas Inventory

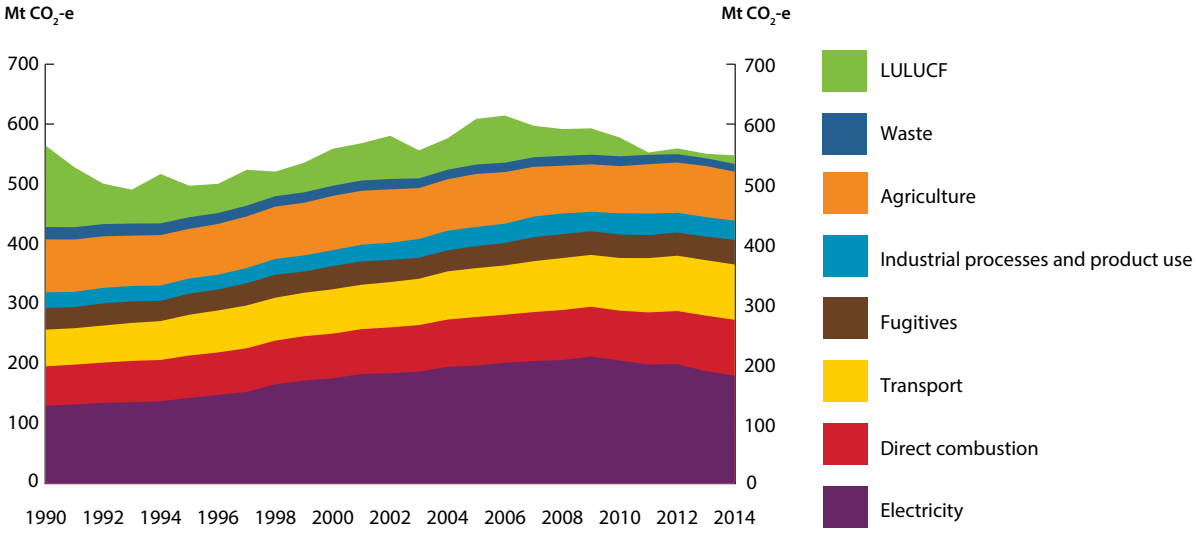
Australia's total emissions in 2013–14 are estimated to have been 548 Mt CO_2-e, a decrease of two per cent below the 1999–2000 level of 559 Mt CO_2-e (Figure 3).

Electricity generation was the largest source of greenhouse gas emissions in Australia in 2013–14, accounting for 33 per cent of total emissions (Figure 4). Both transport and the direct combustion of fuels were the next largest sectors, each contributing 17 per cent of total emissions. Agriculture contributed 15 per cent of emissions in 2013–14. The remaining domestic emissions were shared between fugitives (eight per cent), industrial processes and product use (six per cent), LULUCF (three per cent) and waste (two per cent).

There has been a significant (15 per cent) decrease in emissions from electricity generation since emissions peaked in 2008–09, driven by both demand-side and supply-side factors. A number of drivers are contributing to the drop in demand, which include: a consumer response to an increase in retail electricity prices; improvements in energy efficiency of buildings and technology; increased output from household solar; and structural change in the economy including a reduction in output from some manufacturing sectors. On the supply side there has been a shift towards less emission intensive sources that has been caused by a combination of long-term and temporary factors. Since the mid-1990s, there has been a strong shift towards gas in new generation capacity and the Renewable Energy Target has encouraged growth in wind capacity. More recently, hydro electricity output has been above long-term averages; however, as this level of output is difficult to sustain in the long-term, this is considered a temporary factor.

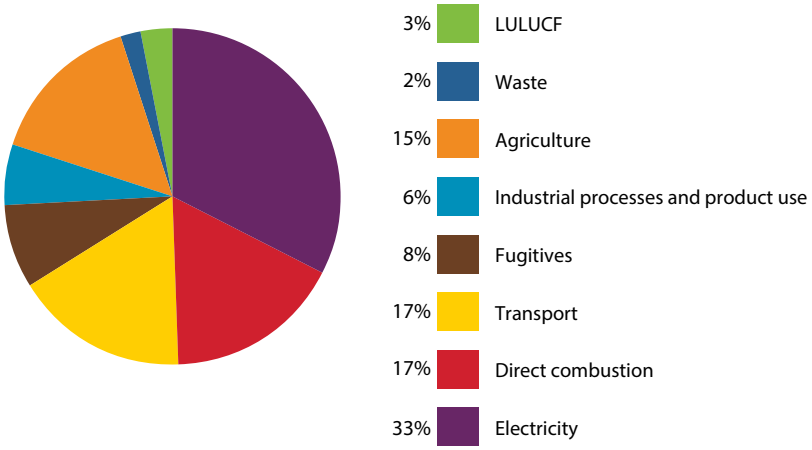
The largest increases in emissions over the period 1989–90 to 2013–14 came from direct combustion and transport. Emissions from direct combustion grew by around two per cent annually, driven by growth in combustion emissions from mining as well as from basic non-ferrous metal and basic chemicals manufacturing. Transport emissions rose due to increased transport activity, primarily from both private passenger vehicles and freight vehicles.

Figure 3 Domestic emissions, 1990 to 2014[8]



Source: DoE 2015a.

Figure 4 Domestic emissions by share, 2014



Note: totals may not sum due to rounding.
Source: DoE 2015a.

8 Note: all years in figures refer to the financial year ending in the year shown.

Projections Results — Overview

Australia's cumulative abatement task is 236 Mt CO_2-e

From 2012–13 to 2019–20, the total emissions reduction required to achieve the minus five per cent emissions trajectory is 236 Mt CO_2-e (excluding any estimate of the abatement from the Emissions Reduction Fund).

This is 185 Mt CO_2-e lower than the previous estimate of the abatement task of 421 Mt CO_2-e. The main factors leading to this change in the outlook include:

- lower electricity demand;
- poor agricultural seasonal conditions;
- reduced output from emissions-intensive manufacturing; and
- weaker growth expectations for coal production.

Australia's cumulative abatement task from 2013 to 2020 has steadily fallen by around 1,100 Mt CO_2-e, from 1,335 Mt CO_2-e in 2008 to 236 Mt CO_2-e in 2014–15 as the Australian economy became less emissions intensive.

The cumulative abatement task is calculated using the following steps:

- Over the period 2013 to 2020, Australia's cumulative emissions are projected to be 4822 Mt CO_2-e in the absence of further policy measures (Figure 5 shows the cumulative emissions by sector).
- The target trajectory required to meet the emissions abatement target of five per cent below 2000 levels permits a maximum of 4457 Mt CO_2-e over the period 2013 to 2020.[9]
- Before taking account of the CP1 carry-over, the difference between the projection and the target trajectory is 365 Mt CO_2-e.
- The cumulative abatement task is reduced by 129 Mt CO_2-e of surplus units from CP1[10].
- The cumulative abatement task is determined by the difference between the projection and target trajectory, less surplus units from CP1. The calculation is outlined in Table 1.

Table 1 Cumulative abatement task, 2013 to 2020

	Domestic target: 5 per cent below 2000 in 2020 (Mt CO_2-e)
Initial cumulative abatement task	365
Less estimated Kyoto Protocol CP1 carry-over	-129
Final cumulative abatement task	**236**

Note: totals may not sum due to rounding.
Source: DoE estimates.

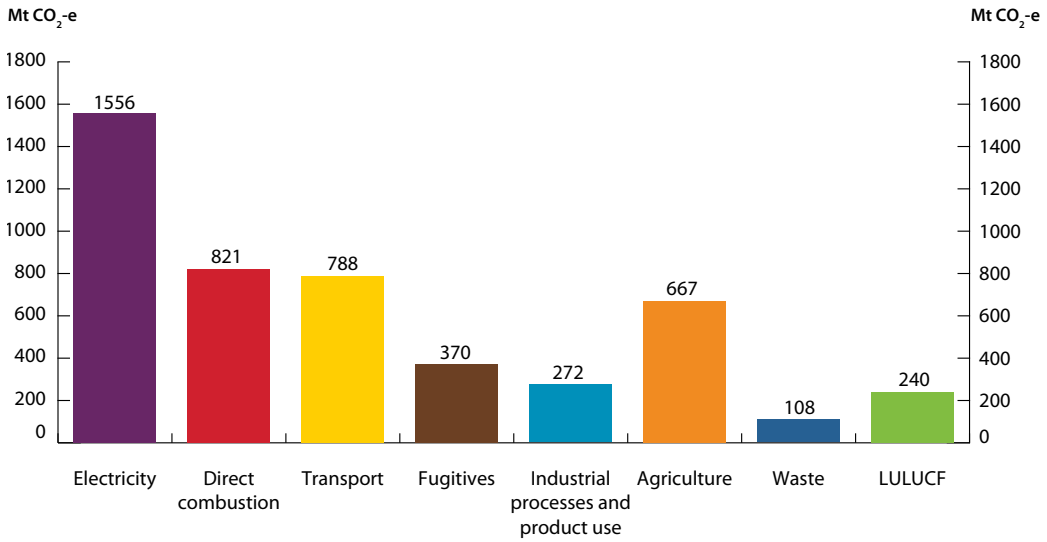
Figure 6 displays how the abatement task is calculated, based on emissions over CP2 (2013 to 2020) and carry-over from CP1 (2008 to 2012).

In the period 2008 to 2012, the area between the National Greenhouse Gas Inventory and the CP1 QELRO (orange area: 129 Mt CO_2-e) is the cumulative emissions amount below Australia's CP1 commitment. This volume of emissions savings can contribute to meeting the CP2 target.

9 This has been adjusted to take account of 8 Mt CO_2-e of abatement from voluntary action over the period 2013 to 2020 as this is additional to the abatement task.

10 Based on official estimates of CP1 carry over from the 2012 National Inventory Report (DoE 2014)

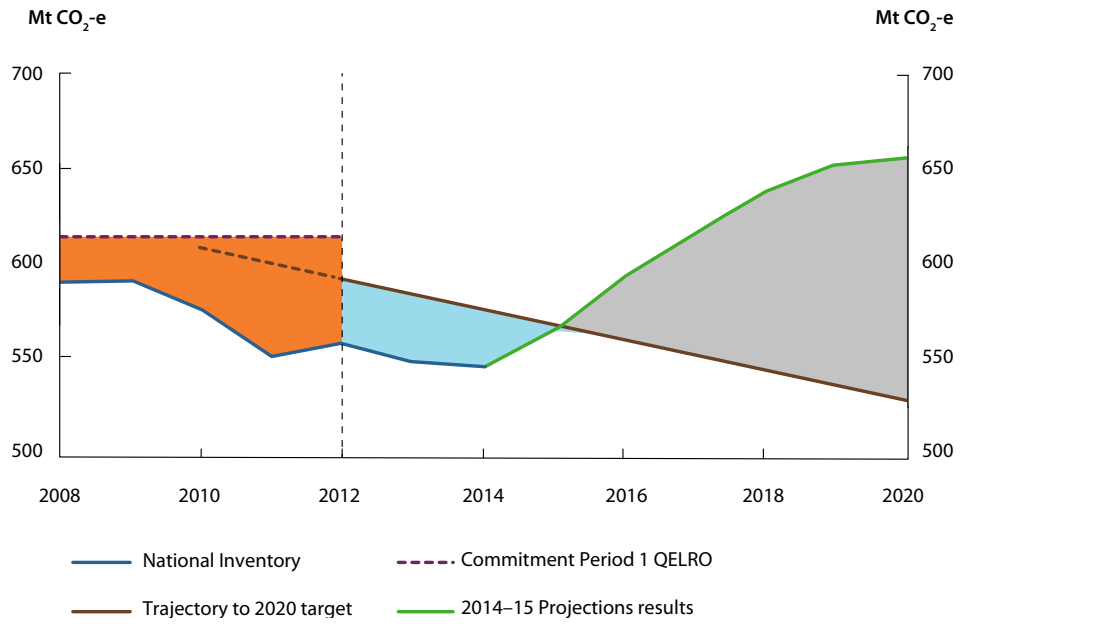
Figure 5 Cumulative emissions by sector, 2013 to 2020



Source: DoE estimates.

In the period 2013 to 2020, in some years Australia is below the target trajectory and the area below the trajectory (blue area: 69 Mt CO_2-e) counts as a reduction to the cumulative abatement task. However, Australia's emissions are expected to grow and there is an increasing gap between projected emissions and the target trajectory (grey area: 426 Mt CO_2-e). The initial cumulative abatement task is therefore 365 Mt CO_2-e[11] (grey area minus blue area) and the cumulative task is 236 Mt CO_2-e (grey area minus blue area, minus orange area).

Figure 6 Cumulative abatement task, 2013 to 2020[12]



Source: DoE 2015a; DoE estimates.
Based on official estimates of CP1 carry over from the 2012 National Inventory Report (DoE 2014).

11 Includes adjustment for voluntary action.
12 Note: all years in figures refer to the financial year ending in the year shown.

Australia needs to reduce its emissions to 530 Mt CO_2-e in 2020

The Government is committed to reducing Australia's emissions to five per cent below 2000 levels by 2020.

- In 2000 Australia's emissions were 559 Mt CO_2-e, making the 2020 target 530 Mt CO_2-e (Table 2).
- Without taking into account abatement from the Emissions Reduction Fund, Australia's emissions are projected to reach 656 Mt CO_2-e in 2019–20, which is a 17 per cent increase on 1999–2000 levels. A reduction of 126 Mt CO_2-e or 19 per cent from business as usual emissions is required to reach the minus five per cent target.

Table 2 Australian 2014–15 Projections results in 2019–20

	1999–2000 Mt CO_2-e	2013–14 Mt CO_2-e	2019–20 Mt CO_2-e
National Greenhouse Gas Inventory data	559	548	-
2014–15 Projections	-	-	656
2019–20 target level[11] (five per cent below 1999–2000)	-	-	530
2020 abatement task	-	-	126

Note: totals may not sum due to rounding. The 2020 target has been adjusted to take account of voluntary action. This makes the target more stringent by 1 Mt CO_2-e. Source: DoE 2015a, DoE estimates.

Emissions are projected to increase across all sectors from 2013–14 to 2019–20. Overall, before taking account of the Emissions Reduction Fund, emissions are expected to grow more strongly in the period to 2019–20 compared to recent history:

- Fugitive and direct combustion emissions are projected to grow strongly (by 33 and 23 per cent respectively) in response to export demand for Australian LNG and coal (Table 3).
- The LULUCF sector is also expected to grow strongly. This reflects projected increases in land clearing and forest harvest activity and the diminished effect of past changes in land management practices which have reduced emissions over recent times (Figure 7).
- Emissions from the electricity sector are expected to increase from their current level. This reflects higher expected levels of coal-fired generation in the next few years due to a significant decline in hydro electricity output, higher gas prices resulting in lower levels of gas-fired generation and the lower costs faced by the electricity sector following repeal of the carbon tax from 1 July 2014.

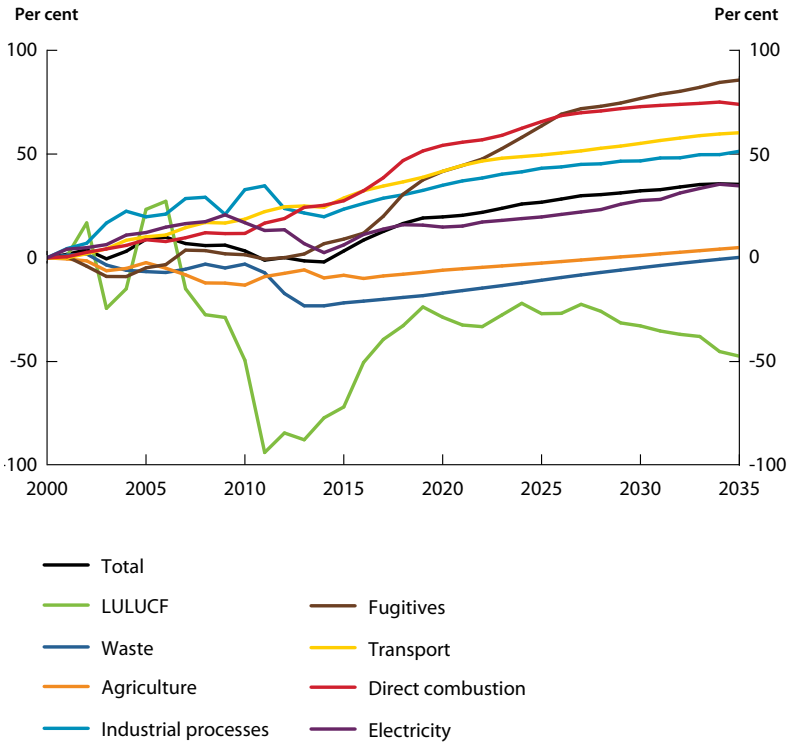
Table 3 Sectoral breakdown of 2014–15 Projections results to 2029–30

	1999–2000 Mt CO_2-e	2013–14 Mt CO_2-e	2019–20 Mt CO_2-e	2029–30 Mt CO_2-e
Electricity	175	180	201	224
Direct combustion	75	93	115	129
Transport	74	92	105	115
Fugitives	39	41	55	68
Industrial processes and product use	27	32	36	39
Agriculture	91	82	85	92
Waste	17	13	14	16
LULUCF	62	14	44	41
Total	**559**	**548**	**656**	**724**
Total excluding LULUCF	497	534	612	683

Note: totals may not sum due to rounding. Source: DoE 2015a; DoE estimates.

13 The 2020 target includes a 1 Mt CO_2-e adjustment in 2020 for voluntary action.

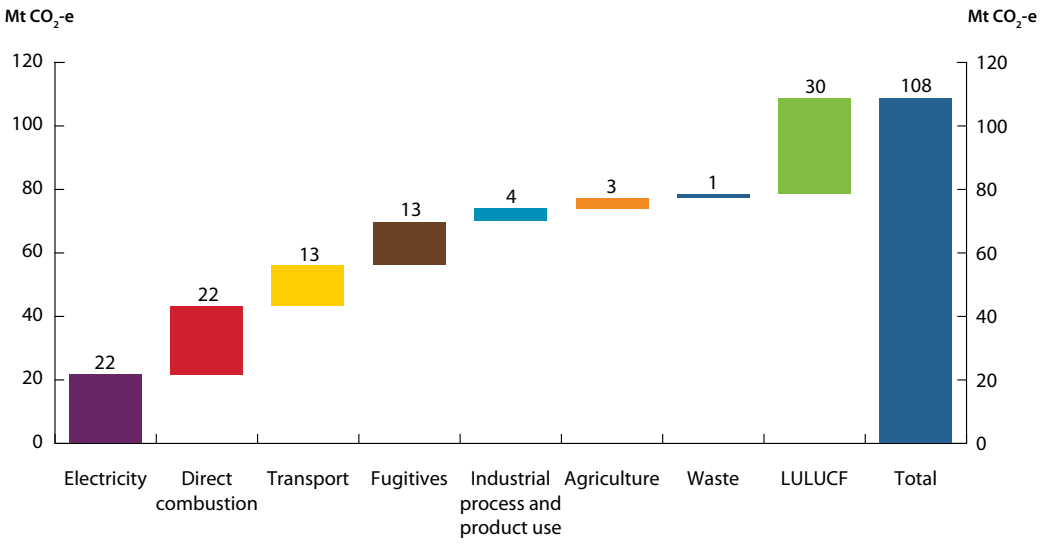
Figure 7 Annual percentage change in emissions relative to 2000 levels by sector[14]



Source: DoE 2015a; DoE estimates.

Australia's emissions are projected to rise by 108 Mt CO_2-e between 2013–14 and 2019–20. Projected emissions growth is due to increases in the extraction of Australia's energy resources (direct combustion and fugitive emissions sectors), lower oil prices leading to increases in transport emissions and electricity demand growth being increasingly met by higher levels of electricity generation from coal-fired power stations (electricity) (Figure 8).

Figure 8 Sectoral emissions growth, 2014 to 2020



Source: DoE estimates.

14 Note: all years in figures refer to the financial year ending in the year shown.

Box 1: The Quantified Emissions Limitation or Reduction Objective

A Quantified Emission Limitation or Reduction Objective (QELRO) is expressed as a percentage of emissions in the 1990 base year. For the first commitment period (CP1) under the Kyoto Protocol, Australia committed to a QELRO of 108 per cent, limiting average annual emissions to eight per cent above the 1990 base year over the five-year period from 2008 to 2012. The second commitment period (CP2) will run for eight years, from 2013 to 2020, and, at the UNFCCC Conference of the Parties negotiation in Doha, 2012, Australia inscribed 99.5 per cent of 1990 base year emissions as its CP2 QELRO in Annex B of the Kyoto Protocol. The Australian Government has not yet ratified these amendments and will consider ratification at an appropriate time.

The QELRO is used to calculate an 'assigned amount', or emissions budget for the commitment period. This is determined by multiplying the QELRO percentage by emissions in the base year, and then by the number of years in the commitment period.

The QELRO was established in 2012 to be consistent with the trajectory to meet the Government's target to reduce emissions to five per cent below 2000 levels in 2020. The Government is free to choose any emissions trajectory for the CP2, provided that total emissions (net of international credits, Kyoto Protocol Removal Units from the land sector and surplus CP1 units) do not exceed the assigned amount.

Under the Kyoto Protocol, surplus assigned amount units from CP1 can be 'carried over' and used towards the CP2 QELRO.

In addition, under the Kyoto Protocol, accounting for Forest Management requires a comparison of net anthropogenic emissions in the commitment period, 2013 to 2020, against projected net anthropogenic emissions for a Forest Management Reference Level, designed to reflect a projection of forest net emission outcomes consistent with policies and practices as at December 2009.

Kyoto Protocol Removal Units are issued for the amount by which actual net anthropogenic emission outcomes achieved over 2013 to 2020 are lower than the net anthropogenic emissions projected in the Forest Management Reference Level, up to a cap of 3.5 per cent of national emissions from the industrial and agriculture sectors.

The cumulative abatement task required to meet the CP2 QELRO permits a maximum of 4488 Mt CO_2-e over the period 2013 to 2020. Over this period and without taking account abatement from the Emissions Reduction Fund, Australia's cumulative emissions are projected to be 4851 Mt CO_2-e under Kyoto Protocol rules. Before taking account of the CP1 carry-over, the difference between the projection and the target trajectory is 371 Mt CO_2-e. After accounting for the inclusion of 129 Mt CO_2-e of surplus units from CP1, the cumulative abatement task for the CP2 QELRO is 242 Mt CO_2-e.[15]

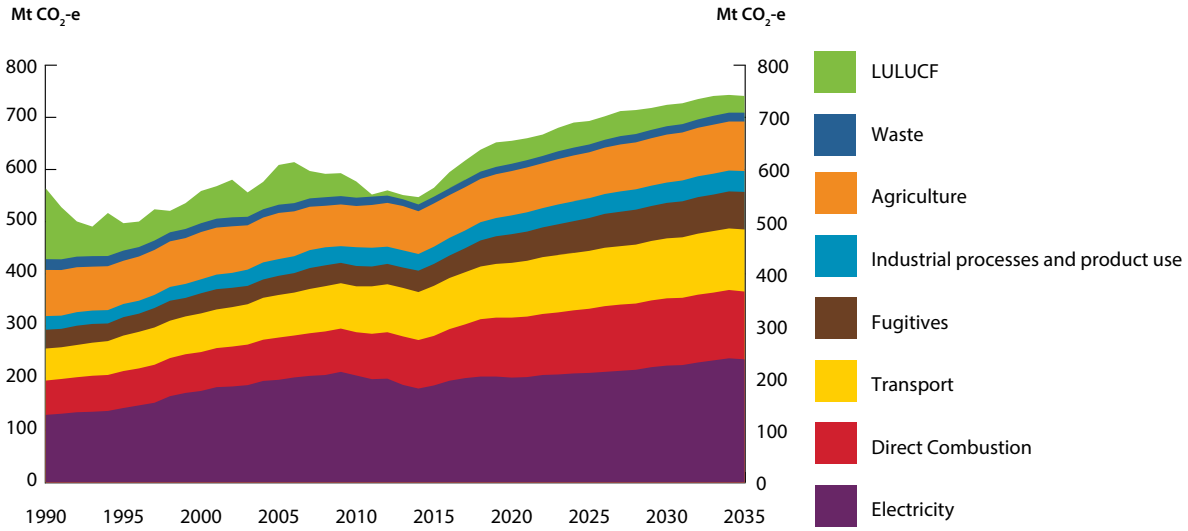
15 This has been adjusted to take account of 8 Mt CO_2-e of abatement from voluntary action over the period 2013 to 2020 as this is additional to the abatement task.

Projections to 2029–30

Australia's emissions are projected to reach 724 Mt CO_2-e in 2029–30, before taking account abatement from the Emissions Reduction Fund and in the absence of complementary policy measures.

Projected 2029–30 emissions provide an indication of long-term emissions trends. Projected emissions growth to 2029–30 is dominated by electricity generation emissions, as electricity demand increases with growth in economic activity and coal-fired electricity generation retains a high share of total electricity generation. Emissions from direct combustion and fugitives also increase significantly, primarily as a consequence of the extraction of coal and natural gas in increasing volumes for export (Figure 9).

Figure 9 Domestic emissions, 1990 to 2035[16]

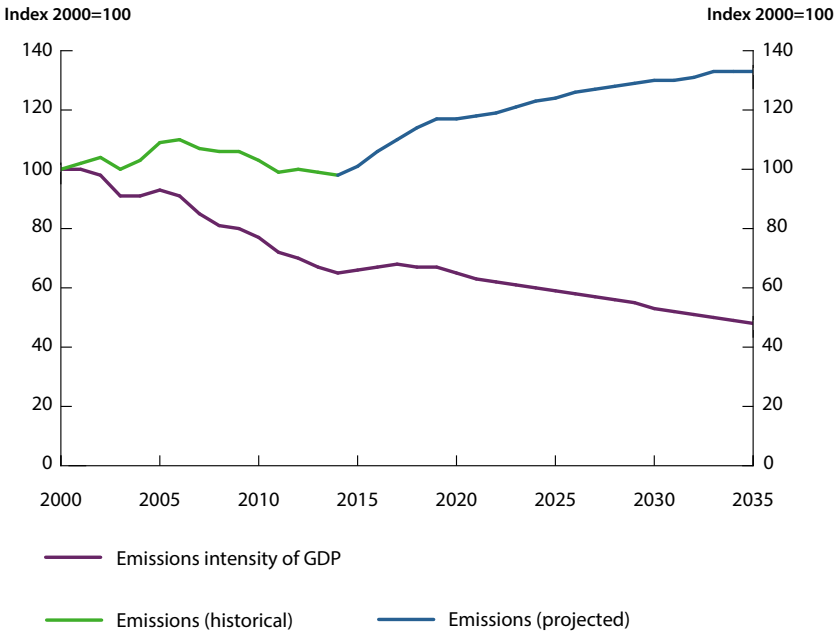


Source: DoE 2015a; DoE estimates.

Indicators of the emissions intensity per unit of production in the economy continue to fall steadily. Australia's gross domestic product is projected to be 62 per cent larger in 2029–30 than it was in 2013–14, outpacing projected emissions growth over the same period (Figure 10).

16 Note: all years in figures refer to the financial year ending in the year shown.

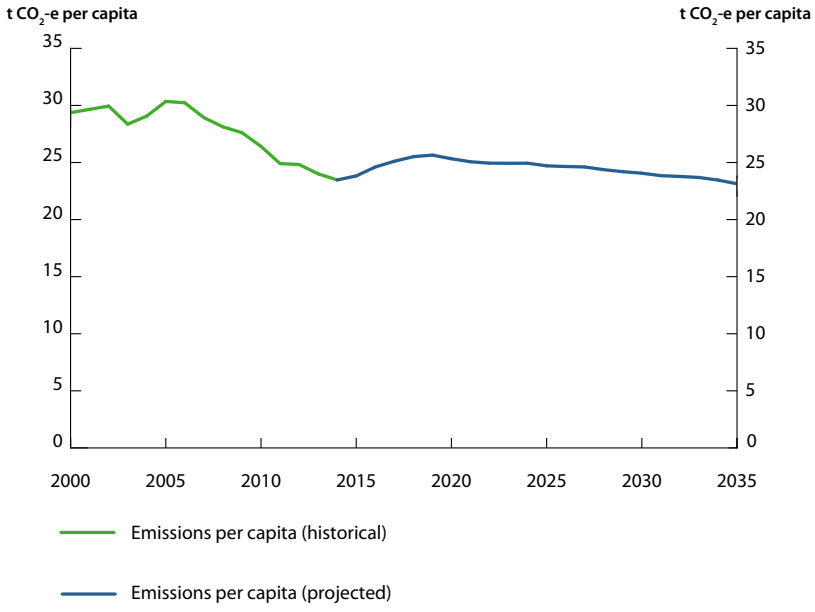
Figure 10 Emissions intensity of GDP relative to 2000 levels, 2000 to 2035[17]



Source: Australian Government 2014b; DoE 2015a; Department of the Treasury and DoE estimates.

Australia's population is projected to be 29 per cent higher in 2029–30 than it was in 2013–14, growing at a rate similar to projected emissions over the same period (ABS 2013). Australia's emissions per capita are projected to be slightly lower by 2030, having risen to 2018–19 before slowly declining to 24 t CO_2-e per capita in 2029–30 (Figure 11).

Figure 11 Emissions per capita, 2000 to 2035



Source: Australian Bureau of Statistics 2013; DoE 2015a; DoE estimates

17 Note: all years in figures refer to the financial year ending in the year shown.

Sectoral trends

Electricity

Electricity generation is the largest source of emissions in the National Greenhouse Gas Inventory. Emissions in 2013–14 were 180 Mt CO_2-e, accounting for 33 per cent of Australia's total emissions. Electricity sector emissions increased strongly to 2008–09 but have since declined driven by both demand-side and supply-side factors. These included the impact of energy efficiency programs, the closure of electricity intensive industrial facilities (such as aluminium smelters), consumer responses to rising electricity prices and the increasing penetration of renewable energy sources. Overall emissions have increased by 4 Mt CO_2-e since 1999–2000, or two per cent. Electricity emissions have fallen by 32 Mt CO_2-e since their high point in 2008–09.

Electricity demand, the electricity generation fuel mix and government policies have a strong influence on electricity emissions. Other key drivers include Australia's economic outlook and demand for Australia's exports. The projection includes emissions from fuels combusted to generate electricity from major grid, mini-grid and off-grid sources. The allocation of fuel consumed for electricity generation is consistent with the coverage of the electricity sector in the September 2014 Quarterly Update of the National Greenhouse Gas Inventory (DoE 2015a).

Electricity emissions are projected to be 201 Mt CO_2-e in 2019–20, an increase of 12 per cent above 2013–14. In 2029–30, emissions are projected to be 224 Mt CO_2-e, an increase of 24 per cent above 2013–14.

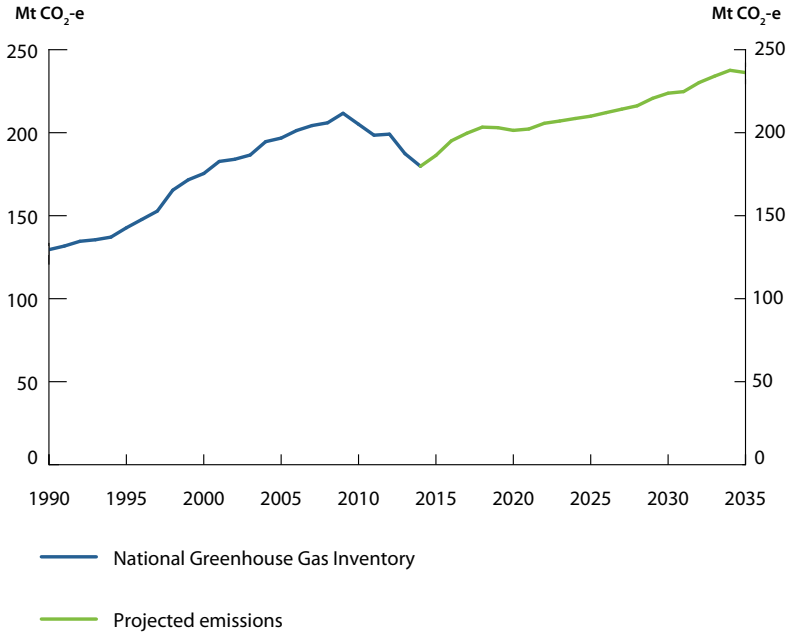
Emissions from the electricity sector are expected to increase from their current low point. This reflects higher expected levels of coal-fired generation in the next few years and this is a result of a number of factors including: a significant decline in hydro electricity output, higher gas prices resulting in lower levels of gas-fired generation and lower costs for the electricity sector following the repeal of the carbon tax from 1 July 2014. Without considering the potential of the Emissions Reduction Fund, coal-fired generation is projected to continue to supply the bulk of Australia's electricity requirements to 2035.

The projection includes a Renewable Energy Target consistent with a policy position of a 'real 20 per cent' Large-scale Renewable Energy Target. Under this scenario, renewable generation still grows to 2020.

Electricity demand is projected to reverse its recent decline and grow over the projections period predominantly due to new coal seam gas projects and upstream processing for LNG projects. However, as the east coast LNG projects mature, this growth is expected to flatten after 2017–18. Demand from general business is muted to 2017–18 then grows as projected economic activity increases. Residential electricity demand is expected to be relatively stable to 2018. However, as the effect of higher electricity prices subsides (due to incomes rising faster than electricity prices) and as the population grows, residential demand is expected to gradually grow to 2034–35.

Figure 12 shows historical and projected electricity emissions.

Figure 12 Historical and projected electricity emissions, 1990 to 2035[18]



Source: DoE 2015a; DoE estimates; ACIL Allen 2015.

Direct combustion

Emissions from direct combustion were 93 Mt CO_2-e in 2013–14, equating to 17 per cent of Australia's total emissions in 2013–14. Direct combustion emissions have increased 25 per cent from 1999–2000 levels and direct combustion is the second-largest emissions sector after electricity.

Direct combustion emissions occur when fuels are combusted for stationary energy purposes to generate heat, steam or pressure (excluding electricity generation). Direct combustion emissions are produced from almost all sectors of the economy including energy, mining, manufacturing, buildings and primary industries.

Historically, direct combustion emissions growth has resulted from increased manufacturing activity.

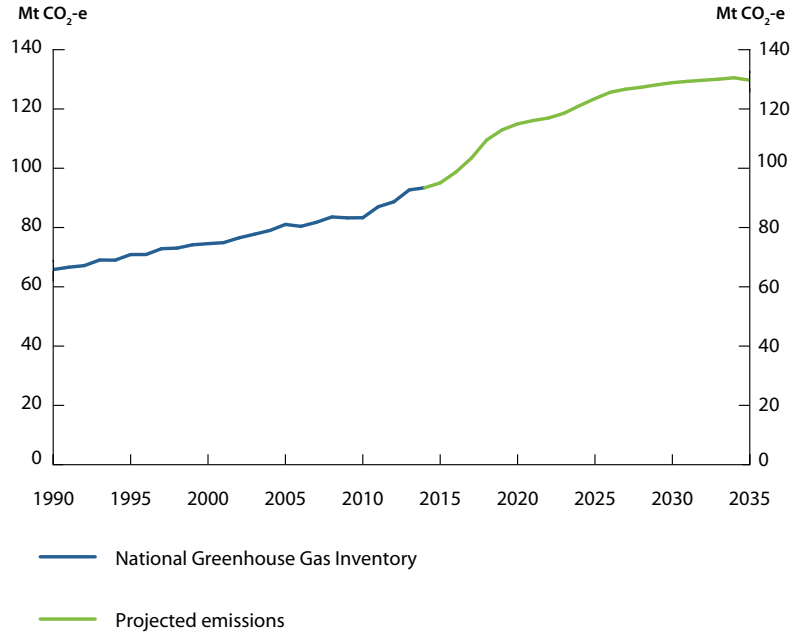
Direct combustion emissions are projected to grow to 115 Mt CO_2-e in 2019–20 and 129 Mt CO_2-e in 2029–30.

Emissions growth over the projections period is forecast to arise from increased activity in the energy sector, particularly the significant expansion in LNG production, and to a lesser degree, growth in the mining sector.

Figure 13 shows historical and projected direct combustion emissions.

18 Note: all years in figures refer to the financial year ending in the year shown.

Figure 13 Historical and projected direct combustion emissions, 1990 to 2035[19]



Source: DoE 2015a; DoE estimates.

Transport

Transport emissions have increased by 24 per cent since 1999–2000, to be 92 Mt CO_2-e in 2013–14. Transport emissions were 17 per cent of the National Greenhouse Gas Inventory in 2013–14.

Emissions from transport include emissions from direct combustion of fuels in road transportation, railways, domestic shipping, domestic aviation, off road recreational vehicle activity, and pipeline transport. Road transport includes light vehicles: private road transport and light commercial vehicles; and heavy vehicles. Private road transport accounted for 46 per cent of transport emissions in 2013–14.

The main determinants of transport emissions are the size of the population, the viability of more efficient engine types, and the availability of low emissions fuels.

Transport emissions are projected to increase by 14 per cent to 105 Mt CO_2-e over the period 2013–14 to 2019–20. From 2013–14 to 2029–30, transport emissions are projected to increase by 25 per cent to be 115 Mt CO_2-e.

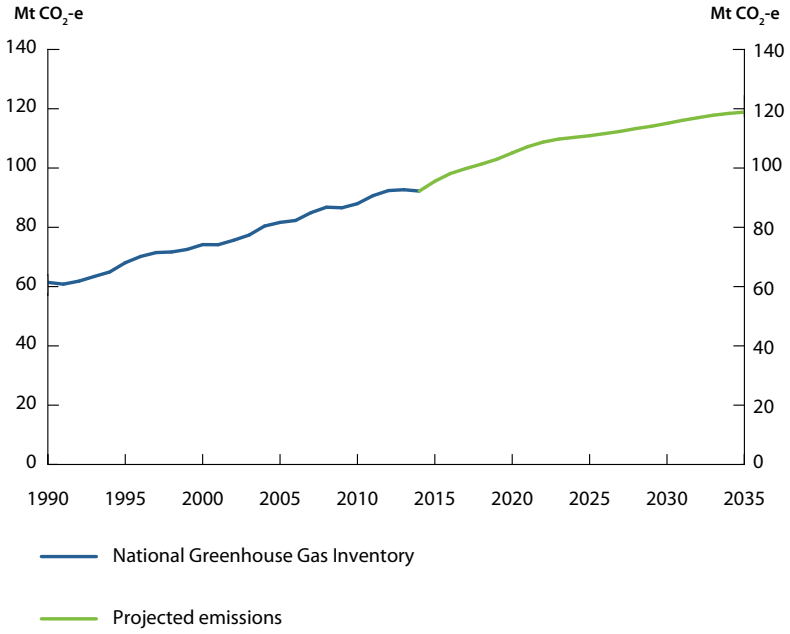
Oil prices are assumed to average $85 a barrel (US2014) over the projections period. Relatively low oil prices are likely to result in increased transport activity and reduced incentives for the development of more efficient engines and low emissions fuels. This results in increased emissions over time.

While minor improvements in the efficiency of internal combustion engines and greater use of alternative engine types are expected, more efficient engine types will not start to become viable until around the second half of the 2020s. However, light vehicle emissions per kilometre travelled are expected to fall from about 260g CO_2-e in 2013–14, to about 190g CO_2-e in 2034–35. Heavy vehicle emissions per kilometre travelled are expected to fall from about 1kg CO_2-e in 2013–14 to about 810g CO_2-e in 2034–35.

Figure 14 shows historical and projected transport emissions.

19 Note: all years in figures refer to the financial year ending in the year shown.

Figure 14 Historical and projected transport emissions, 1990 to 2035[20]



Source: DoE 2015a; DoE estimates.

Fugitives

In 2013–14 fugitive emissions from fossil fuels were 41 Mt CO_2-e. This represented eight per cent of Australia's total emissions. From 1999–2000 to 2013–14, fugitive emissions grew by 3 Mt CO_2-e, or seven per cent.

Fugitive emissions arise from the production, processing, storage, transmission and distribution of fossil fuels such as coal, oil and natural gas. The greatest share of fugitive emissions comes from coal mining activities, including a small amount of emissions from decommissioned mines.

Fugitive emissions are projected to reach 55 Mt CO_2-e in 2019–20, which is a 42 per cent increase on 1999–2000 levels. In 2029–30, fugitive emissions are projected to reach 68 Mt CO_2-e, which is a 77 per cent increase on 1999–2000 levels.

Fugitive emissions levels are strongly influenced by the rate of production and the emissions intensity of that production. Coal mines' emissions intensities depend on the type of mine (underground or open cut), the gassiness of the coal seam and, for underground mines, the rate of flaring. Variation in LNG projects' emissions intensities is mainly due to differing reservoir carbon dioxide levels.

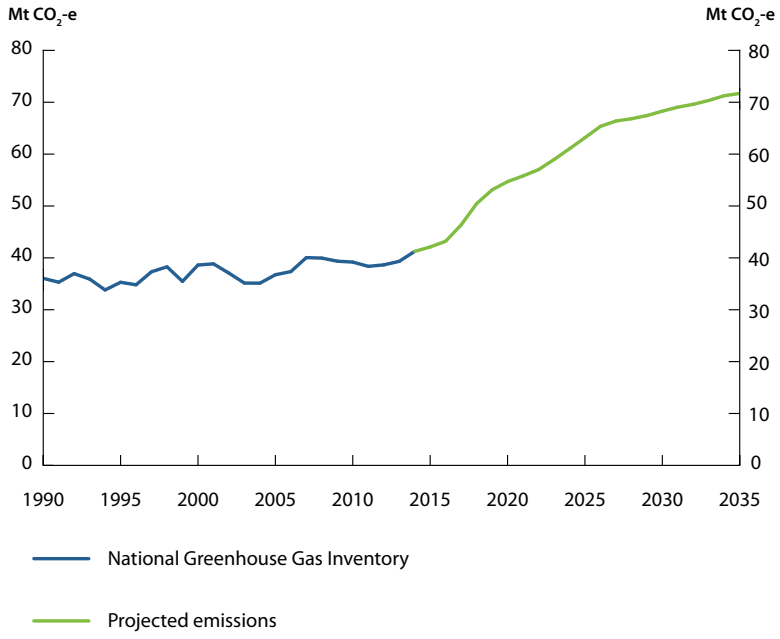
Rising export demand for Australia's energy resources, particularly coal and LNG, is expected to lead to large increases in production volumes and fugitive emissions over the projections period. From 2013–14 to 2034–35, Australian coal production is expected to continue its recent strong rate of increase as global demand, particularly in China and India, increases. Over the same period, Australian LNG production is expected to grow with Australia projected to become the world's largest LNG exporter by 2018–19 (Bureau of Resources and Energy Economics 2014). The expansion of Australia's LNG industry is expected to arrive in two five year waves from 2014–15 and from 2022–23.

20 Note: all years in figures refer to the financial year ending in the year shown.

Fugitive emissions from gas produced for domestic use are projected to increase slightly over the projections period, while fugitive emissions from crude oil and refinery production are projected to be relatively stable. The split of fugitive emissions between the coal sector and the oil and gas subsectors remains fairly constant at around two-thirds to one-third throughout the projection period.

Figure 15 shows historical and projected fugitive emissions.

Figure 15 Historical and projected fugitive emissions, 1990 to 2035[21]



Source: DoE 2015a; DoE estimates.

Industrial processes and product use

Industrial processes and product use emissions were 32 Mt CO_2-e in 2013–14, an 18 per cent increase above 1999–2000 levels. Industrial processes and product use contributed six per cent of Australia's total greenhouse gas emissions in 2013–14.

Emissions from industrial processes and product use are non-energy related emissions. They include by-product gases from chemical reactions in production processes and the release of synthetic greenhouse gases. Industrial processes and product use emissions are categorised into the following subsectors: mineral products (such as cement clinker production), metal production, chemical industry, product uses as substitutes for ozone depleting substances, other product manufacture and use, non-energy products from fuels and solvent use — lubricant use, and other production — food and drink.

Historically, the major emissions sources in this sector have been iron and steel production, aluminium production and clinker production for cement manufacturing. Since 1994–95 the product uses as substitutes for ozone depleting substances has increased significantly as hydrofluorocarbons (HFCs) replaced ozone depleting substances as a result of the Montreal Protocol.

Industrial processes and product use emissions are projected to be 35 Mt CO_2-e in 2019–20, an increase of 10 per cent from their 2013–14 level. In 2029–30 emissions are projected to be 38 Mt CO_2-e, a 19 per cent increase on their 2013–14 level.

21 Note: all years in figures refer to the financial year ending in the year shown.

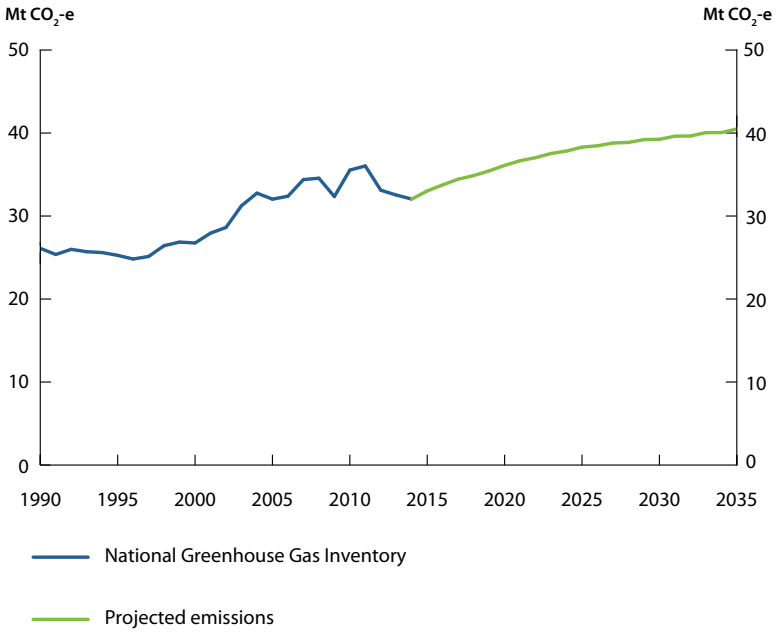
The increase in emissions is driven by projected increases in chemical production and the product uses as substitutes for ozone depleting substances. Ammonia and nitric acid production are projected to increase with several new facilities expected to commence in the short term. These chemicals are used to produce ammonium nitrate for use in explosives for the mining industry. Synthetic greenhouse gas emissions increase due to projected increases in purchasing new air conditioners and refrigerators and as HFCs continue to replace ozone depleting substances in old equipment.

In contrast, emissions from metal production and clinker production are projected to decline or remain steady throughout the projections period. Emissions are projected to fall initially due to several recent closures of aluminium and clinker facilities. Production from these subsectors has recently been affected by rising energy and input costs and excess world production capacity. These factors are projected to continue placing pressure on domestic production throughout the period to 2020.

In most industries, emissions intensity is constant over time due to the nature of chemical reactions occurring in fixed proportions. An exception is nitric acid production, where emissions intensity is projected to decline due to the use of catalysts which reduce nitrous oxide emissions into nitrogen and oxygen gases.

Figure 16 shows historical and projected industrial processes and product use emissions.

Figure 16 Historical and projected industrial processes and product use emissions, 1990 to 2035[22]



Source: DoE 2015a; DoE estimates.

22 Note: all years in figures refer to the financial year ending in the year shown.

Agriculture

Agriculture emissions have decreased by 10 per cent since 1999–2000, to be 82 Mt CO_2-e in 2013–14. Agriculture emissions were 15 per cent of the National Greenhouse Gas Inventory in 2013–14.

Emissions from agriculture include methane and nitrous oxide from livestock and crop production, and from burning of savannas. With the exception of carbon dioxide from liming and the application of urea, emissions of carbon dioxide from agriculture are not counted in the projection because they are considered part of the natural carbon cycle. Beef cattle accounted for 45 per cent of agriculture emissions in 2013–14; dairy cattle and burning of savannas accounted for 11 per cent each; and sheep accounted for 16 per cent.

The main drivers of agriculture emissions are seasonal conditions, demand for exports, and productivity.

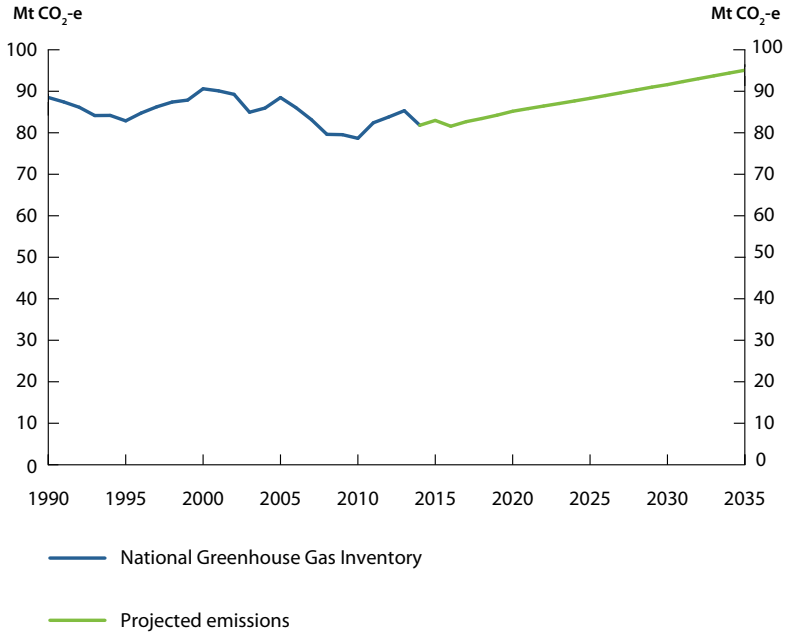
Agriculture emissions are projected to increase by four per cent to 85 Mt CO_2-e over the period 2013–14 to 2019–20. From 2013–14 to 2029–30, agriculture emissions are projected to increase by 11 per cent to be 91 Mt CO_2-e.

Export demand is expected to strengthen as a result of growth in foreign incomes and population and a more favourable exchange rate. Current poor seasonal conditions are expected to return to normal in late 2015, and projected productivity growth would allow Australian producers to maintain their competiveness. Overall this will see growth in agricultural production.

Additional research has led to lower, more accurate estimates of emissions from agricultural activity. This has seen a step change in emissions expectations from the sector in the National Greenhouse Gas Inventory (DoE 2015a). These emissions factors are held constant over the projections period.

Figure 17 shows historical and projected agriculture emissions.

Figure 17 Historical and projected agriculture emissions, 1990 to 2035[23]



Source: DoE 2015a; DoE estimates.

23 Note: all years in figures refer to the financial year ending in the year shown.

Waste

Waste emissions were 13 Mt CO_2-e in 2013–14, a 23 per cent decrease on 1999–2000 levels. Waste contributed two per cent of Australia's total greenhouse gas emissions in 2013–14.

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.

Waste emissions have declined since 1990 due to improved diversion of waste from landfill to recycling and increasing methane capture in all subsectors.

Key drivers of solid waste emissions are methane capture rates and waste deposited in landfill, which is affected by population, per-capita waste generation and waste diversion. In the wastewater subsector, key drivers are population growth, growth in industrial production and methane capture rates.

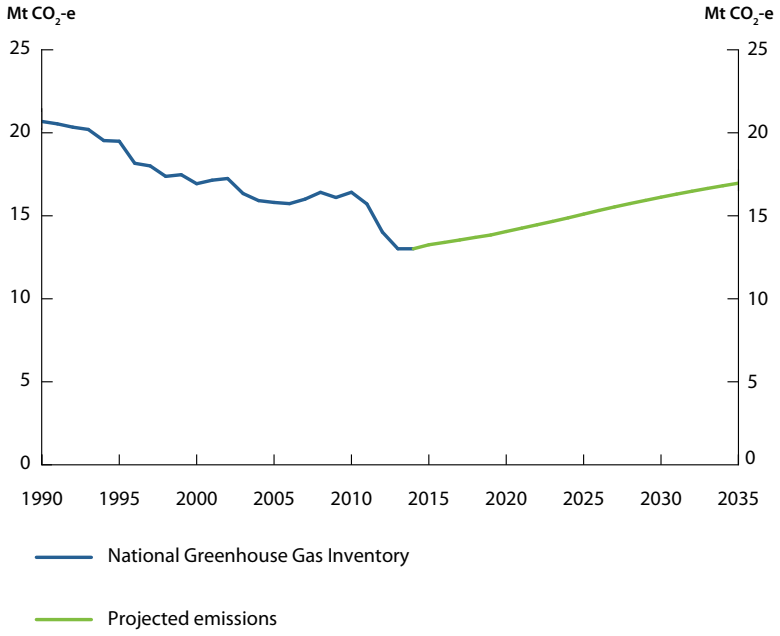
Waste emissions are projected to be 14 Mt CO_2-e in 2019–20, an increase of eight per cent from their 2013–14 level. In 2029–30 emissions are projected to be 16 Mt CO_2-e, a 24 per cent increase on their 2013–14 level.

Waste emissions are expected to increase across the projections period. While methane capture increased substantially in the period from 2010–11 to 2013–2014, much of this methane capture was for legacy waste deposited prior to 1 July 2012 under the carbon price and Carbon Farming Initiative. As a consequence, abstracting from the effect of any methane capture efforts under the Emissions Reduction Fund, methane capture levels are expected to decline over time with declining methane generation from legacy waste. In the face of declining methane capture rates, increasing population and increasing waste generation per capita result in an increase in emissions.

Emissions from wastewater increase steadily across the projections period. While there are increases in wastewater methane capture, these are outweighed by increases in population (for domestic and commercial wastewater) and industrial processing activity (for industrial wastewater).

Figure 18 shows historical and projected waste emissions.

Figure 18 Historical and projected waste emissions, 1990 to 2035[24]



Source: DoE 2015a; DoE estimates.

Land use, land use change and forestry

Preliminary estimates of emissions from LULUCF were 14 Mt CO_2-e in 2013–14, a 77 per cent decrease from 1999–2000 levels. LULUCF contributed three per cent of Australia's total greenhouse gas emissions in 2013–14.

The Australian Government has indicated that it will use the Kyoto Protocol classification system for tracking towards the 2020 emissions reduction target. Estimates of changes in emissions over time, consistent with this approach, are presented. Specific rules relating to Forest Management have been applied in determining Australia's QELRO under the second commitment period of the Kyoto Protocol (see Box 1 on page 14).

Emissions from LULUCF include carbon dioxide emissions and removals from and to the land and biosphere. In the Kyoto Protocol reporting system, emissions are classified as coming from deforestation, afforestation and reforestation, forest management, cropland management, grazing land management and revegetation.

Carbon dioxide and other greenhouse gases are released when forest vegetation is cleared, burned or left to decay, and as soil carbon declines over time. In contrast, removals can occur when permanent changes in management practices generate changes in the levels of woody biomass stocks over the longer term. Historically, emissions have declined mainly due to declining deforestation emissions as a result of increased land clearing restriction laws and a decline in the farmers' terms of trade.

Emissions from LULUCF are projected to be 44 Mt CO_2-e in 2019–20, an increase of 212 per cent from their 2013–14 level. In 2029–30 emissions are projected to be 41 Mt CO_2-e, a six per cent decrease from their 2019–20 level.

Emissions projections for deforestation were modelled from estimated relationships between areas of land clearing activity and movements in the farmers' terms of trade. For afforestation and reforestation, planting rates are the major factor influencing future emissions. Forest management emissions are primarily dependent on native forest harvesting rates.

24 Note: all years in figures refer to the financial year ending in the year shown.

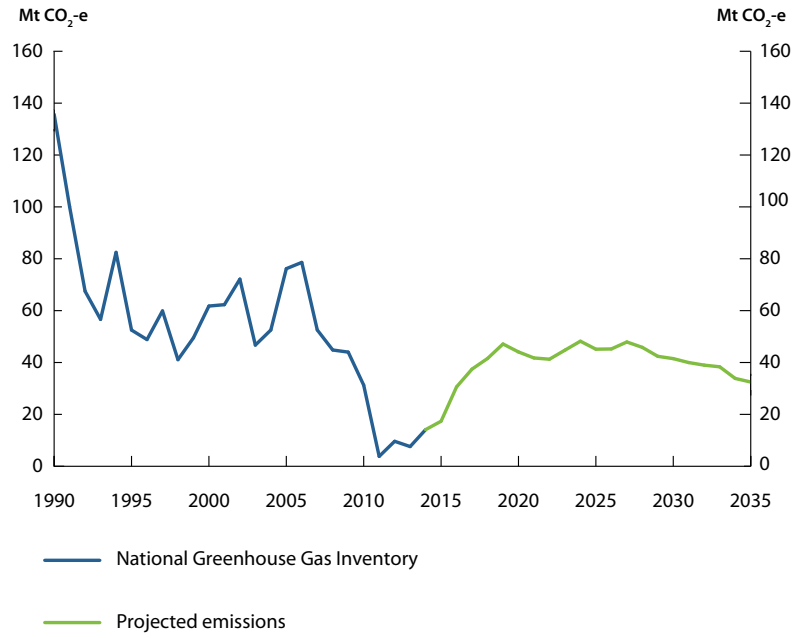
Deforestation emissions are projected to increase initially, reflecting upward pressure on clearing activity from recent regulatory reforms and recent high prices. Over the medium term clearing activity continues, in part in response to increasing global agricultural demand, but at a decreasing rate.

Afforestation and reforestation removals are projected to fall significantly to 0.5 Mt CO_2-e in 2019–20 (that is, net emissions are projected to rise to -0.5 Mt CO_2-e in 2019–20) due to an increase in harvesting supported by a projected increase in demand for Australian wood products. Harvesting of a large share of Australia's plantation timber is expected to meet projected timber demand, with remaining timber demand expected to be met from timber from native forest. Consequently, forest management removals are also projected to fall, similar to afforestation and reforestation removals.

Removals are likely to increase as a result of programs and regulatory approaches that encourage environmental plantings. These programs include *The 20 Million Trees Program*, the *Green Army Program* and offsets created under state vegetation management acts or major project approval processes.

Figure 19 shows historical and projected LULUCF emissions.

Figure 19 Historical and projected land use, land use change and forestry emissions, 1990 to 2035[25]



Source: DoE 2015a; DoE estimates.

25 Note: all years in figures refer to the financial year ending in the year shown.

Appendix A — Changes from previous projection

In December 2013, the Department released *Australia's Abatement Task* and *2013 Projections* (DoE 2013).

The cumulative abatement task from 2013 to 2020 is 185 Mt CO_2-e lower in the current projections than in the 2013 Projections.

- The most significant change is to cumulative emissions from 2012–13 to 2019–20 which is 335 Mt CO_2-e lower in the current projections than in the 2013 Projections. The change in emissions is due to:
  - changes to the projected emissions outlook (approximately 89 Mt CO_2-e)[26] and
  - new historic data (i.e. the first projected year is 2014–15 while in the 2013 Projections it was 2012–13), improved estimation methods and emission factors in the National Greenhouse Gas Inventory (approximately 251 Mt CO_2-e).[27]
- The target trajectory has also been revised down by 155 Mt CO_2-e. This is due to National Greenhouse Gas Inventory revisions of the 1990 and 2000 base year emissions which are the key inputs to the target trajectory.
- The net effect of changes to the Inventory and emissions factors on the cumulative abatement task is to reduce it by approximately 96 Mt CO_2-e relative to the 2013 Projections.

The net result is a reduction in the abatement task of 185 Mt CO_2-e and Table 4 and Figure 20 outline the factors contributing to this change.

Table 4 Change in cumulative abatement task (2013 to 2020) since 2013 Projections

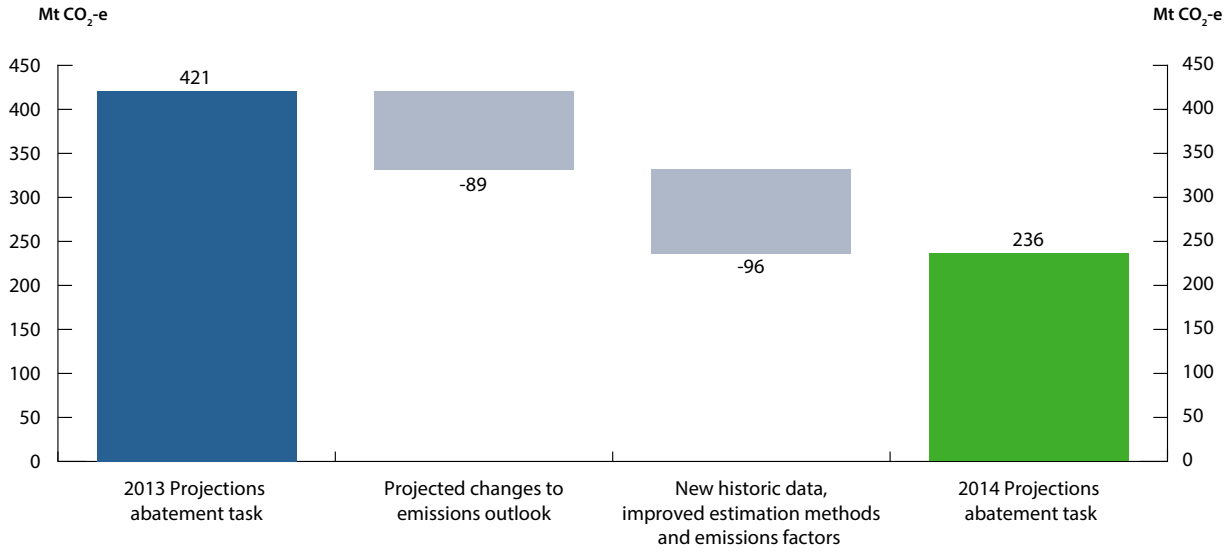
	Mt CO_2-e
2013 Projections abatement task	**421**
Projected changes to emissions outlook	-89
New historic data, improved estimation methods and emissions factors	-96
Difference in cumulative abatement task	**-185**
2014–15 Projections abatement task	**236**

Note: totals may not sum due to rounding. Source: DoE estimates.

26 This is inclusive of the change to the abatement estimate from voluntary action which has been revised down from 15 Mt CO_2-e to 8 Mt CO_2-e of cumulative abatement over the period 2013 to 2020. This is because additional audited data is now available showing GreenPower uptake has fallen.

27 This is inclusive of the revision down to the CP1 carry over from 131 Mt CO_2-e in the Emissions Reduction Fund White Paper to 129 Mt CO_2-e to include an adjustment to the carry over amount to take account of cancelled units from the Kyoto Protocol first commitment period.

Figure 20 Change in cumulative abatement task (2013 to 2020) since 2013 Projections



Changes to the National Greenhouse Gas Inventory

These projections are prepared on the same basis as the National Greenhouse Gas Inventory and reflect recalculations and updates made in the September 2014 Quarterly Update (DoE 2015a):

The recalculations in the Quarterly Update predominantly relate to the full implementation of new international reporting guidelines agreed upon at the UNFCCC Conference of the Parties in 2013[28] and new data from domestic sources. In accordance with the new requirements, including those contained in the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (Guidelines), the September Quarterly Update reflects the following changes.

- For the first time, emissions and removals associated with the Kyoto Protocol LULUCF classifications: forest management, grazing land management and cropland management have been reported;
- Emission estimates have been reallocated between the energy, industrial processes and other products and transport sectors. This change does not affect the overall total emission figures;
- Non-CO_2 emission factors in the stationary energy sector have been updated throughout the time series updates, reflecting the 2006 IPCC Guidelines;
- CO_2 emission factors in the electricity sector, for all fuels other than coal, have been updated throughout the time series, reflecting updated oxidation factors. In previous Quarterly Updates, default oxidation factors of less than 100 per cent were applied consistent with the IPCC Good Practice Guidance (2000). With the adoption of the 2006 IPCC Guidelines, these oxidation factors have been updated to default values of 100 per cent oxidation); and
- Agriculture sector methods and data changes have been implemented to fully implement the IPCC 2006 Guidelines, and reflect new research and management data available for livestock, agricultural soil and savanna burning emissions.

28 For more detail, see International Guidelines in section 9.2 of the *Quarterly Update September 2014* (DoE 2015a).

The incorporation of new NGERs data has resulted in recalculations throughout the time series for open cut coal mines and fugitive emissions from natural gas transmission sectors.

Recalculations have also been performed for solid waste on the basis of new NGERs data. In addition to the inclusion of new reporting entities in the solid waste sector, corrections were undertaken to the procedure used to ensure integration with the output of the harvested wood products model.

The Quarterly Update has also incorporated data from the 2014 Australian Energy Statistics (AES), published by the Department of Industry and Science, Office of the Chief Economist (former Bureau of Resources and Energy Economics). The AES provides national energy data for 2013–14 and includes recalculations to earlier years reflecting the progressive implementation of NGER data.

Changes to the emissions outlook

In 2020, domestic emissions are projected to be 30 Mt CO_2-e lower than reported in the 2013 Projections (Table 5). The majority of the difference can be attributed to the agriculture, fugitives and LULUCF sectors.

Emissions from agriculture are projected to be 20 Mt CO_2-e lower in 2019–20 than reported in the 2013 Projections. Expectations regarding world economic growth, export demand and the productivity of livestock producers are lower than when the 2013 Projections were developed. Ongoing cost pressures and slaughter of breeding animals in response to poor seasonal conditions have contributed to expectations of lower productivity for beef and sheep producers.

Emissions from fugitives are projected to be 25 Mt CO_2-e lower in 2019–20 than reported in the 2013 Projections. In particular, projections of fugitive emissions from coal mines are lower as a result of three main factors. First, production forecasts have been revised downwards since the 2013 Projections, after recent falls in global coal prices caused by surplus supply and relatively weak demand. Second, the projections assume a higher rate of flaring than in the 2013 Projections. Third, more accurate emissions factors have been applied (as noted above).

Direct combustion emissions are forecast to be lower from 2012–13 to 2019–20 when compared to the 2013 projections. This reduction is the result of the Bulwer Island petroleum refinery closure, the Gove alumina refinery closure and lower residential and commercial emissions in response to rising natural gas prices. The magnitude of the reduction has been offset by stronger projected growth in mining emissions.

Emissions from LULUCF are projected to be higher than was projected in the 2013 Projections. Net emissions from afforestation and reforestation, cropland management and grazing land management have been revised up since the 2013 Projections. Partly offsetting this change is that deforestation and forest management emissions are lower than in the 2013 Projections.

Lower electricity demand particularly in the National Electricity Market due to the closure of electricity-intensive facilities, such as the Point Henry aluminium smelter, and stronger growth expectations in rooftop solar photovoltaic, has led to a lower electricity generation projection relative to the 2013 Projections.

Emissions from transport are higher than in the 2013 Projections as a result of a lower oil price assumption, which would reduce the viability of low emissions fuels and more efficient vehicle types, and see people drive more.

Table 5 Changes from 2013 projections by sector

	2013–14 Mt CO_2-e	2019–20 Mt CO_2-e	Cumulative 2012–13 – 2019–20 Mt CO_2-e	2029–30 Mt CO_2-e
Electricity	-8	0.7	-39	-20
Direct combustion	-1	-4	-32	-5
Transport	-2	7	22	9
Fugitives	-13	-25	-151	-32
Industrial processes and product use	2	-0.7	0.5	-6
Agriculture	-17	-20	-152	-32
Waste	-0.6	-0.7	-10	2
LULUCF	-7	14	26	8
Total	**-45**	**-30**	**-335**	**-76**

Note: totals may not sum due to rounding.
Source: DoE 2013; DoE estimates.

Appendix B — Key assumptions

The projections are completed by the Department of the Environment in consultation with a range of Commonwealth agencies including the Department of the Treasury and the Department of Industry and Science. A number of external consultancies were also undertaken with sector specific experts. All were provided with updated and standardised macroeconomic assumptions. This provided consistent model outlooks across all the sectors and accounted for recent changes in commodity prices. The macroeconomic parameters were also applied to all emissions sectors to ensure consistency throughout the projections.

The projections have been compiled against an outlook for the Australian economy consistent with the macroeconomic parameters in the 2014–15 Budget and MYEFO (Australian Government 2014a, 2014b).

Commodity assumption estimates were based on a range of sources, mainly the Department of Industry and Science's Resources and Energy Quarterly, IBISWorld reports, Wood Mackenzie's LNG Tool and AME's coal supply service. These sources were cross checked against company statements about the timing of new projects commencing and facility closures. The production estimates beyond 2019–20 were produced in consultation with Department of Industry and Science and the Department of the Treasury.

Key assumptions include:

- An amended Renewable Energy Target, based on a policy position of a 'real 20 per cent' Renewable Energy Target. This includes an amended Large-scale Renewable Energy Target of 20 per cent of electricity demand in 2020, with amended annual targets commencing on 1 January 2016. The electricity used in all defined emissions intensive trade exposed activities is considered to be 100 per cent exempt from Renewable Energy Target liability (for both the Large-scale Renewable Energy Target and the Small-scale Renewable Energy Scheme).
- Export demand for Australian agricultural products consistent with the International Monetary Fund's 2014 World Economic Outlook.
- International prices for oil and gas based on projections from the International Energy Agency's (IEA) *2013 World Energy Outlook* (IEA 2013) (low oil price scenario).
- Coal prices based on Department of the Treasury's medium-term projections, informed by stakeholders and domestic and international experts.
- Population forecasts that are consistent with those in the Department of the Treasury's 2014–15 Budget to 2024–25, and population forecasts consistent with Australian Bureau of Statistics (ABS) modelling thereafter (ABS 2013).[29]
- Employment and gross domestic product growth parameters are consistent with the 2014–15 Budget and MYEFO and forecasts beyond that were based on advice from the Department of the Treasury.
- Abatement from voluntary action is considered additional to the target and carry-over has been adjusted to take account of cancelled units from the first commitment period.

29 The population projection used for this projection is similar to that used in the *2015 Intergenerational Report* (Australian Government 2015).

Appendix C — Total emissions

Australia's emissions peaked in 2005–06 at 614 Mt CO_2-e. By 2011–12, emissions had fallen by 55 Mt CO_2-e. During the two years of the carbon tax, emission fell by 12 Mt CO_2-e. The year-on-year changes are shown in Table 6.

Table 6 Australia's total emissions — National Inventory to 2013–14 and 2014–15 Projections to 2029–30

Financial year ending	Emissions, Mt CO_2-e	Change, Mt CO_2-e
1989–90	563.8	-
1990–91	527.8	-36.0
1991–92	500.4	-27.4
1992–93	490.5	-9.9
1993–94	516.6	26.1
1994–95	497.1	-19.5
1995–96	500.2	3.1
1996–97	523.7	23.5
1997–98	520.7	-3.0
1998–99	535.5	14.8
1999–00	558.8	23.3
2000–01	568.0	9.2
2001–02	580.4	12.4
2002–03	556.1	-24.4
2003–04	576.3	20.2
2004–05	608.7	32.4
2005–06	614.1	5.4
2006–07	597.2	-17.0
2007–08	591.7	-5.5
2008–09	592.9	1.2
2009–10	577.4	-15.5
2010–11	552.5	-24.9
2011–12	559.4	6.9
2012–13	550.5	-8.9
2013–14	547.7	-2.9
2014–15	565.6	18.0
2015–16	594.4	28.8
2016–17	617.3	22.8
2017–18	638.2	20.9
2018–19	652.7	14.5
2019–20	655.6	2.9
2020–21	659.8	4.2
2021–22	667.6	7.8
2022–23	678.3	10.7
2023–24	689.6	11.3
2024–25	694.3	4.7
2025–26	702.7	8.4
2026–27	711.5	8.8
2027–28	714.4	2.9
2028–29	718.9	4.5
2029–30	724.5	5.6

Note: totals may not sum due to rounding. Source: DoE 2015a, DoE estimates

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Appendix E — Further information

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

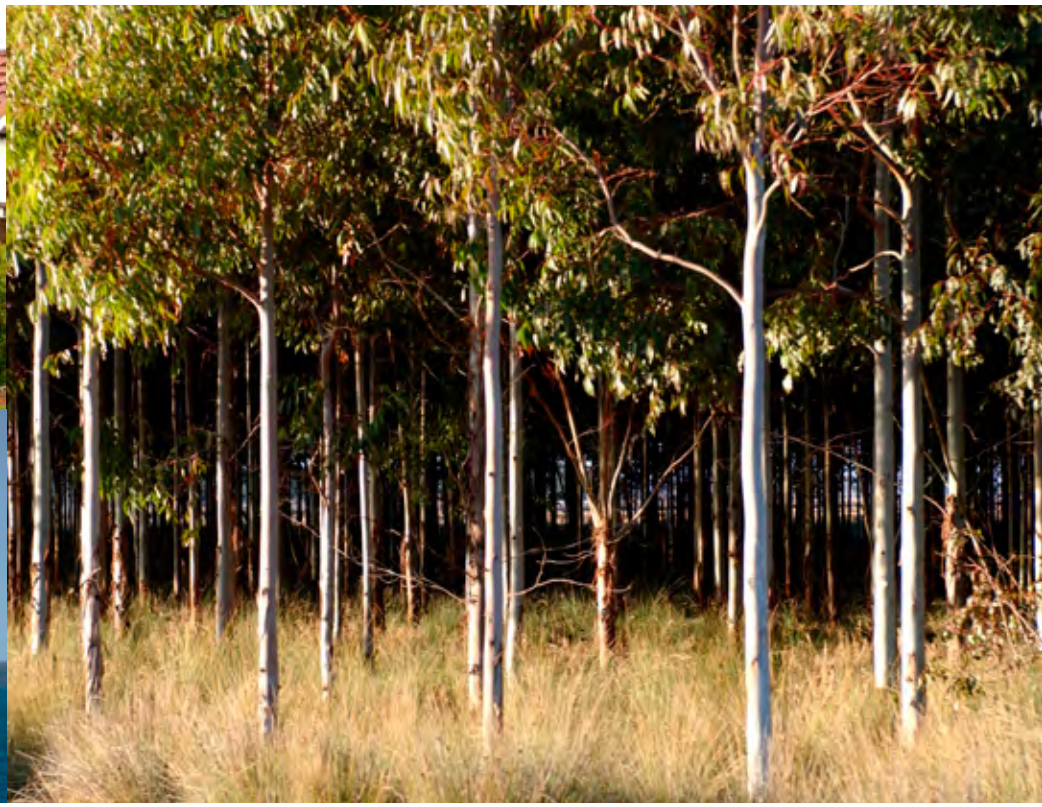
Forthcoming technical sectoral emissions projections papers include:

Electricity generation	Industrial processes and product use
Direct combustion	Agriculture
Transport	Waste
Fugitives	Land use, land use-change and forestry

Copies of related National Greenhouse Gas Inventory and National Carbon Accounting System documents can be obtained from the Department's website.

The estimates in this paper are based on projections current as at March 2015.

environment.gov.au



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