Australian Government
Department of Climate Change and Energy Efficiency

EXECUTIVE MINUTE

on

JOINT COMMITTEE OF PUBLIC ACCOUNTS AND AUDIT REPORT 418

Review of Auditor-General's Reports Nos. 04 to 38 (2009-10)

General comments

The Department of Climate Change and Energy Efficiency supports the recommendation and provides the following report as requested.

Response to the recommendation(s)

Recommendation No. 4 paragraph 1-2

The Committee recommends that the Department of Climate Change and Energy Efficiency provide the Committee with a progress report within 12 months of the tabling of this report on the concrete measures that have been implemented to improve the effectiveness of Australian government abatement programs.

The report should include:
- a copy of the finalised abatement measurement guidelines;
- examples of how 'business as usual' factors and other economic drivers have been taken into account when measuring individual estimates; and
- a copy of the annual report showing the consolidated abatement figures across responsible agencies.

a) Guidelines for measuring abatement and the cost of abatement

In October 2008, following the Strategic Review of Australian Government Climate Change programs (the Wilkins Review), Cabinet directed the Department of Climate Change to develop a methodology for estimating the cost of abatement implicit in new climate change policy proposals to help inform the Cabinet of their relative merits.

Use of a common methodology across the Australian Government will improve the consistency of cost of abatement estimates by different agencies, and within agencies. DCCEE has now developed guidance on estimating the cost of abatement and its two components – abatement from a policy or program, and the costs associated with it.

It is intended that the methodology will be used in the development and assessment of new policy proposals, assessing proposed abatement measures, reporting on the performance of a program and other processes involving assessment/comparison of abatement measures.

The guidance paper, *Estimating the cost of abatement, Framework and practical guidance*, October 2011, is provided at **Attachment A** and is also available on the DCCEE website. http://www.climatechange.gov.au/publications/abatement/estimating-cost.aspx

b) 'Business as usual' factors

An important element of estimating abatement from policies, is being able to determine the 'counterfactual' – what would have happened in the absence of the policy. In many cases it is reasonable to assume that some proportion of the activity induced by the policy would have occurred anyway, for other reasons. In these cases, only the additional abatement that occurs is counted towards the abatement estimate for that policy. Some policies may also bring forward abatement activities that may have otherwise occurred at a later date. Estimating these factors can be difficult as it involves making assumptions about a future situation that does not exist.

Estimating the cost of abatement, Framework and practical guidance provides advice and examples of how to take into consideration business as usual factors in the estimation of abatement. The guidance requires users to estimate the likely abatement and costs in the presence of the policy and in the absence of the policy, with the abatement and costs attributed to the policy being the difference between the two. See sections 2 and 3 of *Estimating the cost of abatement, Framework and practical guidance* for further information.

Two factsheets have also been published on the DCCEE website as part of the annual emissions projections release (February 2011).

1. *Emissions reductions from Government policies and measures*, provides an overview on abatement estimates, what is included and how abatement is estimated. It is provided at **Attachment B** and is available on the DCCEE website. http://www.climatechange.gov.au/publications/projections/australias-emissions-projections/factsheet-emission-reductions.aspx

2. *Home Insulation Program: emissions reductions*, provides a more detailed analysis of the abatement estimate for the Home Insulation Program. This factsheet provides a good example of how business as usual factors were considered. The factsheet is provided at **Attachment C** and is available on the DCCEE website. http://www.climatechange.gov.au/publications/projections/australias-emissions-projections/factsheet-hisp-emissions-reductions.aspx

c) Reporting

The annual emissions projections publication provides the regular reporting mechanism of abatement estimates for policies and programs.

A summary of abatement estimates is provided in the overall document, *Australia's emissions projections 2010*, provided at **Attachment D** and is available on the DCCEE website. http://www.climatechange.gov.au/publications/projections/australias-emissions-projections.aspx

Abatement estimates for each sector are available in each sectoral paper. http://www.climatechange.gov.au/publications/projections/australias-emissions-projections.aspx

A factsheet summarising abatement estimates, *Estimates of emissions reductions from Government policies and measures* is also provided at **Attachment E** and is available on the DCCEE website. http://www.climatechange.gov.au/publications/projections/australias-emissions-projections/fact-sheet-estimates-emissions-reductions.aspx

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Estimating the cost of abatement


Framework and practical guidance

October 2011

thinkchange

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This document is available on the Internet at the following address:

www.climatechange.gov.au/

October 2011

Contents

Introduction

What is the cost of abatement?

The cost of abatement is an estimate of the cost-effectiveness of a policy at reducing carbon emissions, expressed in dollars per tonne of abatement. [1]

Why estimate the cost of abatement?

The Australian Government has set national greenhouse gas emissions reduction targets for 2020 and 2050. Given these targets, the wellbeing of Australians will be maximised if these targets are met in the most cost-effective way. The cost of abatement is a tool that enables the cost-effectiveness of emissions reduction policies to be assessed within this context.

When should the cost of abatement be used?

The relevance of the cost of abatement of a policy depends to a large extent on the objective(s) of the policy. [2] [3]

If abatement is the primary objective of a policy, the cost of abatement will be the primary indicator of its cost-effectiveness. However, if abatement is one of several objectives of the policy, the cost of abatement will be one of several indicators of the policy's cost-effectiveness.

For some policies, such as technology research and development programs, direct abatement may be an incidental outcome and not a key objective of the policy. [4] For such policies, the cost of abatement may be of interest, but may be less relevant to decision makers.

Even where abatement is the sole objective of a policy, other matters such as risk, equity and the role of government in undertaking market interventions may also be relevant to decision makers.

Purpose of the document

For estimates of the cost of abatement to be meaningful, they should be calculated in a sound and consistent way across policies. This document provides a framework and practical guidance for performing a simple cost of abatement analysis. Where policies have far reaching effects on the whole economy, more detailed modelling may be required, such as partial or general equilibrium analysis. Regardless of the analytical approach, the principles in this document still apply.

This framework has been developed by the Department of Climate Change and Energy Efficiency (DCCEE) in consultation with relevant experts, potential users and other interested

[1] In this document, the word 'carbon' is used as shorthand to refer to the six greenhouse gases covered by the Kyoto Protocol.
[2] In this document, the word 'policy' should be read as meaning any policy, measure, program or option that has the mitigation of greenhouse gas emissions as an objective.
[3] Throughout this document 'abatement' is used as shorthand for 'greenhouse gas mitigation'.
[4] In these cases, the aim of the research is to develop technology that will lead to abatement in the future. Any abatement directly achieved from the actual research activities may be only an incidental outcome.

parties. It implements Recommendation 3.4 of the *Strategic Review of Australian Government Climate Change Programs: Final Report* (2008) (the ‘Wilkins Review’) viz: “The Department of Climate Change should develop a methodology for estimating the carbon abatement cost implicit in new climate change policy proposals, to inform consideration of their relative merits.”

Australian Government agencies estimating the cost of abatement and the amount of abatement achieved by a policy should follow the principles set out in this document. This methodology can also be used by other interested parties involved in assessing the cost of abatement implicit in greenhouse gas mitigation policies.

Most of the data required for this analysis is that same data used in a cost-benefit analysis.

Further guidance

DCCEE is able to provide advice and assistance to those using this methodology. Users of this document may register their details with DCCEE to receive updates.

DCCEE welcomes ongoing comments and feedback on this methodology.

Please direct questions and comments to the following email address:

costofabatement@climatechange.gov.au

Summary

Cost of abatement

Estimating the cost of abatement involves calculating the potential abatement of the policy and the cost of achieving this abatement. Dividing the cost by the abatement gives the average cost per tonne of abatement.

Cost of abatement methodology in brief

The cost of abatement can be calculated using seven broad steps as shown in Figure 1. Each of these steps is demonstrated in detail in this document.

Some issues to bear in mind when performing these calculations are:

- data gaps;
- additionality;
- discounting costs;
- adapting the methodology to suit the purpose; and
- sensitivity analysis.

It is important that the cost of abatement is calculated for only the ‘additional’ abatement and costs stimulated by the policy. In other words, the costs and abatement that occur as a result of the policy. For this reason a key part of the methodology is subtracting any abatement and costs/savings that would have occurred in the absence of this policy from those that occur in the presence of the policy.

There are many different ways to calculate the cost of abatement. The suitability of different calculation methods will depend on the nature and structure of the policy. Regardless of the calculation method used, it is important that the principles of this methodology and in particular ‘additionality’ are adhered. DCCEE can advise on the suitability of alternative methods.

Figure 1: Cost of abatement methodology

1. Evaluation framework	(a) What is the intended action? (b) How many intended actions will occur each year? (c) How long will the intended actions be in effect?
2. Abatement and costs in the presence of the policy	(a) How much will emissions change over time in the presence of the policy? (b) How much will costs change over time in the presence of the policy?
3. Abatement and costs in the absence of the policy	(a) How much will emissions change over time in the absence of the policy? (b) How much will costs change over time in the absence of the policy?
4. Additional abatement and costs	Subtract step 3 from step 2
5. Cost of abatement	$Cost\ of\ abatement = \frac{cost}{abatement}$
6. Sensitivity analysis	(a) How sensitive is the estimated cost of abatement to changes in key variables? (b) How robust is the input data and what level of precision is appropriate?
7. Reporting and interpretation	(a) How does the cost of abatement estimate compare with alternative policies and the benchmark cost of carbon? (b) How to interpret the results?

Abatement in the presence of a domestic carbon price

A central element of the Australian Government's Clean Energy Future Plan is a carbon pricing mechanism.[5] The mechanism starts with a fixed price and transitions to a cap and trade scheme. The fixed price period will commence on 1 July 2012 and continue until 30 June 2015. From 1 July 2015 there will be annual caps for the emissions covered by the mechanism.

[5] Australian Government (2011), *Securing a Clean Energy Future: The Australian Government's climate change plan*, available online at: www.cleanenergyfuture.gov.au

In the presence of a national emissions cap, policies that aim to abate emissions (either in covered or uncovered sectors) will not generally cause additional abatement. [6] However, they could change the nature and the economic cost of the abatement that occurs to meet the cap and how much of that abatement occurs in Australia.

Changing the distribution of abatement can have public policy benefits where the policy unlocks cheap abatement that the carbon pricing mechanism is unable to access. For example, if households are unaware of the benefits of a new energy efficiency technology, policies that help households access this technology may unlock abatement that would otherwise not be accessed. In these situations an estimate of the cost of abatement of the proposed policy is essential to estimate the cost of these reductions. Abatement and cost of abatement estimates should state if the abatement is not additional to a national emissions cap.

Other important issues associated with calculating the cost of abatement in the presence of a carbon pricing mechanisms are explained in Section 2 and 3.

What to report

This section outlines the various measures that should be reported to provide the whole picture of the cost of abatement of a policy.

Cost of abatement metrics

There are two commonly used measures for the cost of abatement:

- resource cost of abatement, and
- fiscal cost of abatement.

These metrics are different and should not be compared. In most cases, the resource cost of abatement is most relevant to the overall cost-effectiveness of a policy.

The resource cost of abatement is a measure of the economic cost of the policy per tonne of carbon abated. It includes the costs (and savings) incurred by governments, households, businesses and non-government organisations. A true resource cost of abatement of a policy would be based on the cost to the whole economy (in terms of the value of foregone output) of the changed allocation of resources between activities that results from the policy. This methodology provides a framework for a simplified partial analysis that includes the opportunity cost of resources directly used or saved by the policy. Where policies have far reaching effects on the whole economy, more detailed modelling may be required, such as partial or general equilibrium analysis.

The fiscal cost of abatement is a measure of the abatement leverage achieved by a dollar of government resources. It is based on the budget impact of the policy per tonne of carbon abated. This measure does not take into account the costs (and savings) incurred by households, businesses, non-government organisations and other levels of governments. As a result, it does not provide an indication of the overall economic cost-effectiveness of a policy.

The benchmark cost of carbon

The benchmark cost of carbon is a metric against which the resource cost of abatement of a policy can be assessed.

[6] There are mechanisms in the Clean Energy Future plan to take eligible voluntary actions into consideration when setting pollution caps. Hence, the abatement from this eligible voluntary action will be additional.

The benchmark cost of carbon represents the cost of reducing emissions through available alternative means. In this context, instead of implementing the proposed policy the government, or private actors, could reduce their emissions at the cost of purchasing carbon permits.

In the presence of the carbon pricing mechanism the benchmark cost of carbon is the domestic carbon price. Further detail is provided in Section 7.

Generally, a cost of abatement lower than the benchmark cost of carbon will indicate that the policy may be a cost effective method of reducing carbon pollution. However, it is important to remember that a low cost of abatement does not necessarily mean that a proposed policy should always be implemented or continue if it is an existing policy. Decision makers will weigh up all issues, such as risk, equity and the role of government in undertaking market interventions.

Metrics to report

It is recommended that the following information is reported:

Cost of abatement

- Resource cost of abatement (assessed over the useful life of the actions)

Abatement-related information

- Abatement in the target year (e.g. 2020)
- Cumulative abatement to the target year (e.g. 2020)
- Cumulative abatement over the useful life of the actions

Cost-related information

- Total resource cost over the useful life of the actions, including a breakdown of the private costs (capital and operating) and fiscal costs.
- Total fiscal cost over the forward estimates period

Sensitivity analysis should always be conducted and reported. In some cases it may be appropriate to report abatement or costs on an annual basis.

Fiscal cost refers to government expenditures which are net of any government revenues associated with the policy. In some cases it may be appropriate to report gross expenditure and revenue separately.

It is important that the abatement and cost of abatement estimates state whether the abatement is additional to the abatement delivered by carbon pricing mechanism.

Incorporating uncertainty into cost of abatement estimates

The reliability of a cost of abatement estimate depends on the quality of input data and information, such as the expected levels of policy take-up, abatement per action and costs. In most situations there will be a level of uncertainty surrounding these inputs.

Where the level of uncertainty is relatively low, a best estimate of the cost of abatement can be provided (e.g $x per t CO_2-e). In other situations, it may be difficult to determine the best estimate because the uncertainty surrounding key inputs is high. In these cases a range (e.g $x to $x per t CO_2-e) may be more suitable.

In some circumstances, there may be little relevant data or information (e.g. if the program involves new technology) and it may be preferable to calculate a hypothetical 'what if' cost of abatement estimate detailing the assumptions on which the estimate is based.

All estimates should be accompanied by a sensitivity analysis to provide an indication of the range of plausible outcomes.

Glossary

Abatement	In this document, 'abatement' is used interchangeably with greenhouse gas mitigation. Abatement can be either the reduction of carbon emissions into the atmosphere or the removal of carbon from the atmosphere. For example, improved efficiency in the use of electricity can reduce emissions and carbon can be removed from the atmosphere through forestry sequestration.
Actions in operation	A measure of how many *intended actions* are expected to be in operation and reducing emissions over a specified time period as a result of the policy that is being assessed.
Base year	The first year of the *evaluation period.* Costs are expressed in dollars of the base year.
Benchmark cost of carbon	A metric against which the resource cost of abatement of a policy can be assessed. It represents the cost of reducing emissions through available alternative means.
Capital costs	Costs associated with the purchase and installation of capital goods (used for production).
Carbon	In this document, 'carbon' is used as shorthand for the six types of greenhouse gases covered by the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). Emissions of each of these gases can be measured in tonnes of carbon dioxide equivalent (t CO_2-e).
Cost of abatement	An estimate of the cost-effectiveness of reducing emissions through a policy, expressed in dollars per tonne of abatement.
Direct costs	Expenditures and savings that directly result from implementing the *intended actions*. They do not include second round costs or savings. For example, when implementing new energy efficient lighting in an office the direct costs and savings are the cost of installing the lighting and the electricity savings due to the lighting, while the second round costs or savings could be increased productivity of office workers. They also do not include the impacts to other sectors as a result of the reallocation of resources to this policy.
Discounting	Discounting allows the comparison of costs and benefits through time. A discount rate reflects society's preferences for present consumption over future consumption (the time value of money), and any other risk factors associated with the cash flows.
Expected useful life (of an intended action)	The period of time over which the intended action is expected to achieve *abatement*.
Evaluation period	The period over which the *abatement* and costs of a policy are assessed.

	It includes both the implementation period and the entire period that intended actions are expected to achieve abatement.
Fiscal costs	The *direct costs* —net of any savings—incurred by a government from introducing a policy. It includes additional budgetary costs (such as grants, subsidies and administrative costs) and revenue forgone as a result of the policy. It excludes costs/savings incurred by individuals, households, businesses, non-government organisations and other levels of governments. See also *resource costs* and *private costs*.
Fiscal cost of abatement	The average *fiscal costs* divided by the total *abatement* over the same period. It is a measure of the abatement leverage achieved by a dollar of Australian Government resources. It is not a metric of the cost-effectiveness of a policy and is not comparable with the resource cost of abatement or the benchmark cost of carbon.
Forward estimates period	The three year period following the current budget year.
Intended action	The action through which the proposed policy, measure or program is expected to achieve abatement. For example, replacing an electric hot water system with a solar hot water system, or planting a hectare of trees.
Net present value of costs	The present value of a stream of cash flows (both costs and savings) over future years. This can be calculated by *discounting* all cash flows by an appropriate rate.
Nominal prices	Actual prices, observed or expected, before adjustment for inflation.
Operating costs	The ongoing costs or savings associated with *actions in operation*. For example, maintenance or energy costs.
Policy	A government intervention or commitment that may be delivered through regulation (e.g. legislation, standard-setting) or financing (e.g. grant programs, rebate programs, tax concessions).
Policy take-up	The extent to which the policy results in actions that reduce emissions. See *actions in operation*.
Private costs	Costs and savings borne by businesses, households, other levels of government or other private sector organisations.
Real prices	Prices expressed in terms of a specific base year, adjusted to remove the impact of inflation.
Rebound effect	When people or organisations benefit from reduced costs in one area they may spend at least some of those ‘savings’ on buying more goods or services in that area. For example, a household could use the money saved in electricity bills from improving energy efficiency to buy additional or larger electrical appliances in their home or to consume more electricity in home air conditioning to increase comfort levels. In this methodology, the impact of the rebound effect on *abatement* and *direct costs* is included when it is considered significant.

Resource costs	In this methodology they are the additional *direct costs*—net of any savings—to all actors in the economy as a result of a *policy*. They include the additional *direct costs* incurred by government, individuals, households, businesses and non-government organisations directly attributable to that *policy*.
Resource cost of abatement	The average *resource costs* (discounted at the appropriate rate) divided by the total abatement over the same period.
Second-round costs	Costs caused by the flow-on effects of implementing the policy. Second-round costs are a subset of *indirect costs*.
Sequestration	The removal of carbon dioxide from the atmosphere and storage (e.g. through growing additional biomass).

1. Evaluation framework

Establishing the evaluation framework involves describing what actions the proposed policy will bring about in each year of the evaluation period. This involves:

- describing the proposed policy;
- estimating the take-up of intended actions in the presence of the policy; and
- setting up a time schedule of intended actions in operation over the evaluation period.

1.1. Describe the proposed policy

Describing the proposed policy requires specifying the following:

- The intended action through which the proposed policy or program is expected to achieve abatement, including any specific equipment or technology that is expected to be deployed. For example, the replacement of an electric hot water system with a solar hot water system.
- The government's chosen policy mechanism and any funding the government is expected to provide. Policy mechanisms generally provide incentives through grants, loans or subsidies, or introduce regulations, such as mandatory or voluntary standards.
- The policy implementation period, which is the number of years over which the policy will be implemented, including the provision of funding.
- The target group of businesses, households or other organisations at which the policy is aimed.

It is also important to identify any other incentives, including existing policies that are expected to have an impact on the take-up, abatement and costs associated with this policy. This information will be used in Section 3 which examines the abatement and costs that would have occurred in the absence of the policy.

Box 1: Hypothetical WIDGET Example - Describe the proposed policy

In this example, a hypothetical device called a WIDGET has been invented that decreases household electricity use.

In the proposed policy the government will provide a $200 rebate to each household upon receiving proof of installation. Funding will be available to all households from 1 July 2012 to 30 June 2014. The total cost of purchasing a WIDGET is $1,000.

In this example:

1. The intended action is the installation of the WIDGET to reduce electricity use.
2. The policy mechanism is the $200 rebate to provide an incentive for households to install the WIDGET.
3. The policy implementation period is two years (from 1 July 2012 to 30 June 2014).
4. The target group is all households in Australia.

1.2. Estimate the annual take-up of intended actions in the presence of the policy

Policy take-up is the number of target group members expected to perform the intended action in the presence of the policy. This estimate should be made considering all the incentives or regulations in place that influence the target group's response.

Some of the target group members may have performed the intended action in the absence of the policy due to other incentives. This should be noted and referred to in Section 3.

Policy take-up can be influenced by a range of factors. For grant or rebate programs this could include:

- The total number of target group members eligible to take up the policy.
- The maximum number of intended actions the available funding can supply.
- The expected willingness and capacity of target group members to take up the policy. This will be influenced by factors such as the target group's awareness and the required cost and effort to participate.

For regulations, the take-up rate of the intended actions can be influenced by:

- The number of target group members covered by the regulation; and
- Any alternative options for the target group members to comply with the regulation (e.g. paying a penalty or other alternative actions).

Any significant uncertainties about the take-up rate should be included in the sensitivity analysis of the estimate (see Section 6).

Box 2: Hypothetical WIDGET Example – Estimate the take-up of intended actions

A study was undertaken that found that WIDGETs are technically able to be installed in every household in Australia and only a small number of WIDGETs are already installed. The study identified factors that limit take-up. For example, the upfront cost to households ($800 after the $200 rebate), the inconvenience of installing the WIDGETs and household's low awareness of the WIDGETs. The study concluded that a take-up of 50,000 households per annum is likely.

1.3. Creating a schedule of intended actions

The abatement associated with many policies will extend long after program funding has ceased. It is important that the period over which a policy's average cost of abatement is estimated reflects the full period over which it is expected to achieve abatement. This period is referred to as the evaluation period and will vary from policy to policy.

The first year of the evaluation period is referred to as the base year. This is used for cost calculations.

Setting up a time schedule of intended actions in operation requires combining the policy implementation period (described above) with the expected useful life of the intended action. The schedule should include all the years in which the actions undertaken during the implementation period are expected to remain in operation and take into account the distribution of take-up over the policy implementation period.

Information that will help determine the expected useful life of the intended actions includes:

- empirical evidence from technical studies and surveys;
- industry estimates of performance and durability; and
- warranty periods commonly offered for products.

Box 3: Hypothetical WIDGET Example – Schedule of intended actions

In Box 2 it was concluded that the uptake is 50,000 per annum during the 2 year implementation period. The expected useful life of the WIDGETs is 7 years.

Therefore the schedule of intended actions is:

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Policy take-up	'000	50	50						
Actions in operation	'000	50	100	100	100	100	100	100	50

The evaluation period for the program is 8 years and the base year for this policy is 2012-13.

2. Abatement and costs in the presence of the policy

The goal in this Section is to estimate the abatement and costs that occur in the presence of the policy.

2.1. Create a schedule of abatement in the presence of the policy

The steps involved in estimating the annual abatement in the presence of the policy are:

- Estimate the annual abatement an intended action is expected to achieve in each year of the evaluation period.
- Multiply the estimated annual abatement per action by the estimated number of actions in operation in each year of the evaluation period.

These steps are elaborated in the following subsections. Please note that these steps do not provide the final abatement estimate. The abatement in the absence of the policy needs to be taken into consideration to derive the additional abatement (see Section 4).

What is abatement?

Abatement can take the form of either the reduction of carbon emissions into the atmosphere or the removal of carbon from the atmosphere. For example, improved efficiency in the use of electricity or fuel can reduce emissions, while carbon can be removed from the atmosphere through increased forestry sequestration.

Abatement actions can lead to reductions in both direct and indirect emissions. Direct emissions are those that are released at the source of an activity. An example is the burning of fuel or release of methane from waste. Indirect emissions are those generated in the wider economy as a result of an activity. For example, the emissions released from the generation of electricity and from the transportation and production of fuels and materials used in an activity.

While it is desirable to estimate all the emissions reductions associated with abatement actions it is often not practical. Incorporating estimates of indirect emissions has the potential to introduce errors into abatement calculations as it is difficult to determine the actual source of all the materials and fuels used in activities and the associated emissions.

It is recommended that in general only the reductions in direct emissions and emissions associated with the combustion of fuel to generate electricity are included in abatement estimates.

It may be appropriate in some circumstances to incorporate indirect emissions in situations where these emissions could significantly influence the abatement estimate. For example, while using biofuels produces lower direct emissions than petrol, they have higher production emissions. Consequently, excluding these indirect emissions would overestimate the abatement from switching from petrol to biofuels.

Estimate the annual abatement per intended action

Estimating the annual abatement expected from each intended action will require access to appropriate abatement data. It may be possible to generate appropriate data using existing studies that estimate energy/fuel consumption, or emissions factors associated with the action targeted by the proposed policy. If there is no suitable data available, it may be necessary to commission a study to provide a robust abatement estimate.

The National Greenhouse Accounts (NGA) Factors and the National Greenhouse and Energy Reporting (NGER) Technical Guidelines, both published by the Department of Climate Change and Energy Efficiency (DCCEE) may be useful sources of emissions data and information.[7][8] The NGA Factors cover each of the six major emissions sectors and are updated annually.[9] In general for this analysis it is recommended that only the direct scope 1 and electricity scope 2 emissions factors are used. The NGER Technical Guidelines contain more detailed emissions factor information and can supplement information found in the NGA Factors.

Emissions factors reported in the NGA Factors and NGERS Technical Guidelines relate to emissions at the time the data was collected. The emissions intensity of activities are subject to change over time due to factors like technological advancement and regulatory requirements. For example, the emissions intensity of electricity generation is expected to decrease over time due to factors such as increased renewable energy generation. This means that a reduction in electricity consumption of 1 MWh this year is expected to result in more abatement than a 1 MWh reduction in electricity consumption in future years.

DCCEE is able to provide guidance and data where possible on key data required for calculating abatement, such as the current and projected emissions intensity of electricity and the emissions intensity of fuels such as coal, gas, petrol and diesel;

Some key questions to consider when assessing the suitability of data are:

- Is the data the most recent and best available?
- Is the data and the methodology behind the data relevant to Australian circumstances? Data from international studies may not be directly applicable to Australia, but it might be possible to adapt the data so as to make it suitable for use in the Australian context.
- Does the data include reasonable assumptions regarding actual expected abatement as opposed to the technical potential/highest possible abatement?
- Is the data applicable to the target group? For example, where there is variation in abatement by location or consumption levels this should be taken into consideration.

When estimating abatement particular care should be taken to ensure that any new sources of emissions expected to be created by the intended action, and any rebound effects, are taken into account. The rebound effect is when people or organisations that benefit from reduced costs in one area spend at least some of those ‘savings’ on buying more goods or services in that area. For example, a household could use the money saved in electricity bills from improving energy efficiency to buy additional or larger electrical appliances in their home or to consume more electricity in home air conditioning to increase comfort levels.

[7] DCCEE 2010, *National Greenhouse Accounts (NGA) Factors*, Commonwealth of Australia, http://www.climatechange.gov.au/publications/greenhouse-acctg/national-greenhouse-factors.aspx
[8] DCCEE 2010, *National Greenhouse and Energy Reporting (NGER) Technical Guidelines*, Commonwealth of Australia, http://www.climatechange.gov.au/publications/greenhouse-report/nger-technical-guidelines.aspx
[9] Six emissions sectors: stationary energy; transport; fugitive emissions; industrial processes; waste; land use, land use change and forestry.

It is also important that all estimates of abatement state whether the abatement is consistent with the accounting rules and arrangements Australia has accepted, or is expected to accept, as part of its national emissions target for 2020.

Box 4: Hypothetical WIDGET Example – Abatement per intended action

A study was undertaken that found that the WIDGET usually saves around 0.8 MWh per annum of electricity in the houses where this rebate is likely to be taken up, after taking into consideration rebound effects. The emissions abatement depends on the emissions intensity of the electricity grid, which varies over time.*

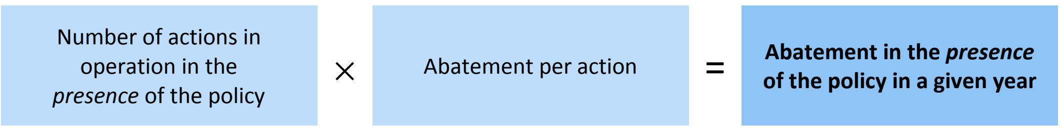
Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Energy savings per WIDGET in operation	MWh/ WIDGET	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Emissions intensity of electricity	t CO_2-e/ MWh	0.90	0.88	0.86	0.84	0.82	0.80	0.78	0.76
Abatement per WIDGET in operation	t CO_2-e/ WIDGET	0.72	0.70	0.69	0.67	0.66	0.64	0.62	0.61

* Figures are illustrative only and should not be used for calculations.

Total annual abatement associated with actions in operation

Total annual abatement is estimated by multiplying the estimated annual abatement per intended action by the number of intended actions in operation in each year. Note that the estimated abatement per intended action will not necessarily be the same in each year of the evaluation period.

Figure 2: Abatement in the presence of the policy



Box 5: Hypothetical WIDGET Example – Abatement in the presence of the policy

The total annual abatement is calculated using the number of actions in operation from Box 3 and the abatement per action in Box 4.

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Actions in operation	'000	50	100	100	100	100	100	100	50
Abatement per WIDGET in operation	t CO_2-e/ WIDGET	0.72	0.70	0.69	0.67	0.66	0.64	0.62	0.61
Abatement in the presence of the policy	Mt CO_2-e	0.036	0.070	0.069	0.067	0.066	0.064	0.062	0.030

Please note that this is not the final abatement estimate. The abatement in the absence of the policy needs to be taken into consideration to derive the additional abatement (see Section 4).

2.2. Create a schedule of costs (and savings) in the presence of the policy

In this methodology the resource costs are the direct costs—net of any savings—to all actors in the economy as a result of a policy. It includes both fiscal costs/savings (those incurred by the government assessing the policy) and private costs/savings (those faced by other levels of government, households, businesses and other non-government organisations).

While, the question of 'who pays' is not relevant for estimating net resource costs, it is useful to track cash flows to allow reporting of private and fiscal costs.

This analysis must include both the capital costs and savings incurred upfront (e.g. cost of installing technology) and the operating costs and savings incurred over the evaluation period (e.g. electricity savings and maintenance costs).

Any savings expected to result from the intended actions are recorded as negative costs.

In general, the treatment of resource costs in cost-effectiveness analysis is the same as the treatment of costs in cost-benefit analysis (CBA). There is already high-quality Australian Government guidance on conducting cost-benefit analysis, and rather than reproduce the parts relating to costs in this document, officials are directed to the CBA guidance in the Best Practice Regulation Handbook (Australian Government 2010), the Australian Government Handbook of Cost-Benefit Analysis (Commonwealth of Australia 2006) and Cost-Benefit Analysis: Concepts and Practice (Boardman et al, 2001), Chapter 17 of which provides a useful discussion of cost-effectiveness analysis. Further information and specialist training can also be provided by the CBA unit within the Office of Best Practice Regulation (www.obpr.gov.au).

Costs (and savings) associated with the intended actions

In the context of this document, the economic analysis is 'partial analysis' and costs are generally limited to direct costs (as opposed to second-round costs). For example, it is possible that new energy efficient lighting in an office could increase the productivity of office workers. However, this impact is difficult to quantify and is likely to be small, so is not included in this assessment. If second-round or indirect costs are expected to be significant, it may be necessary to commission broader economic modelling to estimate the quantitative impacts of these effects.

Estimating the resource costs and savings requires considering:

- capital costs, such as purchase and installation costs; and
- operating costs, including any periodic maintenance costs, noting that:
    - operating costs can change over time, for example due to changes in electricity and fuel prices.
    - operating costs may decrease as a result of the policy or program leading to savings for businesses and households taking up the intended action. For example, energy efficiency actions would be expected to reduce energy consumption.
    - maintenance costs under the proposed policy may not differ greatly from maintenance costs in the absence of the policy. If this is the case, it is acceptable to omit maintenance costs from the assessment, citing the reasons why the difference in maintenance costs is expected to be negligible.

Fiscal costs and savings should be reported in line with normal budget practices. Fiscal costs only include costs and savings for the level of government assessing the policy. For example, if the Australian Government is assessing a policy any cost or savings to state or local governments would not be included as fiscal costs; instead these costs would be included in the private costs (or savings). Estimating the fiscal costs and savings requires considering:

- fixed administration costs;
- variable costs, such as grants and rebates; and
- savings, for example due to reduced operation and maintenance costs.

For Australian Government agencies the fiscal costs and savings should be consistent with those in the associated New Policy Proposal (NPP), for the years covered by the NPP.

Taxes, grants, subsidies and other financial transfers have a zero net resource cost. To avoid double counting, private capital costs must be net of any rebates or subsidies received from the government. Rebates or subsidies are captured in the take-up dependent fiscal costs.

Some key questions to consider when assessing the suitability of cost data are:

- Is the data the most recent and best available?
- Is the data relevant to the target group? For example, if costs are sourced from overseas studies have they been correctly adjusted, including using appropriate exchange rates?

DCCEE is able to provide advice on suitable sources and data where possible.

Two important considerations are inflation and costs in the presence of a carbon price.

Inflation

Inflation is the rate at which the prices of goods and services in an economy rise over time. For example, if there is an inflation rate of 2.5 per cent, a product that cost $100.00 in 2013 would cost $102.50 in 2014. The *nominal* prices are the actual prices, observed or expected, before adjustment for inflation and the *real* prices are the prices adjusted to remove the impact of inflation. In the example above, the price of the product in nominal terms is $100.00 in 2013 and $102.50 in 2014 and $100.00 (in 2013 dollars) in real terms in both years.

Both the resource costs and the fiscal costs of the proposed policy should be stated in real terms in the dollars of the base year (first year of the evaluation period).

Any nominal costs or savings should be converted to base year values at an annual inflation rate of 2.5 per cent. This rate is chosen as it is the midpoint of the Reserve Bank of Australia's inflations target range (2-3 per cent).

$$value\ of\ money\ in\ base\ year = \frac{future\ value\ of\ money}{(1+i)^t}$$

Where,

future value of money is the nominal value of a cash flow.

i is the inflation rate

t is the time in years between the year the cash flow occurs and the base year.

Box 6: Hypothetical WIDGET Example – Inflation

The rebate of \$200 (nominal) is available in 2013 and 2014. Due to inflation the rebate is worth less in 2014 than in 2013 in real terms. Using the inflation rate of 2.5 per cent:

$$2013 \text{ rebate (real \$2013)} = \$200$$

For the 2014 rebate, the time between the year the cash flow occurs (2014) and the base year (2013) is 1 year.

$$2014 \text{ rebate (real \$2013)} = \frac{\$200}{(1+0.025)^1} = \$195$$

Costs in the presence of a carbon price

In the presence of a carbon price, the carbon liability (either direct or through increased electricity or fuel prices) avoided through implementing the policy should not be included as savings for this calculation.[10]

An important situation is where there are direct savings in energy costs as a result of the policy and these energy costs include the costs to the upstream liable entities of purchasing permits (e.g. electricity generators). In this situation the energy cost savings will be inflated because they include a component that reflects the cost of purchasing permits.

There are two approaches that can be used to exclude the savings from avoiding the carbon liability from the resource costs:

1. Do not include the value of the avoided carbon liability in the cost analysis.
   - In this case, the savings to liable entities from avoiding direct emissions (reduced permit purchases) would not be included in the cash flows and similarly the electricity and fuel prices used in the cost analysis would not include the cost of carbon.
2. Include the value of the avoided carbon liability as a saving cash flow and net it out with an equivalent cost item.
   - In this case, the savings to liable entities from avoiding direct emissions would be included and the electricity and fuel prices would include the cost of carbon. However, to net out the value of the avoided carbon liability a cash flow would be included that is equal to the abatement multiplied by the carbon price.

When using the first approach the electricity price excluding the carbon price liability can be approximated as:

$$\begin{matrix}\textit{electricity price, excluding} \\ \textit{carbon price liability}\end{matrix} = \begin{matrix}\textit{electricity price} \\ \textit{with carbon price}\end{matrix} - \textit{emissions intensity} \times \textit{carbon price}$$

It is important that the carbon price used for these calculations is consistent with the electricity price.

The first approach is used in this document's worked example.

[10] When liable entities reduce their emissions as a result of a policy they will need to purchase fewer carbon permits. The avoided cost of purchasing these permits is a saving to the liable entity. This saving represents the value of the abatement delivered by the policy and if it were to be included, the analysis would be a cost-benefit rather than a cost-effectiveness analysis.

Box 7: Hypothetical WIDGET Example – Electricity price excluding carbon price

The WIDGET leads to savings in electricity use, which is covered by a carbon price. The electricity price, excluding the carbon price liability is derived using the first approach described above.*

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Electricity price with carbon price	\$/MWh**	220	225	230	235	240	245	250	255
Emissions intensity of electricity	t CO_2-e/ MWh	0.90	0.88	0.86	0.84	0.82	0.80	0.78	0.76
Carbon price	\$/ t CO_2-e**	23.0	23.6	24.2	26.5	27.6	28.9	30.2	31.7
Electricity price excluding carbon price liability	\$/MWh**	199	204	209	213	217	222	226	231

* All figures are illustrative only and should not be used for calculations.

** In 2012-13 dollars.

Box 8: Hypothetical WIDGET Example – Cost and savings associated with actions

The fiscal costs are the fixed administration cost of \$100,000 per year over the 2 year implementation period and the grant of \$200 per WIDGET.

The private costs and savings are the capital cost and energy savings for households.

The total cost of the WIDGET is \$1,000 (\$2013) each. As \$200 of this cost will come from the Government rebate in 2013, each household purchasing the WIDGET in 2013 will incur a private cost of \$800 per WIDGET. In 2014, \$195 (\$2013) is provided by the Government rebate, so each household will bear a private cost of \$805 per WIDGET.

The only impact of the WIDGET on operating costs is an electricity saving for households. The value of the electricity savings is estimated using the electricity price estimated in Box 7. As electricity savings are negative operating costs, the impact of the WIDGETs on operating costs is estimated using:

$$operating\ costs = -\,electricity\ price \times electricity\ savings$$

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Electricity price excluding carbon price liability	\$/MWh*	199	204	209	213	217	222	226	231
Energy savings per WIDGET in operation	MWh/ WIDGET	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Operating costs (savings) per WIDGET in operation	\$/ WIDGET*	-159	-163	-167	-170	-174	-178	-181	-185

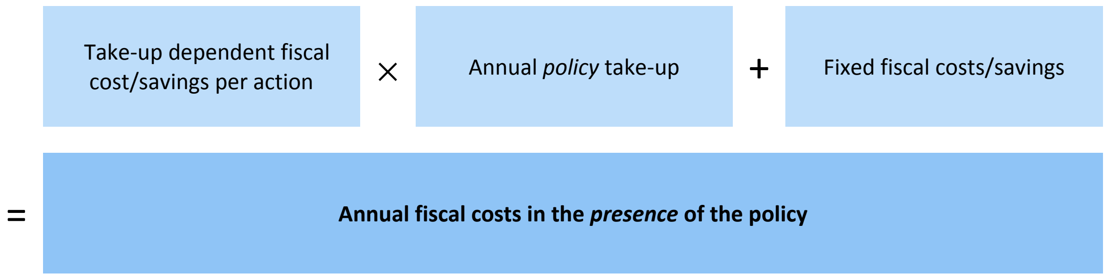
* In 2012-13 dollars.

Fiscal costs

The estimates of the costs (and savings) associated with the intended actions are combined with estimates of policy take-up and actions in operation to derive a schedule of costs. It is important to consider whether the costs are:

- fixed costs, such as the administration cost to the government that will be incurred regardless of policy take-up or the number of actions in operation;
- costs linked to policy take-up such as grants or rebates; or
- costs dependent on the number of actions in operation such as operating costs.

Figure 3: Estimating the annual fiscal costs in the presence of the policy



Box 9: Hypothetical WIDGET Example – Fiscal costs in the presence of the policy

The fixed administration cost of $100,000 ($2013) per year over the 2 year implementation period is incurred regardless of the take-up.

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Administration costs	$m*	0.1	0.1						

The total fiscal cost of the grants depends on the policy take-up (which was derived in Box 2) and the value of the individual grant.

$$cost\ of\ grants = policy\ take\ up \times value\ of\ individual\ grants$$

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Policy take-up	'000	50	50						
Value of individual grants	$/ WIDGET*	200	195						
Cost of grants	$m*	10.0	9.8						

The total annual fiscal costs are:

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Administration costs	$m*	0.1	0.1						
Cost of grants	$m*	10.0	9.8						
Total fiscal costs	$m*	10.1	9.9						

* In 2012-13 dollars.

Private costs

Figure 4: Estimating the annual private costs in the presence of the policy

Private capital cost per action	×	Annual *policy* take-up	=	**Private capital costs in the *presence* of the policy**
Private operating cost per action	×	Actions in operation	=	**Private operating costs in the *presence* of the policy**
Private capital costs	+	Private operating costs	=	**Annual private costs in the *presence* of the policy**

Box 10: Hypothetical WIDGET Example – Private costs in the presence of the policy

The private costs and savings are the capital cost and energy savings for households. The private capital costs of the WIDGETs are $800 per WIDGET in 2013 and $805 in 2014 ($2013) (see Box 8). The total private capital cost depends on the policy take-up (which was derived in Box 3) and the capital cost of the WIDGETs:

$$private\ capital\ costs = take\ up \times private\ capital\ cost\ per\ WIDGET$$

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Policy take-up	'000	50	50						
Private capital cost per WIDGET	$/ WIDGET*	800	805						
Private capital costs	$m*	40.0	40.2						

The private operating costs (electricity savings) depend on the number of WIDGETs in operation and the annual value of the electricity savings.

$$private\ operating\ costs = actions\ in\ operation \times operating\ costs\ per\ action$$

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Actions in operation	'000	50	100	100	100	100	100	100	50
Operating cost (saving) per WIDGET in operation	$/ WIDGET*	-159	-163	-167	-170	-174	-178	-181	-185
Private operating costs	$m*	-8.0	-16.3	-16.7	-17.0	-17.4	-17.8	-18.1	-9.2

The total annual private costs are:

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Private capital costs	$m*	40.0	40.2	0.0	0.0	0.0	0.0	0.0	0.0
Private operating costs (savings)	$m*	-8.0	-16.3	-16.7	-17.0	-17.4	-17.8	-18.1	-9.2
Total private costs (or savings)	$m*	32.0	23.9	-16.7	-17.0	-17.4	-17.8	-18.1	-9.2

* In 2012-13 dollars.

Note that these are not the final cost estimates. The costs in the absence of the policy need to be taken into consideration and discounting needs to be applied (Section 4).

3. Abatement and costs in the absence of the policy

The goal in this Section is to estimate how much of the abatement and costs estimated in Section 2 would most likely take place in the absence of the policy. These abatement and cost estimates are subtracted from the estimated abatement and cost associated with the policy in Section 4. This is to ensure that the final estimate only includes the abatement and costs driven by the policy and not those that would have happened anyway.

In the presence of an emissions cap, the goal in this Section is to determine the abatement and costs associated with the intended actions that would have occurred in the absence of the policy. In the absence of the policy, the quantum of abatement delivered by the policy would still occur via other means under the cap, either domestically or via imports. However, the aim of the cost of abatement in these situations is to assess whether the abatement that a policy yields could be less costly than the abatement that would otherwise occur under the carbon pricing mechanism.

In many cases, it would be reasonable to expect that some proportion of the target group would undertake the intended action without the incentive offered by the proposed policy. Some policy brings forward actions that would have occurred later in the absence of the policy. Other target group members might undertake different actions that would also have material impact on the estimated abatement and costs associated with the proposed policy

When considering what is most likely to happen in the absence of the policy, it is important to consider:

- Existing policies (at all levels of government),
  - If existing policies that relate to the intended actions would still be in operation in the presence of the new policy, the relevant abatement and costs should be included. Where an existing policy would not continue if the new policy is implemented it does not need to be included.
  - Details regarding the expected take-up of existing policies might be available publically, or upon request, from the government department responsible for implementing the policy.
- Existing trends and expected developments in relevant markets, including in the sales of appliances and equipment, and the implementation of processes that provide a similar service to the intended action.
  - Details regarding market trends and forecasts may be available publically, or upon request, in the form of studies carried out on behalf of industry associations, government departments and other interest groups.
- Ensure any market data used for this estimate includes the expected impact of existing policies. If no such data is available, it will be necessary to incorporate into the estimate any policy impacts not included in the data.
- Expected changes to the target group’s circumstances, such as increased provision of information and enhanced understanding of the monetary and climate change consequences of their actions.

- If the best available data does not satisfactorily include estimates of the expected impact of changes to the target group's circumstances, it will be necessary to incorporate these effects.

3.1. Create a schedule of intended actions in the absence of the policy

This is a crucial step because it is a major determinant of the estimated abatement from the policy.

Box 11: Hypothetical WIDGET Example – Intended actions in the absence of the policy

The study found that in the absence of the policy 5,000 households per year would install WIDGETs. The operating life of the WIDGETs is 7 years. Therefore the schedule of intended actions is:

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Take-up in the absence of the policy	'000	5	5						
Actions in operation	'000	5	10	10	10	10	10	10	5

3.2. Create a schedule of abatement in the absence of the policy

Figure 5: Abatement in the absence of the policy

Number of actions in operation in the *absence* of the policy × Abatement per action = **Abatement in the *absence* of the policy in a given year**

Box 12: Hypothetical WIDGET Example – Abatement in the absence of the policy

The abatement per action is the same as in the presence of the policy (see Box 4) and the number of actions in operation is derived in Box 11.

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Actions in operation	'000	5	10	10	10	10	10	10	5
Abatement per WIDGET in operation	t CO_2-e/ WIDGET	0.72	0.70	0.69	0.67	0.66	0.64	0.62	0.61
Abatement in the absence of the policy	Mt CO_2-e	0.004	0.007	0.007	0.007	0.007	0.006	0.006	0.003

3.3. Create a schedule of costs (and savings) in the absence of the policy

Fiscal costs

Where other policies that directly relate to the intended actions remain in operation whilst the new policy is implemented, the associated fiscal costs should be included. Where an existing policy would not continue if the new policy is implemented it does not need to be included.

Box 13: Hypothetical WIDGET Example –Fiscal costs in the absence of the policy

No fiscal costs would be incurred in the absence of the policy.

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Total fiscal costs	$m*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

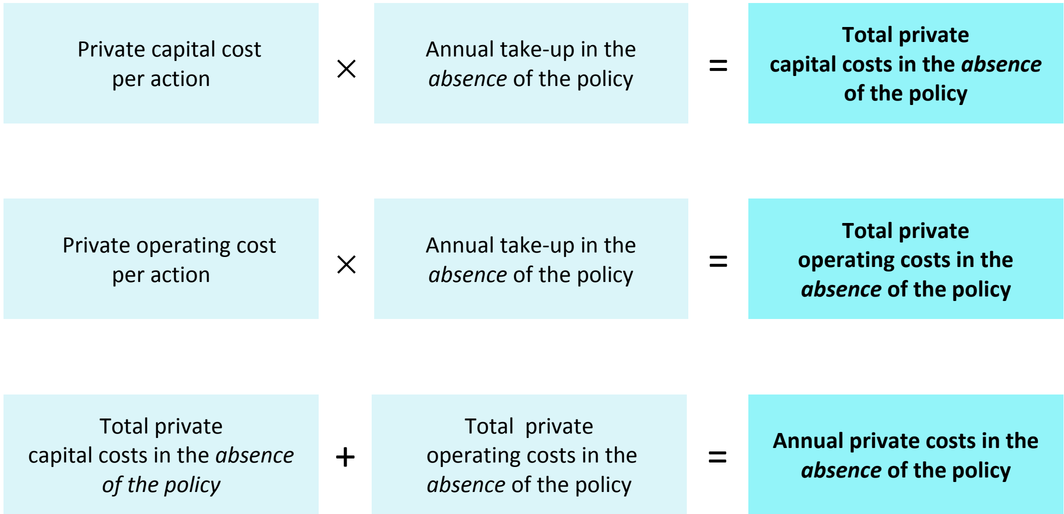
* In 2012-13 dollars.

If the households who install the WIDGETs in the absence of the new policy would have been eligible for a subsidy from another policy, this would have been included.

Private costs

There are often costs (and savings) that would be incurred in the absence of the policy. For example, if some of the intended actions would have occurred in the absence of the policy, or if the action is to install more efficient equipment there are costs associated with installing less efficient equipment.

Figure 6: Estimating the annual private costs in the absence of the policy



Box 14: Hypothetical WIDGET Example – Private costs in the absence of the policy

In the absence of the policy, the households who install the WIDGET would need to pay the total capital cost, as a rebate is not available from the government. The private capital costs of the WIDGETs are $1,000 per WIDGET in 2013 and 2014 (in $2013). The households with WIDGETs installed will receive the same savings in electricity costs as with the policy. Using the methodology in Box 10:

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Take-up in the absence of the policy	'000	5	5						
Private capital cost per WIDGET	$/ WIDGET*	1000	1000						
Private capital costs	$m*	5.0	5.0						

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Actions in operation	'000	5	10	10	10	10	10	10	5
Operating cost per WIDGET in operation	$/ WIDGET*	-159	-163	-167	-170	-174	-178	-181	-185
Private operating costs	$m*	-0.8	-1.6	-1.7	-1.7	-1.7	-1.8	-1.8	-0.9

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Private capital costs	$m*	5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0
Private operating costs	$m*	-0.8	-1.6	-1.7	-1.7	-1.7	-1.8	-1.8	-0.9
Total private costs	$m*	4.2	3.4	-1.7	-1.7	-1.7	-1.8	-1.8	-0.9

* In 2012-13 dollars.

4. Additional abatement and costs

The goal in this Section is to isolate the effect of the policy on abatement, costs and savings. In doing so, we will obtain an estimate of the additional abatement and costs attributable to the policy.

To complete this step we will need to use the results derived in Section 2 and Section 3.

4.1. Cumulative additional abatement

Recall that the schedule derived in Section 2.1 gives us the abatement in the presence of the policy and Section 3.2 gives us the abatement in the absence of the policy.

In this Section, we subtract one from the other to obtain a schedule of the additional abatement for each year. Next, we sum the schedule of additional abatement over the entire evaluation period to obtain an estimate of the cumulative additional abatement attributable to the policy. This is the denominator for the resource cost of abatement.

All estimates of abatement should clearly state whether they are consistent with the carbon accounting rules and arrangements Australia has accepted, or is expected to accept, as part of its national emissions target for 2020.

Figure 7: Deriving the additional annual abatement

Total annual abatement in the *presence* of the policy − Total annual abatement in the *absence* of the policy = **Additional annual abatement**

∑ Additional annual abatement over the evaluation period = **Cumulative additional abatement**

Box 15: Hypothetical WIDGET Example –Additional abatement

The additional abatement is the difference between the abatement in presence of the policy (Box 5) and the abatement in the absence of the policy (Box 12).

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Abatement in the presence of the policy	Mt CO_2-e	0.036	0.070	0.069	0.067	0.066	0.064	0.062	0.030
Abatement in the absence of the policy	Mt CO_2-e	0.004	0.007	0.007	0.007	0.007	0.006	0.006	0.003
Additional abatement	Mt CO_2-e	0.032	0.063	0.062	0.060	0.059	0.058	0.056	0.027

The cumulative additional abatement from this policy is 0.42 Mt CO_2-e.

4.2. Additional annual fiscal and private costs

Additional annual fiscal costs

Recall that the schedule derived in Section 2.2 gives us the fiscal costs in the presence of the policy and the schedule derived in Section 3.3 gives us the fiscal costs in the absence of the policy. In this Section, we subtract one from the other to get a schedule of the additional fiscal costs for each year.

Figure 8: Deriving the additional annual net fiscal costs

Annual fiscal costs in the *presence* of the policy	–	Annual fiscal costs in the *absence* of the policy	=	**Additional annual fiscal costs (non-discounted)**

Box 16: Hypothetical WIDGET Example – Additional fiscal costs (and savings)

The additional fiscal costs are the difference between the fiscal costs in presence of the policy (Box 9) and the fiscal costs in the absence of the policy (Box 13).

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Fiscal costs in the presence of the policy	$m*	10.1	9.9	0.0	0.0	0.0	0.0	0.0	0.0
Fiscal costs in the absence of the policy	$m*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Additional fiscal costs	$m*	10.1	9.9	0.0	0.0	0.0	0.0	0.0	0.0

* In 2012-13 dollars.

Additional annual private costs

Recall that the schedule derived in Section 2.2 gives us the net private costs in the presence of the policy and the schedule derived in Section 3.3 gives us the net private costs in the absence of the policy. In this Section, we subtract one from another to get a schedule of the additional net private costs for each year. This method is applied to the capital, operating and total private costs.

Figure 9: Deriving the additional annual net private costs

Annual private costs in the *presence* of the policy	–	Annual private costs in the *absence* of the policy	=	**Additional annual net private costs (non-discounted)**

Box 17: Hypothetical WIDGET Example – Additional private costs (and savings)

The additional capital, operating and total private costs are the difference between the respective costs in the presence of the policy (Box 10) and in the absence of the policy (Box 14).

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Private capital costs in the presence of the policy	$m*	40.0	40.2	0.0	0.0	0.0	0.0	0.0	0.0
Private capital costs in the absence of the policy	$m*	5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0
Additional private capital costs	$m*	35.0	35.2	0.0	0.0	0.0	0.0	0.0	0.0

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Private operating costs in the presence of the policy	$m*	-8.0	-16.3	-16.7	-17.0	-17.4	-17.8	-18.1	-9.2
Private operating costs in the absence of the policy	$m*	-0.8	-1.6	-1.7	-1.7	-1.7	-1.8	-1.8	-0.9
Additional private operating costs	$m*	-7.2	-14.7	-15.1	-15.3	-15.7	-16.0	-16.3	-8.3

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Private costs in the presence of the policy	$m*	32.0	23.9	-16.7	-17.0	-17.4	-17.8	-18.1	-9.2
Private costs in the absence of the policy	$m*	4.2	3.4	-1.7	-1.7	-1.7	-1.8	-1.8	-0.9
Additional private costs	$m*	27.8	20.5	-15.1	-15.3	-15.7	-16.0	-16.3	-8.3

* In 2012-13 dollars.

Additional annual resource costs

In this Section, we sum the schedule of net fiscal costs derived above and the schedule of net private costs derived above to get a schedule of the additional net resource costs for each year.

Figure 10: Deriving the additional annual net resource costs

Additional annual net fiscal costs (non-discounted) + **Additional annual net private costs (non-discounted)** = **Additional annual net resource costs (non-discounted)**

Box 18: Hypothetical WIDGET Example – Additional resource costs (and savings)

Additional resource costs are calculated using the fiscal cost (Box 16) and the private costs (Box 17).

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Additional fiscal costs	$m*	10.1	9.9	0.0	0.0	0.0	0.0	0.0	0.0
Additional private costs	$m*	27.8	20.5	-15.1	-15.3	-15.7	-16.0	-16.3	-8.3
Additional resource costs	$m*	37.9	30.4	-15.1	-15.3	-15.7	-16.0	-16.3	-8.3

* In 2012-13 dollars.

4.3. Cumulative additional resource costs (discounted)

Cumulative additional net resource costs

In this Section, we first discount the schedule of additional net resource costs to obtain the present values. Next, we sum the schedule of the present values of the additional net resource costs (discounted to base year) over the entire evaluation period to obtain an estimate of the cumulative present value of the additional net resource costs. This is the numerator for the resource cost of abatement.

Figure 11: Discounting the additional annual net resource costs

Additional annual net resource costs (non-discounted) ⟶ *Apply real discount rate* = **Additional annual net resource costs (discounted)**

∑ Additional annual net resource costs over the evaluation period (discounted) = **Cumulative additional net resource costs (discounted)**

Discounting allows us to compare costs and benefits through time. The discount rate reflects society's preferences for present consumption over future consumption (the time value of money), and any other risk factors associated with the cash flows.

Consistent with recommendations by the Office of Best Practice Regulation (2010), the resource costs should be discounted at a **real rate of 7 per cent per year** with sensitivity analysis conducted using rates of 3 and 10 per cent. Refer to the OBPR Best Practice Regulation Handbook for more information on applying discount rates to dollar values over time.

$$Present\ Value = \frac{Future\ Value}{(1+i)^t}$$

Where,

Future Value is the nominal value of a cash flow.
i is the discount rate
t is the time in years between the year the cash flow occurs and the base year.

Unless there is a good reason to the contrary, the base year for the calculation of the net present value of the costs should be the year in which costs are first incurred.

Box 19: Hypothetical WIDGET Example – Discounting resource costs

The additional resource costs are derived in Box 18. The resource cost (saving) in 2020 is -$8.3 million (in $2013). The time between the year the cash flow occurs (2020) and the base year (2013) is 7 years.

Using the discount rate of 7 per cent, the present value of this cost can be calculated:

$$present\ value\ of\ 2018\ resource\ cost\ = \frac{-\$8.3\ million}{(1+0.07)^7} = -\$5.2\ million$$

This step is repeated for each annual resource costs:

Year		2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Additional resource costs	$m*	37.9	30.4	-15.1	-15.3	-15.7	-16.0	-16.3	-8.3
Present value of additional resource costs	$m*	37.9	28.4	-13.2	-12.5	-11.9	-11.4	-10.9	-5.2

* In 2012-13 dollars.

The cumulative present value of the net resource costs is $1.3 million in $2013.

5. Calculating the cost of abatement

In this Section our goal is to derive the resource cost of abatement using the estimates obtained in Section 4.

Figure 12: Deriving the resource cost of abatement

Cumulative additional net resource costs (discounted) ÷ Cumulative additional abatement = **Resource Cost of Abatement ($/tonne)**

Box 20: Hypothetical WIDGET Example – Resource cost of abatement

The cumulative additional resource cost (discounted) is $1.3 million ($2013) (Box 19) and the cumulative additional abatement is 0.42 Mt CO_2-e (Box 15).

$$resource\ cost\ of\ abatement\ = \frac{\$1.3\ million}{0.42\ Mt\ CO_2 - e} = \$3.10\ per\ t\ CO_2 - e$$

The resource cost of abatement for the policy is $3.10 per t CO_2-e ($2013).

If required, the fiscal cost of abatement can be calculated using a similar method to the resource cost of abatement. DCCEE is able to provide advice on differences in the method.

6. Sensitivity analysis

The purpose of this Section is to assess the sensitivity of the estimated resource cost of abatement derived in Section 5 to the underlying parameters.

6.1. Sensitivity analysis

Sensitivity analysis should be carried out for parameters and variables that are subject to significant uncertainty and have a significant influence on the estimated abatement or on the costs and savings associated with the policy.

Start by testing how sensitive the estimate is to changes in individual parameters and variables. This can be carried out by changing one parameter by an amount considered within the bounds of realistic probability and re-running the evaluation including this change, ensuring that the same change is also carried through to the abatement and cost estimates in the absence of the policy. Repeat this process for different parameters and variables, as relevant. The sensitivity of the cost of abatement to particular variables should be reported.

Once parameters and variables that have the most impact on the evaluation have been determined, generate a ‘high’ and ‘low’ estimate of the average cost of abatement associated with the proposed policy or program by combining ‘high’ and ‘low’ values for these factors that lie within the bounds of realistic probability.

Changing the following parameters and variables will often have a significant influence on the final estimated average cost of abatement:

- discount rate (rates of 3 and 10 per cent should be used for sensitivity analysis on the resource cost of abatement);
- policy take-up;
- operating life of actions (which also influences the evaluation period);
- abatement per action in operation;
- projected emissions factors over time;
- costs and savings per action; and
- projected prices of relevant goods and services, including electricity and other fuels.

Box 21: Hypothetical WIDGET Example – Sensitivity analysis

A sensitivity analysis was conducted to find the impact of the following key variables which have a high level of uncertainty.

Year		High	Low
Discount rate	Per cent	10%	3%
Policy take-up	'000	20	80
Take-up in the absence of the policy	'001	8	2
Capital cost of a WIDGET	$/WIDGET*	1200	800
Energy savings per WIDGET	MWh/WIDGET	0.6	1

The results of the sensitivity analysis were:

Year		High	Low
Resource cost of abatement	$/ t CO_2-e*	143	-98
Cumulative abatement over the useful life of the actions	Mt CO_2-e	0.1	0.9
Total private costs over the useful life of the actions	$m*	4.2	-120.0
Private capital costs	*$m**	*19.9*	*91.8*
Private operating costs	*$m**	*-15.7*	*-211.8*
Total fiscal cost over the useful life of the actions	$m*	7.7	31.4
Total resource cost over the useful life of the actions	$m*	12.0	-88.7

* In 2012-13 dollars.

6.2. Qualitative assessment of reliability

Conducting an overall qualitative assessment of the estimate involves making a judgement about our confidence in the input data, and (given the results of the sensitivity analysis) an appropriate level of precision for the estimate—that is, whether to express the result as a point estimate or a range.

Box 22: Hypothetical WIDGET Example – Qualitative assessment of reliability

In this example, a study was undertaken to determine the inputs into this assessment. However, there is large uncertainty surrounding some variables such as the energy savings per household. The analyst assessed the accuracy of the inputs to be sufficient to provide a point estimate with the range from the sensitivity analysis.

7. Reporting and interpretation

7.1. Comparison against other policies and the benchmark cost of carbon

Once we have estimated the cost of abatement associated with the policy we are ready to compare it with the cost of abatement of other abatement policies, and with the benchmark cost of carbon.

Benchmark cost of carbon

The domestic price of carbon units in the base year of the analysis should be used as the benchmark. As units can be banked in the international market and the flexible price period of the carbon pricing mechanism, the current price of carbon units reflects both the current and the expected future value of these units.

In the fixed price period (2012-13 to 2014-15), the domestic price of units in nominal terms will be $23.00 in 2012-13, $24.15 in 2013-14 and $25.40 in 2014-15. The use of international units is not permitted in the fixed price period.

In the flexible price period, the domestic price of units will be linked to the international market as eligible international units can be used in the carbon pricing mechanism.[11] There will be several sources of carbon unit prices during this period, such as the Australian Government auctions. To decrease the impact of any distortions from short term price fluctuations it is recommended that the average price over a substantial time period such as 6 months is used. DCCEE can advise on the suitability of different carbon prices for the benchmark.

Box 23: Hypothetical WIDGET Example – Benchmark cost of carbon

In the hypothetical example, the base year is 2012-13. As a result, the benchmark cost of carbon is $23.00 per t CO_2-e ($2013).

Comparison of the cost of abatement

Analysts should always take care when ranking a collection of mutually exclusive projects based on their cost of abatement. While comparing the cost of abatement across projects indicates which project costs the least per tonne of abatement, this does not always mean the policy is the most efficient of the available options. This is because the cost of abatement (as an effectiveness rather than an efficiency calculation) ignores ‘scale’ effects and would rank projects that produce small amounts of relatively low cost abatement above those that produce much more abatement at a slightly higher cost per tonne.

[11] Unless the domestic price is constrained by either the price floor or ceiling which will apply for the first three years of the flexible price period.

Box 24: Hypothetical WIDGET Example –Comparison of the cost of abatement

The resource cost of abatement is $3.10 per t CO_2-e ($2013). As this is lower than the benchmark cost of carbon of $23.00 per t CO_2-e, according to this metric this policy is cost-effective at reducing carbon emissions.

Comparing policies with different start dates

The cost of abatement of policies that start in different years and hence have differing base years should not be directly compared. These policies should instead be compared to the benchmark cost of carbon in their respective base years.

7.2. Reporting the results

As discussed in the Introduction, the following information about an abatement policy should be estimated and reported in all cases:

Cost of abatement

- Resource cost of abatement (assessed over the useful life of the action)

Abatement-related information

- Abatement in the target year (e.g. 2020)
- Cumulative abatement to the target year (e.g. 2020)
- Cumulative abatement over the useful life of the action

Cost-related information

- Total resource cost over the useful life of the actions, including a breakdown of the private costs (capital and operating) and fiscal costs.
- Total fiscal cost over the forward estimates period

Sensitivity analysis should always be conducted and reported.

The forward estimates period is the three year period following the current budget year. In line with normal budget practices, fiscal costs should be reported in undiscounted nominal terms for this period.

Box 25: Hypothetical WIDGET Example –Reporting the results

		Best	High	Low
Cost of abatement				
Resource cost of abatement	\$ / t CO_2-e*	3.1	143	-98
Abatement-related information				
Abatement in 2020	Mt CO_2-e	0.03	0.01	0.06
Cumulative abatement to 2020	Mt CO_2-e	0.42	0.08	0.91
Cumulative abatement over the useful life of the actions	Mt CO_2-e	0.42	0.08	0.91
Cost-related information				
Total private costs over the useful life of the actions	\$m*	-18.0	4.2	-120.0
Private capital costs	*\$m**	*67.9*	*19.9*	*91.8*
Private operating costs	*\$m**	*-86.0*	*-15.7*	*-211.8*
Total fiscal cost over the useful life of the actions	\$m*	19.3	7.7	31.4
Total resource cost over the useful life of the actions	\$ m*	1.3	12.0	-88.7
Total fiscal cost over the forward estimates period	\$m nom.	20.2	8.2	32.2

* In 2012-13 dollars.

7.3. Interpreting the results

As discussed in the Introduction, the cost of abatement estimate is a measure of the cost-effectiveness of a policy at reducing carbon emissions.

If abatement is the primary objective of a policy, the cost of abatement will be the primary indicator of its cost-effectiveness. However, if abatement is only a secondary objective of the policy, abatement can be regarded as a co-benefit rather than the primary benefit. The weight given to the policy’s cost of abatement should be consistent with that.

It should be remembered that cost-effectiveness may not be the only criterion that will be applied in the assessment of the overall merits of a policy: even if abatement is the sole objective of the policy, other matters such as risk, equity and the role of government in undertaking market interventions may also be relevant to decision makers. Furthermore, this methodology only provides a partial analysis of the direct costs and abatement.

As a result, cost of abatement estimates should be supplemented by qualitative assessments of considerations such as:

- indirect costs and benefits;
- the role of government in undertaking market interventions;
- who will bear the costs or receive the benefits associated with the policy; and
- the risks associated with the policy and how they will be managed.

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Fact Sheet

Emissions reductions from Government policies and measures

Emissions reduction estimates for Government policies and measures are released annually as part of Australia's official greenhouse gas emissions projections.

What is an emissions reduction measure?

For the purpose of Australia's greenhouse gas emissions projections an emissions reduction measure is:

'an action taken and/or mandated by government – sometimes in conjunction with business or industry – to accelerate mitigation of climate change.'

The Department imposes the following criteria for a policy or program to be defined as an emissions reduction measure and an estimate for the measure to be provided in the projections:

1. *It is an action taken or mandated by government.*

2. *Its primary purpose is to reduce greenhouse gas emissions.*

Reduced greenhouse gas emissions may be an ancillary benefit or a co-benefit of a policy, but unless the policy is primarily designed to reduce emissions it is not considered an emissions reduction measure.

For example improving public transport to reduce traffic congestion is likely to result in lower greenhouse gas emissions. However, if reducing emissions is not one of the primary purposes of the policy it is not considered to be an emissions reduction measure.

3. *It is additional to what is already in place.*

Only measures that lead to emissions reductions that would not have occurred in the absence of the measures are included. This is consistent with our international reporting obligations and avoids including emission reductions that would have occurred anyway.

For example, in some cases, a policy may help households or business to undertake emission reduction actions that they would still need to perform in the absence of the measure. Emission reductions are hence not caused by this policy and the policy would not be considered an emissions reduction measure.

In some cases, a policy may bring forward emissions reduction actions that would have occurred at a later date. The emissions reductions that result from the 'bring forward' are considered additional and hence meet the criteria for an emissions reduction measure.

4. *It is measurable.*

Abatement estimates are only provided if it is possible to quantify the emissions reductions from the measure. In some cases, this is not possible. For example, this may be because the policy is still under development or it is funding for research that may enable future emissions reductions which are unable to be estimated at this stage.

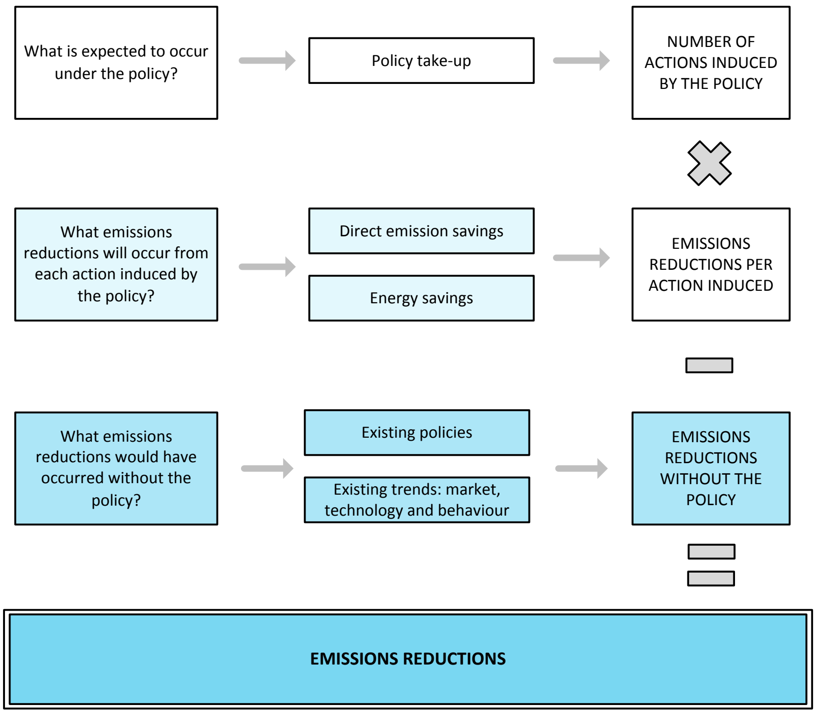
How are emissions reductions estimated?

Emissions reduction estimates are derived by either modelling, by external consultants or in-house calculations by the Department, or a combination of these approaches. They are based on reported emissions and/or knowledge of actions.

Australia's estimates of emissions reductions are consistent with international monitoring, verification and reporting requirements, and are periodically submitted to the United Nations for review.

Where multiple programs contribute to the same emissions reductions, these reductions are allocated amongst the programs to avoid double counting.

Simplified methodology for estimating emissions reductions from a measure



How are estimates of emissions reductions used?

There are different ways of reporting emissions reductions from measures that can be useful for different purposes.

Annual emissions reduction estimates

Annual emissions reduction estimates are provided in the emissions projections. Average annual emissions reductions over the Kyoto period and in 2019-20 are usually reported. These are used to determine the contribution of a measure to meeting our targets.

Cumulative emissions reduction estimates

Cumulative estimates are the total emissions reductions over the whole life of the measure, or over a specified period. These can be a useful indicator of the effectiveness of measure in reducing greenhouse gas emissions but should not be compared to annual targets.

To download a copy of the *Australia's emissions projections 2010* please visit www.climatechange.gov.au

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Factsheet

Home Insulation Program: emissions reductions

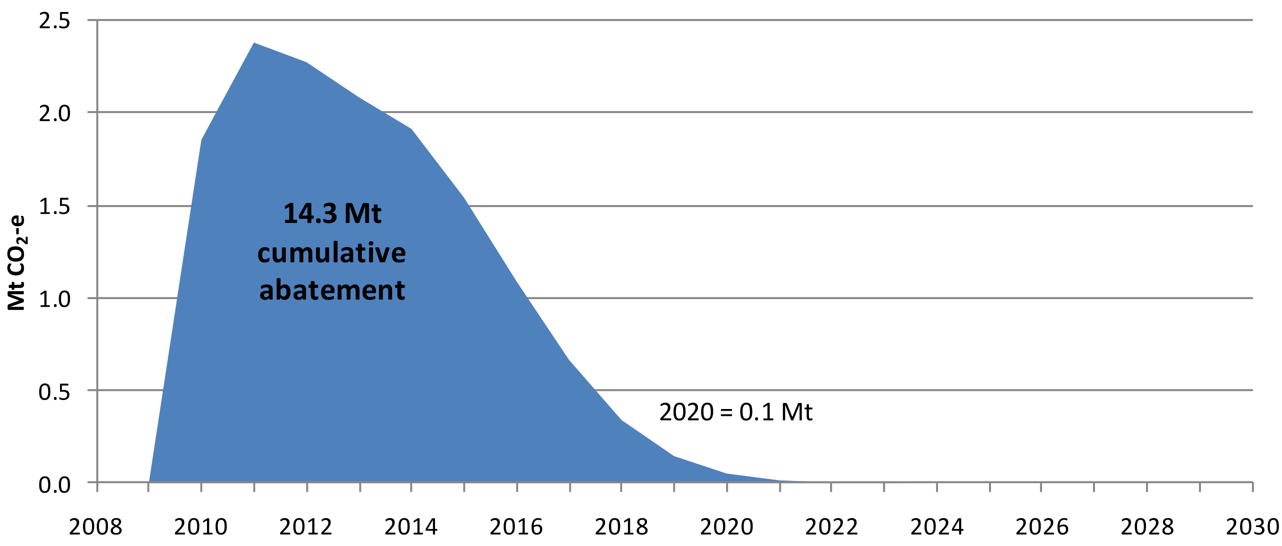
The Home Insulation Program was designed primarily to promote employment and stimulate the Australian economy in response to the global financial crisis, but additional benefits of the program included encouraging immediate energy savings and lowering household energy bills.

It has also been successful in bringing forward significant quantities of emissions reductions that would otherwise not have occurred.

Projected emissions reductions

Emissions reductions from the Home Insulation Program were calculated as part of the annual process undertaken by the Department to project Australia's greenhouse gas emissions.

Figure 1: Emissions reductions from the Home Insulation Program, 2008 to 2020



Emissions reductions from the program peak at 2.4 Mt CO_2-e in 2011, coinciding with the first full year of benefits to the 1.2 million homes insulated. Abatement declines over time for a number of reasons discussed below.

In the period to 2015, the program generates more than 10 Mt CO_2-e of abatement. Total cumulative abatement from the program is more than 14 Mt CO_2-e. This is the result of around 20,000 GWhs of electricity savings and 25 PJ of natural gas savings.

Factsheet

Changes since the previous estimate

The abatement estimate included in *Australia's emissions projections 2010* is the first time an estimate for the Home Insulation Program has been provided separately. Abatement has previously been published for the Energy Efficient Homes Package which also included the Solar Hot Water Rebate.

The *2010 Intergenerational Report* published in January 2010 reported that in 2020, 3 Mt CO_2-e were expected to be reduced on account of the Energy Efficient Homes Package. Of this, 2.5 Mt CO_2-e was directly attributed to the Home Insulation Package.

A number of improvements to the abatement estimation methodology have been made since this time:

- The number of homes insulated under the program has been adjusted to reflect the 1.2 million homes insulated by the end of the program, not the 1.9 million expected in January 2010 (-0.9 Mt CO_2-e).
- The estimate of how many homes would have been insulated in each year without the program has been improved and incorporated (-1.0 Mt CO_2-e). This is a revised estimate of how many homes are additional to the business as usual number.
- The estimate of energy savings (-0.5 Mt CO_2-e) has been improved to:
    - take into account household behaviour change in response to having insulation installed; and
    - more accurately identify interactions with other Government programs such as energy efficiency and the Renewable Energy Target.
- The current estimate of emissions reductions as a result of the Home Insulation Program on an annual basis is as follows:

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Mt CO_2-e	1.9	2.4	2.3	2.1	1.9	1.5	1.1	0.7	0.3	0.1	0.1

For more information, visit: www.climatechange.gov.au

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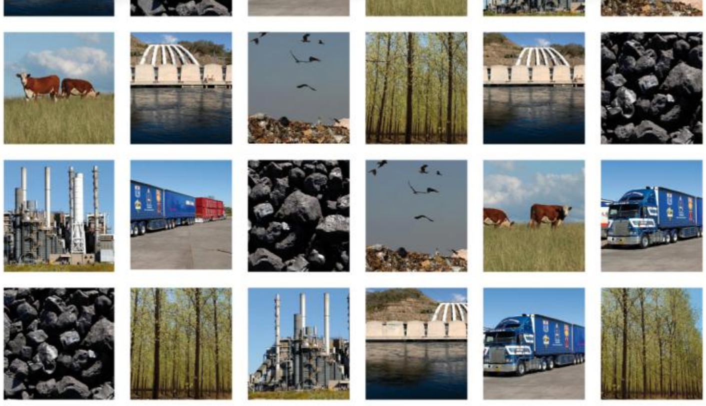
Australia's emissions projections

2010



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Australia's emissions projections

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Suggestions and comments would be appreciated. They should be addressed to:

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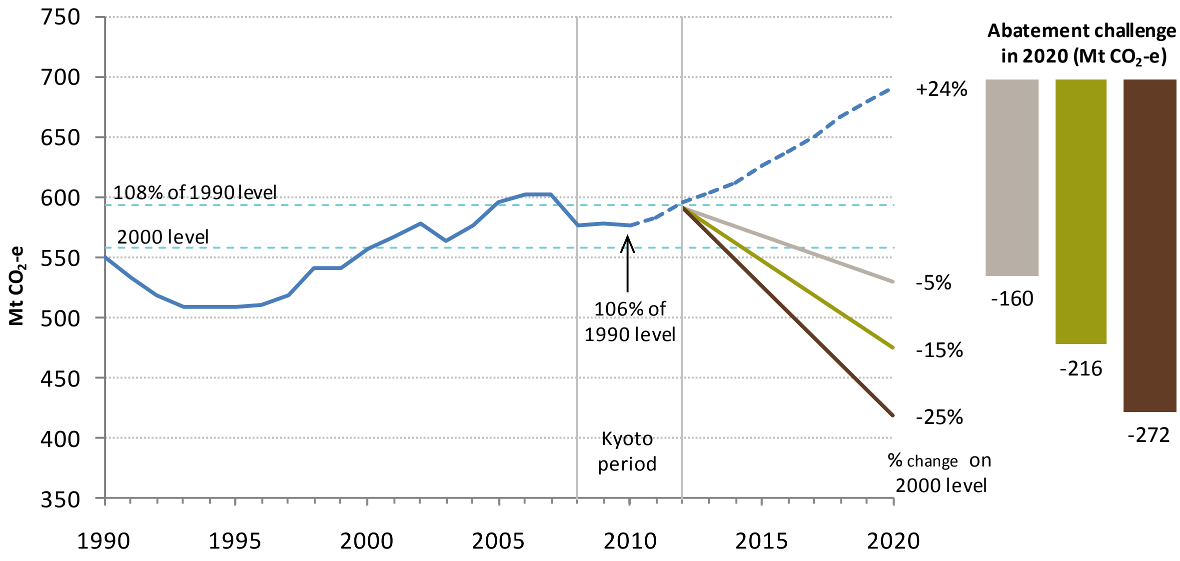
Key points

- 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.

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[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

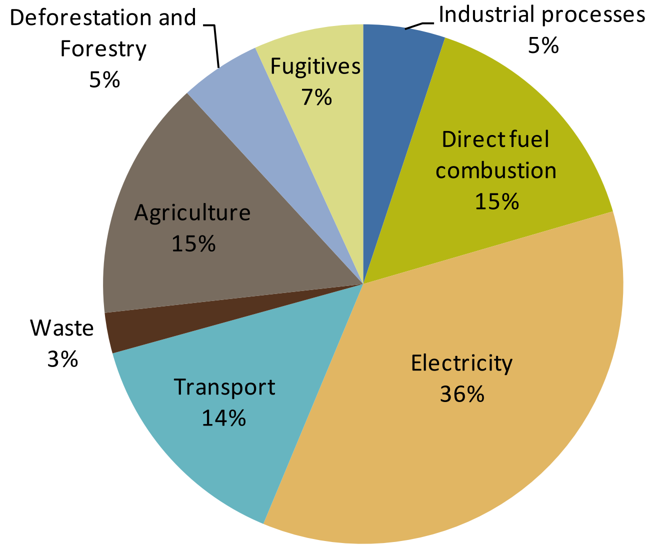
Recent trends – National Greenhouse Gas Inventory

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

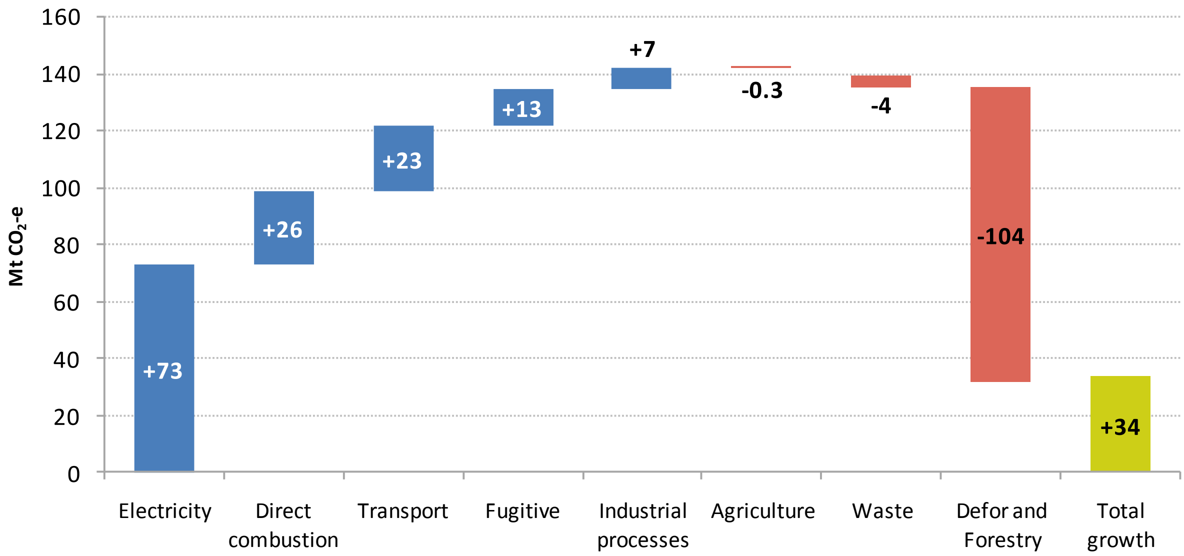
Kyoto period (2008–12)

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.

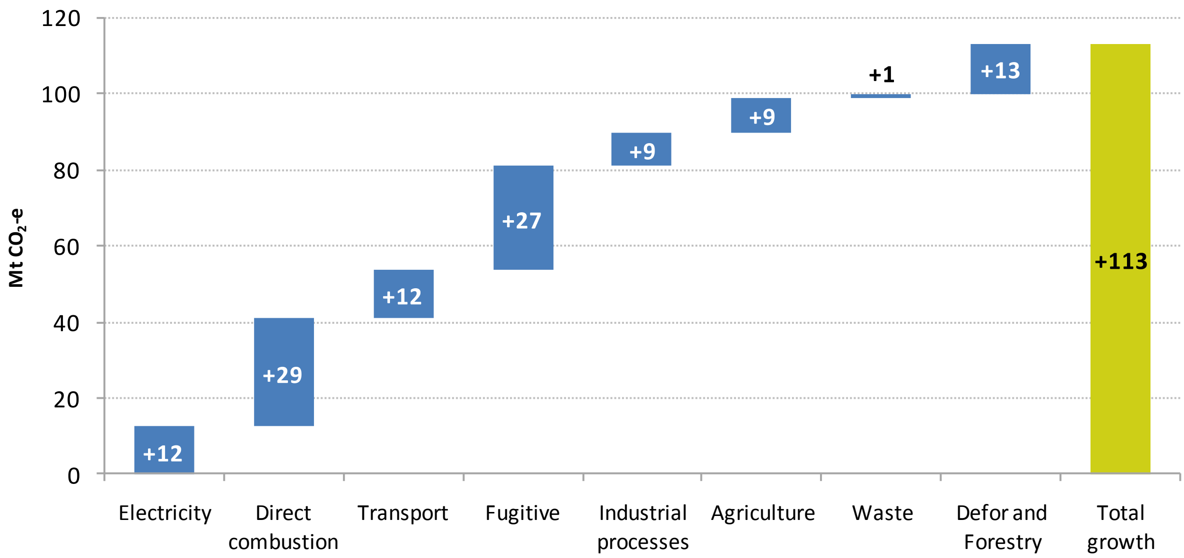
2020

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.

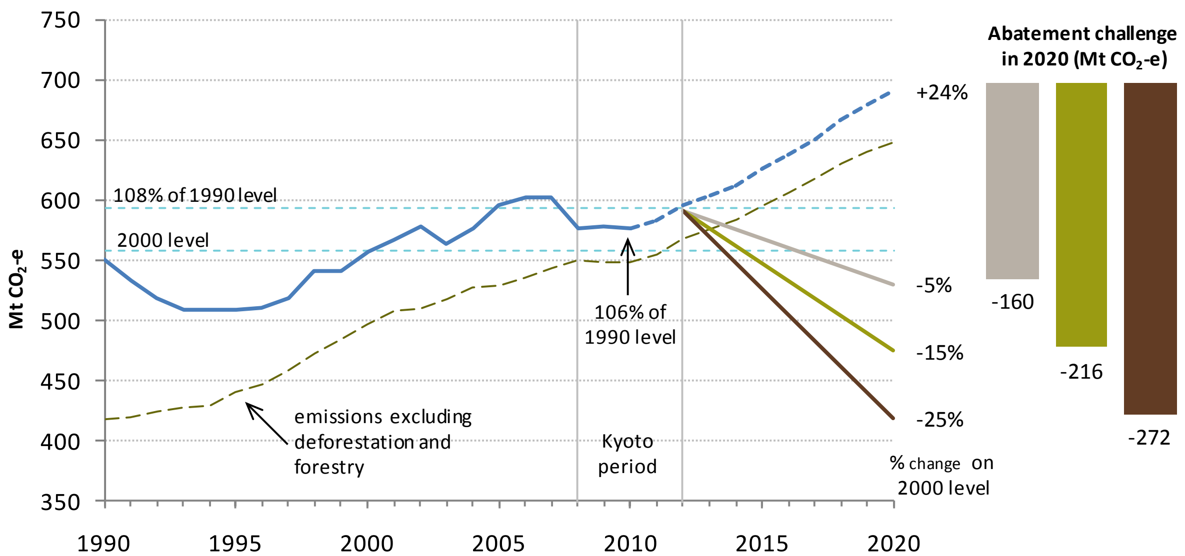
These updated projections represent the starting point for Australia's 'abatement challenge': the amount of abatement that additional policies need to generate to achieve our national emissions targets in 2020.

- 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.

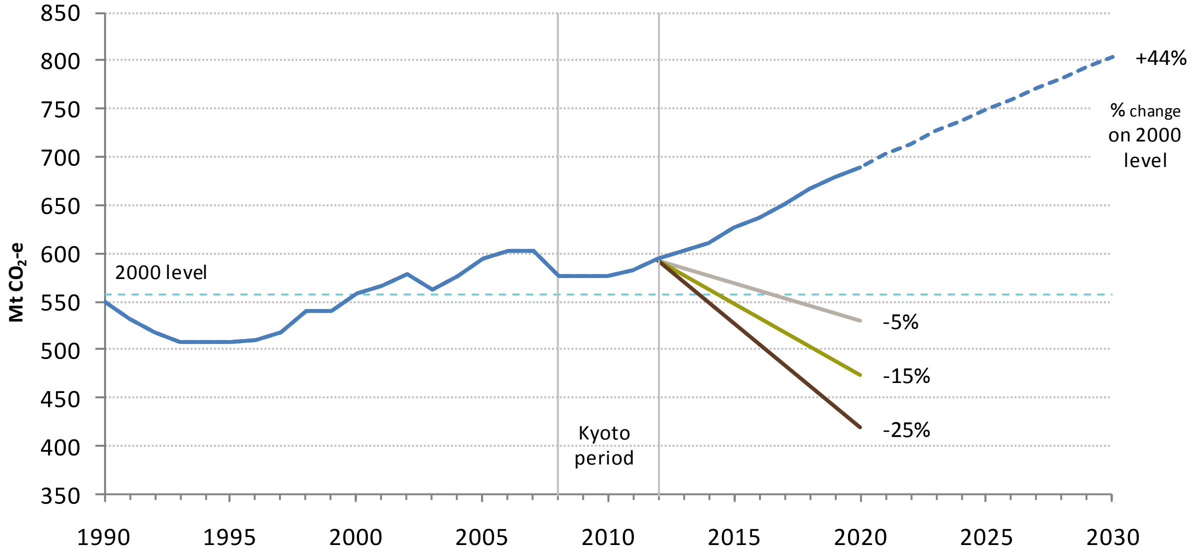
However, global demand for gas is projected to increase as countries shift to less emissions intensive fuels. This may lead to an increase in emissions from the extraction of gas for export. Similarly, Australia's transport emissions could increase, as a result of lower global oil demand and hence lower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

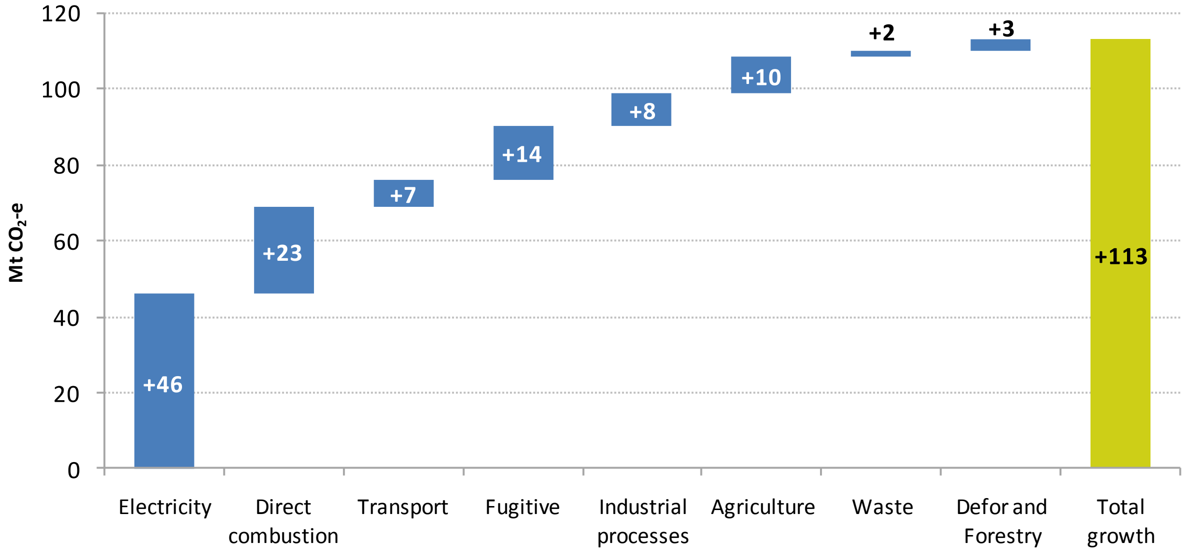
In contrast, the transport sector is projected to experience slower growth from 2020 to 2030 than in the 10 years to 2020. This is due to faster improvements in the fuel efficiency of the passenger car fleet as a result of the increased uptake of hybrid vehicles.

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.

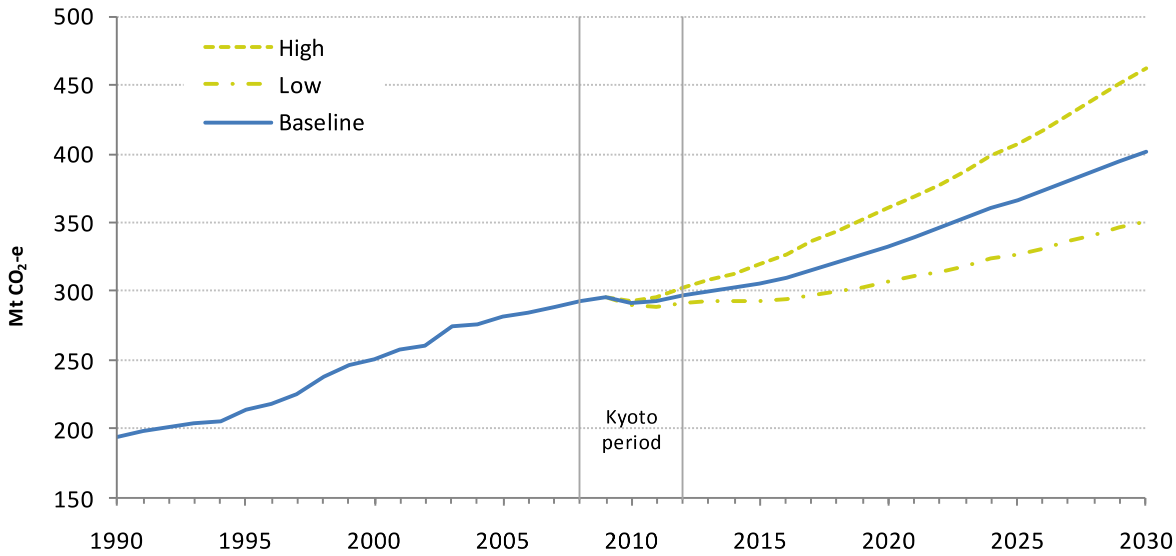
- In contrast, emissions from electricity generation are projected to grow by 6 per cent between 2010 and 2020, much slower than historical rates (15 per cent between 2000 and 2010). Both the Renewable Energy Target and energy efficiency measures are forecast to contribute to slower demand growth and 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.

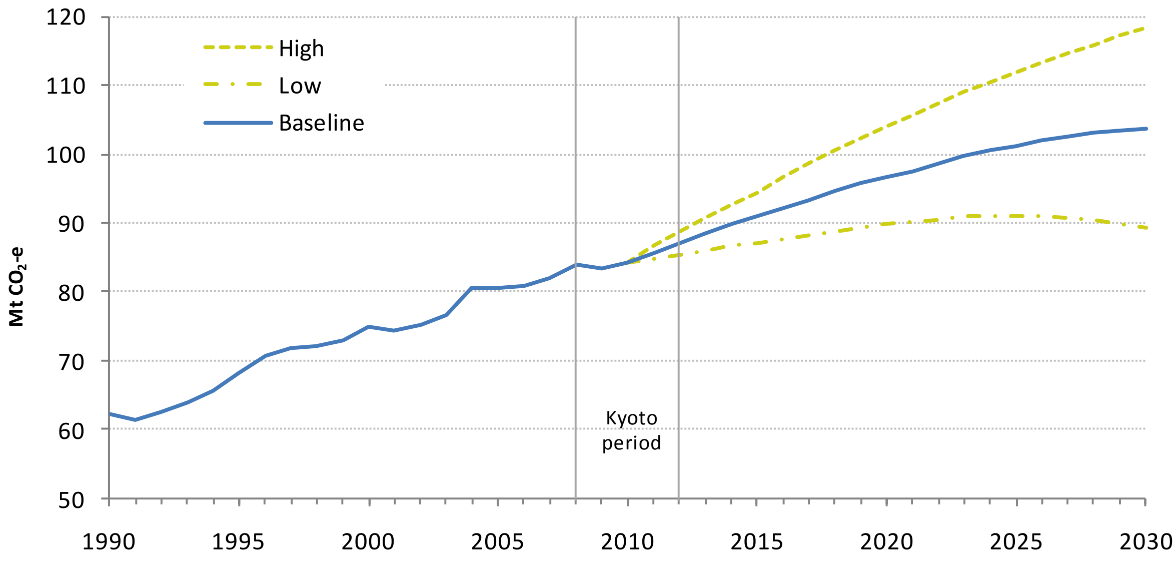
The transport sector covers emissions from the direct combustion (or end-use emissions) of fuels by road, rail, domestic aviation and domestic shipping. Road transport is by far the largest source of emissions in this sector, contributing 86 per cent of transport emissions in 2009.

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.

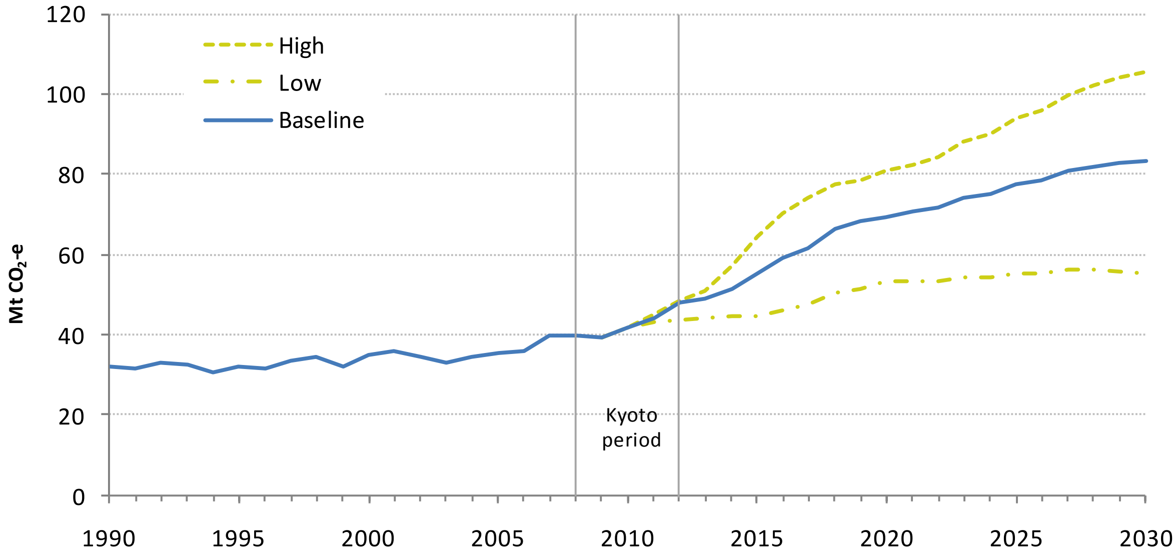
World coal prices are expected to remain above current long-term averages as a result of high global coal demand. Consequently, it is considered new projects currently in the planning stages are more likely to go ahead than not. Nevertheless, if average prices are lower than around $70 per tonne for 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.

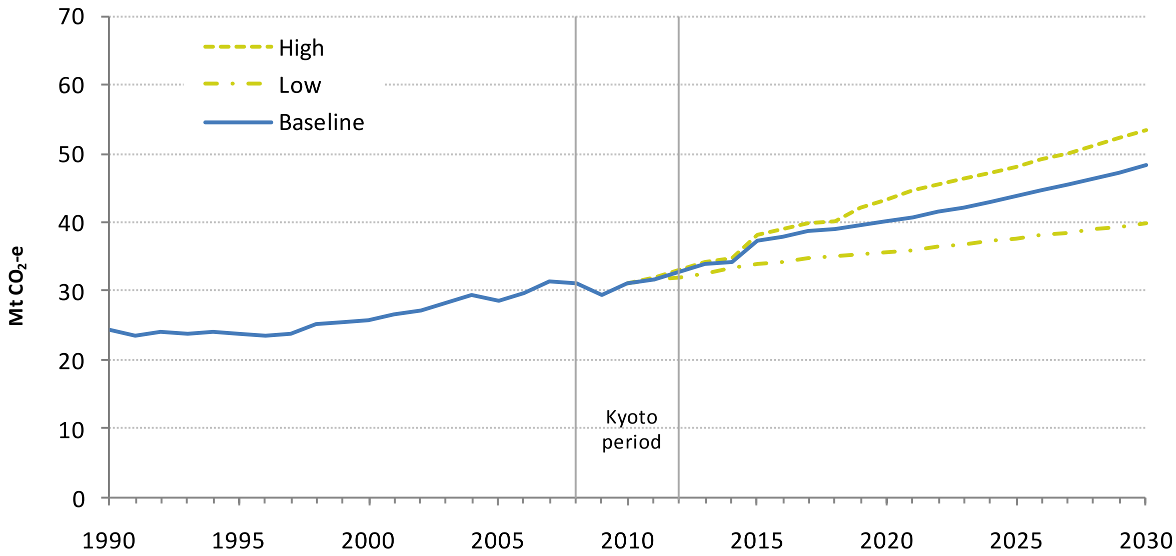
Emissions from industrial processes are the by-products of materials and reactions used in production processes. The emissions arise from non-energy related sources. They include emissions from mineral products (such as cement production), metal production, chemical production, and consumption of HFCs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

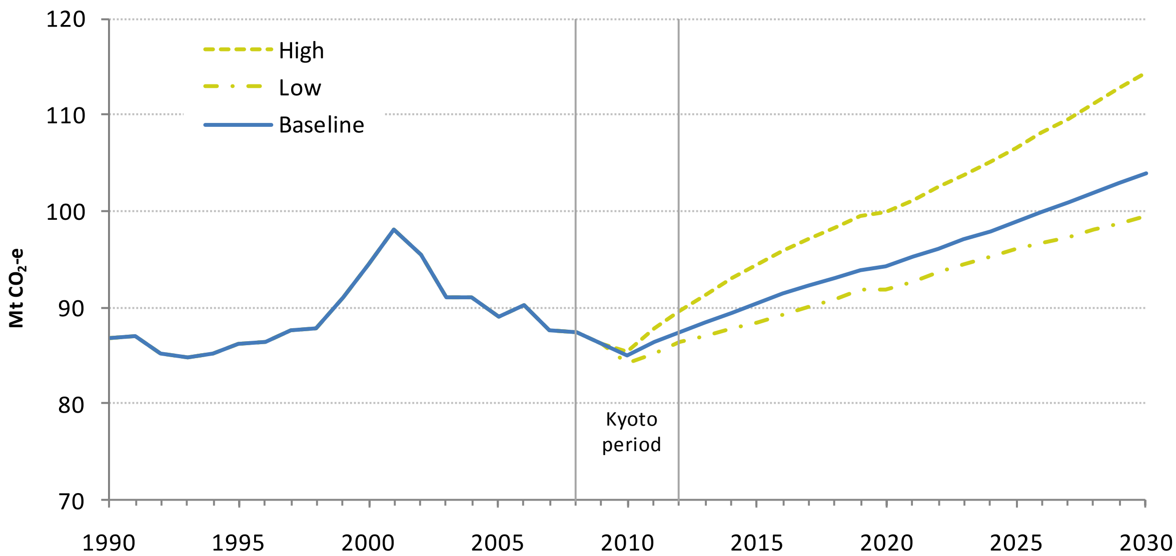
The key drivers impacting on agricultural emissions projections are the size of the livestock herd, which is strongly driven by export demand and climate conditions.

***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.

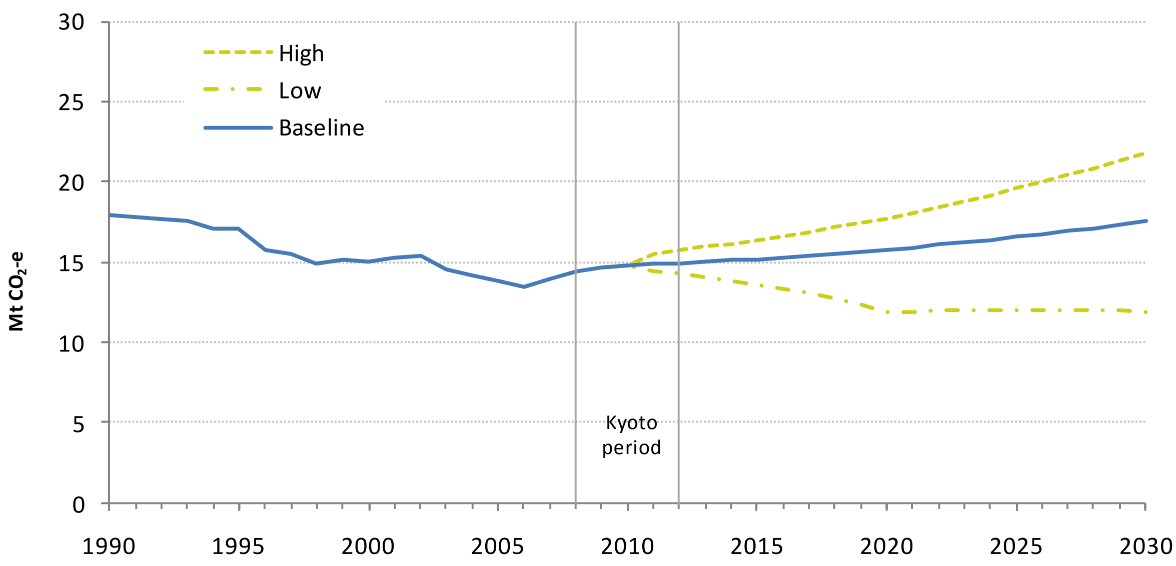
The main factors influencing projected emissions from the solid waste subsector are population growth, the amount of waste produced per person, waste diversion rates and methane capture rates. The main factors in the wastewater subsector are population growth and methane capture rates.

***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.

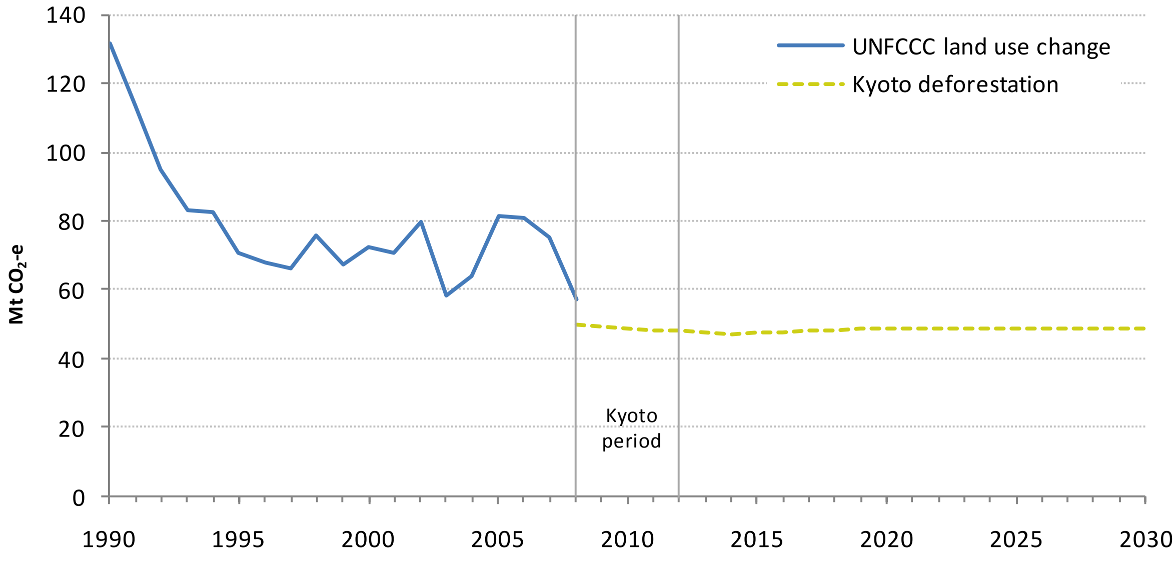
Deforestation is the direct, human-induced removal of forest cover and replacement with pasture, crops or other uses on land that was forest on 1 January 1990. Emissions result from burning of removed forest cover, decay of unburnt cleared vegetation, and emissions from soil disturbed in the process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

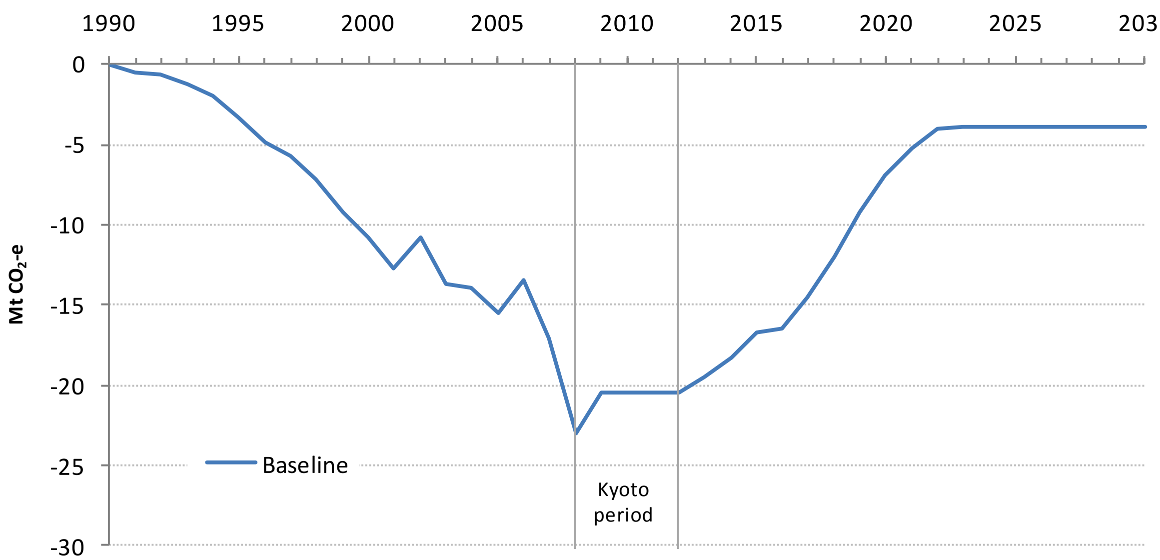
In 2009 the forestry sector contributed 21 Mt CO_2-e of sequestration to reduce Australia's net emissions. The forestry sector, under Kyoto accounting rules, covers new forests established by direct human action on land not forested in 1990. No forestry sinks are included in the 1990 baseline, and only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

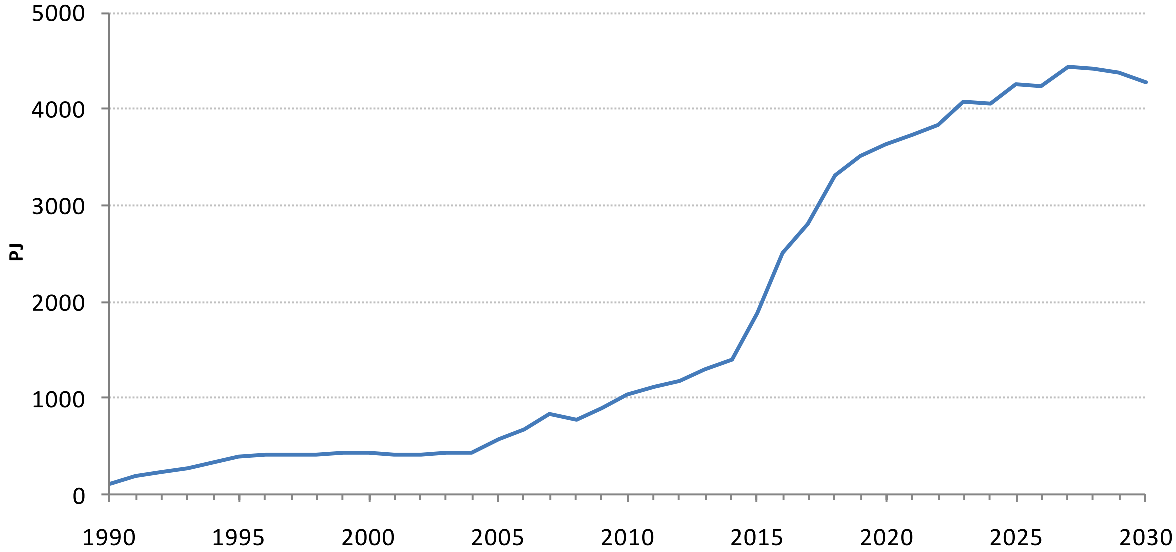
Source: Wood Mackenzie Ltd, Coal Supply Service Australia 2010, DCCEE analysis

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.

Australian Government

Department of Climate Change and Energy Efficiency

Estimates of emissions reductions from Government policies and measures

Name	Kyoto period abatement (Mt CO_2-e)	Abatement in 2015 (Mt CO_2-e)	Abatement in 2020 (Mt CO_2-e)
Alternative Fuels Conversion Program	<0.1	<0.1	<0.1
Clean Energy Initiative: Carbon Capture and Storage Flagship	Not estimated	2.3	2.3
Energy Efficiency in Government Operations	<0.1	0.1	0.1
Energy Efficient homes package: Home insulation program	1.3	1.5	0.1
Greenhouse Challenge	5.3	3.9	2.6
Greenhouse Friendly™	1.3	0.7	0.7
Greenhouse Gas Abatement Program (GGAP)	3.4	3.6	3.6
Industry Greenhouse Program	0.2	0.3	0.3
Land Use Change	18.0	19.6	18.4
Low Emissions Technology Demonstration Fund	<0.1	0	0
National Strategy on Energy Efficiency	14.3	29.7	42.6
Energy Efficiency Opportunities	*2.7*	*5.0*	*4.2*
Energy efficiency requirements: Building codes	*4.2*	*7.7*	*11.8*
Equipment Energy Efficiency (E3) Program	*6.3*	*13.1*	*20.3*
Framework Cool Efficiency Program	*0.1*	*0.2*	*0.4*
Mandatory disclosure requirements: buildings	*<0.1*	*<0.1*	*<0.1*
Phase-out of greenhouse-intensive water heaters	*0.1*	*1.9*	*4.1*
Phase-out of inefficient incandescent lighting	*1.0*	*1.8*	*1.9*
NSW Biofuel Act	0.1	0.3	0.3
NSW Greenhouse Gas Abatement Scheme	0.7	1.6	2.1
Greenhouse Gas Abatement Scheme	*0.7*	*1.1*	*0.9*
NSW Energy Savings Scheme	*0.1*	*0.6*	*1.2*
Queensland Gas Scheme	2.2	4.7	4.3
Renewable Energy Target	8.8	18.6	29.9
Large-scale Renewable Energy Target (LRET)	*4.5*	*16.5*	*26.3*
Small-scale Renewable Energy Scheme (SRES)	*0.2*	*2.1*	*3.7*
Renewable Remote Power Generation Program (RRPGP) and Renewable Energy Commercialisation Program (RECP)	0.1	0.1	0.1
Solar Cities	<0.1	<0.1	<0.1
Victorian Energy Efficiency Target and Energy Saver Incentive Scheme	0.2	0.8	1.6
TOTAL	**56**	**88**	**109**