Australian Government
Department of Climate Change and Energy Efficiency

AUSTRALIA'S EMISSIONS PROJECTIONS

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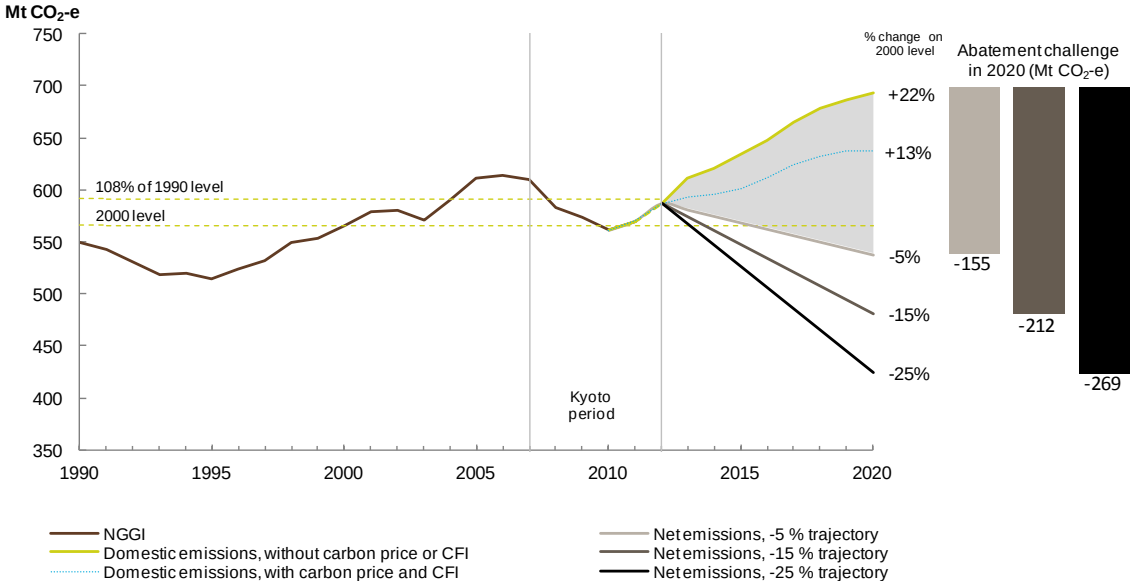
Overview

- Australia remains on track to meet its Kyoto Protocol commitment of limiting emissions to 108 per cent of 1990 levels. The 2012 projections forecast that Australia's emissions are likely to have averaged 575 million tonnes of carbon dioxide equivalent (Mt CO_2-e) over the Kyoto period (2008-2012), which is 105 per cent of the 1990 level.[1] Without the carbon pricing mechanism or Carbon Farming Initiative (CFI), Australia's emissions are forecast to be 693 Mt CO_2-e in 2020 and 786 Mt CO_2-e in 2030.
  - To achieve Australia's unconditional emissions target of a 5 per cent reduction on 2000 levels by 2020, Australia faces an abatement challenge of 155 Mt CO_2-e in 2020.
  - Strong demand for Australian energy exports, such as liquefied natural gas and coal, and reduced sequestration from reforestation are projected to drive strong growth in domestic emissions.
- With the carbon pricing mechanism in place, Australia's net emissions are expected to be limited to 537 Mt CO_2-e in 2020 (Australia's unconditional target of 5 per cent below 2000 levels) and 396 Mt CO_2-e in 2030.[2] The mechanism will be the primary means by which Australia will meet its carbon pricing emissions reduction targets.
  - The carbon pricing mechanism is projected to drive 155 Mt CO_2-e of abatement in 2020. Of this, 55 Mt CO_2-e is expected to occur domestically, including 7 Mt CO_2-e achieved by the CFI. The carbon pricing mechanism is also forecast to drive the sourcing of a further 100 Mt CO_2-e of abatement from overseas.
  - In 2030, the carbon pricing mechanism is projected to achieve 390 Mt CO_2-e of abatement. Of this, 155 Mt CO_2-e is expected to occur domestically, including 10 Mt CO_2-e by the CFI. The carbon pricing mechanism will drive the sourcing of a further 235 Mt CO_2-e of abatement from overseas.
- Over the projections period, significant decoupling of emissions growth from population and economic growth is projected. In 2030, Australia's net emissions per person are projected to be 13 tonnes CO_2-e, down from the current level of 25 tonnes CO_2-e per person. In 2030, net emissions per billion dollars of GDP are projected to be around half the level they would be without the carbon price.

[1] Australia's target under the Kyoto Protocol is to constrain average annual emissions to 108 per cent of the 1990 'base year' level over the first Kyoto commitment period 2008-12. Australia's base year was set in 2009 following the review of Australia's Initial Report under the Kyoto Protocol, at which time the exact mass of emissions Australia could emit during the First commitment period was set. Subsequent revisions to inventory methods have led to small changes in the 1990 emissions level. This paper refers to 1990 emissions levels as those reported under the Kyoto Protocol, unless otherwise specified.

[2] Throughout this publication, the projection of net emissions to 2030 assumes a straight line trajectory from Australia's unconditional emissions reduction target of 5 per cent below 2000 levels in 2020, to the Government's emissions reduction target of an 80 per cent reduction on 2000 levels in 2050. The Climate Change Authority will provide advice to the Government on carbon pollution caps from 2014.

Figure 1 Australia's emissions trends, 1990 to 2020



Note: Trajectories to the 2020 target range are illustrative; they begin in 2012 and assume a straight line reduction to the target. The Government will set the actual trajectory following advice from the Climate Change Authority.

Introduction

Australia releases official projections of its greenhouse gas emissions annually. The previous projections were released in early 2011 (referred to as the 2010 projections). Since the release of the 2010 projections, the Department of the Treasury (Treasury) released modelling in mid-2011, entitled *Strong Growth Low Pollution* (SGLP), which includes projections of Australia's emissions to 2050.[3]

The 2012 projections provide a full update of Australia's emissions projections including:

- an estimate of average emissions for the Kyoto Protocol first commitment period (2008–12);[4]
- a projection to 2020, which provides the basis for estimating the 'abatement challenge' Australia faces in meeting its 2020 targets; and
- an indicative projection of Australia's emissions to 2030.

The 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 projections. Notably, the 2012 projections incorporate the Government's Clean Energy Future plan announced in July 2011 (refer Box 1). A scenario without the carbon price has also been projected, which includes abatement from existing measures such as energy efficiency measures and the Renewable Energy Target (RET). The 2012 projections do not include a scenario excluding abatement from all measures due to the difficulty of forecasting this counterfactual scenario, especially given that some measures have been in place since before 2000.

The projections are developed and presented at a sectoral level, encompassing domestic emissions from stationary energy (including electricity generation and direct combustion), transport, fugitive emissions from fuel production, industrial processes, agriculture, waste and deforestation and reforestation[5].

Australia's *domestic* emissions are defined as all emissions from within Australia, less all removals within Australia, measured and defined in accordance with the Kyoto Protocol.[6] Similarly, abatement arising from the Clean Energy Future plan, for instance from the carbon price and Carbon Farming Initiative (CFI), is presented at a sectoral level for domestic abatement only.

Australia's *net* emissions are comprised of Australia's domestic emissions, less the purchase of international emission units, plus any exports of Australian abatement. Australia is expected to

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

[4] While the first commitment period of the Kyoto Protocol (2008-2012) ended on 30 June 2012, the most recently available emissions data do not cover the entire period, and the estimate of Australia's emissions over period includes a partial projection.

[5] Deforestation and reforestation emissions include emissions sequestered from reforestation and afforestation. Source: Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2011, released 2012.

[6] For the purposes of projecting domestic emissions, it is assumed that the relevant Kyoto Protocol accounting rules are carried on beyond 2012. In the language of the Kyoto Protocol, this would be expressed as: all emissions from within Australia from Annex A sectors, plus net emissions from Article 3.3 activities within Australia.

be a net importer of eligible international emissions units, in order to achieve its emissions reduction targets.

Emissions projections are inherently uncertain, involving judgments about the growth path of global and domestic economies, the implementation of policy actions, technological innovation and human behaviour. The uncertainty increases the further into the future emissions are projected. Therefore, actual emissions in 2030 have greater potential to vary from their projected levels than the 2020 projections.

The same uncertainty applies in predicting the domestic abatement achieved by the carbon price. As a market-based mechanism, the carbon price does not stipulate how or where in the economy abatement occurs, and could achieve domestic abatement beyond, or short of, the levels represented in the projections.

This document contains summaries of the emissions projections for each sector. Detailed sectoral results can be found in the accompanying technical sectoral emissions projections papers on the Department's website at: http://www.climatechange.gov.au.

Methodology

The projections are prepared at a sectoral level, with sectoral definitions consistent with international guidelines adopted by the United Nations Framework Convention on Climate Change (UNFCCC) for accounting under the Kyoto Protocol. The sectoral projections use a combination of top-down and bottom-up modelling. To the extent possible, the sectoral modelling incorporates an outlook for key variables – such as energy demand by fuel type and other commodity forecasts – that is consistent across sectors and consistent with Treasury's modelling in SGLP.

The projections are prepared for the group of six Kyoto Protocol greenhouse gases and expressed in terms of carbon dioxide equivalent (CO_2-e) using the 100-year global warming potentials (GWPs) contained in the Intergovernmental Panel on Climate Change's *Second Assessment Report*. As greenhouse gases vary in their radiative activity and in their atmospheric residence time, converting emissions into CO_2-e allows the aggregate effect of emissions of the various gases to be considered.

Australia introduced a carbon price on 1 July 2012 as the central element of its plan to cut carbon pollution. To reflect the impact of this policy, two projections results are presented:

- a projection that incorporates key policy measures other than the carbon price and CFI; and
- a projection that incorporates key policy measures including the carbon price and CFI.

The projections are based on a range of data including:

- Historical emissions from *Australia's National Greenhouse Accounts: National Greenhouse Gas Inventory* (NGGI), released in April 2010 and *Quarterly Update of Australia's National Greenhouse Gas Inventory, December Quarter 2011*, released in April 2012.
- The international carbon price modelled in SGLP and incorporated in the 2012-13 Budget.
- Industry growth rates and projections of changes to the emissions intensity of the Australian economy from SGLP.
- Sectoral modelling and outlooks of activity levels in specific sectors.

Historical emissions data for 2011 from the *Update of Australia's National Greenhouse Gas Inventory, December Quarter 2011* have been used as the base year for projections of most sectors. In the agriculture, waste and forestry sectors, a base year of 2010 is used (with data sourced from the 2010 NGGI) as quarterly updates are not provided for emissions in these sectors.

The Treasury modelled the impact of the carbon pricing mechanism on the Australian economy and Australia's emissions in SGLP. Treasury modelling indicates that the Australian economy, incomes, jobs and household spending will all continue to grow under the carbon price, while emissions are reduced.

The 2012 emissions projections results align closely with SGLP at an aggregate level, but vary for some sectors. This variation is due to the incorporation of sector-specific information which has become available since the modelling for SGLP was undertaken.

The 2012 projections supplement the SGLP results with detailed sectoral inputs including sectoral modelling, and emissions estimates from Australia's latest *National Greenhouse Accounts*. A detailed list of input data is included in each sectoral paper.

The projections show the impact of the carbon price on Australia's domestic and net emissions. The carbon price is expected to influence domestic emissions through changes to sectoral output and emissions-intensity. The key assumptions section provides an analysis of the sensitivity of domestic emissions to a higher or lower carbon price than the central scenarios, which uses the international carbon price modelled in SGLP. These projections incorporate CFI abatement estimates from 2013 to 2030 from the medium global action scenario in the SGLP report and the Australian Bureau of Agricultural and Resource Economics and Sciences' (ABARES) 2011 special report, *Abatement potential from reforestation under selected carbon price scenarios*.

From July 2015, when the carbon price transitions to the flexible price period, carbon pollution caps will imply a limit on Australia's net emissions. If domestic abatement falls short of that required to meet the carbon pollution cap, liable entities would be expected to purchase eligible international abatement permits[7] to acquit their liabilities under the carbon pricing mechanism. A combination of domestic abatement and the purchase of these units will ensure Australia meets its 2020 targets. Forecasts of international permit purchases are therefore dependent on carbon prices, the level of domestic abatement and carbon pollution caps.

The 2012 projections forecast the total number of international permits purchased by Australian entities. However, it is not possible to predict where in the economy these will be used. For this reason, sectoral projections forecast domestic emissions reductions from the carbon price but not the level of international abatement used in each sector.

Refer to the sectoral papers and supplementary materials for greater detail of the modelling approach used for each sector: www.climatechange.gov.au

[7] International units can be used to meet carbon pricing mechanism liabilities in the flexible price period, subject to certain qualitative and quantitative restrictions. Until 2020, liable parties must meet at least 50 per cent of their annual liability with domestic permits or credits. The list of eligible international units is prescribed in *Australian National Registry of Emissions Units Act 2011.*

Box 1: Clean Energy Future plan

On 10 July 2011, the Government released *Securing a clean energy future: the Australian Government's climate change plan (the Clean Energy Future plan)*. The Government's plan has four elements that unite existing and new policies to reduce emissions: a carbon pricing mechanism; renewable energy target; energy efficiency measures; and action on the land.

The carbon pricing mechanism commenced on 1 July 2012. For the first three years, the carbon price will be set in legislation. It will start at $23 per tonne in 2012-13, rising at 2.5 per cent plus inflation per year. From 1 July 2015, the carbon price will become flexible under a cap-and-trade emissions trading scheme, with the price determined by the market but restricted by a price ceiling for the first three years beyond the fixed price period. Legislation giving effect to the carbon pricing mechanism was passed into law on 8 November 2011.

Emissions covered by the carbon pricing mechanism include those from stationary energy; industrial processes; production of coal and gas; and emissions from non-legacy waste. An equivalent carbon price will also be applied to some transport fuels through the existing fuel tax regime and to synthetic greenhouse gases through the *Ozone Protection and Synthetic Greenhouse Gas Management Act 1989*. Emissions *not* covered by the carbon price include agricultural and forestry sector emissions, some transport emissions and emissions from the combustion of biofuels and biomass.

The first five years of emissions caps will be set by the 2014-15 Budget, and will be extended every year to maintain five years of known caps at any time. An independent body – the Climate Change Authority – will review and recommend the level of emissions caps, as well as the overall operation of the carbon price and the progress towards emissions reduction targets.

The Clean Energy Future legislation includes provision for the use of international units to meet up to 50 per cent of carbon pricing mechanism liabilities, in the flexible period only.

The Government has committed to a 5 per cent reduction in emissions from 2000 levels by 2020, with up to 15 or 25 per cent depending on actions taken by other countries. The unconditional 5 per cent reduction target equates to a 22 per cent reduction from projected levels without the carbon price in 2020. The Government committed to a new long-term target of an 80 per cent reduction in emissions from 2000 levels by 2050 in the Clean Energy Future plan.

Recent trends – National Greenhouse Gas Inventory

The electricity subsector is the largest source of greenhouse gas emissions in Australia, accounting for 34 per cent of total emissions in 2011. The direct combustion of fuels consumed in the manufacturing, mining, construction and commercial sectors, and other sources such as domestic heating and cooking, is the next largest sector with 17 per cent of total emissions. The transport and agriculture sectors contribute a further 15 and 14 per cent of total emissions respectively (Figure 2).

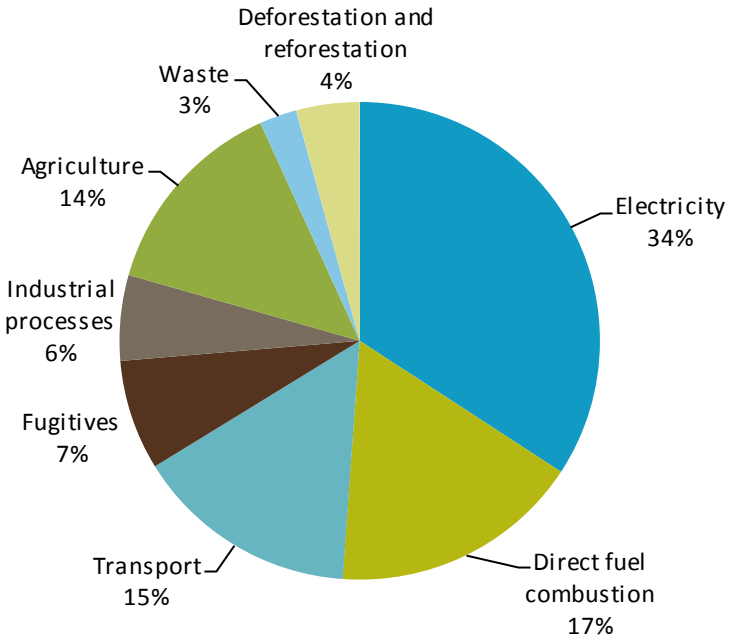
After a relatively steady decline from 2007 to 2010, total emissions have increased in 2011 amid the recovery from the Global Financial Crisis and strong international demand for Australian commodities. Direct fuel combustion, transport and fugitive emissions contributed most to the increase.

There has also been a significant (7 per cent) decrease in emissions from electricity generation since 2009, driven by a combination of factors. Factors including the Queensland floods[8], lower electricity demand during the Global Financial Crisis, and mild weather in the eastern and south-eastern states during 2011 appear to have been partly responsible for the decline. These events have been compounded by longer-term changes, including structural economic change driven in part by the high Australian dollar; increased distributed generation (primarily rooftop solar photovoltaics and solar water heaters); and rising electricity prices, combined with increased energy efficient technologies.

Agriculture emissions also declined strongly between 2008 and 2010, predominantly due to a decrease in savanna fires in coastal areas in the Northern Territory and Western Australia. High slaughter rates for grazing cattle and sheep also contributed to the decrease. Livestock numbers have rebounded strongly since 2010 due to improved water availability since 2008, and preliminary data suggest that agriculture emissions are already increasing sharply.

[8] According to the Energy Supply Association of Australia (2012), electricity consumption in Queensland fell 7.5 per cent in 2011 due to the Queensland floods.

Figure 2 National Greenhouse Gas Inventory, 2011



Note: Deforestation and reforestation emissions include emissions sequestered from reforestation and afforestation.
Source: Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2011, released 2012.

Projections results

The 2012 projection results are presented in the context of three key time periods:

- The Kyoto period (2008-2012) tracks Australia's progress against its commitment under the Kyoto Protocol.
- Projected emissions to 2020 indicate how Australia is tracking against its medium-term emissions reduction target range and present the level of the abatement challenge.
- Projected emissions in 2030 are indicative of Australia's progress against its long-term emissions reduction target of 80 per cent of 2000 levels by 2050.

Table 1 Projected emissions with a carbon price and CFI, 1990 to 2030

	1990	2000	Kyoto period average 2008-12	2020		2030	
	Mt CO_2-e	Mt CO_2-e	Mt CO_2-e	Mt CO_2-e	*Abatement from carbon price and CFI (Mt CO_2-e)*	Mt CO_2-e	*Abatement from carbon price and CFI (Mt CO_2-e)*
Energy	**286**	**361**	**420**	**463**	***41***	**449**	***129***
Stationary	*195*	*251*	*293*	*318*	*22*	*303*	*87*
Transport	*62*	*75*	*85*	*92*	*5*	*88*	*13*
Fugitive	*29*	*36*	*42*	*53*	*14*	*58*	*29*
Industrial processes	**24**	**26**	**31**	**31**	***6***	**33**	***13***
Agriculture	**87**	**92**	**83**	**91**	***1***	**100**	***2***
Waste	**19**	**14**	**14**	**10**	***3***	**7**	***5***
Deforestation and reforestation	**132**	**71**	**27**	**43**	***4***	**42**	***6***
Deforestation	*132*	*82*	*50*	*47*	*4*	*46*	*6*
*Reforestation**	*0*	*-11*	*-23*	*-5*	*0.2*	*-5*	*0.8*
Total domestic emissions	**548**	**565**	**575**	**637**	***55***	**631**	***631***
Internationally sourced abatement	**N/A**	**N/A**	**N/A**	**100**	***100***	**235**	***235***
Total net emissions	**548**	**565**	**575**	**537**	***155***	**396**	***390***

*Emissions changes in reforestation due to the carbon price are increases in a carbon sink

Note: Sub-totals may not sum due to rounding. The projection of internationally sourced abatement in 2030 assumes a straight line trajectory from Australia's unconditional 5 per cent emissions reduction target in 2020 to the Government's emissions reduction target of an 80 per cent reduction on 2000 levels in 2050. The Climate Change Authority will provide advice to the Government on annual carbon pollution caps each year from 2014. In the first instance, caps will be set for a five-year period. Advice will then be provided on setting the annual cap five years in the future.

Kyoto period (2008–2012)

Australia remains on track to meet its Kyoto Protocol first commitment period (2008-2012) goal of limiting emissions to 108 per cent of 1990 levels.[9]

Reduced emissions from deforestation and reforestation have more than offset emissions growth early in the period from increased electricity demand and mining-related emissions from the energy sector. Relative to the 2010 projections, emissions over the Kyoto period have been revised down due to falling electricity demand in the latter part of the period and the flooding during 2011 which temporarily lowered coal production.

- Australia's annual emissions over the first commitment period are likely to average 575 Mt CO2-e. This level is 105 per cent of Australia's 1990 Kyoto level. Average emissions for the first commitment period have been forecast using:
  National Greenhouse Gas Inventory (NGGI) data for 2008 to 2010;
- NGGI Quarterly estimates for stationary energy, fugitive, and industrial processes emissions, and projections for agriculture, waste, deforestation and reforestation emissions in 2011; and
- projected emissions in 2012 for all sectors.

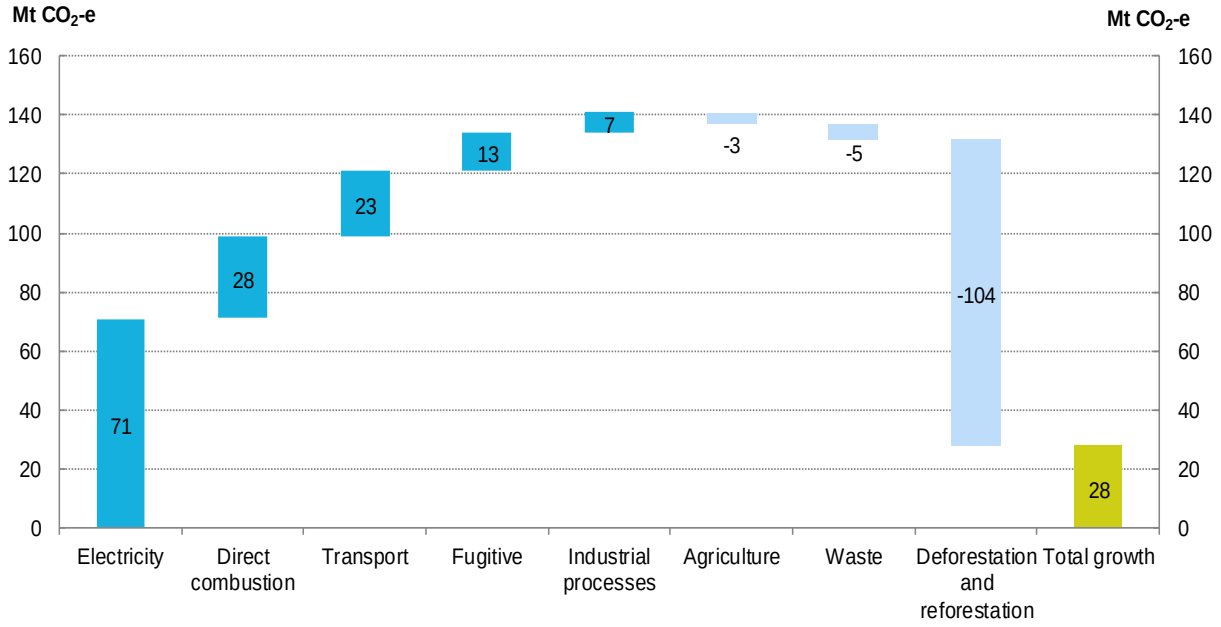
For the purpose of Kyoto Protocol compliance, the final value for Australia's first commitment period emissions will be known following the review of Australia's report on emissions over the period, expected to be submitted to the UNFCCC around 2015.

In absolute terms, Australia's first commitment period annual average emissions are expected to be 28 Mt CO_2-e higher than the 1990 Kyoto level (Figure 3). The major source of this growth is the energy sector[10], driven by Australia's relatively high rates of economic growth and international demand for Australia's resources. The electricity subsector of stationary energy dominates the growth in emissions from 1990 to the Kyoto period with growth of 71 Mt CO_2-e. Emissions growth in the direct combustion subsector of stationary energy and the fugitive emissions subsector are driven by the extraction, production and processing of Australia's energy resources.

[9] Australia's target under the Kyoto Protocol is to constrain average annual emissions to 108 per cent of the 1990 'base year' level over the period 2008-2012. Australia's base year was set in 2009 following the review of Australia's Initial Report under the Kyoto Protocol, at which time the exact volume Australia could emit during the first commitment period was set. Subsequent revisions to inventory methods have led to small changes in the 1990 emission level; these changes do not affect the Kyoto base year.

[10] Energy sector emissions relate to the production and consumption of energy. The sector comprises fugitive emissions and emissions from stationary energy and transport.

Figure 3 Sectoral emissions change, 1990 to Kyoto period average 2008-2012



Targets

The Government has set an emissions reduction target range for 2020. The Government has committed to an unconditional 5 per cent reduction on 2000 levels by 2020, with up to 15 per cent or 25 per cent reductions based on conditions relating to the extent of global action. In January 2010, Australia formally submitted these 2020 targets under the Copenhagen Accord.

The unconditional 5 per cent emissions reduction on 2000 levels sets a target for Australia's net emissions in 2020 of 537 Mt CO_2-e[11] (Table 2). Australia will achieve this target through the combination of domestic emissions reductions (primarily occurring through the carbon price) and the purchase of abatement that occurs overseas. Without the carbon price or CFI, Australia's net emissions are projected to be 155 Mt CO_2-e higher than the target in 2020. This difference is called our 'abatement challenge'.

To achieve the 15 per cent reduction target in 2020, Australia would need to reduce emissions in 2020 by 212 Mt CO_2-e, below the projected level in the absence of the carbon price. To achieve the 25 per cent reduction target, Australia would need to reduce emissions by 269 Mt CO_2-e in 2020.

The Government has set a long-term emissions reduction target of 80 per cent below 2000 levels by 2050.

[11] Based on the currently calculated 2000 level of emissions.

Table 2 The abatement challenge in 2020

	2000[12]	2020 without a carbon price or CFI	Abatement challenge	% reduction from scenario with no carbon price and no CFI
	Mt CO_2-e	Mt CO_2-e	Mt CO_2-e	%
Baseline emissions	565	693		
-5% target			155	22
-15% target			212	31
-25% target			269	39

Projections to 2020

Australia's net emissions are expected to decrease to 537 Mt CO_2-e in 2020 with the carbon price and imports of international permits, to achieve the Government's unconditional national emissions target of 5 per cent below 2000 levels in 2020. The carbon price is projected to achieve 55 Mt CO_2-e of domestic abatement in 2020. Of this, the carbon price itself drives 48 Mt CO_2-e of domestic abatement and a further 7 Mt CO_2-e of abatement is achieved from the CFI. A further 100 Mt CO_2-e of abatement is projected to be sourced from overseas. Overall, it is forecast that cumulative net emissions will be reduced by 755 Mt CO_2-e over the period to 2020.

The carbon price will limit growth in Australia's domestic emissions over the period to 2020. Domestic emissions are projected to be 637 Mt CO_2-e in 2020, 8 per cent lower than they would have been without a carbon price (Table 1). Projected domestic emissions growth to 2020 is dominated by direct combustion and fugitive emissions associated with the production of energy resources, which is driven by expected strong export demand for Australia's natural resources, particularly LNG (Box 2). Declining levels of carbon sequestration from reforestation are also projected to increase domestic emissions to 2020.

[12] The 2000 emissions level is sourced from the National Greenhouse Gas Inventory, 2010.

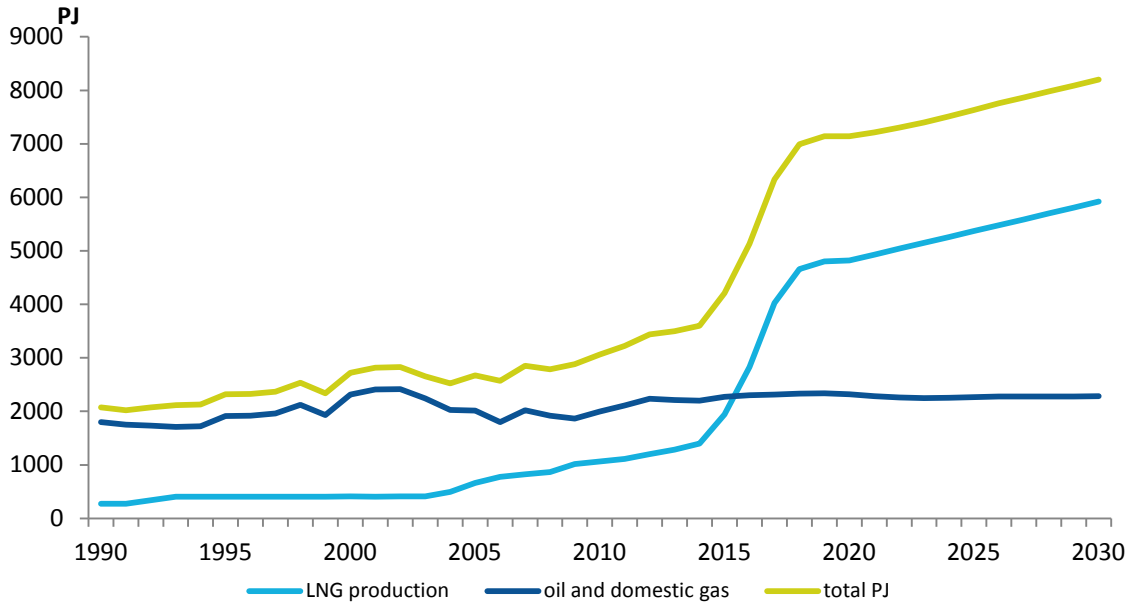
Box 2: The impact of expanded LNG production on emissions

The direct combustion and the fugitive projections both include emissions associated with LNG production. Direct combustion emissions from LNG production mainly arise through natural gas combustion to run stationary equipment, such as compression turbines. Fugitive emissions from LNG production arise from venting and flaring of waste gas and from unintended emissions such as equipment leaks.

Emissions from LNG production are projected to increase strongly over the projection period, with the bulk of the increase occurring in direct combustion. Fugitive emissions do not increase so strongly, in part because future LNG projects are projected to have lower average fugitive emissions intensity compared to historical domestic gas and LNG projects.

The chart below shows that LNG production is forecast to become an increasingly large share of oil and gas production, with aggregate production of LNG rising from around 13 per cent of oil and gas production in 1990 to 35 per cent in 2011 and 72 per cent in 2030.

Figure 4 Projected oil and gas production to 2030

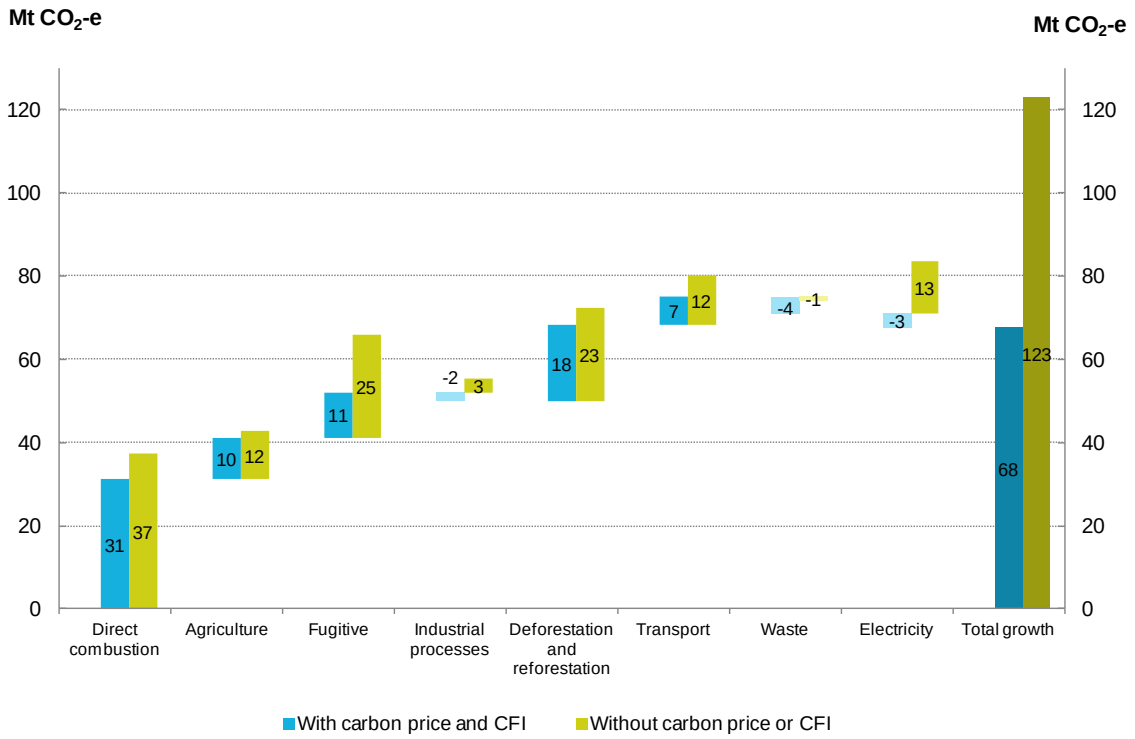


The strong growth in emissions associated with LNG production over the projections period means that oil and gas production is responsible for an increasing share of total domestic emissions. In 1990, oil and gas was responsible for 3 per cent of the Kyoto inventory total. This increased to 6 per cent in 2011, and is projected to reach 10 per cent in 2020 and 12 per cent in 2030 in the presence of a carbon price.

Total emissions growth is expected to be moderated by domestic emissions reductions driven by the carbon price (Figure 5). Despite the growth in direct combustion and fugitive emissions, their emissions levels are lower (5 and 21 per cent respectively) than they would be without the carbon price. Combined abatement in the direct combustion and fugitive sectors comprises 36 per cent of domestic abatement achieved by the carbon price in 2020 (Figure 7). Compared to a scenario without the carbon price, electricity emissions are 16 Mt CO_2-e (8 per cent) lower in 2020.

In some sectors, the carbon price is projected to lead to absolute falls in domestic emissions. The combination of the carbon price and the RET is expected to increase the use of less emissions intensive fuels and technologies in the electricity sector, leading to a decrease in domestic emissions of 3 Mt CO_2-e from 2011 to 2020.

Figure 5 Sectoral domestic emissions changes, 2011 to 2020



Excluding emissions from land use, land use change and forestry (LULUCF), the projected domestic emissions growth under the carbon price is significantly lower than historical levels. Domestic emissions from non-LULUCF sources are projected to increase by 1 per cent per year between 2011 and 2020 compared to growth of 1.3 per cent per year between 1990 and 2011. Without the carbon price the projected growth in domestic emissions is forecast to accelerate to a rate of 1.8 per cent per year (Figure 6).

Growth in LULUCF emissions is projected to be higher than during the historical period. Changes in emissions between 1990 and 2011 were largely driven by changes to government land clearing rules and incentives for establishing plantation forests, which are not expected to be repeated.

Figure 6 Comparison of emissions with and without emissions from deforestation and reforestation, 1990 to 2020

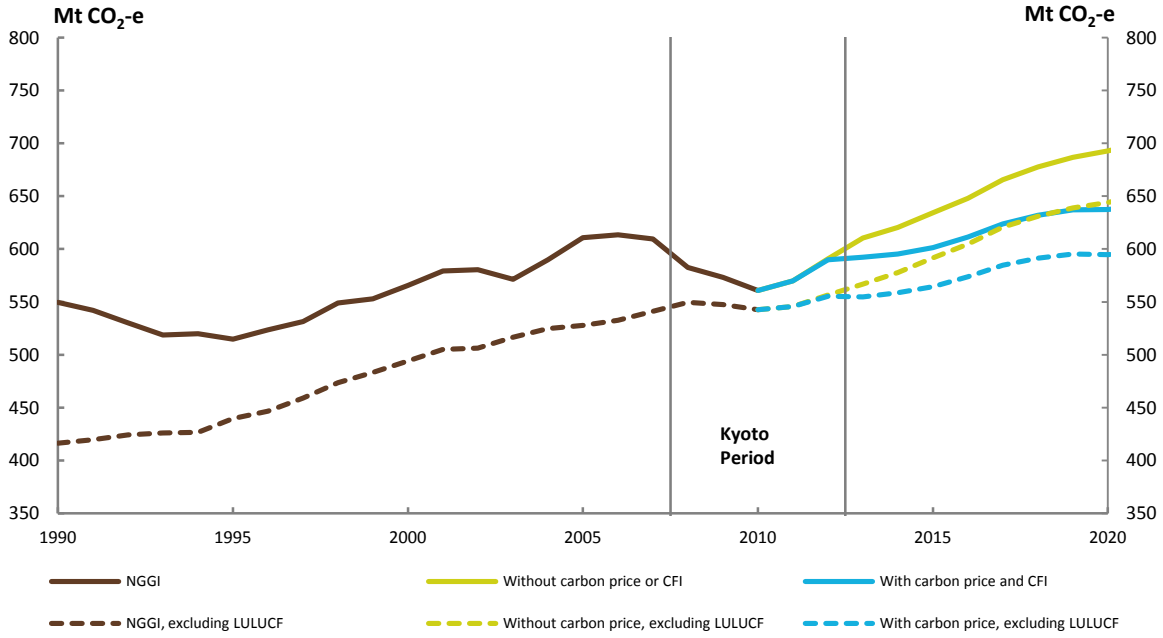
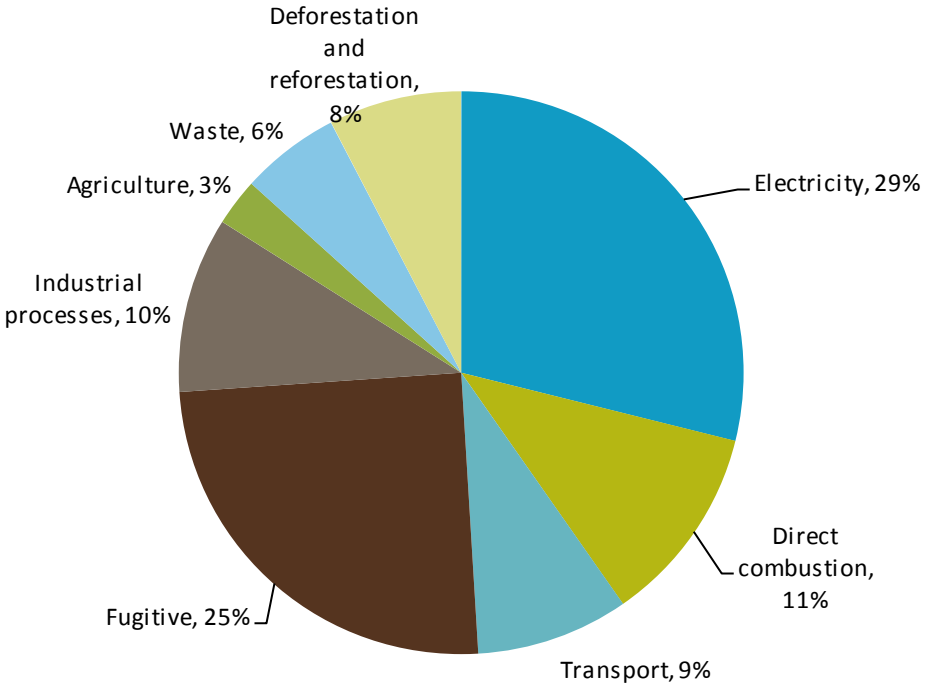


Table 3 Emissions in 2020 with and without a carbon price and CFI

	2020 with a carbon price and CFI	2020 without a carbon price or CFI	Abatement in 2020	Per cent reduction with a carbon price and CFI
	Mt CO_2-e	Mt CO_2-e	Mt CO_2-e	%
Electricity	191	207	16	-8
Direct combustion	127	133	6	-5
Transport	92	97	5	-5
Fugitive	53	67	14	-21
Industrial processes	31	36	6	-15
Agriculture	91	92	1	-2
Waste	10	13	3	-24
Deforestation and reforestation	43	47	4	-9
Internationally sourced abatement	-100	0	100	-
Total	**537**	**693**	**155**	**-22**

Figure 7 Share of domestic abatement by sector in 2020



Projections to 2030

Australia's net emissions are projected to continue to decrease between 2020 and 2030 due to the abatement that will continue to be generated under the carbon price. Assuming a straight line trajectory from the Government's unconditional emissions target in 2020 to the Government's emissions reduction target in 2050 (Figure 10), net emissions in 2030 are projected to be 396 Mt CO_2-e. This is 50 per cent of the projected level of emissions without the carbon price or CFI and represents abatement of 390 Mt CO_2-e. The decrease in net emissions between 2020 and 2030 is projected to be 141 Mt CO_2-e.

The growth in domestic emissions during the first half of the 2020s is forecast to be slower than over the decade 2010-2020, and domestic emissions decrease from 2026. Australia's domestic emissions are projected to be 631 Mt CO_2-e in 2030, a 6 Mt CO_2-e reduction on the projected domestic 2020 level. Overall, 1294 Mt CO_2-e of domestic emissions reductions are expected to be driven by the carbon price and CFI between 2012 and 2030.

The carbon price is projected to achieve 155 Mt CO_2-e of domestic abatement in 2030, with domestic emission reductions from all sectors, including agriculture and deforestation and reforestation through the CFI. Further abatement is expected to be sourced from overseas (Table 4). With the carbon price and CFI, domestic emissions from electricity, waste, transport, and deforestation and afforestation, are projected to be lower in 2030 than in 2020. The carbon price impact is particularly striking in the electricity sector; between 2020 and 2030 emissions are projected to fall 23 Mt CO_2-e instead of growing 34 Mt CO_2-e without the carbon price (Figure 8). Abatement in the electricity sector accounts for 47 per cent of the domestic abatement achieved by the carbon price in 2030 (Figure 9). Improved coal mining practices and a projected slowing in the growth of LNG production post-2020 also contribute to lower domestic emissions.

Figure 8 Sectoral domestic emissions changes, 2020 to 2030

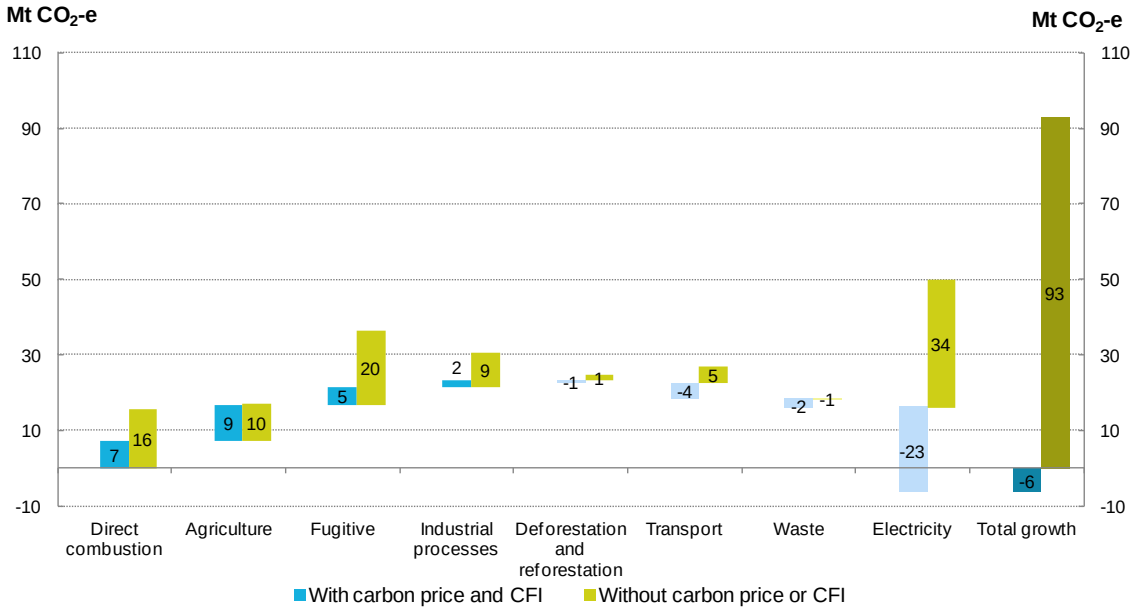


Figure 9 Share of domestic abatement by sector in 2030

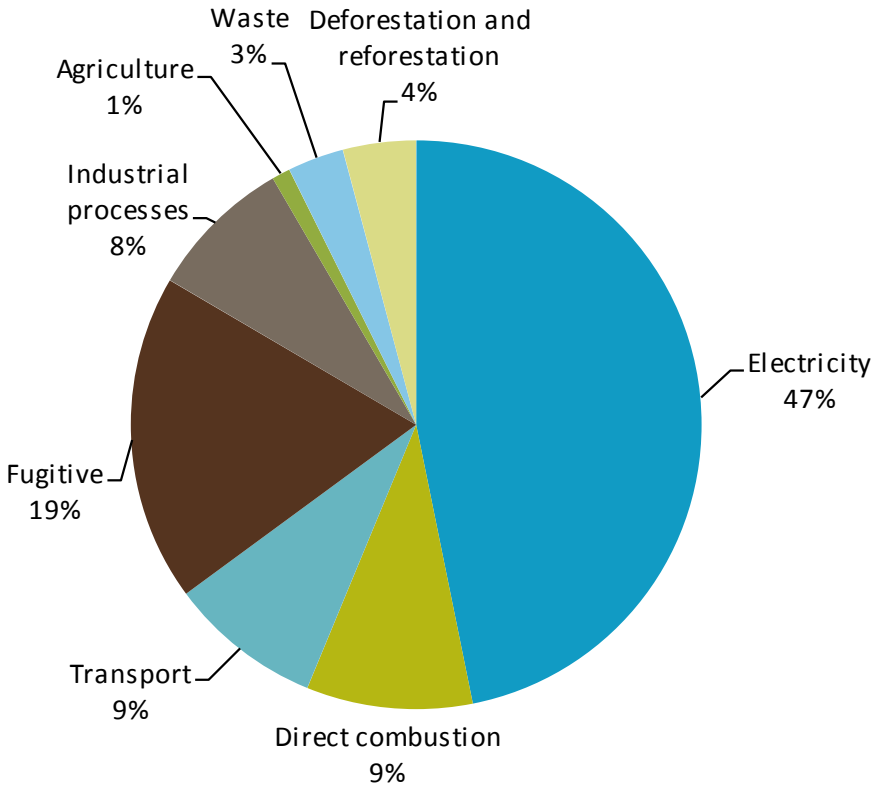


Table 4 Emissions in 2030 with and without a carbon price and CFI

	2030 with a carbon price and CFI	2030 without a carbon price and without CFI	Abatement in 2030	Per cent reduction with a carbon price and CFI
	Mt CO_2-e	Mt CO_2-e	Mt CO_2-e	%
Electricity	168	240	72	-30
Direct combustion	134	149	15	-10
Transport	88	102	13	-13
Fugitive	58	86	29	-33
Industrial processes	33	45	13	-28
Agriculture	100	102	2	-2
Waste	7	12	5	-40
Deforestation and reforestation	42	48	6	-13
Internationally sourced abatement	-235	0	235	N/A
Total	**396**	**786**	**390**	**-50**

Note: Sub-totals may not sum due to rounding. The projection of internationally sourced abatement in 2030 assumes a straight line trajectory from Australia's unconditional emissions target in 2020 to the Government's emissions reduction target of an 80 per cent reduction on 2000 levels in 2050. It does not represent the actual emissions cap in 2030, which the Government will set following advice from the Climate Change Authority.

Covered sector and uncovered sector emissions projections

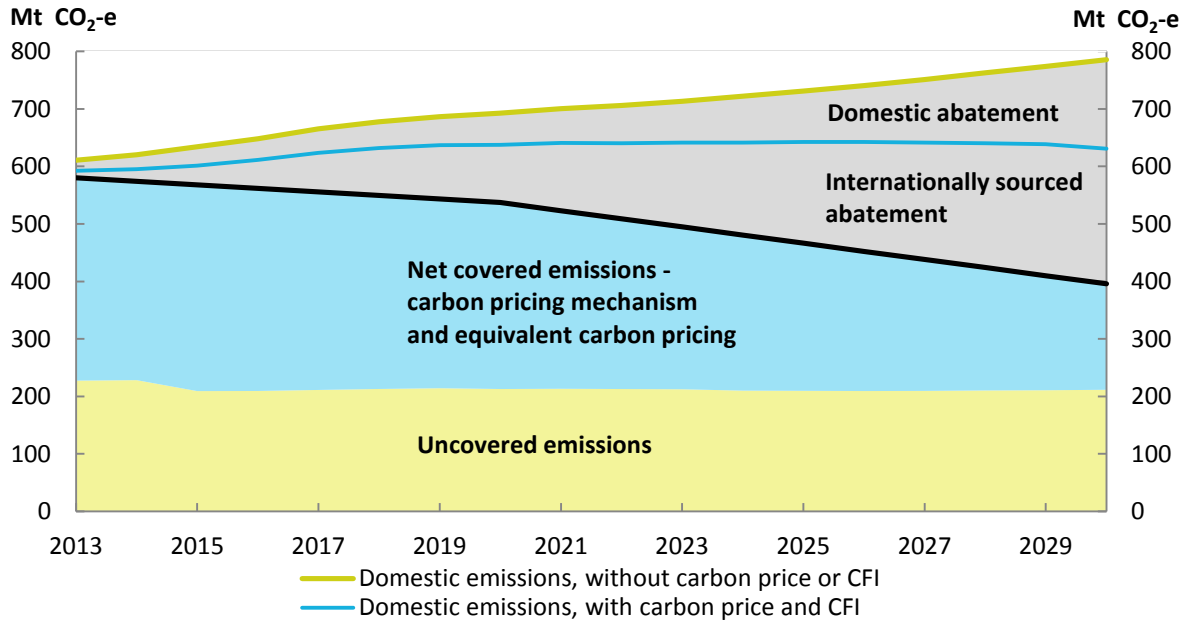
Under the carbon pricing mechanism, entities that emit greenhouse gases that are 'covered' by the scheme will attract a liability.

Covered emissions include emissions from stationary energy, industrial processes, fugitive emissions (other than from decommissioned coal mines), and emissions from non-legacy waste. An equivalent carbon price will be applied to some transport fuels and to synthetic greenhouse gases through changes to existing legislation. Emissions from agriculture and deforestation and reforestation are not covered by the carbon price or an equivalent carbon price. However, the CFI provides a link to the carbon price by allowing these sectors to create offset units to trade into the compliance market, leading to increased domestic abatement.

The projections forecast that in 2020, 55 Mt CO_2-e or 36 per cent of the abatement challenge will be met through reductions in domestic emissions (from both the carbon price and the CFI). The carbon pricing mechanism is projected to drive the remaining 100 Mt CO_2-e through the sourcing of abatement that occurs overseas.

Covered emissions shown in Figure 10 are those which will attract a liability under the carbon pricing mechanism as well as those under an equivalent carbon price. The projections indicate that net covered emissions will decline as the carbon pollution cap binds. Covered emissions net of international abatement are projected to reach 324 Mt CO_2-e in 2020 and 184 Mt CO_2-e in 2030. After the inclusion of heavy road vehicles under the carbon price in 2015, emissions in uncovered sectors are projected to remain relatively constant in the absence of new policies. Uncovered emissions are projected to be 209 Mt CO_2-e in 2030 (Figure 10). The relative stability in uncovered emissions reflects that falling emissions from legacy waste and light vehicle transport are projected to largely offset growth in agriculture sector emissions.

Figure 10 Australia's emissions to 2030



Note: The projection of internationally sourced abatement and covered emissions to 2030 assumes a straight line trajectory from Australia's unconditional emissions target in 2020 to the Government's emissions reduction target of an 80 per cent reduction on 2000 levels in 2050. It does not represent the actual emissions cap in 2030, which the Government will set following advice from the Climate Change Authority.

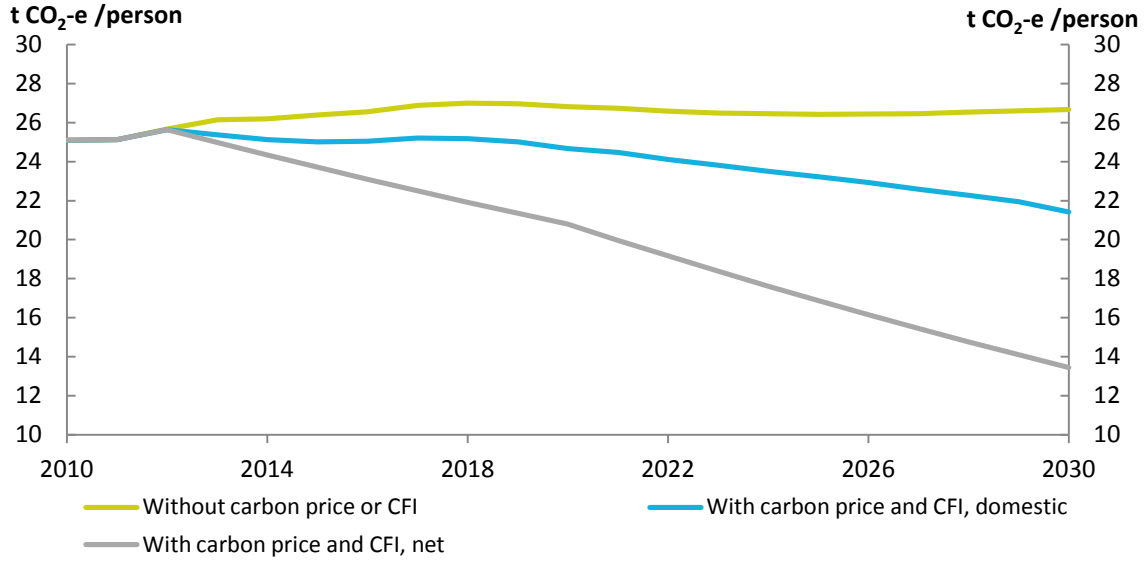
Emissions, population and GDP growth

In an emissions-intensive economy, population growth and economic growth are both factors that can lead to growth in greenhouse gas emissions. Per person, Australia is one of the highest emitting countries in the world, emitting over 25 tonnes CO_2-e per person.

The introduction of the carbon price begins Australia on a path to decoupling population growth from emissions growth, with net emissions per person projected to decrease by 3.5 per cent per year between 2012 and 2030. By 2030, net emissions per person are projected to be 13 tonnes CO_2-e, around half the level projected without the carbon price (Figure 11).

Without the carbon price or CFI, emissions per person are projected to increase on average by 0.2 per cent per year between 2012 and 2030. In 2030, it is estimated that emissions would be 27 tonnes of CO_2-e per person without the carbon price.

Figure 11 Domestic and net emissions per person to 2030



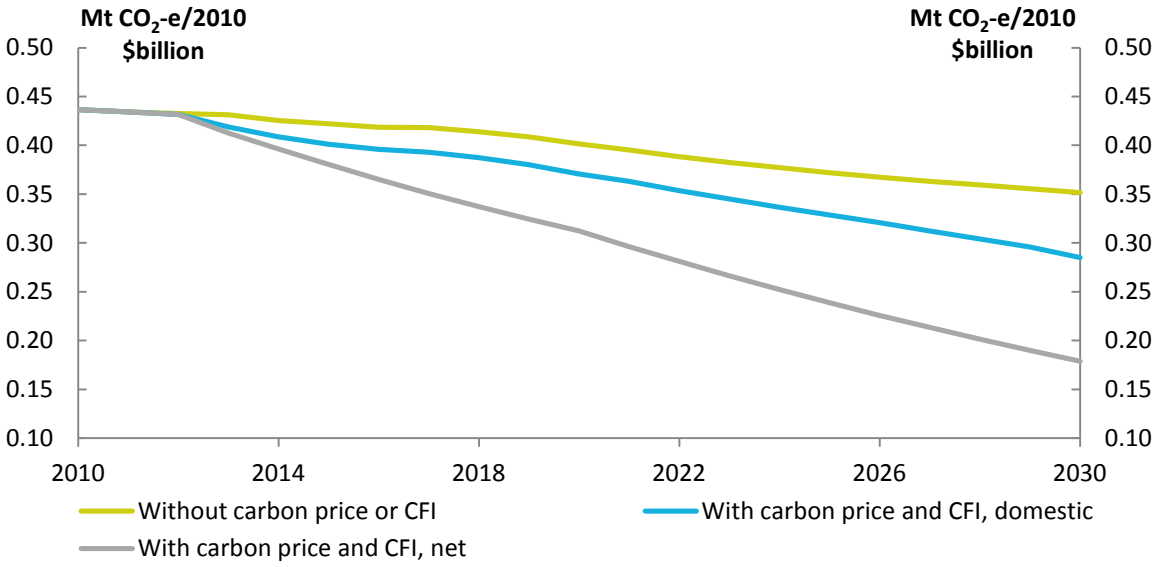
Using economic output as modelled in SGLP[13], under all scenarios the emissions intensity of the economy (Mt CO_2-e/ 2010 $billion GDP) is expected to decrease between 2012 and 2030. This is partly due to a continuation of structural changes in the economy away from emissions intensive manufacturing and existing abatement measures in place.

The introduction of the carbon pricing mechanism is projected to accelerate the decoupling of emissions growth from economic growth. While the carbon price is projected to have little impact on economic growth, the emissions intensity of growth is projected to decrease markedly as capital and processes become less emissions-intensive.

Net emissions intensity with the carbon price and CFI is projected to decline by 28 per cent between 2012 and 2020 and then by a further 43 per cent from 2020 to 2030. Net emissions intensity is projected to reduce by an average of 5 per cent per year with the carbon price and CFI compared to 1 per cent per year on average without the carbon price or CFI (Figure 12).

[13] In SGLP, the economy is projected to grow strongly with or without the carbon price (at around 3 per cent per year). As noted elsewhere, emissions results align closely with SGLP, and differences are largely due to the incorporation of more recent sector-specific information.

Figure 12 Domestic and net emissions per billion dollars of GDP to 2030



Energy

Energy **emissions (consisting of the stationary energy, transport and fugitive sectors) are estimated to reach 420 Mt CO_2-e per year on average over the Kyoto period, an increase of 47 per cent above the 1990 level. In 2020, emissions are projected to reach 463 Mt CO_2-e, 8 per cent lower than they would be without a carbon price. Emissions in 2030 are expected to be 449 Mt CO_2-e, 20 per cent below the level reached without a carbon price.**

Stationary energy

The stationary energy sector is the largest emissions sector. In 2011 it represented 51 per cent of Australia's total greenhouse gas emissions and at 290 Mt CO_2-e, emissions were 49 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 have historically included 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 have affected 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 293 Mt CO_2-e per year over the Kyoto period, an increase of 50 per cent above the 1990 level. In 2020, domestic stationary energy emissions are projected to reach 318 Mt CO_2-e, 22 Mt CO_2-e (7 per cent) lower than they would be without a carbon price. In 2030 domestic emissions are projected to be 303 Mt CO_2-e, 22 per cent below projected levels without a carbon price.**

The introduction of the carbon price is expected to significantly change the growth trajectory of domestic stationary energy emissions. While domestic emissions are projected to grow between 2012 and 2030, the growth rate is far lower with a carbon price than without.

Domestic stationary energy emissions are projected to increase by 10 per cent from 2011 to 2020 but projected to grow by 17 per cent over the same period in the absence of a carbon price. Emissions growth in each sub-sector differs significantly, reflecting the different factors driving demand and abatement in the sectors.

- Emissions from direct fuel combustion are projected to increase by 32 per cent from 2011 to 2020, driven largely by strong export demand for Australia's energy and mineral resources. With the carbon price, emissions are projected to be 6 per cent lower in 2020 than without a carbon price.

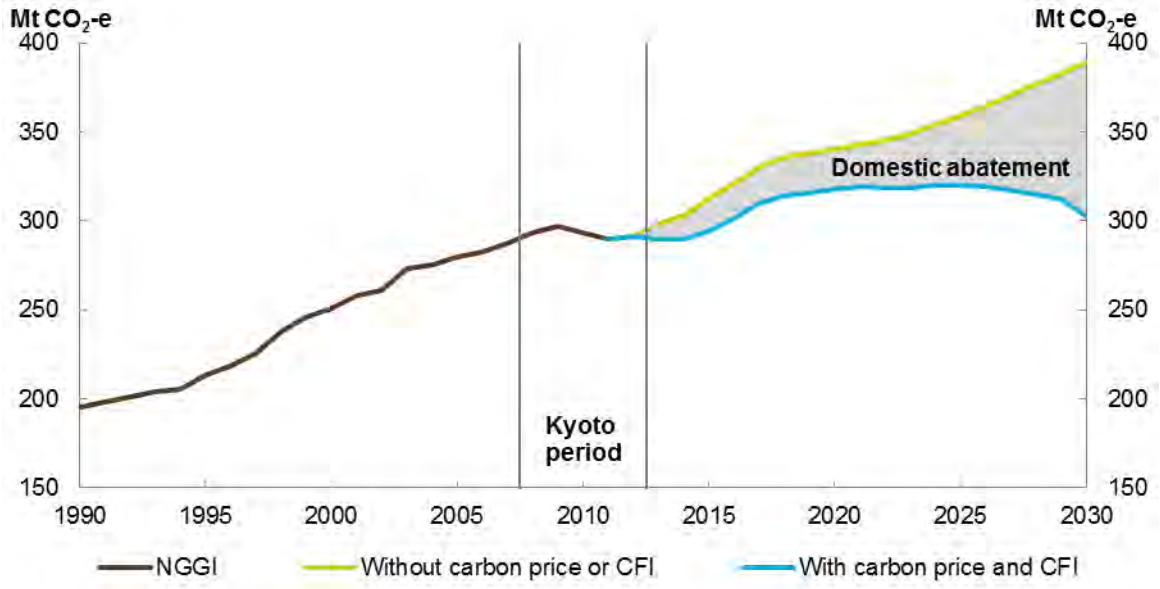
- Domestic emissions from electricity generation are projected to fall by 2 per cent from 2011 to 2020, instead of growing by 6 per cent without the carbon price, as the carbon price (on top of the RET) is projected to unlock abatement opportunities in the electricity generation sector by encouraging the use of less emissions-intensive fuels. The carbon price is projected to drive 16 Mt CO_2-e of abatement in 2020 as brown coal's share of the generation fuel mix decreases to around 14 per cent while the share of renewable energy increases to 20 per cent.[14]

Domestic stationary energy emissions are projected to peak in 2025, at which point they begin to decline to 2030, as large-scale uptake of renewable energy in the electricity generation sector offsets growth in direct combustion emissions. In 2030, domestic stationary energy emissions are 22 per cent lower than the without carbon price scenario.

- In 2030, direct fuel combustion emissions are projected to be 15 Mt CO_2-e lower than without a carbon price.

- In 2030, electricity sector emissions are 72 Mt CO_2-e lower than without the carbon price, as renewable energy is predicted to rise to 31 per cent of the electricity fuel mix.

Figure 13 Stationary energy emissions projection



[14] Renewable energy generation in 2020 is not expected to equal the total amount of large-scale certificates (LGCs) surrendered under the RET in 2020, due to the RET's provision for liable entities to bank certificates for use in future years and differences in coverage between the RET and the renewable energy categories reported in these projections. It is projected that the sum of renewable energy generation from both large-scale and small-scale generators and LGCs banked from previous years will be significantly higher than 20 per cent of total electricity generation in 2020.

Transport

In 2011, the transport sector represented 15 per cent of Australia's total greenhouse gas emissions and at 85 Mt CO_2-e, emissions were 38 per cent above 1990 emissions of 62 Mt CO_2-e. Transport is currently the third largest emitting sector in Australia.

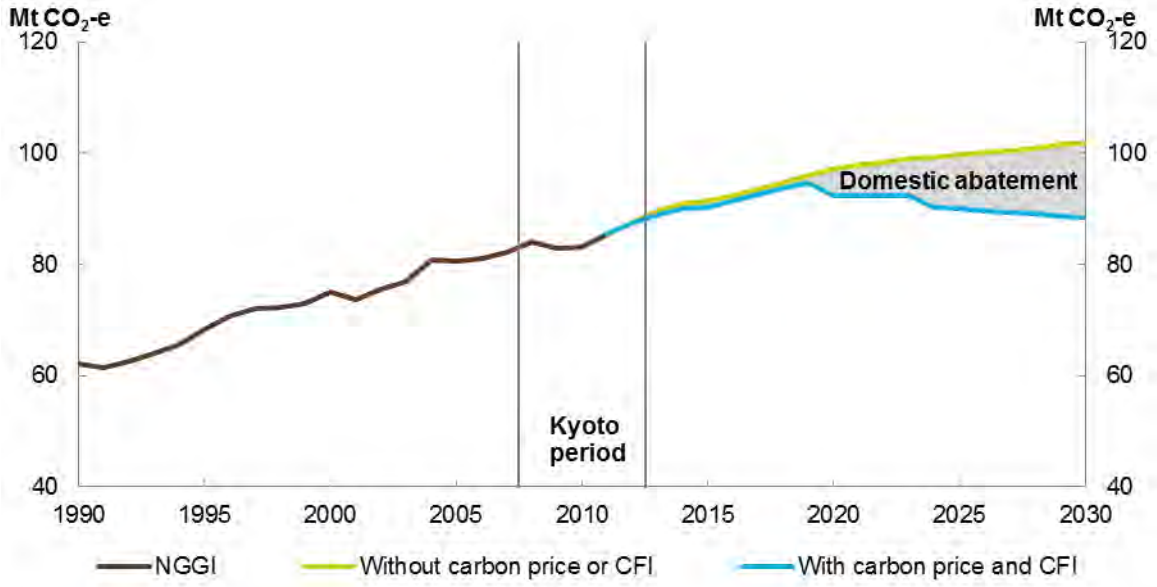
The transport sector covers emissions from the direct combustion (or end-use emissions) of fuels by road, rail, domestic aviation and domestic shipping. Road transport is the largest source of emissions, contributing 85 per cent of transport emissions in 2011. Around two thirds of transport emissions are not covered by the carbon price.

Transport sector emissions are driven primarily by economic activity, population growth and oil prices. Improvements in vehicle technology, such as fuel efficiency and engine design standards, are also significant in determining emissions.

***Transport* emissions are estimated to reach 85 Mt CO_2-e per year over the Kyoto period, an increase of 36 per cent above the 1990 level. In 2020, emissions are projected to reach 92 Mt CO_2-e, 5 Mt CO_2-e (5 per cent) below the level without the carbon price. In 2030, emissions are projected to be 88 Mt CO_2-e, 13 Mt CO_2-e (13 per cent) below the level without the carbon price.**

Most of the abatement in the transport sector occurs from 2020 onwards, the point at which replacement technologies become more widely available. To 2030, road transport is projected to deliver around 85 per cent of the transport abatement through fuel substitution from petrol to lower emissions diesel and biofuels, increased adoption of hybrid vehicles, and the emergence of electric road vehicles. Abatement in domestic aviation, domestic shipping and rail is more limited because of fewer available fuel and technology substitution options and long lifespans of capital stock.

Figure 14 Transport emissions projection



Fugitives

In 2011, fugitive emissions from fuels represented around 7 per cent of Australia's total greenhouse gas emissions and at 42 Mt CO_2-e, emissions were 45 per cent above 1990 emissions of 29 Mt CO_2-e.

The fugitives sector covers emissions 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.

A key driver of fugitive emissions is growth in the production of coal, oil and natural gas, which is strongly influenced by both export demand, and conditions in major domestic energy intensive sectors. The emissions intensity of production is a second important driver.

***Fugitive* emissions are estimated to average 42 Mt CO_2-e per year over the Kyoto period, an increase of 43 per cent on the 1990 level, after the effects of current mitigation measures are taken into account. In 2020, emissions are projected to reach 53 Mt CO_2-e, 14 Mt CO_2-e (21 per cent) lower than levels without a carbon price. In 2030 emissions are projected to reach 58 Mt CO_2-e, 29 Mt CO_2-e (33 per cent) lower than projected levels without a carbon price.**

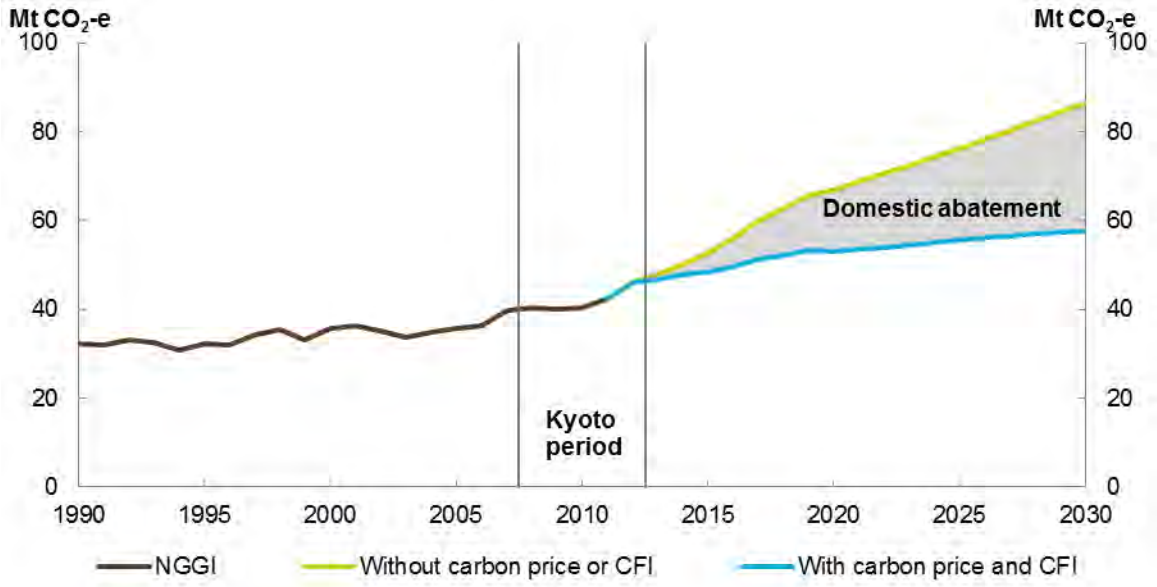
Due to the strength of export demand for Australian fuel production, fugitive emissions are expected to rise between 2012 and 2030 with and without a carbon price, driven by the development of new coal mines and rapid expansion of the Australian liquefied natural gas industry. While production is expected to remain strong in the fugitives sector, the carbon price is projected to moderate emissions growth, driving 14 Mt CO_2-e of abatement in 2020 and 29 Mt CO_2-e of abatement in 2030.

Emissions are projected to reach 53 Mt CO-e in 2020, a 48 per cent increase on 2000 levels but 21 per cent lower than levels without a carbon price. In 2030, emissions are projected to reach 58 Mt CO-e, 33 per cent lower than levels in the absence of a carbon price.

Under the carbon price, the largest improvements in emissions intensity are expected to be driven by coal production shifting away from the most emissions-intensive mines and the uptake of new technologies.

The key uncertainty in the fugitive projections 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. Action on climate change from Australia's key trading partners, such the pledges that China, Japan and India have made under the UNFCCC, may impact on coal demand as these economies transition to cleaner energy sources.

Figure 15 Fugitive emissions projection



Industrial processes

In 2011, the industrial processes sector represented 6 per cent of Australia's total greenhouse gas emissions and at 33 Mt CO_2-e, emissions were 36 per cent above 1990 emissions of 24 Mt CO_2-e.

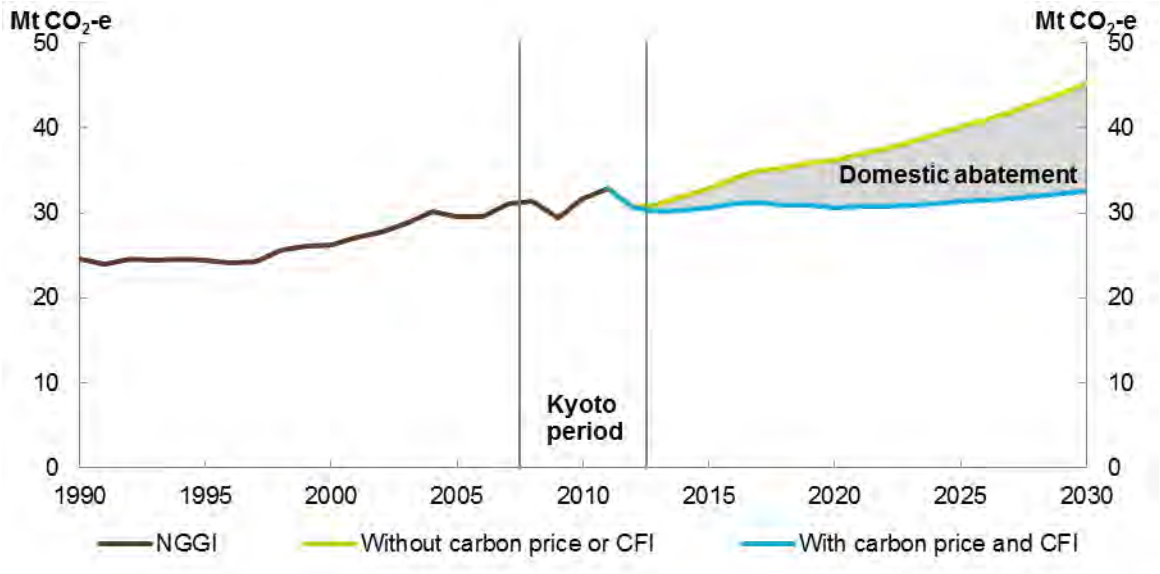
Emissions from industrial processes are the by-products of the use of non-energy related materials and reactions in production processes. They include emissions from mineral products (such as cement production), metal production, chemical production, and consumption of synthetic greenhouse gases.

Key drivers of industrial processes emissions are growth in production of metals, chemicals and mineral products, and in the stock of equipment with synthetic gases (such as refrigerators and air conditioners). Technological change is also an important driver where it results in falling emissions intensity in production processes.

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. In 2020, emissions are projected to be stable at 31 Mt CO_2-e, 6 Mt CO_2-e (15 per cent) lower than levels without a carbon price. In 2030 emissions are projected to be 33 Mt CO_2-e, 13 Mt CO_2-e (28 per cent) lower than levels without a carbon price.

The carbon price drives abatement by encouraging the adoption of new low emissions processes and technologies. Metal production currently is largest source of emissions within industrial processes but with the carbon price, its emissions are projected to decline by 5 Mt CO_2-e between 2011 and 2020. The chemical industry is the fastest growing subsector; emissions are projected to grow around 4 per cent per year between 2011 and 2020.

Figure 16 Industrial processes emissions projection



Agriculture

In 2011, the agriculture sector is expected to account for 14 per cent of Australia's total greenhouse gas emissions.[15] At 81 Mt CO_2-e, emissions from agriculture were 7 per cent below 1990 emissions of 87 Mt CO_2-e.

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

The key driver impacting on agricultural emissions projections is the size of the livestock herd, which is strongly driven by export demand and climate conditions. Emissions declined strongly between 2000 and 2008 as livestock numbers fell during the drought, and from 2008 to 2010 as slaughter rates for grazing cattle and sheep continued to be high. Livestock populations have since rebounded strongly following the increase in rainfall and improved water availability. Climate conditions also affect savanna fires in the Northern Territory and Western Australia, another source of agriculture emissions.

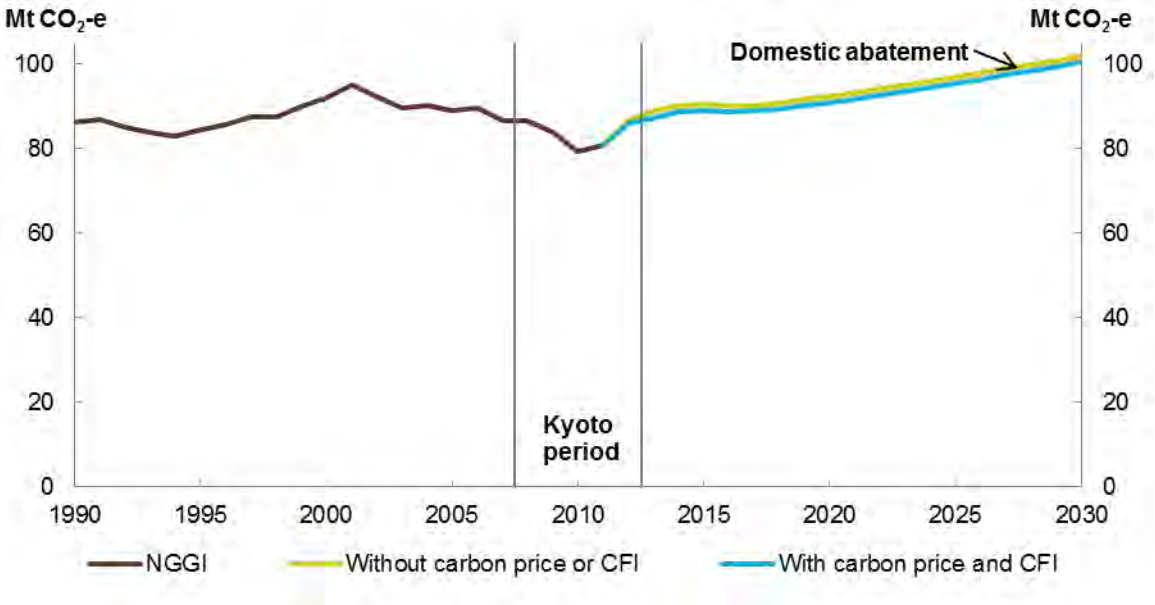
Agriculture **emissions are projected to reach 83 Mt CO_2-e per year over the Kyoto period, 4 per cent below the Kyoto 1990 level. Emissions are projected to increase to 91 Mt CO_2-e in 2020 and 100 Mt CO_2-e in 2030. Abatement achieved by the carbon price is projected to occur through the CFI. Abatement achieved through the CFI leads to domestic emissions being 1 Mt CO_2-e (2 per cent) lower in 2020 and 2 Mt CO_2-e (2 per cent) lower in 2030 than without these measures.**

Improved water availability and international demand for agricultural commodities are the key drivers of growth in agriculture emissions. Following the breaking of the drought in southern and eastern Australia, farmers have begun rebuilding their flocks and herds since 2010 after recent lows. Emissions from all subsectors of agriculture are projected to increase to 2020. Savanna burning emissions are projected to increase to the long-term historical average and remain stable across the projections period.

One uncertainty in the agricultural sector is the extent to which climate change will increase the frequency and magnitude of droughts during the projection period. Qualitatively, more frequent and severe droughts could decrease livestock and cropping activity, leading to lower emissions.

[15] The most recent agriculture emissions data are for 2010. 2011 emissions are projected, not actual.

Figure 17 Agriculture emissions projection



Waste

In 2011, the waste sector is expected to account for 2 per cent of Australia's total greenhouse gas emissions, and at 14 Mt CO_2-e, emissions are estimated to be 26 per cent below 1990 emissions of 19 Mt CO_2-e[16].

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.

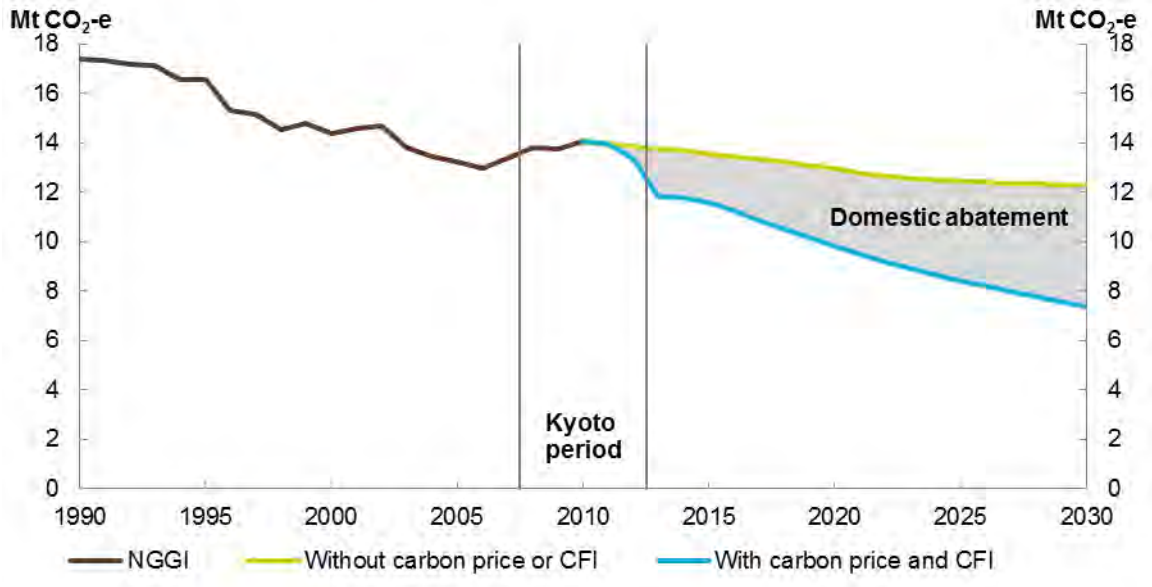
Key drivers of waste emissions are waste deposited in landfill, which is affected by population, waste diversion, waste generation rates, and methane capture rates. Waste emissions have generally declined since 1990 due to improved diversion of waste from landfill to recycling and increasing methane capture in the sector.

***Waste* emissions are projected to reach 14 Mt CO_2-e per year over the Kyoto period, a decrease of 27 per cent from the Kyoto 1990 level, after the effects of current mitigation measures are taken into account. Emissions are projected to decrease to 10 Mt CO_2-e in 2020, 3 Mt CO_2-e (24 per cent) lower than the level without the carbon price. In 2020, 1 Mt CO_2-e of abatement from the carbon price is expected to be achieved through the CFI through reductions in legacy waste emissions. In 2030, emissions are projected to be 7 Mt CO_2-e, 5 Mt CO_2-e (40 per cent) lower than the level without the carbon price.**

Some waste facility operators are expected to reduce their emissions under the carbon price by capturing additional methane for electricity generation or flaring. The carbon price may also drive improvements in waste diversion to reduce emissions further.

Some abatement is projected to occur in addition to the impact of the carbon price due to jurisdictional targets for waste diversion and additional methane capture driven by the RET.

Figure 18 Waste emissions projection



[16] The most recent waste emissions data are for 2010. 2011 emissions are projected, not actual.

Deforestation

In 2011, deforestation is expected to account for around 8 per cent of Australia's total greenhouse gas emissions and at 46 Mt CO_2-e, emissions are estimated to be 65 per cent below 1990 emissions of 132 Mt CO_2-e[17].

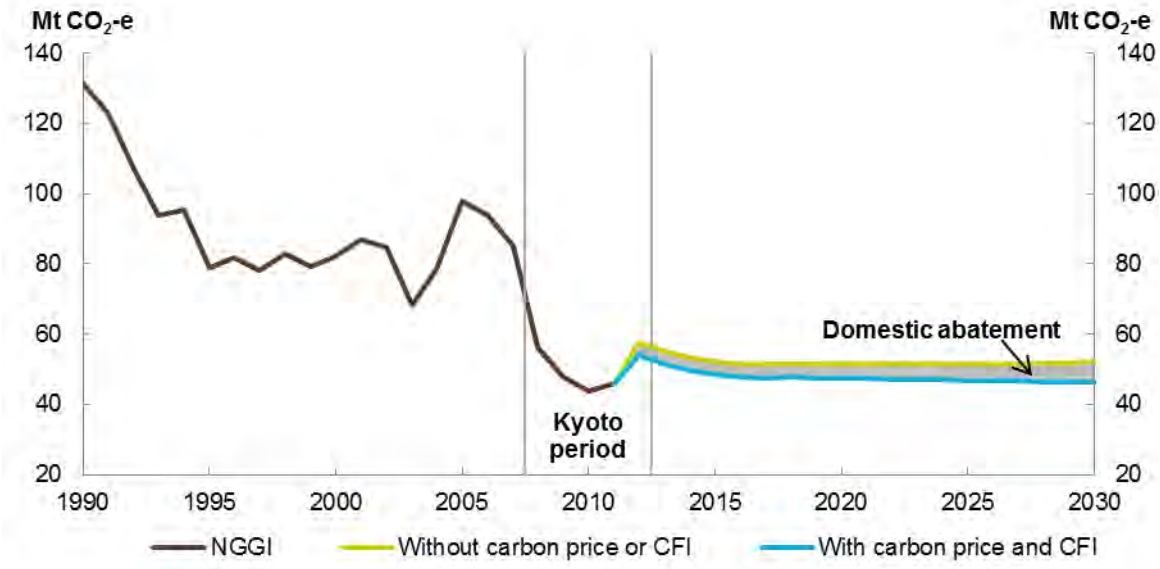
Deforestation is the direct, human-induced removal of forest cover and replacement with pasture, crops or other uses on land that was forest on 1 January 1990. Emissions result from the burning of removed forest cover, decay of unburnt cleared vegetation, and emissions from soil disturbed in the process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

Deforestation activities are influenced by factors such as farmers' terms of trade, technological change, climatic events (e.g. drought) and government land-clearing policies. The deforestation projections are based on biomass and soil carbon modelling for different forest types and forecast land clearing rates.

Annual rates of land clearing have decreased substantially since 1990 with consequent reductions in estimated emissions. Future land clearing rates are based on forecast farmers' terms of trade, with high terms of trade providing an economic incentive to clear land.

Deforestation **emissions are projected to reach 50 Mt CO_2-e per year over the Kyoto period, a decrease of 62 per cent from the 1990 level. Emissions are projected decline to 47 Mt CO_2-e in 2020 and 46 Mt CO_2-e in 2030. Abatement achieved by the carbon price through the CFI leads to emissions being 4 Mt CO_2-e (8 per cent) lower in 2020 and 6 Mt CO_2-e (11 per cent) lower in 2030 than without these measures.**

Figure 19 Deforestation emissions projection



Note: Deforestation emissions under Kyoto accounting rules can only be calculated for the Kyoto period (2008-2012). UNFCCC reporting for land use change is presented in the chart for the period 1990-2007 to provide a historical time-series. Unlike UNFCCC reporting, Kyoto accounting rules for deforestation include only deforestation of land that was forested in 1990. The projection from 2012 has been prepared consistent with accounting rules under the first commitment period of the Kyoto Protocol.
Source: DCCEE.

[17] The most recent deforestation emissions data are for 2010. 2011 emissions are projected, not actual.

Reforestation activities

In 2011, removals (or sequestration) due to reforestation activities are expected to contribute 22 Mt CO_2-e of sequestration to reduce Australia's net emissions[18]. 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.

The estimates of sequestration in these projections are limited to removals in the land sector activities under Article 3.3 of the Kyoto Protocol[19]. The removals result when carbon is sequestered by forest plantations growing on this land.

Key drivers for removals from reforestation activities are the area of the plantation forest estates, past rates of plantation establishment, and harvesting rates.

Sequestration over the Kyoto period with the application of the Kyoto Protocol harvest sub-rule[20] is projected to be 23 Mt CO_2-e per year. Sequestration is projected to be 5 Mt CO_2-e in 2020, and 2030. Abatement in reforestation activities achieved by the carbon price through the CFI leads to sequestration being 0.2 Mt CO_2-e (4 per cent) higher in 2020 and 0.8 Mt CO_2-e (19 per cent) higher in 2030 than without these measures.

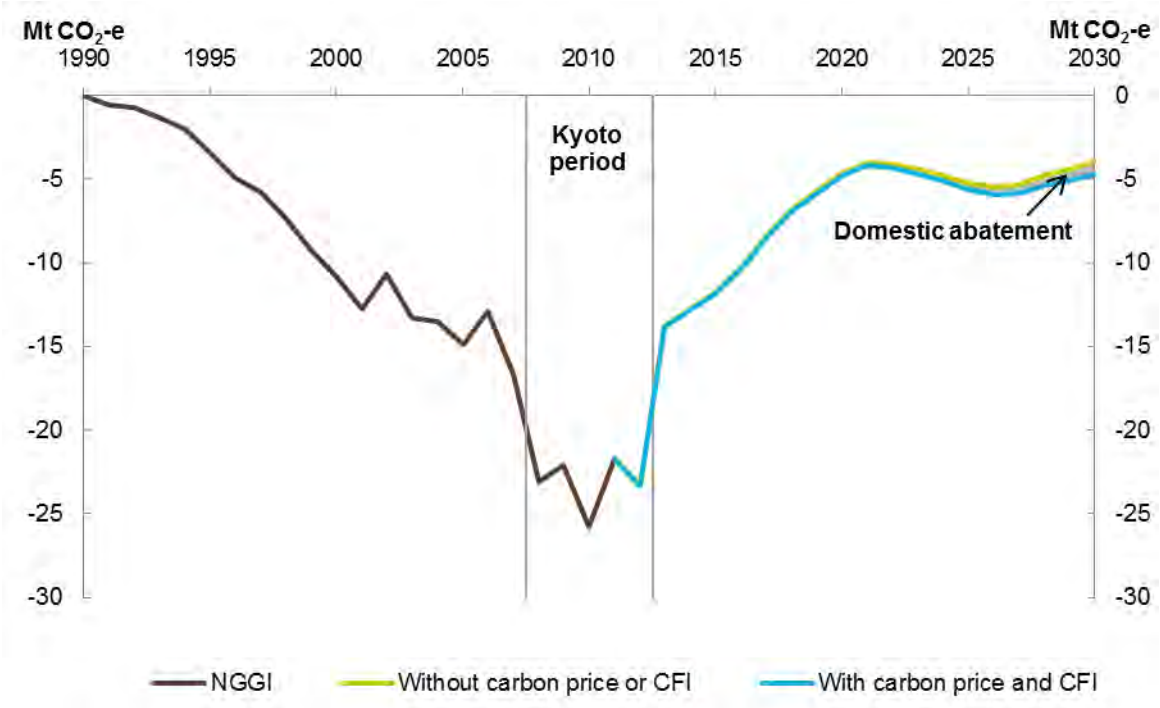
In 2010, the rate of plantation establishment was the lowest since 1990. This may have been caused by the economic conditions for forest products, including the historically high value of the Australian currency in 2010, making it more challenging to export plantation products overseas. With several major producers exiting the plantation forestry market, the projections assume slow growth in the total area of forest plantations to 2030.

[18] The most recent reforestation activity emissions data are for 2010. 2011 emissions are projected, not actual.

[19] The activities listed under Article 3.4 of the Kyoto Protocol (cropland management, grazing land management, forest management and revegetation) have not been included in these projections, nor previous projections, but may be included in future, pending future decisions by the Australian Government regarding a second commitment period of the Kyoto Protocol.

[20] 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.'

Figure 20 Reforestation activities emissions projection



Note: The data have been smoothed post-2012 and do not include the effect of the harvest sub-rule in the period 2008-2012.
Source: DCCEE analysis.

Taking action to reduce Australia's emissions

Abatement from measures in covered sectors

In previous projections, the abatement achieved by Government policies and programs (or 'measures') was calculated by measuring the difference between a 'with measures' scenario and a 'business and usual' scenario that excluded the impact of measures. In the 2012 projections, no business as usual scenario has been modelled and the abatement achieved by key measures has been incorporated into both the 'with carbon price' and 'without carbon price' scenarios.

Through the *Clean Energy Act 2011*, the Australian Government legislated that after an initial fixed price period, a 'cap-and-trade' emissions trading scheme (ETS) will begin from 2015. From 1 July 2015, emissions in sectors covered by the ETS will be subject to the cap. Once the cap is introduced, emissions reductions from other measures in covered sectors will not reduce net emissions beyond the level achieved by the cap.

However, abatement measures within a covered sector will:

- influence the composition of abatement, that is, the amount of abatement achieved domestically as distinct from international sources; and
- change the cost of achieving abatement targets.

While measures that operate in sectors under the ETS cap will not achieve any additional *net* abatement beyond that achieved by the ETS, it is still possible to calculate the proportion of *domestic* abatement achieved by measures under the cap. However, this is a complex task.

Many of the measures overlap, making it hard to attribute abatement to a particular measure. For example, some measures might provide financial incentives or information to encourage the installation of energy efficient equipment. However, the equipment itself may have been regulated by minimum energy performance standards. In such cases, it is important to ensure abatement is not attributed to multiple measures and thereby 'double counted'. This is a task that can be difficult, especially in the absence of granular data.

Quantifying abatement from measures also requires making assumptions around what would have happened in the absence of the measure (known as a 'counterfactual' scenario). Factors such as rates of technological improvement, price elasticity of demand, or capital and building stock turnover rates, are integral to estimating how much abatement a measure achieves in addition to 'business as usual'.

The introduction of the economy-wide carbon pricing mechanism introduces a further layer of complexity into the task of isolating abatement attributable to particular measures. A carbon price provides a price incentive to encourage abatement. This incentive to reduce carbon pollution will arise for entities that face a direct carbon price liability. However, as these costs are passed through to downstream consumers the carbon price will be felt, and will drive abatement throughout the economy, including where existing measures are in place.

Measures that provide a financial incentive to achieve abatement (such as the RET) will overlap with the carbon price, as both provide a price signal that will support the generation of renewable energy to some extent. Quantifying the abatement achieved by measures such as the RET requires determining to what extent the carbon price would drive the generation of renewable energy itself, and hence what additional generation is being driven by the RET.

Where regulatory or other measures target *non-price* barriers to abatement (such as information failures or split incentives), it could be expected that they would achieve domestic

abatement beyond the level achieved by the carbon price. However, in these cases, attributing abatement to measures will require assessing the significance of non-price barriers and the extent to which measures are targeted at these barriers.

Due to these complexities in attributing abatement to specific measures in the presence of an economy-wide carbon price, abatement estimates for measures operating in sectors covered by the carbon price have not been published in the 2012 emissions projections.

Abatement from measures in uncovered sectors

For measures targeting the abatement of greenhouse gas emissions not covered by the carbon price, there is no direct overlap between the measures and the carbon price. These measures could be expected to achieve domestic abatement in addition to the abatement achieved by the carbon price.

Abatement attributed to key measures in uncovered sectors is provided below:

Table 5 Abatement from measures of emissions not covered by the carbon price

Name	Abatement (Mt CO_2-e)	
	2015	2020
Queensland and New South Wales land clearing legislation	19.6	18.4
WA Smart Travel	0.5	0.4
Greenhouse Friendly	0.4	0.3
Greenhouse Gas Abatement Scheme	1	1
Total	**21.8**	**20.1**

Note: Sub-totals may not sum due to rounding.

Carbon Farming Initiative

The Carbon Farming Initiative (CFI) commenced on 15 September 2011. The CFI is a unique type of measure in that it provides abatement in sectors not covered by the carbon price and allows liable parties under the carbon price to use CFI credits to offset their emissions. Because of its link to the carbon pricing mechanism, the CFI does not lead to additional *net* abatement beyond that which would be delivered by the carbon pricing mechanism. However, the CFI does increase the amount of abatement achieved domestically (as distinct from international sources) in a similar way to measures in sectors covered by the carbon price.

Abatement attributed to the CFI is presented below:

Table 6 Abatement from the Carbon Farming Initiative

Name	Abatement (Mt CO_2-e)	
	2015	2020
Carbon Farming Initiative		
Deforestation activities	3.7	4.0
Reforestation activities	<0.1	0.2
Waste activities	1.6	1.1
Agriculture activities	1.7	1.9
Total	**7.0**	**7.2**

Note: sub-totals may not sum due to rounding.

Changes from previous projections

Australia releases official projections of its greenhouse gas emissions annually. In February 2011, the Department of Climate Change and Energy Efficiency released *Australia's emissions projections 2010* (the 2010 projections). Since the release of the 2010 projections, the Commonwealth Treasury released *Strong Growth, Low Pollution: Modelling a carbon price* (SGLP) which included projections of Australia's emissions to 2050. The Treasury modelling used a suite of models including sector-specific and economy-wide, computable general equilibrium models, to analyse the impact of the carbon price on the Australian economy and Australia's emissions. This section summarises differences between the 2012 projections, the 2010 projections and SGLP.

Changes from 2010 projections

Since the release of the 2010 projections, the NGGI has been updated to include complete 2010 and preliminary 2011 emissions data. The 2012 projections incorporate these updated data. The updated NGGI shows that emissions for 2010 were lower than had been previously projected. Based on the most recent NGGI, average annual emissions over the Kyoto first commitment period are estimated to have been 105 per cent of Kyoto 1990 levels and 6 Mt CO_2-e lower on average than the 2010 projections of 106 per cent of Kyoto 1990 levels (Table 7). This change has been driven by the following factors:

- Lower average annual emissions from the agriculture sector (3 Mt CO_2-e on average per year) due to improvements in the NGGI's savanna burning methodology to better account for greenhouse gas emissions from burning different types of vegetation.
- Lower average emissions from electricity generation (3 Mt CO_2-e on average per year), due to a contraction in electricity demand and the impacts of extreme weather events.
- Higher average annual emissions from direct combustion (2 Mt CO_2-e on average per year), due to stronger growth in emissions in 2010 and 2011 than previously projected.
- Lower average annual emissions from deforestation, reforestation and afforestation (1 Mt CO_2-e on average per year) due to better information gained from new forestry satellite imagery.

The most significant change between the 2010 projections and the 2012 projections stems from the introduction of the carbon price and the CFI. In 2020, domestic emissions in the with carbon price scenario are projected to be 52 Mt CO_2-e lower than the 2010 projections' 'with measures' scenario with the carbon price and CFI achieving 55 Mt CO_2-e of abatement. In 2030, emissions are projected to be 172 Mt CO_2-e lower than the 2010 projections with the carbon price and CFI achieving 160 Mt CO_2-e of abatement.

Emissions in the 2012 projections' without carbon price scenario are 3 Mt CO_2-e higher in 2020 than in the broadly-comparable 2010 projections 'with measures' scenario. The upward revision is largely due to higher than previously forecast gas combustion in LNG production, based on final investment decisions being recently taken on a number of large LNG projects. Due to these changes, emissions from direct combustion in the 2012 projections are 14 Mt CO_2-e higher than the 2010 projections.

Emissions from deforestation and reforestation in the 2012 projections without carbon price scenario are 5 Mt CO_2-e higher in 2020 than in the 2010 projections. Projected sequestration from reforestation has been revised down due to current plantation rates being at historical low

levels. The deforestation emissions projection has also been revised up as a result of methodological improvements incorporating new land clearing observations, updated estimates of long-term average biomass densities and the effects of farmers' terms of trade.

Higher projected emissions from direct combustion and deforestation and reforestation in the 2012 projections are partially offset by changes in the electricity and industrial processes sectors. These revisions are largely due to developments in the Australian manufacturing sector since the release of the 2010 projections. Gross output from emissions-intensive industries such as aluminium and steel production is forecast to be significantly lower than in the 2010 projections, following plant closures amid a high Australian dollar and low global metal prices. Where possible, these closures have been incorporated into the 2012 projections. Agriculture, waste and fugitive emissions in 2020 have also been revised down since the 2010 projections.

In 2030, the without carbon price scenario is 18 Mt CO_2-e lower than the 2010 projections. This is predominantly due to lower projected emissions from electricity generation that outweighs upwards revisions to direct combustion and deforestation and reforestation.

Emissions from electricity generation in the 2012 projections are 19 Mt CO_2-e lower in 2030 than in the 2010 projections. The 2012 projections incorporate Treasury's electricity demand forecast from the SGLP modelling, which is lower than the forecast underpinning the 2010 projections. Treasury's electricity demand forecast is influenced by lower predicted growth in energy-intensive industries and different forecasts for energy prices than the 2010 projections.

Other sectors projected to have lower emissions in 2030 than in the 2010 projections include the waste sector (5 Mt CO_2-e lower), due to better forecasts of jurisdictional waste diversion rates and methane capture rates; and the agriculture sector (2 Mt CO_2-e lower) which has been affected by changes to the savanna burning methodology in the NGGI.

Table 7 Changes from 2010 projection

	Kyoto period average 2008-12	**2020 without carbon price or CFI**	**2020 with carbon price and CFI**
	Mt CO_2-e	Mt CO_2-e	Mt CO_2-e
Energy	-2	6	-35
Electricity	*-3*	*-7*	*-23*
Direct Combustion	*2*	*14*	*8*
Transport	*-0.1*	*0.6*	*-4*
Fugitive	*-0.7*	*-2*	*-16*
Industrial processes	-0.1	-4	-9
Agriculture	-3	-2	-3
Waste	-0.8	-3	-6
Deforestation and reforestation	-0.7	5	0.9
Deforestation	*1*	*3*	*-1*
Reforestation	*-2*	*2*	*2*
Total	**-7**	**3**	**-52**

Note: Sub-totals may not sum due to rounding.

Changes from SGLP

In general, the 2012 projections are broadly in line with SGLP modelling. In aggregate, the abatement challenge in 2020 is projected to be 155 Mt CO_2-e, 4 Mt CO_2-e smaller than that in SGLP. In many sectors, emissions projections have been based heavily on results from SGLP. However, the 2012 projections use bottom-up modelling to update the SGLP without carbon price scenario for new information. This includes updated information relating to changes in industry sectors, particularly iron and steel, LNG production and more recent data on reforestation and deforestation activities. As noted in the previous section, the 2012 projections also incorporate updated information from the NGGI for 2010 and 2011, whereas the latest complete NGGI data available during the SGLP exercise was from 2009. The updated information has resulted in some differences between the 2012 projections and SGLP.

In the 2012 projection, emissions without a carbon price in 2020 are 7 Mt CO_2-e higher than projected in SGLP modelling, taking into account abatement achieved by the CFI[21]. The biggest sectoral differences from SGLP are higher emissions from land use change and forestry and direct combustion. The 2012 projections incorporate more recent data on current forestry plantation and logging rates, as well as more recent information on LNG production over the period to 2020.

In 2020, domestic emissions with the carbon price and the CFI are 16 Mt CO_2-e higher than the SGLP modelling, with the most significant differences in the land use change and forestry and direct combustion sectors as noted above. The impact of the carbon price on the output and emissions intensity of each sector is based on SGLP modelling, leading to very close projections in the other sectors.

Further details regarding revisions can be found in each technical sectoral paper. These can be found on the Department's website http://www.climatechange.gov.au.

[21] The SGLP without carbon price scenario includes abatement from the CFI.

Key assumptions

General assumptions

The 2012 projections are largely based on SGLP results and have consequently been prepared according to the economic outlook presented in the SGLP report and the 2012-13 Budget. The macroeconomic variables most relevant to the preparation of the projections include:

- forecasts of gross domestic product (GDP) and gross national income;
- Australian population forecast;
- the international carbon price modelled in SGLP and incorporated in the 2012-13 Budget;
- improvements in energy efficiency at a global, national and sectoral level;
- electricity technology assumptions; and
- industry growth rates and projections of changes to the emissions intensity of the Australian economy from SGLP.

The projections are supplemented by data from a range of sources in addition to SGLP results. The supplementary data is used to incorporate developments in sectors since SGLP, as well as provide greater sectoral detail. For a detailed list of input data, refer to each sectoral paper.

Sensitivity of emissions to the carbon price

Australia's net emissions are not sensitive to changes in the carbon price as the emissions cap will ensure that net emissions are 537 Mt CO_2-e in 2020, with abatement achieved through a combination of domestic abatement and international permit imports. However, changes in the carbon price would change the amount of abatement achieved domestically. Liable entities will meet their liability by reducing their emissions when it is cost effective for them to do so and purchase permits when their cost of abatement exceeds the carbon price. This trade-off results in domestic emissions being higher (lower) under a lower (higher) carbon price.

The with carbon price projection was prepared using the international carbon price modelled by Treasury in SGLP. This carbon price is fixed for the first three years of the carbon pricing mechanism beginning at $23 per tonne of carbon dioxide equivalent (t CO_2-e) in 2012-13 and increasing by 2.5 per cent in real terms each year until 30 June 2015. From 2015-16, the carbon pricing mechanism will transition to a flexible price cap-and-trade emissions trading scheme and Australia's carbon price is expected to follow the international carbon price. Treasury modelling indicates an international carbon price of $29/t CO_2-e in 2015-16.

Analysis was run on the 2012 projections to indicate the sensitivity of domestic abatement from the carbon price to different carbon price levels up to 2020. The analysis is based on recalibrated SGLP modelling of changes to the level of abatement achieved under a lower or higher carbon price[22]. These scenarios provide an indication of sensitivity to the carbon price mechanism, which show broadly linear changes in domestic emissions.

[22] The low and high sensitivity scenarios are hypothetical demonstrations of domestic emissions' sensitivity to changes in a carbon price. The upper and lower bounds do not represent government policy and are intended to be purely illustrative.

The higher price series considered in SGLP and in this analysis could be above the price ceiling outlined in the *Clean Energy Act 2011*. This means that the high carbon price sensitivity analysis could demonstrate a greater response in emissions than would arise if the price ceiling was reached.

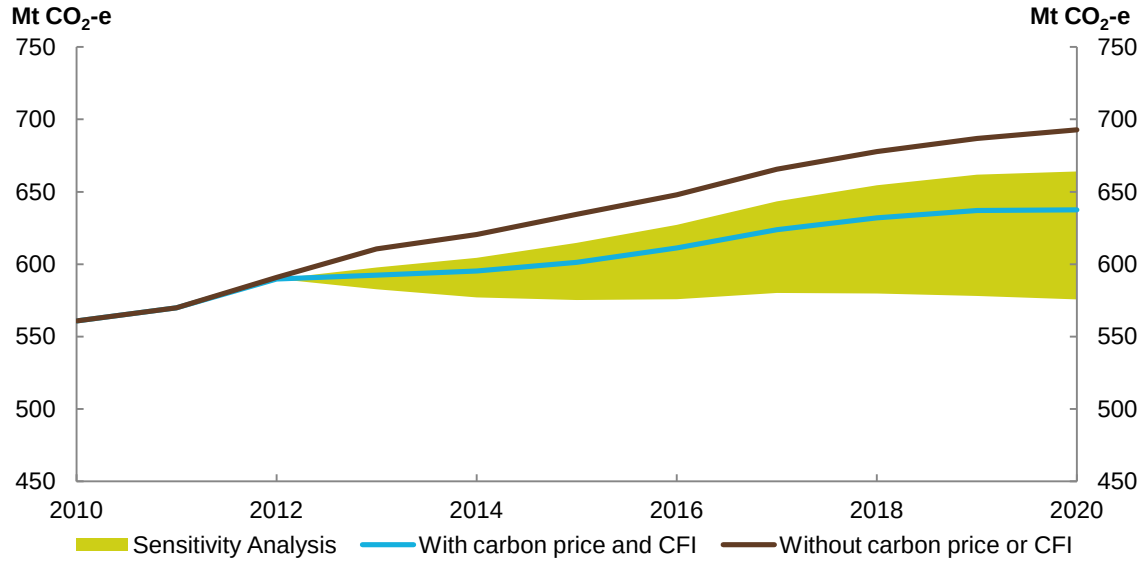
The low carbon price scenario assumes a nominal domestic starting price of $10/t CO_2-e in 2012-13 rising by 5 per cent per year plus inflation to 2020.

In the low carbon price scenario, less domestic abatement is achieved by 2020 and emissions are closer to the level they would have been in the absence of a carbon price. The lower carbon price induces 29 Mt CO_2-e of domestic abatement in 2020; around half of the domestic abatement achieved in the central scenario. However, it is possible that as businesses innovate and respond to the carbon price signal the cost of abatement in particular industries could differ from what is modelled in the projections. If greater opportunities for inexpensive abatement are identified than in the projections, it may be possible that higher levels of domestic abatement will occur in certain areas of the economy.

The high carbon price scenario presents the impact of a higher carbon price on domestic emissions. The high price scenario assumes a nominal starting price of $30/t CO_2-e in 2012-13, increasing by 5 per cent per year plus inflation for three years, transitioning to a flexible international price in 2015-16 of around $61/t CO_2-e.

In the high price scenario, domestic abatement from the carbon price reaches 130 Mt CO_2-e in 2020, more than double the abatement achieved in the central scenario as domestic abatement would be relatively more cost effective.

Figure 21 Australian emissions with a higher or lower starting carbon price



Source: Treasury, 2011 with DCCEE analysis. The sensitivity scenarios are purely illustrative and do not represent Government policy. For example, between 2012 and 2015, the carbon price will be fixed (starting at $23 per tonne of CO_2-e), which is not represented on the figure above.

This analysis does not take into account the economic cost of achieving varying levels of abatement sooner or later. SGLP provided a comprehensive analysis of the implications of carbon pricing on the economy, at a global, national, regional and sectoral level.

The sensitivity analyses presented in the sectoral projections are for key additional uncertainties in each sector and are discussed in more detail in the sectoral chapters.

The estimates in this paper are based on projections current at September 2012.

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 reforestation

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