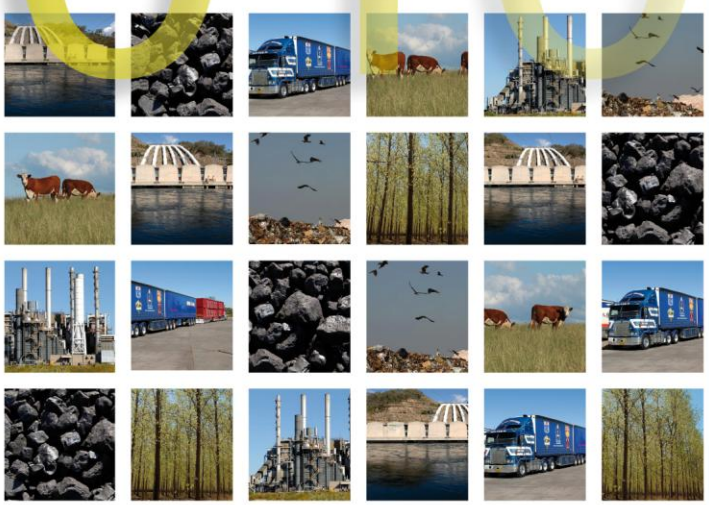
Australian Government
Department of Climate Change
and Energy Efficiency

# Australia's emissions projections

2010



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December 2010

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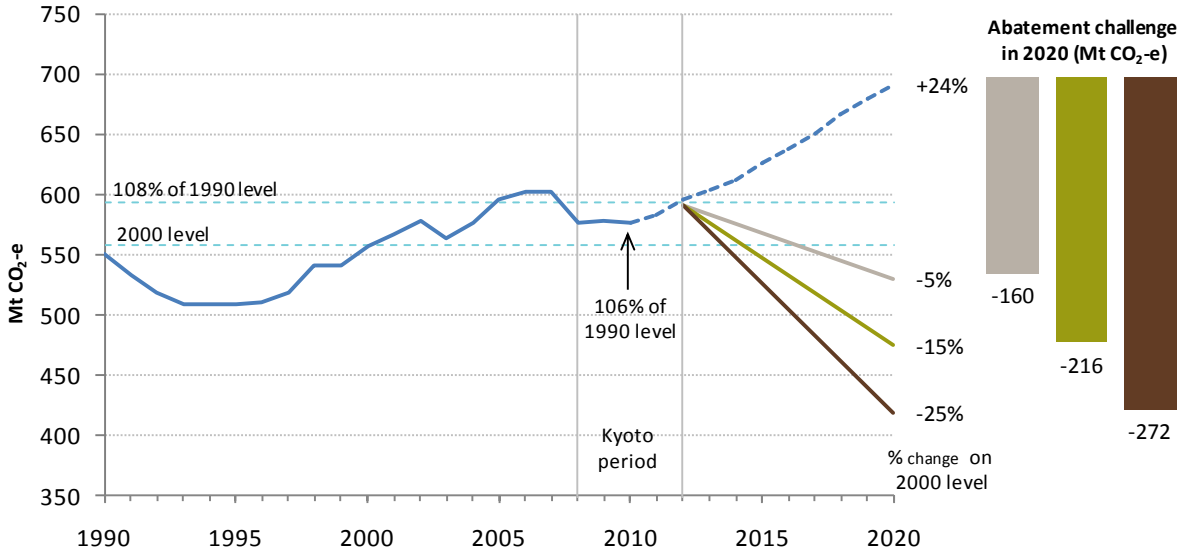
## Key points

- Australia remains on track to meet its Kyoto protocol target of limiting emissions to 108 per cent of 1990 levels. These projections show Australia's emissions are likely to average 582 Mt $CO_2$-e per year over the Kyoto period (2008–12) which is 106 per cent of 1990 levels.
- In the absence of further policy action, strong growth in emissions is projected between now and 2020. This is primarily the result of strong demand for Australia's energy exports, in particular, coal and liquefied natural gas. Emissions are projected to reach 690 Mt $CO_2$-e in 2020, or 24 per cent above 2000 levels.
- The level of projected emissions in 2020 represents the starting point for Australia's 'abatement challenge': the amount of abatement required from additional policies to achieve our national emissions targets in 2020.
  - Based on these projections, Australia requires additional abatement of between 160 Mt $CO_2$-e and 272 Mt $CO_2$-e in 2020, depending on the target.
- These projections are made on the basis of current policies and measures in place to reduce emissions. Therefore, they estimate Australia's emissions in the absence of a carbon price.
  - The Australian Government has reiterated its intention to introduce a carbon price in Australia to reduce emissions and meet the 2020 target. These projections will be updated as domestic and international climate change policies evolve.

Figure 1 Australia's emissions trends, 1990 to 2020




Note: Trajectories to the 2020 target range are illustrative, they begin in 2011-12 at 108 per cent of 1990 levels (consistent with Australia's Kyoto Protocol first commitment period target) and assume a straight line reduction to the target.

# Introduction

Australia releases official projections of its greenhouse gas emissions annually. The previous projections were released as part of Australia's *Fifth National Communication on Climate Change*, a report under the United Nations Framework Convention on Climate Change (referred to as the 2009 projections).

The 2010 projections provide a full update of Australia's emissions projections including:

- A projection of baseline emissions for the Kyoto Protocol first commitment period (2008–12) and to 2020[1]. This provides the basis for estimating the 'abatement challenge' Australia faces in meeting its 2020 targets.
- An indicative projection of Australia's emissions out to 2030.

These projections are based on:

- Historical emissions data from *Australia's National Greenhouse Accounts: National Greenhouse Gas Inventory*, released in May 2010 and *Quarterly Update of Australia's National Greenhouse Gas Inventory, June Quarter 2010* released in November 2010.
- Economic and population forecasts consistent with the *Pre-Election Economic and Fiscal Outlook (PEFO) 2010*, released in July 2010 and the *Intergenerational Report 2010*, released in March 2010 (see key assumptions, page 26).

These projections have been developed on the basis of current policies in place, including, where possible, the effects of policies and measures announced since the last projection. Hence they illustrate expectations of Australia's emissions in the absence of a domestic carbon price.

The Australian Government has reiterated its intention to introduce a carbon price in Australia to reduce emissions and meet its 2020 targets. These projections assume current levels of global policy action on climate change (see Box 1). Consistent with the domestic policy assumptions, they do not include additional global action, such as the Copenhagen Accord pledges. The projections will be updated as domestic and international climate change policies evolve.

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 2030 projection should be considered indicative as the projection of underlying variables is less robust beyond 2020.

[1] All years in this publication are Australian financial years, ending on 30 June of the year quoted.

Further details on each sectoral projection including abatement from policies and measures are provided in a set of technical papers published on the Department's website www.climatechange.gov.au

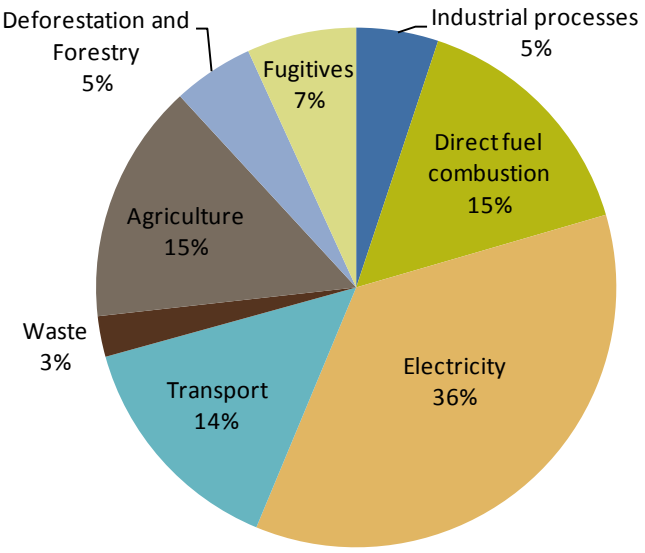
## Recent trends – National Greenhouse Gas Inventory

Based on the latest National Greenhouse Gas Inventory (NGGI June Qtr 2010) the electricity subsector is the largest source of greenhouse gas emissions in Australia, accounting for 36 per cent of total emissions. The direct fuel combustion and agriculture sectors each contributed around 15 per cent to total emissions in 2009, with transport the next biggest at 14 per cent of total emissions.

Recent trends in the NGGI show that Australia's total emissions have been relatively stable from 2007 to 2010, with many sectors experiencing low levels of growth due to the impact of the global financial crisis on industrial production and the demand for electricity. In addition, drought conditions over the same period have caused a decline in emissions from the agriculture sector.

In the June quarter of 2010, Australia experienced reduced trend emissions growth as a result of changes in the fuel mix of electricity generation including a surge in hydroelectricity generation in the National Electricity Market (NEM) (an increase of 33 per cent on the previous quarter) reflecting recent good rainfall. Marked decreases also occurred in electricity generation from black and brown coal, resulting in the lowest quarterly levels of coal-based electricity generation in the NEM since 2003. Even though hydroelectricity is back to full capacity, emissions are forecast to increase through the projection period. This is the result of the expected recovery in industrial production and increase in electricity demand in line with GDP growth.

Figure 2 National Greenhouse Gas Inventory, 2009



# Projections results

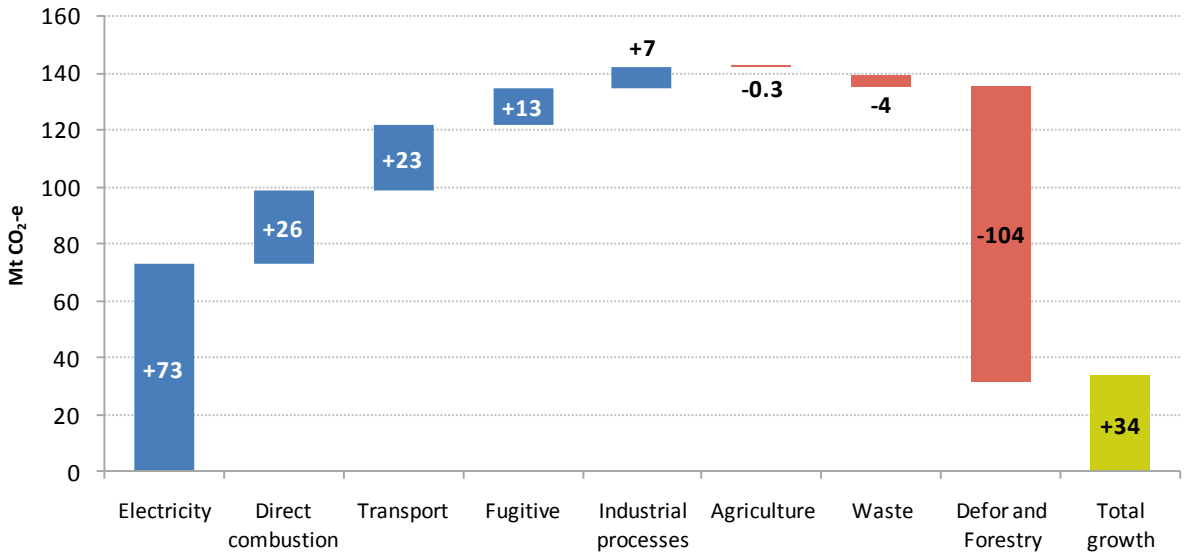
## Kyoto period (2008–12)

Australia remains on track to meet its Kyoto Protocol target of limiting emissions to 108 per cent of 1990 levels. Australia's emissions are projected to average 582 Mt $CO_2$-e per year over 2008–12, which is 106 per cent of 1990 levels.

Australia's total emissions are expected to grow by 34 Mt $CO_2$-e between 1990 and the Kyoto period 2008–12[2]. The major source of growth over this period is the energy sector, driven by Australia's relatively high rates of economic growth and international demand for Australia's resources. The electricity subsector dominates the growth in emissions over this period and is projected to increase by 73 Mt $CO_2$-e, or 57 per cent. Direct combustion of fuels and the transport sector also contribute to growth over the period.

A substantial decrease has occurred in deforestation emissions since 1990 due to reduced land clearing. Emissions from deforestation are projected to drop from 132 Mt $CO_2$-e in 1990 to 49 Mt $CO_2$-e by 2008–12, a reduction of 83 Mt $CO_2$-e or 63 per cent. In addition, Australia is able to offset growth in other emissions sources through 21 Mt $CO_2$-e of sequestration resulting from large scale establishment of new forest plantations since 1990.

Figure 3 Sectoral emissions growth 1990 to Kyoto period 2008–12




At the aggregate level, the Kyoto period 2008–12 projection is substantially unchanged from the previous projection (0.2 Mt $CO_2$-e higher). However, this is a result of offsetting sectoral revisions.

[2] The Kyoto period estimates refer to the average of emissions over the five years of the first commitment period of the Kyoto Protocol, 2007-08 to 2011-12.

The coal fugitives and transport sectors have each been revised upwards by 3 Mt $CO_2$-e on average over the Kyoto period. This is a result of an upward revision to the coal production forecast and the incorporation of new mine-specific emissions factors. The transport revision is due to a partial reallocation of diesel fuel from the direct fuel combustion (mining) subsector into the transport sector.

All other sectors have been revised down since the previous projection, with the largest negative revision occurring in the agriculture sector (3 Mt $CO_2$-e), due to a slower recovery from the drought than previously projected. See Table 5 for further analysis on the changes from the previous projection.

Table 1 Emissions, 1990 to 2020

| | 1990 | 2000 | Kyoto period average 2008-12 | | 2020 | |
|---|---|---|---|---|---|---|
| | Mt $CO_2$-e | Mt $CO_2$-e | Mt $CO_2$-e | Increase on 1990 (%) | Mt $CO_2$-e | Increase on 2000 (%) |
| Energy | 286 | 361 | 421 | 47% | 498 | 38% |
| *Stationary* | *195* | *251* | *294* | *51%* | *332* | *33%* |
| *Transport* | *62* | *75* | *85* | *37%* | *97* | *29%* |
| *Fugitive* | *29* | *35* | *43* | *46%* | *69* | *97%* |
| Industrial processes | 24 | 26 | 31 | 29% | 40 | 56% |
| Agriculture | 87 | 94 | 86 | -0.4% | 94 | -0.2% |
| Waste | 19 | 15 | 15 | -21% | 16 | 5% |
| Deforestation and forestry | 132 | 62 | 28 | -79% | 42 | -32% |
| *Deforestation* | *132* | *72* | *49* | *-63%* | *49* | *-33%* |
| *Forestry* | *0* | *-11* | *-21* | *n/a* | *-7* | *-36%* |
| **Total** | **548** | **558** | **582** | **6%** | **690** | **24%** |

The total impact of policies and measures has been estimated at 56 Mt $CO_2$-e on average per year over the Kyoto period. By 2020, it is projected that abatement from these measures would have increased to 109 Mt $CO_2$-e. The Renewable Energy Target and energy efficiency measures are the main contributors to Australia's abatement efforts. See Table 4 for a full breakdown of abatement estimates for policies and measures.

## 2020

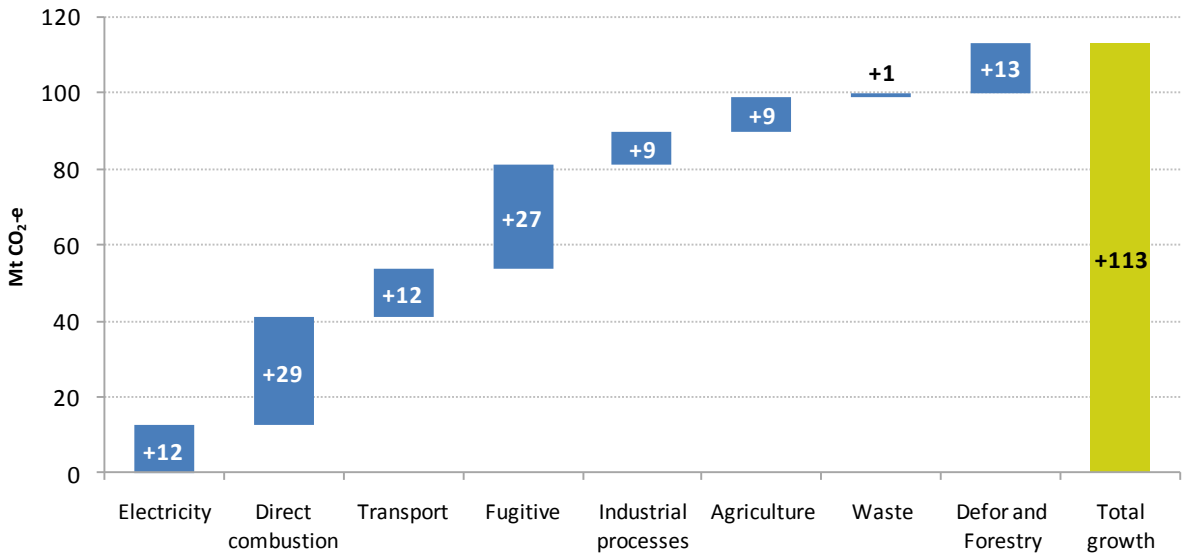
Without further policy action, Australia's emissions are projected to continue to increase. In 2020, emissions are projected to reach 690 Mt $CO_2$-e, or 24 per cent above 2000 levels.

The projected trend growth in emissions is above historical growth patterns. In aggregate, emissions are projected to increase by 1.8 per cent per year between 2010 and 2020; much

stronger than average growth of 0.4 per cent per year in the previous decade. This is largely because increases in emissions from 2000 to 2010 were partially offset by reductions in emissions from deforestation and increases in sequestration from the forestry sector. In the projection period, no further reductions or sequestration in these areas are assumed, with emissions growth forecast to align more closely with trend growth in emissions excluding deforestation and forestry (see Figure 5).

Growth to 2020 is dominated by emissions associated with the extraction and processing of energy resources driven by strong export demand. Fugitive emissions from coal mines and oil and gas projects, as well as direct fuel combustion emissions from LNG projects, account for almost half of the growth in Australia's total emissions from 2010 to 2020.

Figure 4 Sectoral emissions growth 2010 to 2020




While in previous decades, emissions from electricity generation have accounted for the majority of growth in emissions, from 2010 to 2020 they are projected to increase by only 6 per cent (or 12 Mt $CO_2$-e), much lower than the historical growth rate. This is primarily due to the increased electricity generated by renewable technologies, promoted by the Renewable Energy Target.

## Targets

The Australian Government is committed to reducing Australia's carbon pollution. The Government has set emissions reduction targets of 5 to 15 per cent, or 25 per cent below 2000 levels by 2020. The Government has committed to an unconditional 5 per cent reduction on 2000 levels by 2020; up to 15 per cent reductions in the context of an international agreement where major economies agree to substantially restrain carbon pollution and advanced economies take on reductions comparable to Australia; and by 25 per cent, under strict conditions including global action capable of stabilising greenhouse gases at 450 parts per million or lower.

On 27 January 2010, Australia formally submitted these 2020 targets under the Copenhagen Accord. Meeting these targets will require strong and concerted action on multiple fronts.

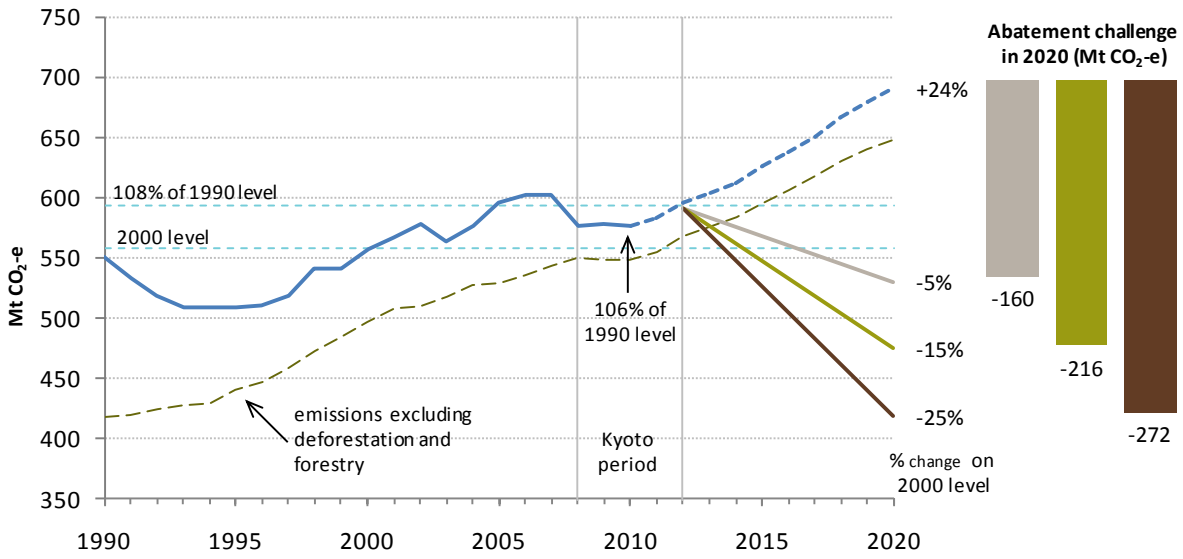
These updated projections represent the starting point for Australia's 'abatement challenge': the amount of abatement that additional policies need to generate to achieve our national emissions targets in 2020.

- To achieve the 5 per cent reduction target (against 2000 levels) Australia would need to reduce emissions by an additional 160 Mt $CO_2$-e in 2020. To achieve the 15 per cent reduction target, Australia would need to reduce emissions by an additional 216 Mt $CO_2$-e in 2020. To achieve the 25 per cent reduction target, Australia would need to reduce emissions by an additional 272 Mt $CO_2$-e.

Table 2 The abatement challenge in 2020

| | 2000 | 2020 | Abatement challenge | % reduction from baseline |
|---|---|---|---|---|
| | Mt $CO_2$-e | Mt $CO_2$-e | Mt $CO_2$-e | % |
| Baseline emissions | 558 | 690 | | |
| *-5% target* | | 530 | 160 | 23 |
| *-15% target* | | 474 | 216 | 31 |
| *-25% target* | | 418 | 272 | 39 |

Figure 5 Baseline sector emissions trends, 1990 to 2020




Note: Trajectories to the 2020 target range are illustrative, they begin in 2011-12 at 108 per cent of 1990 levels (consistent with Australia's Kyoto Protocol first commitment period target) and assume a straight line reduction to the target.

### Box 1: The sensitivity of Australia's emissions to assumptions about international action on climate change

A key uncertainty of this update of projections is global demand for Australia's energy exports, such as LNG and coal. Demand is strongly influenced by assumptions about global conditions, in particular global action on climate change.

While we have not tried to quantify these effects in this exercise, it is likely that projected emissions for Australia would be lower in a world of stronger action on climate change than projected here.

These projections incorporate only currently implemented global climate change measures. This is consistent with our domestic policy assumptions of including only currently implemented Australian policies and measures to address climate change. Therefore, these projections illustrate the most likely projection of Australian emissions given current levels of policy action, both domestically and internationally.

However, important international policy advances have been made recently, including national pledges under the Copenhagen Accord and the Cancun Agreements to reduce emissions. While there is some uncertainty around the mechanisms countries may adopt to meet these commitments, achievement of these pledges will influence Australia's emissions.

The International Energy Agency's *World Energy Outlook 2010* states that under the New Policies scenario (where there is cautious implementation of Copenhagen Accord pledges[a]), world energy demand would grow more slowly (1.2 per cent p.a.) than under the Current Policies scenario (1.4 per cent p.a.). Hence global demand for Australia's energy exports is likely to be lower under a scenario with greater international action than the baseline scenario presented here.

Modelling undertaken by the Treasury in *Australia's Low Pollution Future* (2008) showed that given action on climate change by other countries, the output of some of Australia's export industries would grow more slowly than in the case of no action, as world demand slows and consumers substitute towards lower emissions commodities.

In particular, global demand for Australia's coal would be expected to grow more slowly, meaning that fugitive emissions from coal mining would be lower. Global demand for other emissions intensive export commodities may also grow more slowly, leading to slower growth in electricity consumption or the direct use of fossil fuels in resource processing and manufacturing processes.

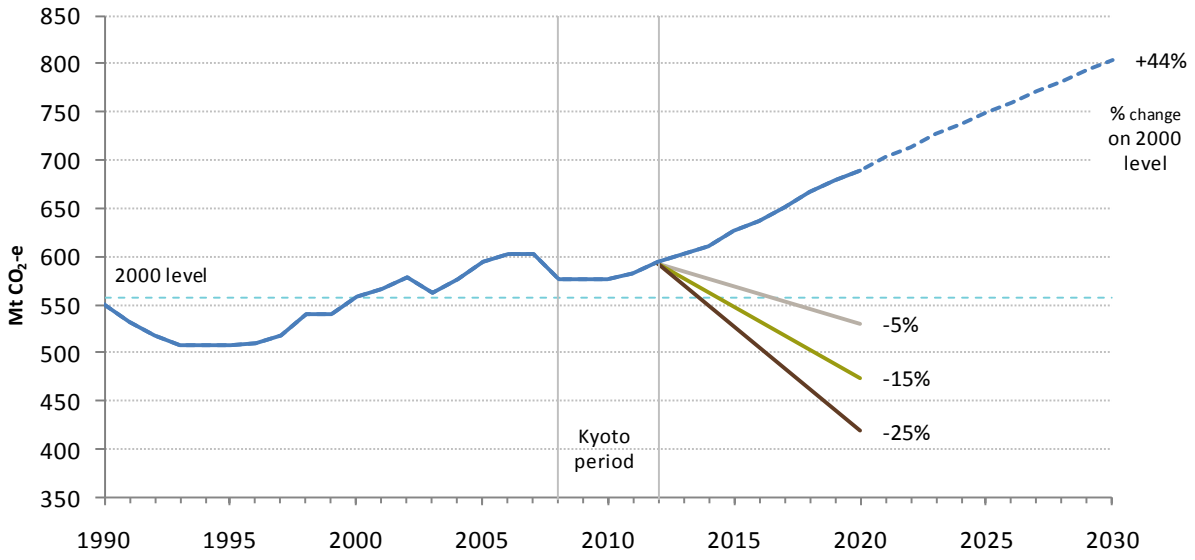
However, global demand for gas is projected to increase as countries shift to less emissions intensive fuels. This may lead to an increase in emissions from the extraction of gas for export. Similarly, Australia's transport emissions could increase, as a result of lower global oil demand and hence lower oil prices than would otherwise be the case.

[a] Includes cautious low end Accord pledges, but does not assume these are fully implemented in countries "where uncertainty about climate policy is very high".

## 2030

Projected emissions trends to 2030 show that, without further policy action, Australia's emissions will continue to increase. Emissions in 2030 are projected to reach 803 Mt $CO_2$-e, or 44 per cent above 2000 levels. The projection to 2030 is considered indicative as there is greater uncertainty surrounding sectoral trends after 2020.

Figure 6 Baseline sector emissions trends, 1990 to 2030




Emissions trends from 2020 to 2030 are forecast to differ markedly from those of the decade 2010 to 2020. Unlike 2010 to 2020, more than half of the growth is projected to come from the stationary energy sector. In the absence of further policy intervention, there is a projected shift back to fossil fuel electricity generation after the Large-scale Renewable Energy Target peaks in 2020.

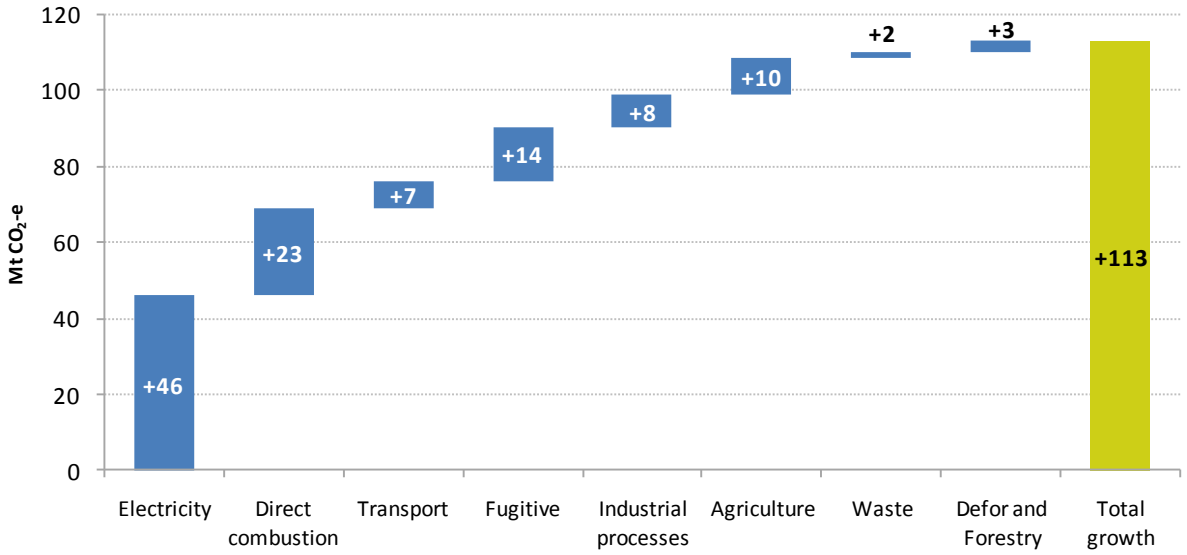
In contrast, the transport sector is projected to experience slower growth from 2020 to 2030 than in the 10 years to 2020. This is due to faster improvements in the fuel efficiency of the passenger car fleet as a result of the increased uptake of hybrid vehicles.

The fugitives and direct combustion sectors continue to contribute to growth although not as strongly as in the 10 years to 2020. This is due to greater uncertainty and lower global demand for Australia's energy exports after 2020.

## Table 3 Emissions, 1990 to 2030

| | 1990 | 2009 | Kyoto period average | 2020 | 2030 |
|---|---|---|---|---|---|
| | Mt $CO_2$-e | Mt $CO_2$-e | Mt $CO_2$-e | Mt $CO_2$-e | Mt $CO_2$-e |
| Energy | 286 | 418 | 421 | 498 | 589 |
| *Stationary* | *195* | *295* | *294* | *332* | *402* |
| *Transport* | *62* | *83* | *85* | *97* | *104* |
| *Fugitive* | *29* | *39* | *43* | *69* | *83* |
| Industrial processes | 24 | 29 | 31 | 40 | 48 |
| Agriculture | 87 | 86 | 86 | 94 | 104 |
| Waste | 19 | 15 | 15 | 16 | 18 |
| Deforestation and forestry | 132 | 29 | 28 | 42 | 45 |
| *Deforestation* | *132* | *50* | *49* | *49* | *49* |
| *Forestry* | *0* | *-21* | *-21* | *-7* | *-4* |
| **Total** | **548** | **577** | **582** | **690** | **803** |

## Figure 7 Sectoral emissions growth from 2020 to 2030




The following section presents the emissions projections for each sector in more detail. Further sectoral information can be found in the accompanying technical sectoral emissions projections papers on the Department's website www.climatechange.gov.au.

## Energy

***Energy*** **emissions (consisting of the stationary energy, transport and fugitive sectors) are projected to reach 421 Mt $CO_2$-e per year over the Kyoto period, an increase of 47 per cent above the 1990 level, after the effects of current greenhouse measures are taken into account. In 2020, emissions are projected to reach 498 Mt $CO_2$-e. The indicative projection to 2030 indicates emissions are expected to reach 589 Mt $CO_2$-e.**

## Stationary energy

The stationary energy sector is the largest emissions sector. In 2009 it represented 51 per cent of Australia's total greenhouse gas emissions and at 295 Mt $CO_2$-e, emissions were 51 per cent above 1990 emissions of 195 Mt $CO_2$-e.

The stationary energy sector includes emissions from electricity generation and the direct combustion of fuels (fuels consumed directly in the manufacturing, mining, construction and commercial sectors and other sources such as domestic heating and cooking).

Key drivers influencing emissions growth from stationary energy include the structure and growth of Australia's economy, the demand for Australia's exports, the fuel mix used in electricity generation and energy efficiency improvements across the economy. These factors affect the demand for electricity and its emissions intensity, as well as the demand for fuel for direct combustion.

***Stationary energy*** **emissions are projected to reach 294 Mt $CO_2$-e per year over the Kyoto period, an increase of 51 per cent above the 1990 level, after the effects of current greenhouse measures are taken into account. In 2020, stationary energy emissions are projected to reach 332 Mt $CO_2$-e. The indicative projection to 2030 indicates emissions are expected to reach 402 Mt $CO_2$-e.**

Stationary energy emissions are projected to increase by 14 per cent between 2010 and 2020, mainly as a result of increased emissions from direct fuel combustion.

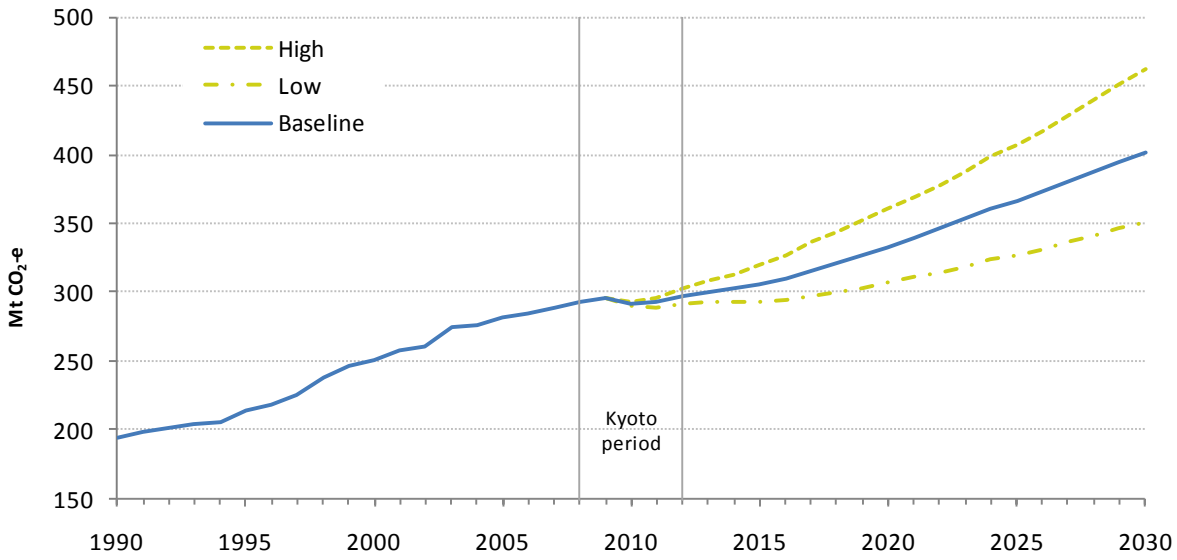
- Emissions from direct fuel combustion are projected to increase by 32 per cent between 2010 and 2020 driven largely by strong economic growth and increased export demand for Australia's mineral and energy resources.
- In contrast, emissions from electricity generation are projected to grow by 6 per cent between 2010 and 2020, much slower than historical rates (15 per cent between 2000 and 2010). Both the Renewable Energy Target and energy efficiency measures are forecast to contribute to slower demand growth and lower emissions intensity of electricity generation over this period.

Over the Kyoto period, annual emissions from stationary energy are projected to average 1 Mt $CO_2$-e lower than the previous projection. Projected emissions from the sector in 2020 have been revised up by 11 Mt $CO_2$-e.

- Emissions from electricity generation are projected to average 2 Mt $CO_2$-e more per year over the Kyoto period than in the previous estimate. Average annual emissions from direct fuel combustion have been revised down by 3 Mt $CO_2$-e over the Kyoto period as a result of a technical reallocation of some emissions to the transport sector.
- In 2020, electricity emissions are projected to be 2 Mt $CO_2$-e higher compared with the previous projection. Direct combustion emissions have been revised up by 9 Mt $CO_2$-e in 2020, mainly as a result of higher gas consumption for LNG production. Updated modelling has enabled the stationary energy projection to incorporate detailed LNG production forecasts used to develop the oil and gas fugitive emissions projection. The inclusion of this information has led to increases in emissions from stationary energy.

The impact of emissions abatement measures in the stationary energy sector is estimated to be 26 Mt $CO_2$-e per year over the Kyoto period, increasing to 85 Mt $CO_2$-e in 2020. Major emissions abatement measures in the Stationary Energy sector include the Large-scale Renewable Energy Target and the Small-scale Renewable Energy Scheme, energy efficiency measures and other State and Local Government measures.

Figure 8 Stationary energy emissions projection



## Transport

In 2009 the transport sector represented 14 per cent of Australia's total greenhouse gas emissions and at 83 Mt $CO_2$-e, emissions were 34 per cent above 1990 emissions of 62 Mt $CO_2$-e.

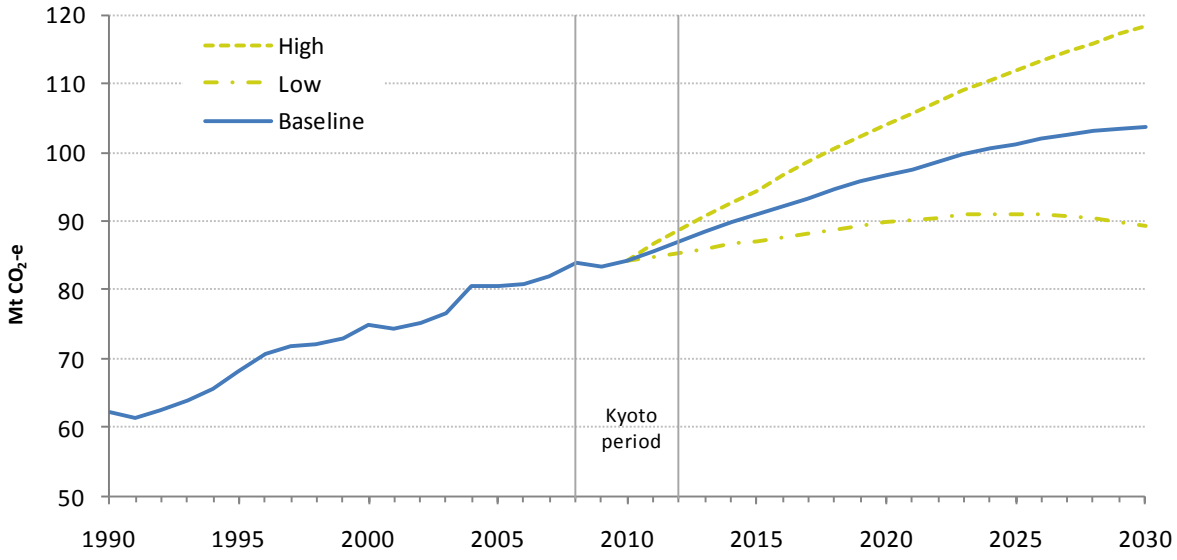
The transport sector covers emissions from the direct combustion (or end-use emissions) of fuels by road, rail, domestic aviation and domestic shipping. Road transport is by far the largest source of emissions in this sector, contributing 86 per cent of transport emissions in 2009.

Transport sector emissions are driven primarily by economic activity, population growth and oil prices. Other significant factors include improvements in vehicle technology, such as fuel efficiency and design standards; changes in the travel behaviour of individuals in response to trends in personal incomes; and the impact of greenhouse gas abatement measures introduced by governments.

***Transport* emissions are projected to reach 85 Mt $CO_2$-e per year over the Kyoto period, an increase of 37 per cent above the 1990 level, after the effects of current greenhouse measures are taken into account. In 2020, emissions are projected to reach 97 Mt $CO_2$-e. The indicative projection to 2030 indicates emissions are expected to reach 104 Mt $CO_2$-e.**

Transport emissions are projected to increase by 15 per cent between 2010 and 2020. This increase is driven primarily by population and income growth for passenger travel and economic growth for freight transport. The magnitude of this increase is partially suppressed by forecast efficiency improvements in the passenger car fleet, as consumers shift to smaller cars, use more diesel fuel and increase the use of hybrid cars.

Figure 9 Transport emissions projection



## Fugitives

In 2009 the fugitives sector represented 7 per cent of Australia's total greenhouse gas emissions and at 39 Mt $CO_2$-e, emissions were 35 per cent above 1990 emissions of 29 Mt $CO_2$-e.

Fugitive emissions from fuels (the fugitives sector) are a subsector of the energy sector covering emissions that are associated with the production, processing, transport, storage, transmission and distribution of fossil fuels such as black coal, oil and natural gas. Emissions from decommissioned ("abandoned") underground coal mines are also included. The fugitives sector does not include the emissions arising from the combustion of these fuels, these emissions are accounted for under the stationary energy and transport sectors.

The two key components of the fugitives sector are emissions from coal mines and from major oil and gas projects. Fugitive emissions are determined in part by the level of total production of coal, oil and natural gas, but more importantly by the emissions intensity of that production.

***Fugitive* emissions are projected to reach 43 Mt $CO_2$-e per year over the Kyoto period, an increase of 46 per cent above the 1990 level, after the effects of current greenhouse measures are taken into account. In 2020, emissions are projected to reach 69 Mt $CO_2$-e. The indicative projection to 2030 indicates emissions are expected to reach 83 Mt $CO_2$-e.**

The strong increase in fugitive emissions to 2020 is due to significant export demand for Australia's energy resources, which is forecast to drive development of new coal mines and oil and gas fields.

- Emissions from the fugitives sector have been revised up by 9 Mt $CO_2$-e in 2020 when compared to the previous projection. This is primarily a result of revisions to forecast coal production and the incorporation of mine-specific emissions factors into the projection.
- The key uncertainty in the fugitives projection is the continued strong demand for Australia's energy exports. International policy settings affect Australian coal production because of the high proportion of coal that is exported.
- Global action on climate change consistent with the Copenhagen Accord pledges would result in demand for Australia's coal being lower than these projections assume. See Box 1 for further discussion on the global assumptions used in these projections.

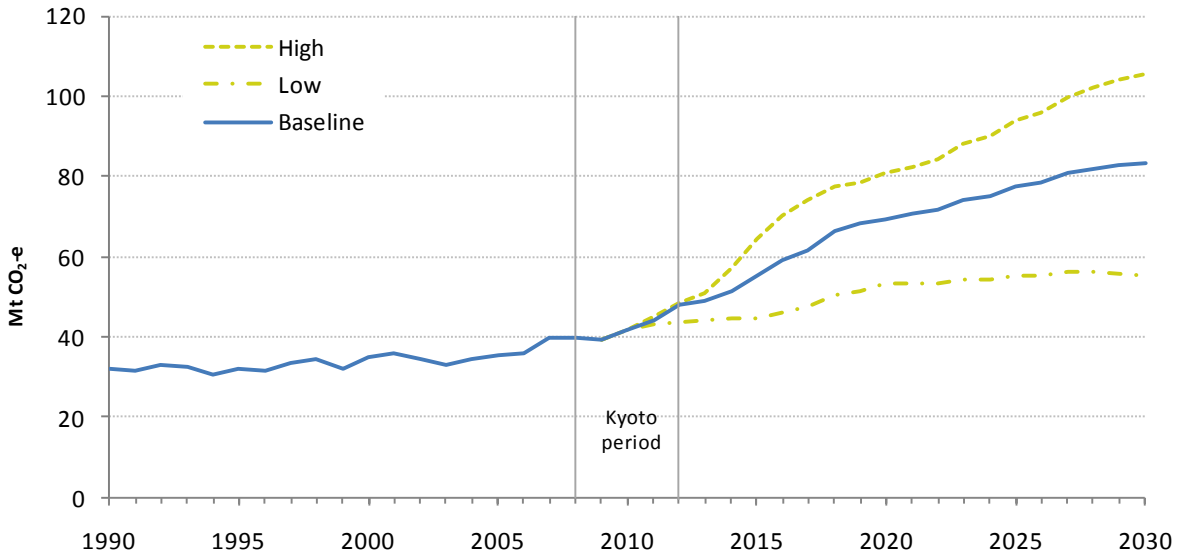
World coal prices are expected to remain above current long-term averages as a result of high global coal demand. Consequently, it is considered new projects currently in the planning stages are more likely to go ahead than not. Nevertheless, if average prices are lower than around $70 per tonne for thermal coal and $100 for metallurgical coal, coal production would be expected to be significantly lower than the current projection. In that case, emissions would similarly be lower.

Figure 10 illustrates high and low sensitivities for the fugitives sector.

The low sensitivity is based on the IEA's *World Energy Outlook 2010* projection of Australia's coal production in the New Policies scenario. This is consistent with an expectation that world coal prices would fall if global action on climate change was sufficient to meet commitments made in the Copenhagen Accord.

The high scenario assumes Australia's coal production grows more rapidly than currently expected. This is consistent with an expectation that Australia would produce more coal if global economic growth and coal prices were higher than assumed here.

Figure 10 Fugitive emissions projection



# Industrial processes

In 2009 the industrial processes sector represented 5 per cent of Australia's total greenhouse gas emissions and at 29 Mt $CO_2$-e, emissions were 22 per cent above 1990 emissions of 24 Mt $CO_2$-e.

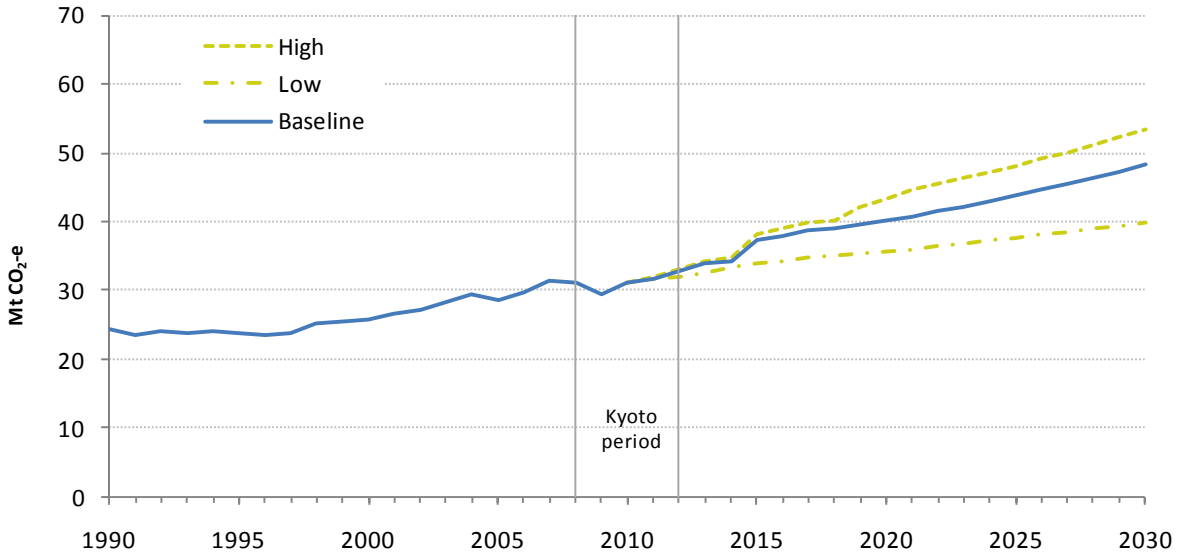
Emissions from industrial processes are the by-products of materials and reactions used in production processes. The emissions arise from non-energy related sources. They include emissions from mineral products (such as cement production), metal production, chemical production, and consumption of HFCs and $SF_6$ gases.

Production levels largely influence annual fluctuations in emissions. Over time, technological change in production processes can have a significant impact on emissions from this sector.

**Emissions from *industrial processes* are projected to reach 31 Mt $CO_2$-e per year over the Kyoto period, an increase of 29 per cent above the 1990 level, after the effects of current greenhouse measures are taken into account. In 2020, emissions are projected to reach 40 Mt $CO_2$-e. The indicative projection to 2030 suggests emissions will reach 48 Mt $CO_2$-e.**

Metal production is the largest subsector within industrial processes, with emissions projected to increase by around 4 Mt $CO_2$-e between 2009 and 2020. The chemical industry is the fastest growing subsector. Following a decline in 2010, emissions are projected to grow around 5 per cent per year between 2010 and 2020, an increase of around 4 Mt $CO_2$-e.

Figure 11 Industrial processes emissions projection



## Agriculture

In 2009 the agriculture sector represented 15 per cent of Australia's total greenhouse gas emissions and at 86 Mt $CO_2$-e, emissions were around 0.7 per cent below 1990 emissions of 87 Mt $CO_2$-e.

Agriculture sector emissions mostly comprise methane and nitrous oxide from enteric fermentation in livestock, manure management, rice cultivation, agricultural soils, savanna burning and field burning of agricultural residues.

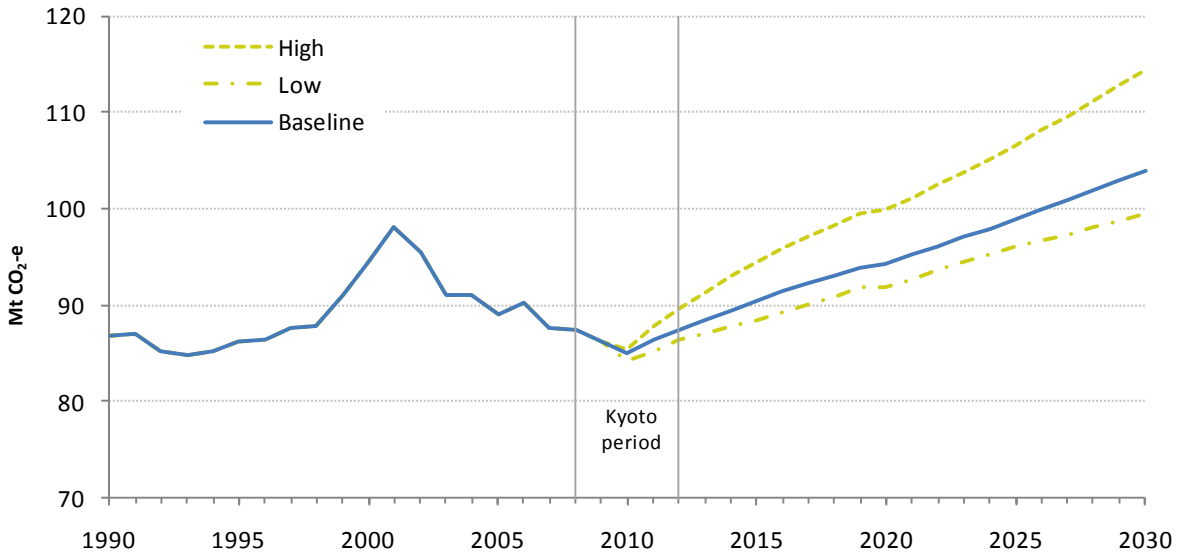
The key drivers impacting on agricultural emissions projections are the size of the livestock herd, which is strongly driven by export demand and climate conditions.

***Agriculture*** **emissions are projected to reach 86 Mt $CO_2$-e per year over the Kyoto period, 0.4 per cent below the 1990 level. In 2020, emissions are projected to reach 94 Mt $CO_2$-e. The indicative projection to 2030 indicates emissions are expected to reach 104 Mt $CO_2$-e.**

The trend decline in agriculture emissions from 2000 to the Kyoto period is a result of prolonged drought conditions over extensive areas of Australia, which led to a decline in animal populations, causing a corresponding decline in emissions from livestock.

Water availability is a key element in projecting agriculture activity and emissions in Australia. Following the breaking of the drought in southern and eastern Australia in 2010, animal flocks and herds are expected to increase in the coming years, rebuilding after recent lows. Emissions from all subsectors of agriculture are projected to increase to 2020, with the exception of savannah burning, which is expected to be fairly stable at long-term average levels.

Figure 12 Agriculture emissions projection



## Waste

In 2009 the waste sector represented 3 per cent of Australia's total greenhouse gas emissions and at 15 Mt $CO_2$-e, emissions were 22 per cent below 1990 emissions of 19 Mt $CO_2$-e.

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

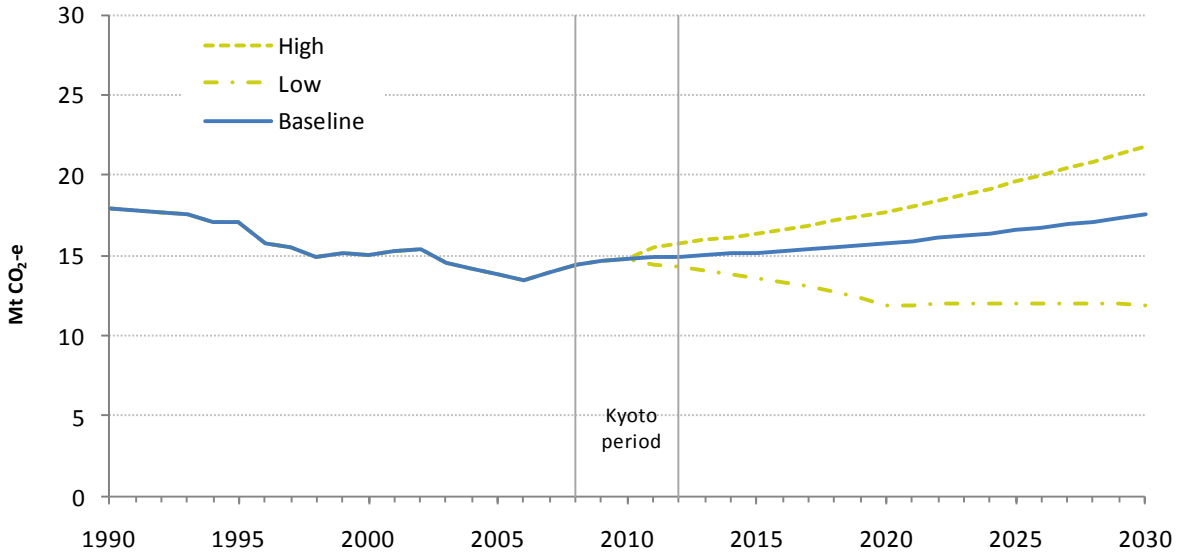
The main factors influencing projected emissions from the solid waste subsector are population growth, the amount of waste produced per person, waste diversion rates and methane capture rates. The main factors in the wastewater subsector are population growth and methane capture rates.

***Waste* emissions are projected to reach 15 Mt $CO_2$-e per year over the Kyoto period, a decrease of 21 per cent from the 1990 level, after the effects of current greenhouse measures are taken into account. Emissions are projected to reach 16 Mt $CO_2$-e in 2020 and 18 Mt $CO_2$-e in 2030.**

The historical decline in waste emissions reflects the fact that potential emissions from waste generated have been offset by increasing diversion of waste through recycling and increasing rates of methane recovery in the sector.

Waste emissions are projected to increase slightly to 2020, reflecting increased waste generation which is primarily driven by population growth. Future emissions trends in the waste sector are dependent on future policies, such as the National Waste Policy, which is yet to be finalised and has not been incorporated into these projections.

Figure 13 Waste emissions projection



## Deforestation

In 2009 the deforestation sector represented around 9 per cent of Australia's total greenhouse gas emissions and at 50 Mt $CO_2$-e, emissions were 62 per cent below 1990 emissions of 132 Mt $CO_2$-e.

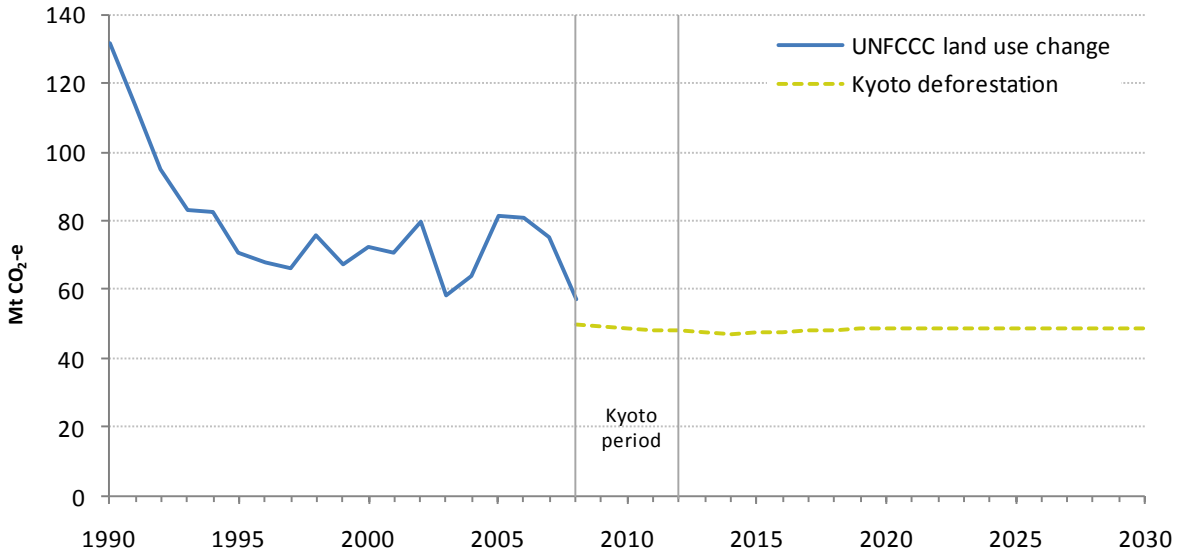
Deforestation is the direct, human-induced removal of forest cover and replacement with pasture, crops or other uses on land that was forest on 1 January 1990. Emissions result from burning of removed forest cover, decay of unburnt cleared vegetation, and emissions from soil disturbed in the process of land clearing. Annual rates of deforestation have decreased substantially since 1990 with consequent reductions in estimated emissions.

Emissions from deforestation are influenced by the area of forest cover removal and the method of forest conversion and land development, and rely on estimates of the amount of carbon sequestered in biomass and soils, which differ by type, geography and climate.

***Deforestation*** **emissions are projected to reach 49 Mt $CO_2$-e per year over the Kyoto period, a decrease of 63 per cent from the 1990 level, after the effects of current greenhouse measures are taken into account. By 2020 and 2030, emissions are projected to remain at around 49 Mt $CO_2$-e, as there are no further declines in clearing projected.**

The Governments of Queensland and New South Wales have introduced legislation to limit the amount of land clearing in those states. For the Kyoto period, the combined effect of this legislation to reduce emissions is estimated to be 18 Mt $CO_2$-e per year.

Figure 14 Deforestation emissions projection




Note: Deforestation emissions under Kyoto accounting rules can only be calculated for the Kyoto period. UNFCCC reporting for land use change is presented in the chart to provide a historical time-series, although they are not strictly comparable. Unlike UNFCCC reporting, Kyoto accounting rules for deforestation include only deforestation of land that was forested in 1990.

## Forestry

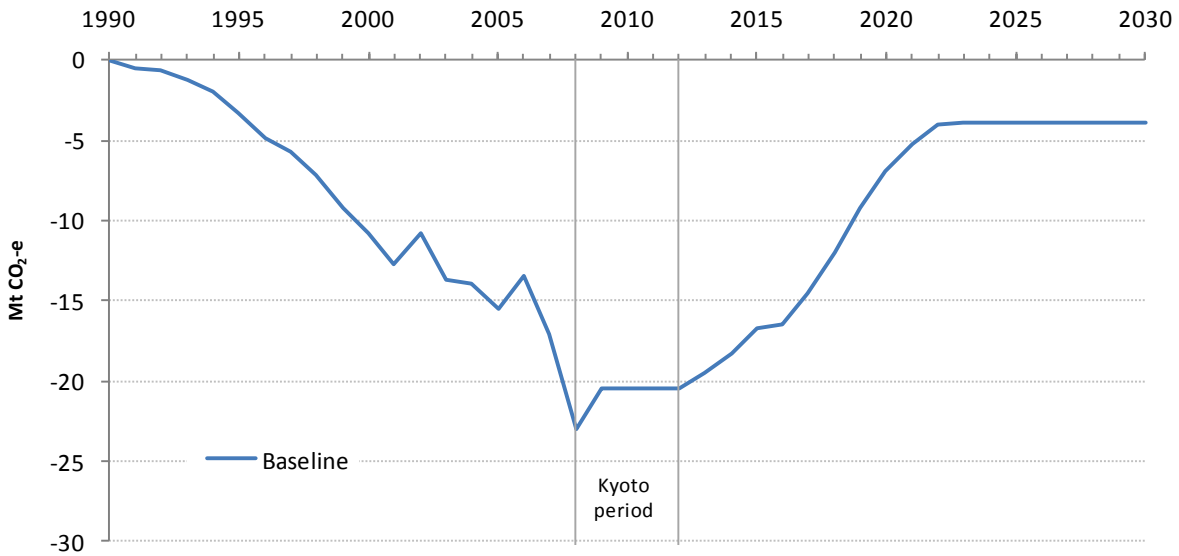
In 2009 the forestry sector contributed 21 Mt $CO_2$-e of sequestration to reduce Australia's net emissions. The forestry sector, under Kyoto accounting rules, covers new forests established by direct human action on land not forested in 1990. No forestry sinks are included in the 1990 baseline, and only *afforestation* and *reforestation* occurring since 1 January 1990 is credited.

Sequestration from commercial forestry and environmental plantings is dependent on the area of the forestry estate, the contribution of forest growth in each year and the rate of harvesting. In all cases, projections rely on estimates of the amount of carbon sequestered in biomass, which differ by tree species and for different climatic and geographical conditions.

**Sequestration over the Kyoto period 2008–12 with the application of the Kyoto Protocol harvest sub-rule[3] are projected to be 21 Mt $CO_2$-e per year. Without the sub-rule in 2020, sequestration is projected to reach 7 Mt $CO_2$-e. Indicative projection to 2030 shows sequestration is projected to be in the order of 4 Mt $CO_2$-e.**

For the purposes of this projection, it is assumed that the harvest sub-rule finishes at the end of the first commitment period, as the rules for any post-2012 period are currently the subject of international negotiation.

Figure 15 Forestry emissions projection




[3] The Kyoto Protocol harvest sub-rule (paragraph 4 of the Annex to Decision 16/CMP.1) states "debits resulting from harvesting during the first commitment period following afforestation and reforestation since 1990 shall not be greater than credits accounted for on that unit of land".

## Taking action to reduce Australia's emissions

Australia's domestic action to reduce emissions from business-as-usual levels encompasses a wide range of measures across all sectors and sources of greenhouse gas emissions. These measures are projected to deliver greenhouse gas emissions abatement of 56 Mt $CO_2$-e per year over the Kyoto period and 109 Mt $CO_2$-e in 2020.

More than 30 policies and measures have been estimated in this projections update. Only a selection of measures is presented here. See each sectoral paper for a full list of policies and measures.

The largest abatement measures include:

- Renewable Energy Target, including the Small-scale Renewable Energy Scheme (SRES) and the Large-scale Renewable Energy Target (LRET).
- National Strategy on Energy Efficiency (NSEE)
- State Government Land Clearing Legislation
- Other State Government programs

Some election commitments made in the federal 2010 election have not been included as some key policy design elements are only in the early stages of development.

The Government has committed to implement the Carbon Farming Initiative (CFI), which provides a mechanism for crediting abatement that occurs in the land sector. The Carbon Farming Initiative is expected to provide incentives for activities to reduce emissions from agriculture, forestry, land use change and waste. Future projections updates will take into account the progress in development of methodologies and any initial indications of project activity in response to the Carbon Farming Initiative.

Table 4 Greenhouse gas abatement from policies and measures

| Name | Kyoto period average (Mt $CO_2$-e) | 2020 (Mt $CO_2$-e) |
|---|---|---|
| Renewable Energy Target | 8.8 | 29.9 |
| *Large-scale Renewable Energy Target (LRET)* | *8.6* | *26.3* |
| *Small-scale Renewable Energy Scheme (SRES)* | *0.2* | *3.7* |
| National Strategy on Energy Efficiency | 14.3 | 42.6 |
| *Equipment Energy Efficiency (E3) Program* | *6.3* | *20.3* |
| *Energy efficiency requirements: Building codes* | *4.2* | *11.8* |
| *Mandatory disclosure requirements: Buildings* | *<0.1* | *<0.1* |
| *Framework Cool Efficiency Program* | *0.1* | *0.4* |
| *Phase-out of incandescent lighting* | *1.0* | *1.9* |
| *Phase-out of inefficient water heaters* | *0.1* | *4.1* |
| *Energy Efficiency Opportunities Program* | *2.7* | *4.2* |
| Queensland Gas Scheme | 2.2 | 4.3 |
| Victorian Energy Efficiency Target and Energy Saver Incentive Scheme | 0.2 | 1.6 |
| Greenhouse Gas Abatement Program (GGAP) | 3.4 | 3.6 |
| Greenhouse Challenge Plus | 5.3 | 2.6 |
| NSW Biofuel Act | 0.1 | 0.3 |
| NSW and Qld Land clearing legislation | 18.0 | 18.4 |
| Other measures | 3.8 | 5.7 |
| **Total** | **56** | **109** |

Notes:
These estimates do not attempt to indicate the economic efficiency of programs or to calculate the cost per tonne of abatement.

Only a selection of policies and measures are presented here, see the sectoral papers for a complete list of policies and measures for each sector.

Overlap between policies and measures has been deducted from these estimates. Therefore each estimate reflects the net abatement attributed to that policy or measure.

## Changes from the 2009 projection

The updated baseline Kyoto period projection of 106 per cent of 1990 levels is 0.2 Mt $CO_2$-e higher than the 2009 projection (see Table 5). The higher Kyoto period projection reflects offsetting sectoral revisions. These revisions are primarily due to the incorporation of data from the latest *National Greenhouse Gas Inventory*.

- The transport sector has been revised up 3 Mt $CO_2$-e on average per year from the previous projection, reflecting a partial re-allocation of diesel fuel from the mining industry (previously captured in the direct combustion sector) to the transport sector.
- The fugitives sector is also 3 Mt $CO_2$-e higher per year over the Kyoto period due to new coal mine specific emissions factors and increased coal production forecasts.
- These increases have been offset by a decline in agriculture emissions (3 Mt $CO_2$-e), from longer than expected drought conditions and the offsetting re-allocation of diesel fuel from the direct combustion sector to the transport sector. There were other small declines in the industrial processes and forestry sectors.

The updated baseline projection in 2020 is 21 Mt $CO_2$-e higher than the 2009 projection. The higher 2020 projection reflects higher projected emissions across all sectors except agriculture, due to higher economic forecasts. Economic growth assumptions have been revised since the previous projections and are higher over the first few years of the projections period than they were in the previous projection.

In 2020, the largest revisions occurred in the stationary energy sector and the fugitives sector.

- The upward revision to stationary energy sector emissions (11 Mt $CO_2$-e) is primarily a result of an upward revision to direct combustion emissions. Direct combustion emissions have been revised up by 9 Mt $CO_2$-e in 2020, mainly as a result of higher forecast gas consumption associated with LNG production. Updated modelling has enabled the stationary energy projection to incorporate detailed LNG production forecasts used to develop the oil and gas fugitive emissions projection, leading to increases in emissions from stationary energy.
- The revision to fugitives (9 Mt $CO_2$-e) is primarily a result of revisions to forecast coal production and the incorporation of mine-specific emissions factors into the projection. Coal forecast has been revised up due to strong demand for Australia's coal exports on the back of strong terms of trade.
- Projected emissions from the industrial processes sector in 2020 have been revised up by 3 Mt $CO_2$-e, due to stronger projected emissions growth from the chemicals industry and metal production.

- Offsetting some of these increases, is a decrease in projected emissions from agriculture (3 Mt $CO_2$-e) as a result of a slower forecast recovery from the drought than previously projected.

Table 5 Changes from 2009 projection

| | Kyoto period average 2008-12 | 2020 |
|---|---|---|
| | Mt $CO_2$-e | Mt $CO_2$-e |
| Energy | +5.3 | +20.6 |
| *Stationary* | *-0.9* | *+10.8* |
| *Transport* | *+3.3* | *+1.3* |
| *Fugitive* | *+2.9* | *+8.5* |
| Industrial processes | -1.4 | +2.5 |
| Agriculture | -3.0 | -2.8 |
| Waste | -0.1 | +0.3 |
| Deforestation and forestry | -0.6 | 0.0 |
| *Deforestation* | *-0.1* | *0.0* |
| *Forestry* | *-0.5* | *0.0* |
| **Total** | **+0.2** | **+20.7** |

Further details regarding revisions can be found in each technical sectoral paper, these can be found on the Department's website www.climatechange.gov.au.

# Key assumptions

*General assumptions*

Economic and population forecasts are consistent with the *Pre-Election Economic and Fiscal Outlook (PEFO) 2010*, released in July 2010 and the *Intergenerational Report 2010*, released in March 2010.

Table 6 GDP and population assumptions

| | 2010 to 2020 | 2020 to 2030 |
|---|---|---|
| GDP (average annual percentage growth) | 3.0 | 2.6 |
| Population (average annual percentage growth) | 1.4 | 1.3 |

*Commodity prices*

Oil prices were sourced from the *2009 World Energy Outlook*, International Energy Agency.

Table 7 Oil price assumptions

| | 1990 | 2009 | Kyoto period average | 2020 | 2030 |
|---|---|---|---|---|---|
| Oil price (2009$US/barrel)[1] | 35 | 72 | 82 | 102 | 118 |

[1] West Texas Intermediate (WTI)

World thermal coal prices are assumed to average above $65 per tonne over the projections period and metallurgical coal prices above $100 per tonne in line with strong world demand for energy resources.

Source: ABARE, *Australian Commodities*, March Qtr 2010.

World gas prices are assumed to average $8 per gigajoule over the period.

Source: pitt&sherry, *Projected Fugitive Emissions from Oil and Gas, 2010-2020*, 2009.

*Coal production*

Table 8 Coal production (run-of-mine), 2010, 2015 and 2020

| | 2010 | 2015 | 2020 |
|---|---|---|---|
| Black coal - underground | 115 | 150 | 200 |
| Black coal - surface | 385 | 510 | 550 |
| Brown coal | 70 | 70 | 70 |
| **Total** | **570** | **730** | **820** |

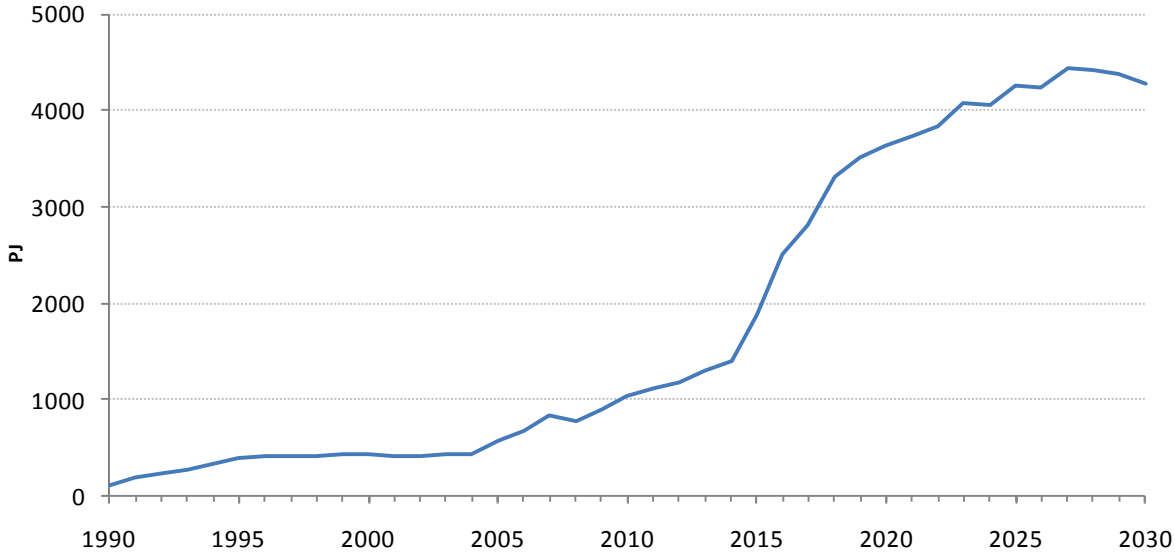
Source: Wood Mackenzie Ltd, Coal Supply Service Australia 2010, DCCEE analysis

*LNG production*

Coal seam gas (CSG) is assumed to account for around 15 per cent of LNG production by 2020 and 20 per cent by 2025. The remaining production is assumed to come from conventional sources.

Source: pitt&sherry, *Projected Fugitive Emissions from Oil and Gas, 2010-2020*, 2009.

Figure 16 LNG production, 1990 to 2030



The estimates in this paper are based on projections current at December 2010.

**Further information about projections of greenhouse gas emissions is available on the DCCEE website:**

http://www.climatechange.gov.au

**Technical sectoral emissions projections papers include:**

Stationary Energy

Transport

Fugitive

Industrial Processes

Agriculture

Waste

Deforestation and Forestry

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