Post-2020 emissions reduction target
Report of the UNFCCC Taskforce
Acknowledgements

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Executive summary: a strong and responsible 2030 target

Acting on climate change

Australia has a strong track record on climate change. Australia more than achieved its Kyoto Protocol first commitment period target (2008-2012). We are on track to meet and beat our 2020 target of a five per cent reduction on 2000 emissions levels, equivalent to a 13 per cent reduction on 2005 levels.

As part of an enduring framework to deliver significant emissions reductions the Government is implementing a suite of Direct Action policies, including the $2.55 billion Emissions Reduction Fund which has already purchased 47 million tonnes of emissions reductions. The gains made will be protected by the Fund’s safeguard mechanism which takes effect from 1 July 2016.

The Australian Government has agreed a target to reduce greenhouse gas emissions so they are 26-28 per cent below 2005 levels by 2030. This target will build on Australia’s strong performance and commitments to date. The target has been set following wide public consultation and consideration of the analysis of Australia’s national circumstances presented in this report. It is a progression beyond Australia’s current undertaking.

Climate change is a global issue

Climate change is a global issue. All countries must work together to address it.

The Australian Government is announcing its 2030 emissions reduction target in the context of concluding a global climate change agreement at the December 2015 United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties in Paris. All countries have agreed to formally submit their targets well in advance of Paris.

UNFCCC Parties agreed to a collective goal of limiting global average temperature rise to less than 2°C above pre-industrial levels. The scale of this challenge is over 25 times greater than Australia’s annual emissions. That is why it is vital that the Paris negotiation deliver participation and commitments from the entire international community.

To have a meaningful global impact, all countries need to act to limit and reduce their greenhouse gas emissions. This means the Paris Agreement must deliver full participation and commitments to take coordinated action by all countries. Australia, together with all UNFCCC members, has agreed the commitments should be appropriate to countries’ national circumstances so they can work alongside plans for strong economic growth, jobs and development.
Australia’s 2030 target is a strong and fair contribution

Australia's 2030 target is a significant increase on our 2020 target.

Our 2030 target compares well to other developed countries across a range of metrics. Our target delivers one of the largest reductions in emissions per capita and emissions per unit of gross domestic product of all developed countries. In absolute terms our target is in the range of efforts of other key developed countries.

As a prosperous nation we have the capacity to do our fair share. Acting in concert with others means we can contribute while remaining competitive to protect our economy and jobs.

Our target is even stronger once our national circumstances are taken into account. It will require substantial and sustained effort to reach it. Our population is growing faster than most other developed countries (around 1.5 per cent a year, compared to the OECD average of 0.4 per cent). This will push up our emissions.

Electricity generation contributes one third of our emissions. With an abundant endowment of cheap, accessible coal, we rely more heavily than other developed countries on emissions intensive electricity generated using coal. This creates real challenges to reduce emissions without impacts on the economy.

We also export more resources (half of our exports in 2013) and agricultural products (12 per cent of exports) than many other developed countries. Limiting emissions in these sectors is difficult using current technology. Just looking at our domestic emissions data does not capture the fact that our exports, such as liquefied natural gas and high quality coal, are helping emerging economies grow and lower global emissions by displacing lower quality energy sources.

A responsible target to deliver on our 2030 commitments

Australia’s 2030 target is responsible. It builds on our previous action and is consistent with strong economic growth and jobs.

We have shown we can do it. Between 2000 and 2013 the economy grew by nearly 50 per cent and our population grew strongly, while greenhouse gas emissions fell by two per cent. Australia's emissions per capita have declined by 19 per cent since 2000 and by 22 per cent since 2005. Emissions per unit of gross domestic product have fallen by 33 per cent since 2000 and by 28 per cent since 2005.

Our 2030 target is achievable, taking sensible actions that deliver overall benefits or are low cost. There are accessible and cost-effective abatement opportunities across all sectors of the Australian economy beyond 2020. Direct action measures by the Australian Government, State and Local governments and actions by business and the community can all work together to reduce Australia’s post-2020 emissions.

Under Australia’s target, the Australian economy and wages will continue to grow strongly. Analysis suggests the economy will grow slightly more slowly than it would without action by Australia and other countries. The impacts will differ across sectors of our economy.
For example, coal exports will be impacted – largely as a consequence of the climate actions of other countries rather than those of Australia. There are also upsides such as increased demand for agricultural and services exports.

Ultimately, the costs and benefits of our target will depend on the policies and other choices we make to keep our economy strong – not just to reduce emissions but to adapt to changes in global demand. The Government’s reform agenda: lower taxes; less regulation; investing in small business, productive infrastructure and childcare; and returning the Budget to surplus will keep our economy strong and jobs growing.

Technology will be critical in achieving low cost emissions reductions. The Government’s Industry, Innovation and Competitiveness Agenda is implementing a wide range of actions to build business capability and better facilitate commercialisation by business.

The Government has chosen a 2030 target, rather than a 2025 target, to provide longer term certainty to business. It will allow a smoother transition given investment timeframes and the current oversupply of electricity generation in the Australian market. Employment impacts will be reduced for policy changes introduced gradually, with advance notice so business and individuals can adjust.

**Domestic policy steps to achieve Australia’s 2030 target**

The overall design of Australia’s 2030 target policy framework will be considered in detail in 2017-2018, before the end of the current commitment period in 2020. At that time, lessons from implementation of the Emissions Reduction Fund will be available.

In the interim, the Government will consult on and where appropriate implement initiatives that have a high prospect of achieving low cost emissions reductions and delivering other benefits. These include: working with Council of Australian Governments’ Energy Ministers to develop a National Energy Productivity Plan; improving the efficiency of vehicles; phasing down hydrofluorocarbons; developing a strategy to improve the utilisation of solar power and other renewables; and developing a low emissions technology roadmap.

These measures align with other policies delivering significant emissions reductions, including the Renewable Energy Target which will deliver more than 23 per cent of Australia’s electricity from renewables by 2020, Minimum Energy Performance Standards for appliances and the 20 Million Trees programme. These measures are complemented by other actions including the Green Army programme and the Asia Pacific Rainforest Recovery Plan.

The Australian Renewable Energy Agency is already supporting around $1 billion of new and innovative renewable energy, energy storage and energy efficiency technologies.

The Government’s current policy suite is designed to reduce emissions, while improving energy and agriculture productivity, reducing costs and delivering positive environmental outcomes. This will be a key consideration in setting policies to achieve the target.
The Government is further supporting work to improve capabilities and scientific understanding of climate change impacts and adaptation. This includes the National Environmental Science programme, National Climate Change Adaptation Research Facility and through work to improve the environmental health of the Great Barrier Reef.

While the Government will continue to lead Australia’s action on climate change, everyone has a role to play. Achieving our 2030 target will involve coordinated action at all levels of government with contributions from business and the community.

The target appropriately accounts for stakeholder views

Australia’s target strikes the right balance for Australia in reflecting the views of the community, business and other stakeholders expressed during consultation.

Of individuals who made a submission, 73 per cent want the Government to take action on climate change, whereas 27 per cent do not. Many non-government organisations and individuals supported targets with far deeper emissions cuts than Australia’s partners and competitors. It is important that Australia act in unison with other countries. Reducing emissions ahead of the rest of the world could lead to transfer of emission intensive industries offshore, with minimal difference to global climate outcomes.

Many businesses want a target that balances Australia’s fair contribution with the need to act in step with trading partners to preserve competitiveness. They want our national circumstances considered. They also want the investment security of a long-term and stable target and policy framework to achieve it. For this group, policies are as important as the target itself and they want to play a part in their development. Non-government organisations and academic bodies also support clear and predictable targets and policy frameworks.
Chapter 1: Introduction and context
How the review came about

On 10 December 2014, the Prime Minister and the Minister for Foreign Affairs announced a review of Australia’s international emissions reduction targets in the lead-up to the United Nations Framework Convention on Climate Change (UNFCCC) conference in Paris, in December 2015. The UNFCCC Taskforce (the Taskforce) was established in the Department of the Prime Minister and Cabinet to coordinate the review. The Ministers for Foreign Affairs and the Environment oversaw the review. The review’s terms of reference are listed in box 1.1.

Box 1.1: Terms of reference

Climate change is a global issue requiring all countries to work together. Australia supports strong and effective action and will play a responsible role in addressing this issue, and also act in a way that protects our international competitiveness and national interest.

Australia has committed to work constructively towards the 2015 UNFCCC conference in Paris. In preparation, a Taskforce has been established in the Department of the Prime Minister and Cabinet to coordinate the provision of information to the Government. The Taskforce will ensure the Prime Minister, and the Ministers for Foreign Affairs, Trade and Investment, Industry and Science, and the Environment are fully informed on developments in the science, domestic and international emissions trends and the climate change policies of other countries.

The Taskforce will provide advice on Australia’s approach to climate change and on the development of the negotiating strategy for the UNFCCC, drawing appropriately from the evidence. The Government has committed to a review of emissions reduction targets in 2015 in the context of negotiations on the new global climate agreement to be concluded at the Paris conference. The Ministers for Foreign Affairs and the Environment will oversee the review, which the Taskforce will coordinate.

Taskforce responsibilities will also include coordination and advice on options to reduce Australia’s greenhouse gas emissions and adapt to our changing climate and the range, combination and cost of domestic instruments that could be used to meet a post-2020 target.

The Taskforce will comprise seconded officers from relevant portfolios, draw on and coordinate related activity across Government, and draw on the expertise of scientists and academics as required.
The Steering Committee was chaired by the Department of the Prime Minister and Cabinet and comprised senior officials from the Departments of Foreign Affairs and Trade, the Environment, Industry and Science and the Treasury and co-opted officials from the Departments of Infrastructure and Regional Development and Agriculture as required.

To undertake the review, the Taskforce worked closely with the Departments of Foreign Affairs and Trade, the Environment, Industry and Science and the Treasury including through seconded officials from each of these agencies.

How the review was conducted

A range of information was drawn on to conduct the review, including economic analysis, Australia’s emissions inventory and projections, information received through the consultation process, material from expert international bodies and the wide range of existing Government and expert publications.

What’s in the review

The review is structured in the following way:

Chapter 2: Australia’s role in global action on climate change discusses what Australia is doing and the approach taken internationally to bring forward post-2020 commitments.

Chapter 3: Public consultation and summary of stakeholder views outlines the approach the Government took to consultation and the stakeholders’ views on setting a post-2020 target and policies to achieve it.

Chapter 4: Australia’s national circumstances outlines Australia’s unique national circumstances, including what drives our projected emissions.

Chapter 5: Australia’s 2030 target analyses various Australian target scenarios and how they compare to other country targets and the economic impact on Australia.

Chapter 6: Policy options to achieve Australia’s 2030 target discusses the role of government, business and the community, policy options and the process for settling a policy framework and implementation.
Chapter 2: Australia’s role in global action on climate change

Key points

• The international community has committed to working together to reduce emissions based on the latest scientific evidence.

• Australia has a proven track record of acting on climate change domestically and working with other countries to support international action.

• Our 2020 emissions reduction target delivers one of the highest reductions in emissions per capita and emissions per unit of GDP.

• The UNFCCC conference in Paris in December 2015 will be an important milestone in recognising that all countries must contribute to address it.

• Countries are submitting their post-2020 targets as part of their “intended nationally determined contributions” for a new global agreement. These will not be formally negotiated in Paris. They are expected to be a progression on existing efforts.

• A new global agreement with commitments by all countries is in Australia’s national interest.
2.1 Australia’s response to climate change

Climate change is a global issue

Climate change is a global issue that requires all countries to work together to address it. Calls for a global treaty to address climate change culminated in the adoption of the UNFCCC in 1992. The ultimate goal of the UNFCCC is the:

> stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic [human-induced] interference with the climate system (UNFCCC 1992).

Australia was a founding Party to the UNFCCC.

UNFCCC Parties have agreed to a collective goal of limiting global average temperature rise to less than 2°C above pre-industrial levels.

Meeting this goal will require concerted action globally, in particular by countries that represent a significant share of world emissions. Internationally coordinated efforts are needed to ensure global emissions reduce over time, without emissions simply shifting from one country to another (carbon leakage).

China, the United States (US), the European Union (EU) and India together accounted for over half of global emissions in 2011 (figure 2.1).

Figure 2.1: Global emissions

Source: World Resources Institute (WRI), Climate Analysis Indicators Tool, accessed 12 June 2015; cait2.wri.org. Notes: Shares are for 2011 and do not include emissions from Land Use, Land Use Change and Forestry (LULUCF). More recent WRI estimates are materially different from Australia’s official inventory.

The level of certainty around the science has improved since 1997, and the need for prudent action reinforced (boxes 2.1 and 2.2).
Box 2.1: Climate science

Data and analysis released by the Bureau of Meteorology (BOM) and Commonwealth Scientific and Industrial Research Organisation (CSIRO) shows that:

- Australia’s climate has warmed by 0.9°C since 1910, and the frequency of extreme weather has changed;
- rainfall averaged across Australia has slightly increased since 1900, with the largest increases in the northwest since 1970;
- rainfall has declined since 1970 in the southwest. Autumn and early winter rainfall has mostly been below average in the southeast since 1990;
- extreme fire weather has increased, and the fire season has lengthened, across large parts of Australia since the 1970s;
- global mean temperature has risen by 0.85°C from 1880 to 2012; and
- global mean sea level has risen by 22.5 cm from 1880 to 2012 (BOM & CSIRO 2015).

Average rainfall in southern Australia is projected to decrease and heavy rainfall is projected to increase over most parts of Australia.

In 2014, the global average near-surface temperature was 0.57°C above the 1961-1990 average. Global average rain and snowfall was close to the long term average, but was unusually low or high in particular areas. Sea surface temperatures were 0.44°C above the 1961-1990 average.

Further climate change is expected, with a high degree of confidence that warming will continue and sea levels will keep rising. Changes in rainfall patterns are also expected, but scientific confidence about this is lower. The size of future climate change impacts depends on a range of factors, including future global emissions.

The Intergovernmental Panel on Climate Change (IPCC), established in 1988, provides an assessment of the state of climate science every six years. These assessments are subject to multiple rounds of review from IPCC member governments, including the Australian Government, registered experts and observer organisations.

Box 2.2: Impacts of climate change

Climate change would impose environmental and socio-economic impacts on Australia. Australia is a hot, dry continent with a naturally variable climate. Climate change could increase this variability and further expose our environment to impacts like significant weather events, reduced water and heat stress.

Environmental impacts

Australia is home to more unique species than any other country in the world and has the greatest number of habitat types (Morton & Sheppard 2014). Climate change will affect Australia’s land and biodiversity, our water, coasts and reefs, and iconic natural systems.

Climate change presents risks to Australia’s biodiversity by reducing or altering habitat and increasing competition for habitat, water and food. Plant life is also potentially affected by
the changing climate, with ecosystem changes driven by plants’ different adaptation levels. Changes in plant species can have large effects on the ecosystem, including on animals that use plants for habitat and food and nutrient cycles in ecosystems (Steffen et al. 2009).

Australia’s water resources may also be affected by climate change. For example, water availability in the Murray Darling Basin is predicted to decrease by 12 per cent by 2030 (median availability; Grafton et al. 2013).

Australia’s coastal areas, including our major cities, are vulnerable to sea level rise and storm surge. Vulnerable areas include coastal floodplain ecosystems, wetlands and mangroves. These areas play an important role in reducing the impacts of floodwaters produced by coastal storm events and tropical cyclones, as well as in physically buffering climate change impacts, including sea level rise (Pert et al. 2014; Helman et al. 2010).

**Agriculture, forestry and fisheries**

The impacts of climate change on agriculture present particular challenges, given productivity and profitability are closely linked to natural resources. Challenges include changes in temperature, water availability, weather events and the spread of weeds and diseases. Some regions will benefit from climate change, such as through increased rainfall, but other impacts will be negative.

Forestry is likely to be influenced by changing temperatures and rainfall patterns. Ideal locations for forestry plantations will shift and the potential distribution of pests and diseases impacting on forest growth will alter.

Fisheries could experience reduced yields and changes in the location of the fishery or fundamental characteristics of fish stocks due to higher sea temperatures and changes to ocean currents from climate change. Acidification (reduced alkalinity) of the oceans due to the absorption of higher levels of CO₂ may also have effects. Some shellfish may have trouble building shells in more acidic water, while some crustaceans may grow even stronger shells.

**Infrastructure**

Some transport infrastructure (such as roads, ports and rail networks) may be more susceptible to damage from extreme weather events.

Changing rainfall patterns and temperatures will also place different demands on Australia’s water infrastructure. For example, areas vulnerable to drought may need to invest significantly in new water infrastructure (e.g. building new dams, investing in desalination plants). Sewerage and stormwater infrastructure upgrades, levees and dams may be required to better deal with extreme rainfall events and flooding.

**Insuring against the costs of a changing climate**

By acting as part of a concerted global effort, Australia can help to reduce the global risks of climate change.

It is hard to quantify these risks in the same manner as the costs of acting. Estimates of the impacts of climate change range from as much as 14 per cent of average world consumption per capita by 2050 (OECD 2012), to a global GDP loss of between 0.7 per cent and 2.5 per cent by 2060 (Dellink et al. 2014).
Australia is delivering on its climate commitments

Australia has contributed to international efforts to address climate change since before ratifying the Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol). Australia, alongside other countries, adopted the Kyoto Protocol under the UNFCCC in 1997. The protocol established binding emissions reduction targets for developed countries.

Australia ratified its first commitment period of the Kyoto Protocol in 2007 committing us to limit emissions to 108 per cent of 1990 levels through the period 2008-2012.

Australia outperformed on this target by limiting its emissions to 103 per cent of 1990 levels, despite strong economic and population growth.

Australia has pledged to reduce its greenhouse gas emissions by five per cent below 2000 levels by 2020 under the Copenhagen Accord and Cancun Agreements. This equates to a reduction of 13 per cent below 2005 levels. Australia is on track to meet and beat this commitment.

In 2012, Australia submitted a Kyoto Protocol second commitment period target of 99.5 per cent of 1990 levels over the period 2013-2020. Australia is one of only 35 countries that have put forward a commitment. This target is consistent with Australia’s pledge under the Cancun Agreements. Australia is also on track to meet and beat this commitment.

Actions to meet the 2020 target are discussed in chapter 6.

Australia’s 2020 target compares favourably with international action

Australia’s 2020 emissions reduction target, in absolute terms, is comparable with action taken by other developed nations (figure 2.2).

Figure 2.2: Comparing Australia’s 2020 target with other countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Official target and base year</th>
<th>2020 target on a:</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>1990 base</td>
</tr>
<tr>
<td>Australia</td>
<td>5% below 2000</td>
<td>-6%</td>
</tr>
<tr>
<td>Canada</td>
<td>17% below 2005</td>
<td>+1%</td>
</tr>
<tr>
<td>US</td>
<td>17% below 2005</td>
<td>-3%</td>
</tr>
<tr>
<td>Japan</td>
<td>3.8% below 2005</td>
<td>+6%</td>
</tr>
<tr>
<td>EU</td>
<td>20% below 1990</td>
<td>-20%</td>
</tr>
<tr>
<td>New Zealand</td>
<td>5% below 1990</td>
<td>-5%</td>
</tr>
<tr>
<td>Republic of Korea</td>
<td>30% below business as usual</td>
<td>+85%</td>
</tr>
</tbody>
</table>

Note: Canada, Japan, the EU, New Zealand and Republic of Korea comparisons exclude LULUCF emissions, consistent with their base year accounting.
Absolute emissions reduction targets tell only part of the story. Figures 2.3 and 2.4 show Australia’s efforts to reduce emissions compared to the efforts of other developed countries. The graphs show that when Australia’s emissions reductions are measured as a percentage improvement on a per person (per capita) or per unit of GDP basis (emissions intensity), our effort is comparable to or exceeds that of Canada, the US, Japan, the EU, New Zealand and Korea.

**Figure 2.3: Change in emissions per person – 2020 relative to 2005 levels**

Source: Population from Commonwealth of Australia, 2015-16 Budget (Australia) and UN World Population Database, 2012, medium fertility (other countries). Emissions data from DOE 2015a, National Inventory Report (DOE 2015b) (Australia), Intended Nationally Determined Contribution Submission by the Republic of Korea (Korea) and national inventory reports submitted to the UNFCCC (other countries).

**Figure 2.4: Change in emissions intensity – 2020 relative to 2005 levels**

Source: GDP from Commonwealth of Australia, 2014-15 Budget (Australia) and OECD database (2014a) (other countries). Emissions data from DOE, 2015a, National Inventory Report (DOE 2015b) (Australia), Intended Nationally Determined Contribution Submission by the Republic of Korea (Korea) and national inventory reports submitted to the UNFCCC (other countries).
For some developing countries, their per capita emissions are growing while emissions intensity is falling. For example, China has pledged to reduce their emissions intensity by 40-45 per cent below 2005 levels by 2020. China’s emissions per capita are projected to rise 120 per cent by 2020 (relative to 2005), but their level of per capita emissions will still be low compared to other countries.

Australia has also performed well in its efforts to constrain growth in emissions. Between 2000 and 2013 Australia’s absolute emissions declined two per cent while our domestic economy increased nearly 50 per cent and our population grew strongly (figure 2.5).

Figure 2.5: Australia has cut emissions while expanding our population and economy

Internationally, efforts are focused on post-2020 targets and securing a new global agreement that will include all 195 UNFCCC countries. Key countries are not currently increasing their 2020 targets. Countries with targets that are conditional on the extent of global action, including New Zealand, the EU and Norway are not increasing their targets at this time. One hundred of the 195 countries have 2020 pledges.

Australia is playing its part in the global response to climate change

Climate change is a challenge which must be addressed as part of the broader suite of issues facing the international community. Australia assists developing countries through our foreign aid programme, support for lower emissions energy technologies, forests and agriculture and through multilateral climate forums.
International assistance

In 2014, Australia committed $200 million to the Green Climate Fund to further assist the global response to climate change. Australia has been on the Board of the Fund since its inception, which guides key investment decisions.

Pacific Island countries see climate change as a priority issue. Australia supports a range of programmes in the Pacific. For example, the Climate and Oceans Support Programme ($32 million from 2012 to 2016) is helping 14 Pacific national meteorological services make seasonal forecasts and make information accessible to their governments and communities.

Support for low emissions energy technologies

Australia’s resource exports provide emerging economies with energy vital to economic development and poverty reduction. This includes Liquefied Natural Gas (LNG) and black coal, which can then be used in high efficiency, low emissions power generation.

Australia has partnered with the world’s major emitters and emerging economies in our region. For example, in 2014, Australia signed a Memorandum of Understanding with China on Climate Change Cooperation, and we are working together on emissions accounting and inventory practices.

We are a partner country of the Global Methane Initiative, which researches and promotes cost-effective methane recovery from agriculture, waste, oil and gas, and coal mining to produce energy and reduce emissions.

As a member of the International Partnership for Energy Efficiency Cooperation, Australia implements the Group of 20 (G20) Energy Efficiency Action Plan agreed in 2014, including work on energy efficient buildings.

Support for forests and agriculture

Effective measures to combat illegal logging help efforts to address climate change. In 2014, the Government hosted an Asia-Pacific Rainforest Recovery Summit and is working with regional countries and stakeholders to develop an Asia-Pacific Rainforest Recovery Plan. New due diligence requirements under the "Illegal Logging Prohibition Regulation 2012" came into effect on 30 November 2014 for importers of regulated timber products and processors of domestically grown raw logs. The Government is supporting actions to reduce emissions from deforestation and forest degradation (REDD) in developing countries.

We are a founding member of the Global Research Alliance on Agricultural Greenhouse Gases, which focuses on research, development and extension of technologies and practices that grow more food without increasing emissions.

Multilateral climate forums

Australia partners with other countries in a range of climate change forums, including taking action to phase out ozone depleting substances under the Montreal Protocol.

We also collaborate with key economies through the G20 on initiatives that drive economic growth and have a positive impact on the climate. Australia is a member of the Major
Economies Forum on Energy and Climate. We are working with other countries to address emissions from international shipping and civil aviation which represent a significant source of emissions and are not directly addressed by the UNFCCC and the Kyoto Protocol.

2.2 Paris and post-2020 climate action

The two decades since the UNFCCC was established have seen growth in international action on climate change. However, there has also been growth in emissions, in particular in emerging economies, which have increased their share of total emissions (figure 2.6). Australia’s share of global emissions has remained between 1.3 and 1.7 per cent since 1990.

Figure 2.6: Share of global emissions

![Share of global emissions graph](image_url)

Source: World Resources Institute, Climate Analysis Indicators Tool, accessed 23 June 2015; cait2.wri.org. Shares do not include emissions from LULUCF.

In 2011, Parties to the UNFCCC agreed to develop a new global climate change agreement that would extend to all countries by the Paris conference in December 2015. The Paris Agreement will take effect from 2020, succeeding the Kyoto Protocol commitments and Cancun pledges.

A new global agreement for future action

Having a new agreement that applies to all countries is important. The global distribution of energy use, emissions and wealth has changed dramatically over the past two and a half decades and will continue to change this century. To meet the challenge of climate change, we need emissions reduction commitments by all countries, not just developed countries as was the case under the Kyoto Protocol.

The Paris Agreement can set a durable foundation for future global action. The Agreement should establish a common, rules-based system that contains provisions to ensure transparency and show how countries are tracking towards their commitments.
Australia has played an active role in the international negotiations on climate change to date. For example, Australia chairs the Umbrella Group which brings together ten developed countries in the UNFCCC. Australia will continue to build on its strong track record of contributing practical outcomes in the negotiations for the Paris Agreement.

**Intended nationally determined contributions**

Ahead of Paris, UNFCCC countries are preparing their “intended nationally determined contributions” (INDCs). These INDCs set out the emissions reduction targets each country will adopt post-2020.

INDCs will be nationally determined, and will not be formally reviewed or negotiated at Paris (box 2.3). For this reason, we expect a diversity of INDCs including different types of targets and policy measures.

**Box 2.3: Intended nationally determined contributions**

UNFCCC countries agreed the international expectations for INDCs, including that they be:

- a progression beyond the country’s current undertaking;
- clear, transparent and easy to understand;
- announced well in advance of the Paris conference; and
- focused on mitigation (adaptation can be included as an optional component).

To facilitate the clarity of INDCs, countries have been encouraged to include information about their targets, such as the reference point (base year), time frames and/or periods for implementation, coverage of greenhouse gases and sectors, planning processes, assumptions and accounting approaches.

Countries are expected to explain their INDC in light of their national circumstances, and how it contributes towards achieving the UNFCCC’s ultimate objective.

The UNFCCC Secretariat will, by 1 November 2015, assess the aggregate impact of the post-2020 targets countries have submitted in INDCs and prepare a report.

Countries are yet to determine the final form in which the Paris Agreement will recognise countries’ post-2020 targets.
Countries that have committed to further action

As of 11 August 2015, 53 countries have submitted an INDC (figure 2.7 and 2.8). These countries represent around 63 per cent of global emissions and 73 per cent of global economic output.

Most countries have announced a single target number, or a small range allowing for uncertainty or a margin of error. Most developed countries have put forward an absolute reduction target. Most developing countries have put forward targets that reduce the rate of increase in their emissions compared to business as usual (BAU). In particular, China has announced it will reduce its emissions intensity 60 to 65 per cent by 2030 on 2005 levels. This is projected to lead to a 150 per cent rise in emissions by 2030 (Figure 2.7), although their emissions per capita in 2030 will still be below many developed country levels. Countries have provided supporting material with their targets, including in some cases a summary of policies to achieve their target (appendix 2).

Figure 2.7: Targets submitted by key countries, on a 2005 base
Figure 2.8: Countries’ submitted post-2020 targets as at 11 August 2015.

<table>
<thead>
<tr>
<th>Country</th>
<th>Target (%)</th>
<th>Base year</th>
<th>End year</th>
<th>Equivalent target in 2030 (%) when using a 2005 base year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>-26 to -28</td>
<td>2005</td>
<td>2030</td>
<td>-26 to -28</td>
</tr>
<tr>
<td>US</td>
<td>-26 to -28</td>
<td>2005</td>
<td>2025</td>
<td>no 2030 target</td>
</tr>
<tr>
<td>EU</td>
<td>-40</td>
<td>1990</td>
<td>2030</td>
<td>-34</td>
</tr>
<tr>
<td>Japan</td>
<td>-26</td>
<td>2013</td>
<td>2030</td>
<td>-25</td>
</tr>
<tr>
<td>Canada</td>
<td>-30</td>
<td>2005</td>
<td>2030</td>
<td>-30</td>
</tr>
<tr>
<td>Russia</td>
<td>-25 to -30</td>
<td>1990</td>
<td>2030</td>
<td>+59 (a)</td>
</tr>
<tr>
<td>New Zealand</td>
<td>-30</td>
<td>2005</td>
<td>2030</td>
<td>-30</td>
</tr>
<tr>
<td>Norway</td>
<td>-40</td>
<td>1990</td>
<td>2030</td>
<td>-18</td>
</tr>
<tr>
<td>Switzerland</td>
<td>-50</td>
<td>1990</td>
<td>2030</td>
<td>-52</td>
</tr>
<tr>
<td>Iceland</td>
<td>-40</td>
<td>1990</td>
<td>2030</td>
<td>-41</td>
</tr>
<tr>
<td>Serbia</td>
<td>-9.8</td>
<td>1990</td>
<td>2030</td>
<td>no data available</td>
</tr>
<tr>
<td>Liechtenstein</td>
<td>-40</td>
<td>1990</td>
<td>2030</td>
<td>-49</td>
</tr>
<tr>
<td>Monaco</td>
<td>-50</td>
<td>1990</td>
<td>2030</td>
<td>-50</td>
</tr>
<tr>
<td>Marshall Islands</td>
<td>-32</td>
<td>2010</td>
<td>2025</td>
<td>no 2030 target</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Target (%)</th>
<th>Base year</th>
<th>End year</th>
<th>Specified target type</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>-60 to -65</td>
<td>2005</td>
<td>2030</td>
<td>reduction of CO₂ emissions intensity of GDP; peaking around 2030</td>
</tr>
<tr>
<td>Republic of Korea</td>
<td>-37</td>
<td>N/A</td>
<td>2030</td>
<td>absolute reduction from BAU</td>
</tr>
<tr>
<td>Mexico (b)</td>
<td>-25</td>
<td>N/A</td>
<td>2030</td>
<td>absolute reduction from BAU</td>
</tr>
<tr>
<td>Morocco</td>
<td>-13</td>
<td>N/A</td>
<td>2030</td>
<td>absolute reduction from BAU</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>-64</td>
<td>N/A</td>
<td>2030</td>
<td>absolute reduction from BAU *conditional on support</td>
</tr>
<tr>
<td>Kenya</td>
<td>-30</td>
<td>N/A</td>
<td>2030</td>
<td>absolute reduction from BAU</td>
</tr>
<tr>
<td>Singapore</td>
<td>-36</td>
<td>2005</td>
<td>2030</td>
<td>reduction of emissions intensity of GDP; peaking around 2030</td>
</tr>
<tr>
<td>Former Yugoslav Republic of Macedonia</td>
<td>-30</td>
<td>N/A</td>
<td>2030</td>
<td>absolute reduction of CO₂ from BAU</td>
</tr>
<tr>
<td>Trinidad and Tobago</td>
<td>-30</td>
<td>N/A</td>
<td>2030</td>
<td>absolute reduction from BAU in the public transportation sector only</td>
</tr>
<tr>
<td>Gabon</td>
<td>-50</td>
<td>N/A</td>
<td>2025</td>
<td>absolute reduction from BAU</td>
</tr>
<tr>
<td>Benin</td>
<td>N/A</td>
<td>N/A</td>
<td>2030</td>
<td>increase sequestration through reforestation to 163 Mt from 2020-2030</td>
</tr>
<tr>
<td>Andorra</td>
<td>-37</td>
<td>N/A</td>
<td>2030</td>
<td>absolute reduction from BAU</td>
</tr>
</tbody>
</table>

Note: Commitments relative to BAU, can allow for increases in actual emissions. For example, Morocco’s proposal to reduce emissions by 13 per cent by 2030 relative to BAU is estimated to allow for an actual increase in emissions of around 57 per cent from 2010 to 2030. Commitments based on emissions intensity of GDP can see absolute emissions continue to rise as those countries’ GDP continues to grow. (a) Calculation based on the low end of Russia’s target. (b) Mexico’s target includes greenhouse gases and short lived climate pollutants.
Chapter 3: Public consultation and summary of stakeholder views

Key points:

- The Government has engaged business, non-government organisations (NGOs) and the wider community.
- The majority of stakeholders support taking action on climate change.
- Stakeholders outlined post-2020 targets they support, factors the Australian Government should consider in setting a target, impacts of possible targets and policy recommendations.
  - Many businesses want the government to balance climate action with consideration of Australia’s national circumstances and competitiveness.
  - Many NGOs support a target in line with the global 2°C goal.
  - Views from the community range from taking no action to making immediate and significant cuts to emissions.
### 3.1 Approach to consultation

The Government has undertaken public consultation on Australia’s post-2020 emissions reduction target, including:

- a five week public consultation process;
- Ministerial roundtables; and
- stakeholder engagement by the UNFCCC Taskforce.

The Review has drawn extensively on the views expressed through the consultation process in formulating this report.

#### Public consultation


The issues paper set out the context for consideration of a target, including that the Government would look at Australia’s national circumstances and the scope and nature of other countries’ targets.

The issues paper asked three questions and invited the community to address these in their submissions:

- What should Australia’s post-2020 target be and how should it be expressed? In responding to this question you could consider the base year (e.g. 1990/2000/2005), the end year (e.g. 2025/2030), the type of target and why the suggested target is preferred.
- What would the impact of that target be on Australia? In responding to this question you could, for example, consider the impact on our economy, jobs, business and on the environment.
- Which further policies complementary to the Australian Government’s direct action approach should be considered to achieve Australia’s post-2020 target and why?

Submissions closed on 1 May (some submissions were made after that date and were also accepted). A total of 498 submissions were received; 138 from organisations and 360 from individuals. The majority of submissions focussed on the three questions posed in the issues paper.

#### Ministerial roundtables

The Minister for Foreign Affairs, the Hon Julie Bishop MP and the Minister for the Environment, the Hon Greg Hunt MP, held roundtables in Sydney (30 April), Perth (1 May), Melbourne (6 May) and Brisbane (7 May).

These roundtables were attended by 64 business, community, environmental, and Indigenous stakeholders. They provided the Government with additional feedback from key stakeholders.
Taskforce engagement

To support the public consultation, the UNFCCC Taskforce held 59 meetings with interested groups from business, NGOs, the academic and scientific community, other government agencies and State, Territory and Local governments. The Taskforce explained the process for setting Australia’s post-2020 emissions reduction target. Stakeholders provided input and advice.

The Taskforce also engaged stakeholders through events hosted by the Crawford School at the Australian National University, the Climate Institute, the Carbon Market Institute and the Australian Industry Greenhouse Network.

The Taskforce also liaised with Government bodies like the Climate Change Authority (CCA), which was also undertaking a review of targets, including on what stakeholders were saying to them.

3.2 Summary of stakeholder views

The following section summarises the key themes in submissions received. These views were also expressed in the Ministerial roundtables and discussions with the UNFCCC Taskforce.

Views on a post-2020 target

Over half of submissions proposed a specific post-2020 target. Individuals and NGOs were more likely to suggest a target than businesses and their peak bodies.

The majority of individuals (73 per cent) who made a submission supported the Government taking action on climate change, including setting a post-2020 target. Around a quarter (27 per cent) of individuals did not support any action on climate change.

The most common reasons cited by individuals for setting a target included: meeting the 2°C goal; protecting the environment; realising the potential for green industry and renewable energy; and ensuring Australia acts in line with other developed countries. The majority of individuals who proposed a target supported one in line with the CCA’s recommendations (30 per cent reduction on 2000 levels by 2025, 40-60 per cent by 2030); exceeding targets of the US, the EU, Canada and Japan.

Individuals who did not support a target generally either did not believe in human-induced climate change and/or did not consider it to be a problem the Government should address.

Over 95 per cent of submissions from organisations supported the Government taking action by setting a post-2020 target. Submissions came from businesses, peak bodies, NGOs, academic institutions, and State and Local governments.

Businesses and peak bodies were more likely to identify the principles they believed should guide setting the target, than a specific target. The key factors nominated were the need to balance Australia as a developed country contributing its fair share to global efforts with the need to act in step with trading partners, competitors and/or developed countries and to consider national circumstances and sectoral impacts.
In setting a post-2020 target the government should weigh the following factors – Australia’s appropriate share; what other countries are actually doing; technical feasibility; environmental credibility and economic cost (Business Council of Australia)

Australia should neither lead, nor lag the rest of the world. Australia’s commitment to the global climate change effort should be consistent with the effort of its peers, avoid opportunities for carbon leakage, and advance Australian business interests (Australian Chamber of Commerce and Industry)

Reducing global net emissions sufficiently to contain climate change to less than 2 degrees will take concerted effort by many nations, iterated and deepened over many years as and when trust and experience grow. Australian targets should be chosen and developed to reflect and support that longer term effort (Australian Industry Group)

Many businesses and peak bodies favoured a 2030 end year to allow longer-term investment planning.

Logically the longer [2030] timeframe gives more opportunity to meet any post-2020 target, as such, the 2030 end year is far more appropriate and gives greater long term investment certainty to the industrial sector (Energy Users Association of Australia)

Businesses also highlighted the global benefits and emissions reduction challenges of Australia’s exports.

There is a global environmental benefit where Australian LNG and coal, which has lower greenhouse gas emissions than many other competitors, replaces poorer quality and more greenhouse gas emissions intensive energy inputs (Business Council of Australia)

The world must pursue the twin objectives of limiting climate change to the lower end of the IPCC’s emissions scenarios, and providing access to affordable energy to support development (BHP Billiton)

A key challenge for the agriculture sector is to reconcile the competing objectives of food and fibre security for a growing global population, while reducing emissions from the sector. An absolute approach to considering agriculture emissions reduction (i.e. net emissions from the sector are reduced) is at odds with this need to expand total production to meet growing demand (National Farmers’ Federation)
Academics and NGOs commonly proposed a target in line with, or higher than, the CCA’s recommendations. Rationales cited by this group were similar to those advocated by individuals.

...*put forward a new commitment from Australia that accords with our responsibilities as a wealthy developed country and reflects the scale of the global challenge* (Oxfam)

*[there are] opportunities for entire new industries* (Australian Council of Trade Unions)

Organisations across all sectors emphasised the need for long term certainty of Australia’s target, and of the policy framework to implement it.

...*investors are interested in a realistic assessment of the long-term emissions reduction objective and suitable policies to support the transition* (Investor Group on Climate Change)

*[we need] ... a clear and stable pathway to meet Australia’s carbon emissions reduction target [and] ... an effective, sustainable and stable response to climate change and implementation of climate policy in a fair and equitable manner* (Australian Council of Social Services)

### Impacts of potential post-2020 targets

Submissions raised both costs and opportunities associated with a post-2020 target, as well as cautioning against setting a target too high or too low.

*Our national interests would not be served by taking on targets that imply a disproportionately high or low burden compared to the actions of other relevant economies. There are risks both from the excessive costs of an inadequately reciprocated target, and the diplomatic and potentially economic damage of a target perceived as too weak* (Australian Industry Group)

A number of organisations cautioned against proposing a target that would damage Australia’s competitiveness. Others raised Australia’s national circumstances – our economic structure and strong economic and population growth – as making it more expensive for Australia to act.

*If Australia takes action that increases costs and reduces competitiveness in an industry or the economy at large, lower cost imports not subject to the same imposts will reduce the market for Australian producers, with obvious flow-on consequences for employment, investment and economic activity* (Australian Industry Greenhouse Network)
Other organisations emphasised the consequences of inaction and the negative impact this would have on the competitiveness of the Australian economy.

*Taking weaker action to reduce emissions in the short term, will only make it harder and much more costly for the economy to reduce emissions in the future. If action is delayed, the cost of reducing emissions will have to be borne inequitably by future generations* (Australian Conservation Foundation)

Submissions raised opportunities associated with reducing emissions.

*There are real financial opportunities to be gained by developing the technologies and business opportunities necessary to reduce greenhouse gas emissions* (City of Sydney)

Individuals raised both costs and benefits. Individuals cited the consequences of inaction, such as environmental and health impacts, and Australia falling behind in the renewables sector. Others mentioned job losses in the mining sector and a short-term slowing of economic growth as negative effects. Individuals who did not support action on climate change stated there would be economic benefits if no emissions reduction target was set.

**Policy options**

Individuals and organisations raised a range of policies to support a post-2020 emissions reduction policy. Policies supported by a large number of individuals and organisations include energy and productivity measures and renewable energy investment.

Business supported technological solutions including research and development (R&D).

*Continued and sustained investment in research and development is key to driving the improvement of carbon efficiency of our farming systems and allowing our agricultural sector to contribute to emissions reductions* (Cotton Australia)

A large amount of Australia's emissions come from electricity generation. Two of the largest generators, AGL and Origin, suggested the need for emissions standards, regulatory measures, and encouragement of clean technologies.

A large number of submissions supported market mechanisms, including international units to help meet the post-2020 target.

*Access to international abatement opportunities, which have tended to offer lower marginal abatement costs than in Australia, is a crucial opportunity to control cost* (Australian Industry Group)

*Australia could invest in overseas permits to help cover for difficult-to-avoid emissions or areas of the economy where immediate emissions reductions may be cost prohibitive* (World Wildlife Fund Australia)
Many submissions from business outlined private sector action to reduce emissions.

*Despite Australian cementitious production increasing by 23 per cent since 1990, our industry has reduced the carbon intensity of its product by over 30 per cent. Greenhouse gas emissions from Australia’s integrated cement manufacturing industry are currently 15 per cent below 1990 levels in absolute terms* (Cement Industry Federation)

*Australian dairy recognises that its potential for growth may impact on its greenhouse gas (GHG) emissions. Even with its growth potential, the industry has an ambitious target to reduce emissions intensity by 30% below 2010 emissions by 2020.* (Dairy Industry Council)

BHP Billiton has a target to reduce emissions while growing their business – in 2014 their business “implemented projects that delivered 800,000 tonnes of GHG reductions.”

Virgin Australia highlighted the International Air Transport Association’s targets to improve international civil aviation operational efficiency by 1.5 per cent annually from 2009 to 2020; achieve carbon neutral growth at industry level from 2020 and halve 2005 emissions levels by 2050.
Chapter 4: Australia’s national circumstances

Key points:

- Without concerted action Australia’s emissions are projected to increase to 2030, reflecting among other things population and economic growth.

- The structure of Australia’s economy and the factors driving Australia’s emissions growth differ from those in other developed countries, in ways that make it harder for us to reduce emissions.
  - Australia’s population is growing faster (around 1.5 per cent per year, compared to the OECD average of 0.4 per cent).
  - Electricity generation contributes 34 per cent of our emissions. We rely more heavily than other developed countries on emissions intensive electricity from coal given Australia’s abundant endowment of cheap accessible coal.
  - We also export more resources (half of our exports) and agricultural products (12 per cent of our exports) than other developed countries.

- These unique national circumstances are important to consider in setting future emissions reduction goals.
4.1 Australia’s greenhouse gas emissions

Australia’s emissions in 2013 were 549 million tonnes of carbon dioxide equivalent (Mt CO$_2$-e). Electricity generation is currently the largest source of Australia’s greenhouse gas emissions accounting for 34 per cent of total emissions with sizeable contributions from direct combustion (e.g. the combustion of fuels for heat in manufacturing processes), transport and agriculture.

Australia’s current emissions profile is different from other OECD countries reflecting Australia’s national circumstances (figure 4.1). For example, Australia has higher emissions from electricity generation, agriculture and fugitives (e.g. methane released from extraction of coal and gas).

Figure 4.1: Emissions profiles of Australia, 2013, and other OECD countries, 2012

Source: DOE 2015b, National Inventory Report 2013 (Australia) WRI, Climate Analysis Indicators Tool, accessed 23 June 2015 (Mexico, Republic of Korea, Israel and Chile); and UNFCCC GHG database (all other OECD countries). Note: To support consistent comparisons OECD emissions are converted to CO$_2$ equivalent values using global warming potentials published in the IPCC Fourth Assessment Report. For OECD countries LULUCF is a net sink of nine per cent of total emissions and has been excluded from the figure.
Box 4.1: Predicting Australia’s emissions

In recent years Australia’s emissions projections have seen a number of downward revisions. Figure 4.2 shows the impact of these revisions on the emissions reduction task associated with Australia’s 2020 target.

By nature, emissions projections are inherently uncertain, involving judgments about the future growth path of global and domestic economies, policy actions, technological innovation and human behaviour. The level of uncertainty around emissions projections increases the further emissions are projected into the future.

The recent revisions reflect a multitude of factors, such as fluctuations in key commodity prices, climatic variations and their impact on agricultural production and outlook and changes in international emissions accounting rules. They also reflect lower electricity demand outcomes due to higher retail electricity prices, energy efficiency activities and the uptake of small scale renewable energy generation.

Figure 4.2: Australia’s cumulative abatement task across projections releases

Since the analysis for the 2014-15 Projections was completed, the Government legislated the Large-scale Renewable Energy Target (LRET) at 33,000 GWh. This means a greater share of Australia’s electricity generation will come from renewable sources than was modelled in the 2014-15 Projections, which assumed an LRET consistent with a ‘real 20 per cent’ Renewable Energy Target. The recent fall in commodity prices is also expected to lead to lower domestic production, particularly for coal. Therefore, projections of business as usual emissions are likely to be lower. The ERF was not included in the 2014-15 Projections because its details were yet to be finalised when the projections were prepared. The intention is to release an update to the Projections later in 2015.
Australia’s emissions are projected to increase 2020 to 2030

From 2020 to 2030, Australia’s emissions are projected to grow one per cent per annum on average to 724 Mt CO$_2$-e before taking into account the Emissions Reduction Fund (ERF) and post-2020 policies.

With the ERF and other action Australia is on track to meet and beat its 2020 target. This means the current business as usual projections overestimate our emissions to 2030. Predictions so far in the future need to be treated cautiously. Predicting Australia’s emissions is inherently uncertain (box 4.1), as demonstrated by a number of downward revisions in emissions projections in recent years (figure 4.2).

Projected emissions growth to 2030 is dominated by electricity generation emissions. Projected electricity demand increases with growth in economic activity and population. Coal-fired electricity is projected to retain a large share of total electricity generation. Emissions from direct combustion and fugitives also increase significantly, primarily from the extraction of more coal and natural gas for export (figure 4.3).

Figure 4.3: Historical and projected emissions, 1990 to 2030

4.2 Our emissions are driven by our national circumstances

Australia’s national circumstances have a large impact on our projected emissions and opportunities for reducing emissions. We are a large country (by area) with a small but growing population, open to trade and integrated into the global economy. Our exports are primarily dependent on emissions intensive industries such as resources and agriculture.

Population

Australia’s population is forecast to grow by 26 per cent between 2015 and 2030. The resulting increased demand for goods and services, including energy, will drive our emissions and present a key challenge in meeting our 2030 target. Australia’s population is projected to continue to grow at a higher rate than most other OECD member countries (figure 4.4).

Figure 4.4: Projected average annual population growth rate, 2015-2030

Source: Commonwealth of Australia, 2015, 2015-16 Budget (Australia), UN population projections, 2012, medium fertility (other countries). Note: UN population projections for Australia estimate an average annual growth rate of 1.1 per cent over the period, 2015-2030.
Economy

Australia has the world’s 12th largest economy, and the 11th highest income per person (IMF 2015; World Bank 2015). In 2013-14 Australia’s GDP was $1.58 trillion. The economy is predicted to grow around three per cent per year to 2030.

Between 2000 and 2013 the economy grew by nearly 50 per cent, which drove emissions up. However, the impact of this growth was offset by structural change towards less emissions-intensive goods and services. Australia, like other developed countries, has experienced a long-term and ongoing structural change in its economy since the 1950s. Services now constitute a larger share of the economy (71 per cent in 2012-13) (figure 4.5).

Figure 4.5: Australian industry sectors, nominal value added shares

![Diagram showing Australian industry sectors, nominal value added shares]


Despite the increasing size of the services sector, the share of GDP Australia derives from emissions intensive mining and agriculture industries is comparatively high relative to other OECD member countries. Australia’s emissions and standard of living will continue to be influenced by trends in demand for Australia’s production and exports.
Trade

Trade makes an important contribution to jobs and economic growth in Australia.

Australia is an open trading nation, with low or zero tariffs and is integrated into global markets. This has accelerated Australia’s specialisation in areas where we have a comparative advantage internationally. Australia has a high proportion of resource (including energy) exports; they make up almost half of our exports (by value), and our agricultural exports are larger than many other developed countries (figure 4.6).

Figure 4.6: Export shares by sector, 2013

Consistent global action will be important given Australia faces a variety of competitors from both OECD and non-OECD countries in a range of emissions intensive sectors. For example, by volume in 2013 Qatar was the world’s largest LNG exporter, Indonesia the largest coal exporter, Russia the largest aluminium exporter and India the largest beef exporter.

Emerging market economies are expected to contribute nearly three-quarters of global economic growth in the medium term (Commonwealth of Australia 2014). Rising per capita incomes in developing countries, further global trade liberalisation and economic integration are expected to continue to drive demand for Australia’s resource and agricultural exports.

Over half of Australia’s top 20 trading partners are countries in the Asia-Pacific region. Given Australia’s proximity to the growing economies of the Asia-Pacific, Australia’s exports have been growing rapidly and are likely to continue to do so. This will result in upwards pressure on Australia’s emissions. Exports of goods and services are projected to increase by around four per cent per year to 2025.

It is estimated that around 39 per cent of Australia’s domestic emissions result from our exports (ABS 2014a). A proportion of these emissions are currently difficult to abate without reducing or ceasing the activity.
Energy commodity exports

Australia is the world’s eighth largest energy producer (BREE 2014b). In 2012-13, Australia exported 80 per cent of its energy production (figure 4.7), which accounts for 21 per cent of Australia’s export earnings (DFAT 2014b).

Figure 4.7: Australian energy production and energy exports 1977-78 to 2012-13

A projected 17 per cent increase in coal exports and a 230 per cent increase in natural gas exports to 2019-20 will increase Australia’s fugitive emissions. Global emission reduction action may lead to coal and gas export growth slowing post-2020 (see chapter 5). Climate action by other countries is more likely to impact our thermal coal exports (primarily used for electricity generation) than our metallurgical coal exports (primarily used for steel making). In 2013-14 thermal coal accounted for 42 per cent of the value of our coal exports compared with 58 per cent for metallurgical coal (DIS 2015a).

In addition to lifting living standards in developing countries, Australia’s energy production, such as coal production, is less emissions intensive than in other countries (Pant 2007). Our exported black coal has high energy content which means that smaller volumes of coal are combusted to achieve the same level of generation. A consideration in choosing a target is that without action by competitors, decreasing energy resource production in Australia may not lead to lower global emissions. It may increase emissions if energy is instead produced more emissions-intensively overseas.
**Agricultural exports**

Another challenge for Australia is how to reduce emissions from a growing agricultural sector. Long-term growth in the sector will be underpinned by meeting the demand for agricultural exports, including meat and dairy exports. This will contribute to improved living standards in developing countries and global food security. The projected global rise of the middle class, particularly in Asia, will contribute to growing demand for these exports.

Agriculture emissions account for 15 per cent of Australia’s total and a large proportion of these emissions result from products that will be exported. Australia exports around 65 per cent of its agricultural production (ABARES 2014). Some agricultural activities such as beef and dairy production have emissions that are hard to reduce with current technology (e.g. methane released from the digestive system of cows). See appendix 4 for further detail on the agricultural sector.
Electricity

Australia’s renewable energy policies and falls in technology costs have delivered significant increases in renewable energy. Australia is on track to have more than 23 per cent of electricity generated by renewable energy by 2020, up from 15 per cent in 2013-14.

Australia has reduced its emissions from electricity generation by 15 per cent since 2008-09 through reducing electricity demand (figure 4.8) and increased low emissions generation (DOE 2015b). Renewable electricity generation grew 7.0 per cent a year while fossil fuel generation was unchanged over the decade to 2013-14. Solar generation grew 53 per cent and wind generation 31 per cent a year over the decade to 2013-14 (DIS 2015b).

However, more so than other OECD countries, Australia’s competitiveness relies on abundant and cheap brown and black coal for electricity generation. This contributes to high emissions intensity of Australia’s electricity generation. In 2013-14, 61 per cent of Australia’s electricity was generated using coal and 85 per cent using fossil fuels (DIS 2015b). Compared to other countries, Australia also has no nuclear generation and has limited opportunity for hydroelectric generation. This creates real challenges to reduce these emissions without significant impacts on the economy.

We need to carefully consider when and how changes are made to electricity generation. While Australia has abundant renewable energy opportunities (discussed under the geography and land use section below) there is currently an oversupply of capacity in our electricity market. Demand for electricity in 2014-15 was flat following declines in recent years (figure 4.8). The Australian Energy Market Operator (AEMO) estimates Australia’s National Electricity Market requires no new generation capacity until 2023-24.

A 2030 target would allow more time for transition, and take advantage of changing technology that will most likely be cheaper because of world demand. Electricity sector impacts from Australian targets are further discussed in appendix 4.

Figure 4.8: National Electricity Market (NEM) demand, annual growth

![Figure 4.8: National Electricity Market (NEM) demand, annual growth](Image)

Source: NEM target demand via AEMO (2015) obtained using NEM-Review software. The NEM covers major population centres in Queensland, New South Wales, Victoria, South Australia and Tasmania and accounts for over 80 per cent of total Australian electricity generation.
Electricity

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Transport

Australian transport emissions are higher on a per capita basis (3.9 tonnes in 2012) than more densely populated countries (e.g. 1.7 tonnes for EU members) but comparable to Canada (4.9 tonnes) and the US (5.3 tonnes) (IEA 2014a).

Australia has amongst the highest population growth rate in the OECD and this is an important driver of aggregate emissions growth in the transport sector. Australia also has relatively long distances between its main population centres, and between farm, mine and market, influencing the nature and scale of Australia’s transport emissions. Australia’s domestic freight task was 591 billion tonne kilometres in 2011-12 (BITRE 2014b), up 56 per cent since 1999-2000.

Road transport is the main means of passenger transport. In 2012-13, 176 billion passenger kilometres were travelled on capital city roads compared to 12.5 billion passenger kilometres on urban rail networks (BITRE 2014a). While a high proportion of our population lives in cities, Australia’s average urban population density is 1,400 people per square kilometre compared with the global average of 4,400 people per square kilometre (Demographia 2015).

Geography and land use

Australia is the world’s largest island and smallest continent, with a land area of 7.7 million square kilometres.

Australia’s geographic characteristics include world leading resources of wind and solar energy. For example, Australia has higher solar radiation per square metre than any other continent (Geoscience Australia 2015).

Emissions from the land sector include emissions from agriculture (discussed above) and land use, land use change and forestry (LULUCF). Agriculture is the most extensive form of land use in Australia making up 406 million hectares or 53 per cent of Australia’s total land mass (ABS 2015c). In 2011, Australia had 108.2 million hectares of forest, covering approximately 14 per cent of the continent. Of this, 106.2 million hectares are native forests and the remainder are plantation forests (DOE 2013).

Net emissions from LULUCF have declined by 88 per cent since 2000 driven by lower rates of land clearing, particularly in Queensland and New South Wales. Emissions and removals from forest land are subject to considerable variability from year to year, particularly due to fires. For example, in 2009 fires in the State of Victoria burned approximately 430,000 hectares of land (Victorian Department of the Environment and Primary Industries 2015).
Our projected emissions growth before any further action is higher than other countries

Australia’s projected emissions growth before any further climate policy action (business as usual) is higher than that reported by other developed countries. Around two-thirds of Australian and global emissions are CO₂ from fuel combustion (e.g. from electricity generation, transport, and industry). Australia’s business as usual projected CO₂ emissions from fuel combustion are expected to increase 1.4 per cent per year between 2015 and 2030 (figure 4.9). In contrast, for the OECD on average these emissions are projected not to grow at all over the same period.

Figure 4.9 shows the combined impact of population growth (purple) and GDP per capita growth (green) is larger for Australia than for OECD countries. In addition, under business as usual conditions the offsetting impacts of reduced energy intensity of the economy (red) and emissions intensity of energy (blue) are smaller for Australia. The projected increase in the production of Australian goods for export, including energy intensive exports like LNG, contributes to the smaller business as usual reduction in the energy intensity of Australia’s economy.

Figure 4.9: Key drivers of average annual change in fuel combustion emissions

Chapter 5: Australia’s 2030 target

Key points:

- A number of Australian target scenarios (ranging from no further action beyond 2020 to 45 per cent below 2005 levels by 2030) have been compared with targets announced by other key countries across a range of metrics.

- Australia’s target of 26-28 per cent below 2005 levels by 2030 is within the range of targets announced by other developed countries in absolute terms, but delivers greater percentage reductions than other developed countries when measured in terms of per capita emissions reductions and emissions intensity reductions.
  - A 2030 target year gives business more certainty, while a base year of 2005 is consistent with the US, Canada and New Zealand.

- It is comparatively more costly for Australia to reduce emissions than other developed countries.
  - This is because the structure of Australia’s economy and the factors driving Australia’s emissions growth differ from those in other developed economies (see chapter 4).

- Analysis in this chapter shows reducing Australia’s emissions will affect the economy. The impacts will differ across the sectors of the economy and be greater the deeper the target. The economic and social impacts of climate change and benefits of a global response (see chapter 2), which are difficult to quantify, are not covered in this chapter.

- The economic impacts are manageable and the economy will continue to grow given:
  - our target is carefully calibrated to those of other countries in terms of effort;
  - our target provides certainty and is set sufficiently far in advance to allow for a smooth transition;
  - low cost policies are chosen; and
  - technological progress continues to be made in relation to energy and emissions efficiency.

- The Government’s Direct Action policy with the Emissions Reduction Fund and its safeguard mechanism is designed to deliver low cost abatement (see chapter 6).
5.1 Target scenarios

A number of possible target scenarios in 2030 were examined, benchmarked against maintaining Australia’s 2020 target level from 2020 to 2030. Targets in figure 5.1 are:

- **scenario 1 (baseline): No further action beyond 2020.** Australia reduces emissions by 13 per cent below 2005 levels by 2020 (its 2020 target), then maintains the settings that achieved the 2020 target and lets emissions grow at approximately business as usual levels reflecting population and economic growth. Under this scenario per capita emissions and emissions intensity of the economy still fall, even though there is no further action. This is because even though our emissions grow after 2020 to reach 2 per cent below 2005 levels, our population and economy in 2030 are much bigger than they were in 2005.

- **scenario 2 (benchmark): 13 per cent below 2005 by 2030,** which holds emissions in 2030 at Australia’s 2020 target level of five per cent below 2000 levels;

- **scenario 3: 20 per cent below 2005 by 2030;**

- **scenario 4: 26 per cent below 2005 by 2030;**

- **scenario 5: 35 per cent below 2005 by 2030;** and

- **scenario 6: 45 per cent below 2005 by 2030,** using the minimum target recommended by the Climate Change Authority of 40 per cent below 2000 levels by 2030.

Figure 5.1 presents the trajectories of different scenarios. Scenario 1 is the estimated baseline for national emissions with no further action beyond 2020, based on modelling conducted by Professor McKibbin for McKibbin Software Group Pty Ltd (McKibbin modelling). Professor McKibbin assessed the economic impacts of reducing energy sector carbon dioxide emission for the targets in scenarios 2, 4, 5 and 6. Scenario 3 was not specifically modelled and is also a scaled result based on the modelling of the other scenarios.

**Figure 5.1: Possible target scenarios for Australia**
Target year and base year

A target year of 2030 better suits Australia’s national circumstances. A 2030 target, compared to a 2025 target, is more likely to allow a smoother economic transition given investment timeframes and the current oversupply of electricity generation in the Australian market. In their submissions many businesses supported a 2030 target. Changes to technology are likely to help reduce the abatement task and lower costs.

A 2005 base year aligns Australia with Canada, the US and New Zealand and helps with transparency. Further detail on Australia’s target parameters is at appendix 1.

5.2 Metric comparison

As described in chapter 3 many stakeholders supported Australia acting in concert with other countries. Australia’s potential targets have been assessed against the targets of other key countries (Canada, the US, Japan, the EU, New Zealand, Republic of Korea (Korea) and China) using the following metrics:

- change in absolute emissions;
- level and change in emissions per capita;
- level and change in the emissions intensity of the economy; and
- average annual change in absolute emissions post-2020.

These metrics, when used together, provide a more complete picture than only assessing changes in absolute emissions. This more complete picture is important, since Australia’s particular national circumstances make it harder for Australia to achieve absolute emissions reductions than other developed countries.

On the basis of these metrics (when evaluated against a 2005 base year) Australia’s 2030 target compares favourably with Canada, the US, Japan, the EU, New Zealand, Korea and China. An assessment of each scenario is provided below and in figures 5.2 and 5.3.

- **scenario 1: No further action beyond 2020.** Australia would have a larger absolute reduction than China, but smaller than others, because of population and economic growth. Our annual average rate of emissions increase would be larger than others. Our per capita emissions would remain higher than all countries in figure 5.2, as would the emissions intensity of our economy in 2030. Our reduction in per capita emissions in 2030 would be larger than Japan, Korea and China but smaller than others. Reductions in emissions intensity would be larger than Japan but smaller than others.

- **scenario 2: 13 per cent below 2005 by 2030.** Australia would have a larger absolute reduction than Korea and China, but smaller than others. All countries except China would have a larger annual average rate of decline in emissions. Our per capita emissions in 2030 would be larger than others, and the emissions intensity of our economy smaller than China but larger than others (reflecting our national circumstances). Our reductions in per capita emissions would be larger than Korea, China, Japan and the EU, although smaller than Canada, the US and New Zealand. Reductions in emissions intensity would be larger than Japan, similar to Korea, Canada and the EU, and smaller than China, New Zealand and the US.
• **scenario 3: 20 per cent below 2005 by 2030.** Australia would have a larger absolute reduction than Korea and China, but smaller than others. Our rate of decline would be larger than China, Korea, and New Zealand, but smaller than others. Our per capita emissions in 2030 would be larger than others (reflecting our national circumstances). The emissions intensity of our economy in 2030 would be smaller than China, and larger than others (reflecting our national circumstances). Our reductions in per capita emissions would be equal largest. Reductions in emissions intensity would also be one of the largest.

• **scenario 4: 26 per cent below 2005 by 2030.** Australia would have a larger absolute reduction than China, Korea and Japan, but smaller than others with a 2030 target. Our rate of decline would be larger than China, Korea and New Zealand, similar to Canada but smaller than others. Australia’s rate of decline would improve to 1.6 per cent per annum from 2020-2030 compared with 0.9 per cent per annum before 2020. By comparison, Canada’s rate of decline improves to 1.7 per cent per annum from 1.2 per cent while New Zealand drops to 0.7 per cent per annum from 1.9 per cent. Our per capita emissions in 2030 would still be larger than others (reflecting our national circumstances). The emissions intensity of the economy in 2030 would be smaller than China, similar to New Zealand and larger than others. We would have the largest reduction in per capita emissions and close to the largest (China) reduction in emissions intensity of the economy.

• **scenario 5: 35 per cent below 2005 by 2030.** Australia would have the largest absolute reduction compared to others with a 2030 target. We would have the largest annual average rate of decline in emissions. Our level of per capita emissions in 2030 would remain larger than others, but Australia would have closed much of the present gap. The level of emissions intensity of our economy in 2030 would be smaller than China and New Zealand and similar to Canada and larger than others. We would have the largest reductions in per capita emissions and emissions intensity of the economy.

• **scenario 6: 45 per cent below 2005 by 2030.** Australia would have by a considerable margin, the largest absolute reductions, average annual rate of decline and reductions in emissions per capita and emissions intensity of the economy. Our level of emissions per capita and emissions intensity in 2030 would be in the range of other countries.

In line with expectations for targets set by UNFCCC countries (box 2.3), scenarios 3, 4, 5 and 6 represent ‘progression’ on Australia’s 2020 target based on absolute emissions reductions.
### Figure 5.2: Emissions reduction targets for countries compared to different metrics

<table>
<thead>
<tr>
<th>Country</th>
<th>Target</th>
<th>2005 Base, 2030 Target</th>
<th>Average annual change in absolute emissions</th>
<th>Countries with an absolute reduction target on a historical base year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Absolute</td>
<td>Per Capita</td>
<td>Intensity</td>
</tr>
<tr>
<td>Australia’s 2030 Target</td>
<td>-26 to -28%</td>
<td>-50 to -52%</td>
<td>-64 to -65%</td>
<td>-0.9%</td>
</tr>
<tr>
<td>6 other scenarios for Australia described below</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenario 1</td>
<td>No further action beyond 2020, emissions grow.</td>
<td>-2%</td>
<td>-34%</td>
<td>-53%</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>13% below 2005 by 2030 (holding emissions at Australia’s 2020 target level)</td>
<td>-13%</td>
<td>-41%</td>
<td>-58%</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>20% below 2005 by 2030</td>
<td>-20%</td>
<td>-46%</td>
<td>-61%</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>26% below 2005 by 2030</td>
<td>-26%</td>
<td>-50%</td>
<td>-64%</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>35% below 2005 by 2030</td>
<td>-35%</td>
<td>-56%</td>
<td>-68%</td>
</tr>
<tr>
<td>Scenario 6</td>
<td>45% below 2005 by 2030</td>
<td>-45%</td>
<td>-63%</td>
<td>-73%</td>
</tr>
<tr>
<td>Canada</td>
<td>30% below by 2005 by 2030</td>
<td>-30%</td>
<td>-44%</td>
<td>-57%</td>
</tr>
<tr>
<td>US</td>
<td>26-28% below 2005 by 2025</td>
<td>N/A</td>
<td>-46%(a)</td>
<td>-62%(a)</td>
</tr>
<tr>
<td>Japan</td>
<td>26% below 2013 by 2030</td>
<td>-25%</td>
<td>-21%</td>
<td>-41%</td>
</tr>
<tr>
<td>EU</td>
<td>40% below 1990 by 2030</td>
<td>-34%</td>
<td>-36%</td>
<td>-57%</td>
</tr>
<tr>
<td>NZ</td>
<td>30% below 2005 by 2030</td>
<td>-30%</td>
<td>-44%</td>
<td>-61%</td>
</tr>
<tr>
<td>Countries with a different target type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Korea</td>
<td>37% below BAU in 2030</td>
<td>-4%</td>
<td>-14%</td>
<td>-57%</td>
</tr>
<tr>
<td>China (b)</td>
<td>60-65% reduction in CO₂ intensity by 2030</td>
<td>150%</td>
<td>127%</td>
<td>-65%</td>
</tr>
</tbody>
</table>


Note: (a) While the US INDC is only to 2025, for the purpose of comparison the lower bound of the US target in 2025 has been extended to 2030. (b) The upper bound of China’s 60-65% reduction in CO₂ intensity is considered to be more consistent with China’s target to peak CO₂ emissions around 2030. China’s 2030 target emissions are derived from OECD GDP projections. Different rates of GDP growth would result in different target emission levels in 2030. (c) Change in intensity is calculated in real $US ‘000 purchasing power parity for all countries except China which is estimated in RMB.
Figure 5.3: Emissions reduction metrics

Source: Population from Commonwealth of Australia, 2015, 2015-16 Budget (Australia), UN population projections, 2012, medium fertility (other countries). GDP data from Commonwealth of Australia, 2014-15 Budget (Australia) and OECD database (2014) (other countries). Emissions data for scenario 1 are modelling assumptions from the McKibbin modelling. Other emissions data is from DOE, 2015b, National Inventory Report 2013 (Australia) national inventory reports submitted to the UNFCCC (Canada, US, Japan, EU, NZ), Intended Nationally Determined Contribution Submission by the Korea and World Resources Institute, Climate Analysis Indicators Tool (China). Note: (a) While the US INDC is only to 2025, for the purpose of comparison the lower bound of the US target in 2025 has been extended to 2030. (b) The upper bound of China’s 60-65% reduction in CO2 intensity is considered to be more consistent with China’s target to peak CO2 emissions around 2030. China’s 2030 target emissions are derived from OECD GDP projections. Different rates of GDP growth would result in different target emission levels in 2030. (c) Change in intensity is calculated in real $US ’000 purchasing power parity for all countries except China which is estimated in RMB.
5.3 Economic impact relative to others

For an emissions reduction commitment to receive enduring support, the impact on people’s standard of living must be considered.

Under the Government’s target of 26-28 per cent below 2005 levels by 2030 and through Direct Action measures (see chapter 6) there are costs but the impacts are manageable and the economy, jobs and wages will continue to grow.

Economic modelling

The review has drawn on a wide range of work to analyse relative economic impacts, including economic modelling, RepuTex and ClimateWorks analysis and comparison against other countries' official cost estimates. The analysis does not factor in the impacts of climate change and the benefits of a global response (box 2.2 in chapter 2), which also need to be considered.

Economic modelling by Professor McKibbin focusses on a comparison between countries. Chapter 6 covers the approach to post-2020 policies.

Further, the McKibbin modelling is limited to CO2 emissions from the energy sector. The modelling does not account for reductions in non energy-industrial emissions (such as CO2 from cement manufacturing), non-CO2 emissions from livestock, or land use change. It therefore may not reflect the impact across the entire economy.

The McKibbin modelling concludes Australia and those economies depicted in figure 5.4 all continue to grow under climate action, but at a slightly slower rate than if they did not act.

The modelling is conservative and may over-estimate the cost of the Government’s target in two ways.

- First, the McKibbin modelling states “(A)ssuming lower energy technology costs reduced these impacts by around one third.”
- Second, specific policies were not modelled, in particular the low cost elements of the Government’s policy (such as the Emissions Reduction Fund, the National Energy Productivity Plan among others) in what was a generic sensitivity analysis.

Given cost and availability of abatement opportunities identified by RepuTex and ClimateWorks, it is reasonable to assume that for lower targets the economic impacts estimated by McKibbin are likely to be at the lower end of the range of costs for those targets.

The McKibbin modelling is broadly consistent with a number of previous assessments showing that the Australian economy will continue to grow and reduce emissions, but that growth reduces as the target increases.

RepuTex and ClimateWorks' have identified a range of low costs options for reducing emissions, particularly through energy productivity, fuel efficiency and land based activities. However the marginal abatement cost to the economy increases at higher targets as higher cost forms of abatement must be accessed to reduce emissions.
RepuTex finds that while there are significant low costs abatement opportunities, some opportunities in the power sector, buildings and industry cost in excess of $300 per tonne (2014 dollars).

Estimated costs from the McKibbin modelling shown in Figure 5.4 would be higher if the average cost of abatement for the two-thirds of emissions modelled is the actual average cost for the whole target.

Modelling for a broad based emissions trading scheme was conducted by the Australian Treasury for the Climate Change Authority. This modelling concludes, for the ‘high price’ scenario, that a 44 per cent reduction below 2000 levels by 2030, using a broad based emissions trading scheme, would lead to a reduction of 2.6 per cent on GDP in 2030 relative to no further action after 2013. Department of Environment has confirmed that based on the Treasury modelling results this would have a nominal cumulative GDP impact of $633 billion.

**Figure 5.4: Estimated effect of post-2020 targets on 2030 real Gross National Income (GNI)**

Source: McKibbin 2015 Note: (a) Scenario 3 was not modelled, the result was estimated in the review using a linear interpolation of the results from scenarios 2 and 4; (b) Australia’s cost is split into the impact of: other countries’ action (striped) and Australia’s domestic action (light blue); other countries’ costs (dark blue) incorporate both components; (c) The modelled cost for Canada (combined with NZ) has been scaled up in the review to reflect Canada’s announced target of 30 per cent below 2005 levels, which is larger than the target originally modelled (22 per cent below 2005 levels by 2030).

Australia committed to reduce emissions to five per cent below 2000 levels by 2020, which is equivalent to 13 per cent below 2005 levels. Further, at the last Conference of the Parties in Peru, Australia and all Parties agreed that the post-2020 target will go beyond existing commitments. For these reasons, assessing the economic impact of the target scenarios against maintaining emissions at the level of Australia’s 2020 target (scenario 2) is a more appropriate reference point.
On this basis, action by Australia to reduce emissions to 26 per cent below 2005 levels would result in an estimated GNI reduction in 2030 of 0.29 per cent relative to maintaining emissions at the 2020 target level.

Countries with similar headline targets can experience very different economic impacts. The modelling results reflect the fact that economic impacts across countries are driven by their economic circumstances, such as electricity structure, trade profiles and domestic climate policies for a given target.

The economic impact of any of the modelled targets on Australia is projected to be greater than for most developed countries, due to our national circumstances (see chapter 4). We also have a higher marginal cost of abatement as discussed later in the chapter.

However, the costs are manageable under the Government’s chosen target.

**Impact on jobs and wages**

The modelling, which assumes short-term rigidity in the labour market, indicates:

- that over the period 2015 to 2030, employment would grow at an annual average rate of 1.81 per cent under a 26 per cent target, compared to 1.83 per cent under Scenario 1.
- Over the same period, real wages are estimated to grow at an annual average rate of 1.10 per cent under a 26 per cent target, compared to 1.12 per cent under Scenario 1.

Short-term impacts on employment could make it difficult for some individuals, particularly mature-aged workers with long associations with a specific industry. In addition to careful choice of policies, Australian Government actions to improve the health of the economy and facilitate labour mobility will help reduce impacts of the target. Labour market flexibility supports a healthy economy as it allows labour to move where it is needed most.

**Impact on sectors of the Australian economy**

Like all economic transitions, different sectors of the economy will be affected differently. This means different impacts on regions and jobs. The modelling estimates the impact of actions by other countries and Australia (in the energy sector) may have a combined negative impact on coal, gas, other mining and durable manufacturing exports but a combined positive impact for agricultural, services and non-durable manufactures exports.

Sectoral impacts will depend both on the level of Australia’s and other country targets as well as the policy choices made by Australia and other countries to achieve their targets. Some policies would have a disproportionate effect on jobs in Australia’s coal industry and in agriculture for example.

**Action by others**

Global actions are likely to reduce global demand for emissions intensive goods. This will shrink their potential export markets and could mean increasing competition from imports.
**Action by Australia**

While the economy continues to grow strongly, the modelling suggests an impact on sectors of the Australian economy from Australian action. Post-2020 policies are still to be finalised and economic impacts will likely be smaller with a more diverse policy mix than modelled (see chapter 6).

Global emissions reductions and the associated climate policies to achieve them may generate benefits for some sectors in the Australian economy:

- Efforts by our major trading partners to generate low emissions-intensive energy could help fuel the rapid expansion of our LNG exports and higher quality coal support future demand for these exports.
- Commercialisation of new power generation technology, including carbon capture and storage, that lowers the emissions from coal consumption and uses Australia’s higher quality coal could change the long term future for these exports.
  - Improving coal-fired power plant efficiency by 40 per cent by using off-the-shelf technology could cut emissions every year by two gigatonnes, equivalent to India’s annual CO$_2$ emissions.
- The International Energy Agency estimates under its ‘450 scenario’ (the 2°C goal) demand for fossil fuels, while reducing, still comprises 69 per cent of energy demand in 2030.
- Innovation and commercialisation of scalable low emissions nuclear reactor technology could enhance future demand for uranium.
- The renewable energy industry may expand to meet domestic demand and the further development of expertise in this sector could help build our renewable export industry.
- Australian farmers can benefit from improving the productivity of their crops or use of marginal grazing lands, while reducing emissions.
- Australia’s high quality measurement, reporting and verification system in forestry might make our emissions sinks attractive to other nations wanting to invest.

Further analysis of sectors of the Australian economy is presented in appendix 4.
Other economic estimates find Australia has a higher cost of abatement than other countries

OECD analysis has found Australia and New Zealand face a much higher cost of achieving 2020 emissions reductions than Canada, the US and the EU (OECD 2009).

The Centre for International Economics (2015) estimates Australia’s marginal abatement cost is higher than the world average. For example, a 40 per cent reduction against business as usual levels is estimated to cost Australia more than double the world average for each tonne of abatement. For Australia, 40 per cent below business as usual levels in 2030 would be equivalent to a target of 29 per cent below 2005 levels by 2030.

The most recent publicly available marginal abatement cost curve for Australia in 2030 was estimated by RepuTex (2015) (figure 5.5), which assumed existing policy at the end of 2014. The analysis indicates emissions reductions of 308 Mt CO$_2$-e in 2030 could be achieved, at a net cost of $9 billion (2014 dollars). RepuTex found that some abatement could be accessed at a net benefit, but at the upper end the marginal abatement cost would be over $300 a tonne. This reinforces the need for careful choice of mechanisms to reduce emissions. In comparison, many other countries’ estimates of their post-2020 emissions reduction policies show they are likely to result in smaller costs and in some cases net benefits (see appendix 2).

Figure 5.5: RepuTex estimates of domestic abatement opportunities in 2030 and their cost

Source: RepuTex 2015, Note: Cost refers to the average marginal abatement cost of each opportunity.
Chapter 6: Policy options to achieve Australia’s 2030 target

Key Points

• The economic transition needed to achieve the target can be managed to protect the living standards of Australians.

• Australia has a comprehensive range of government policies and programmes in place. Businesses and the community are also taking action.

• The Australian Government’s Direct Action policy with the Emissions Reduction Fund and its safeguard mechanism are enduring policies at the core of Australia’s climate change policy framework. They are supported by a range of complementary policies including the Renewable Energy Target and National Energy Productivity Plan. Additional policies and programmes can help deliver low cost emissions reductions beyond 2020.

• The full composition of Australia’s policy mix to achieve a 2030 target at low cost will be considered in detail in 2017-2018, including considering any regulatory impacts. At that time, lessons from implementation of the Emissions Reduction Fund, including both its purchases of additional abatement and safeguard mechanism (to commence on 1 July 2016), will be available.

  ◦ Accessible and cost-effective opportunities to reduce emissions across the Australian economy beyond 2020 will be available through additional policies to help achieve our 2030 target.

  ◦ Technological change will play a key role in reducing emissions.

• The Government’s policy is focused on taking action within Australia, to increase energy productivity, drive fuel efficiency and technology improvements. The Government recognises that some businesses are interested in purchasing international permits and will continue to consult business on this issue.

• In the lead up to the 2017-2018 policy development process, the Australian Government will consult on, and in some cases implement, several initiatives which have a high prospect of achieving low cost emissions reductions and also delivering other benefits. These include:

  ◦ working with the Council of Australian Governments (COAG) Energy Ministers to develop a National Energy Productivity Plan;
  ◦ improving the efficiency of vehicles;
  ◦ phasing down hydrofluorocarbons;
  ◦ developing a low emissions technology roadmap; and
  ◦ developing a strategy to improve the utilisation of solar power (including large scale power) and other renewables.
6.1 The cost is manageable under the right conditions

The economic transition resulting from achieving a target can be managed carefully to protect the living standards of Australians. An abatement target should be calibrated to the economic efforts of others. Certainty is important and the timing of the target should be set with the structure of the economy and transition in mind. Domestic policies should where possible provide a net economic benefit (including delivering co-benefits) and at a minimum have low economic cost.

Our target needs to be calibrated against others’ economic efforts

A global agreement involving both developed and developing economies is needed to protect Australia’s competitiveness. We need comparable action by other countries, so our industry which trades and competes with the world remains on a level playing field. This will ensure industries, jobs and emissions do not just shift overseas (see section 4.2 on Australia’s circumstances).

Certainty and timing of a target will affect the impacts of the transition

Climate change is a long term issue. Business seeks long term certainty to make appropriate investment decisions. Households need certainty too so they can plan asset purchases. As suggested in section 5.1 a 2030 timeframe (as opposed to 2025) will allow Australia to adopt policies to smooth and reduce the costs of adjustment.

Technology will be an important factor in reducing emissions

Economic impacts are lower with quicker technological progress. The pace of technological change is hard to predict and projected prices for solar have been decreasing rapidly. Capital costs for utility scale solar PV are projected to decline from $3,648 in 2013 to $1,637 in 2030 (2012 $/kW) (ClimateWorks 2014).

Improvements in technology and efficiency occur naturally in a competitive market economy. Government has a place to address market failures such as those present at early stages of research and development but should not interfere with business efforts to improve business practices and commercialise new technologies to gain competitive advantage. Business will find ways to improve energy efficiency over time, which will reduce emissions, as they have in the past. This process will be vital to achieving emissions reductions. It will also be in the best interests of business to adopt more efficient technologies, which are less emissions intensive, as their capital stock is turned over with new investment.

Global emissions reduction action is likely to speed up technology improvements that cut the cost of reducing emissions. Global action will increase demand for emissions reduction technology, supporting economies of scale, greater specialisation and more rapid learning by doing.
Net benefit or low economic cost policies should be chosen

Domestic policies should where possible provide a net benefit (including delivering other co-benefits) and at a minimum be low cost.

There is a broad range of possible options to reduce emissions, as demonstrated by RepuTex and ClimateWorks, to achieve Australian target scenarios (figure 5.5 and 6.1). Options include abatement from energy efficiency, lower emissions electricity generation, sequestration (e.g. tree planting, pasture management) and fuel switching. Both RepuTex and ClimateWorks cover a broader range of options than modelled by the McKibbin modelling.

Figure 6.1: ClimateWorks estimate of abatement in 2030 and Australia’s 2030 target


Figure 6.1 provides one example of a mix of abatement opportunities that could help Australia meet its target, against the Australian target scenarios (outlined in chapter 5). Choosing net benefit or low cost options is likely to result in a combination of abatement opportunities from each of the types of abatement. It will also mean emissions reductions through activities not shown in the list. For example, the ERF will continue to deliver abatement beyond 2020, such as through voluntary activities by farmers to regenerate native forest on unproductive land.

The policies chosen to achieve emissions reductions will determine who bears the economic cost associated with it. Without appropriate consideration given to emissions intensive trade exposed industries they could be placed at a competitive disadvantage. If policies act
only to raise domestic prices of electricity then households will bear most of the cost as business will, in general, pass on the higher costs through higher prices.

### 6.2 Existing action to reduce emissions

Australia has a strong track record of reducing our greenhouse gas emissions. The combined actions by all levels of government, business, communities and individuals provide a solid foundation for Australia to achieve emissions reductions to 2020 and beyond.

**Australian Government action**

**Emissions Reduction Fund**

The $2.55 billion Emissions Reduction Fund (ERF) is the centrepiece of the Australian Government’s policy and provides an enduring policy framework to cut emissions by five per cent below 2000 levels by 2020 and deliver future targets. The first auction was held in April 2015. It awarded contracts for 47 million tonnes of emissions reductions at an average price of $13.95 per tonne. Businesses large and small and individuals have successfully participated in the ERF through the first auction. The ERF’s safeguard mechanism, commencing from 1 July 2016, will ensure emissions reductions purchased by the Australian Government through the ERF are not displaced by significant increases in emissions elsewhere in the economy.

The ERF and its safeguard mechanism provide incentives to reduce emissions across the economy. The safeguard mechanism has been legislated and further details will be released in exposure draft regulations in the third quarter of 2015.

The safeguard mechanism covers the major emitting facilities in Australia. It covers most emissions from the electricity sector, 70 per cent of fugitive emissions and around 60 per cent of industrial process and product use emissions. The safeguard mechanism’s coverage is much lower for the transport, land use and waste sectors.

ERF methods are available to deliver emissions reductions across the whole economy and future methods will widen the number of activities able to receive incentives. For example, further methods could increase participation in the land management and agriculture sectors, or incentivise operators to flare otherwise vented gas or use it for generation.

**National Energy Productivity Plan**

The Government has committed to develop a National Energy Productivity Plan with a National Energy Productivity Target of 40 per cent improvement between 2015 and 2030. Improving energy productivity can reduce household and business energy costs and increase economic growth while reducing Australia’s greenhouse gas emissions. It is estimated the Plan will achieve around 250 million tonnes of abatement between 2020 and 2030.
The framework and initial work plan are expected to be agreed with State and Territory governments (States) through COAG’s Energy Council by the end of 2015. The Plan is expected to include a range of measures, for example:

- measures which empower efficient decisions on energy services, such as smart meters, cost-reflective prices, access to information, labels and decision-making tools, and voluntary programmes to inform larger consumers;
- measures which improve energy markets and services, such as support for innovation and competition, reducing barriers to new services and better information for planning; and
- measures which ensure efficient minimum services and address market failures, including through equipment, appliances, buildings and transport.

**Renewable energy**

The Government reformed the Renewable Energy Target scheme to place it on a more sustainable footing. By 2020, more than 23 per cent of electricity generation will come from renewables up from 14.9 per cent in 2013-14.

The Government has also invested over $1 billion in more than 200 projects across a range of renewable energy technologies and is providing $585 million for low emissions fossil fuel programmes.

**Other actions**

A number of actions are being taken that also have a co-benefit of reducing emissions. For example, the Government’s $50 billion infrastructure investment to improve productivity and reduce congestion can also help reduce emissions. Avoiding congestion improves driver efficiency, resulting in fewer emissions and less petrol consumption for a given journey. The economy wide savings are large, with the Infrastructure Australia (2015) audit estimating that the cost of congestion could rise to around $53 billion in 2031, in the absence of additional infrastructure capacity or demand management. A further example is Australia’s participation in international aviation and shipping organisations, which is supporting a reduction in emissions while increasing shipping and aviation efficiency.

**State and Territory Government action**

States are contributing to Australia’s emissions reduction efforts through a variety of actions.

Some States have established legislated emissions reduction targets. All States have measures in place to support renewable energy technologies.

All States have energy efficiency initiatives. In New South Wales (NSW), Victoria, South Australia and the Australian Capital Territory, legislation requires electricity retailers to assist customers to improve their energy efficiency.

States have also worked together, along with the Federal and Local Governments, to improve the sustainability of buildings, through the National Construction Code and Australian Building Codes Board. This is cutting energy bills and reducing emissions.
Some jurisdictions are reducing emissions from government operations. For example, the NSW Resource Efficiency Policy sets efficiency targets and reporting requirements for government operations in energy and water use, waste management and air pollution.

**Local Government action**

Local Governments across Australia are taking a range of emissions reduction actions, such as energy efficiency and generation initiatives that also reduce costs. For example, the City of Greater Geelong has started an eco-challenge to reduce energy use and greenhouse gas emissions. By upgrading their city hall, energy use is down 21 per cent reducing emissions by 143 tonnes per year. Further, a number of Local Governments across Australia have switched from traditional lighting to light emitting diode (LED) street lighting technologies to reduce energy use and decrease maintenance costs.

**Business action**

Businesses are taking action to improve their energy efficiency, invest in new technologies and reduce emissions because it makes commercial sense.

BHP Billiton is one of the world’s largest producers of coal, copper, iron ore and uranium, and has substantial interests in oil and gas. It has an absolute target to maintain its 2017 greenhouse gas emissions below a 2006 baseline. It is doing this by reducing energy consumption through energy efficiency measures, which saves money and reduces emissions. For example, its coal mines in Queensland have been implementing measures to improve electrical and diesel efficiency.

Industries are also contributing to reducing emissions. The dairy industry has a target to reduce emissions intensity by 30 per cent below 2010 levels by 2020. The cement industry has increased production by 23 per cent since 1990, while reducing emissions by 15 per cent. The aviation industry is contributing to global industry efforts to halve net emissions by 2050 based on 2005 levels (box 6.1).

Tackling climate change also presents opportunities, including for companies affected by Australia’s transitioning economy. Precision Components, a car components manufacturer in South Australia, has cooperated with three companies to provide solar technology to Japan.

**Box 6.1: Our national airlines continue to fly high**

Qantas and Virgin, as part of the International Air Transport Association, have set clear and measurable targets. These include improving fuel efficiency by 1.5 per cent per year to 2020 and cutting net emissions by 50 per cent by 2050 using 2005 as the base year. The airlines are using several strategies to lower their fuel consumption, including lighter and newer aircraft and deploying advanced technology to reduce engine usage.
Action by individuals and the community

Many individuals and community groups are already taking direct action to mitigate climate change and save money. These efforts range from using energy more efficiently, such as turning lights off and using efficient appliances, to walking and cycling rather than driving. Australia leads the way in rooftop solar (ESAA 2015) with over 1.4 million households having installed solar panels on their roofs. Some households have also made decisions to purchase more energy efficient vehicles, including hybrids.

Indigenous communities in Northern Australia are using traditional fire management practices to reduce emissions. This sustainable means of looking after their country and cultural values also provides jobs and economic independence.

Voluntary actions

The voluntary National Carbon Offset Standard (NCOS) allows individuals and businesses to voluntarily relinquish carbon abatement units (including through approved, high quality international units) to offset carbon emissions. The biggest users of the NCOS include Qantas and Virgin.

The Government will shortly announce reforms to the NCOS to enable businesses and the community to take further opportunities to be carbon neutral.
6.3 Achieving Australia’s 2030 commitments

The overall design of Australia’s policy framework for its 2030 target will be considered in detail in 2017-2018.

The ERF, Renewable Energy Target and the National Energy Productivity Plan will all deliver reductions beyond 2020. A detailed consideration of the policies closer to 2020, in 2017-2018, will provide an understanding of emissions reductions from these policies and set a policy mix that will deliver our 2030 target. At that time, lessons from implementation of the ERF, including both its purchases of additional abatement and safeguard mechanism (to be implemented July 2016), will be available.

Analysis by the Department of the Environment provides estimates of the contributions that Direct Action policies could make towards the Government’s 2030 target (figure 6.2).

Figure 6.2: Achieving Australia’s 2030 target through Direct Action

![Diagram of emissions reductions](Image)

Source: DOE

Decisions on the policies should be based on a detailed investigation of the specific abatement opportunities, constraints and other policy considerations within different sectors. The Australian Government has a leadership and coordinating role, but action by State and Local Governments, business and the community will help Australia achieve its 2030 emissions reduction target.

The 2017-2018 policy development process will:

- ensure policies work together efficiently and do not impose undue regulatory burdens;
- look at the actions being undertaken by the Federal, State and Local Governments, and voluntary actions by business and the community;
- build on Direct Action implementation experience (e.g. implementation of the ERF and its safeguard mechanism); and
- include close consultation across governments, business and the community, and involve detailed economic assessment of policy options.
Policy options for the post-2020 period

A range of policy options for the post-2020 period has been identified below that may warrant detailed assessment as part of the policy development process. This is in addition to assessing the existing actions to reduce emissions such as the ERF and the National Energy Productivity Plan.

Electricity supply

Electricity generation was the largest source of Australia’s emissions in 2013, accounting for 34 per cent of Australia’s total emissions. Electricity generation assets are long term investments. However, as old generators are retired, there is an opportunity to transition to lower emissions. The Government will develop a strategy to improve the utilisation of solar power, including large scale power and opportunities to further support community, off-grid and government housing projects and other renewables. The impact of technologies, such as batteries that would improve the viability of solar and other renewables, could also be considered. Canada’s and the US’ experiences with minimum efficiency standards for electricity generators could be considered too.

Transport

Domestic transport emissions accounted for 17 per cent of Australia’s emissions in 2013. Business as usual transport emissions are projected to increase 24 per cent by 2030.

Reducing emissions intensity within the transport sector presents significant opportunities to improve national productivity through, for example, reduced fuel costs.

Road transport contributes the majority of emissions in the Australian domestic transport sector (84 per cent). Current policies for vehicle greenhouse gas emissions are focused on education and information (e.g. the Green Vehicle Guide and fuel consumption labelling). Also, motoring organisations like the NRMA provide information to households on vehicle fuel efficiency and transport companies have initiated their own action (box 6.2).

Box 6.2: Linfox – not putting the pedal to the metal

Between 2007 and 2014-15, Linfox (Australia’s largest privately owned logistics company) took energy efficiency actions that have reduced emissions intensity by 44 per cent. Its strategy reduces emissions across the business including through: adopting new truck and tyre technologies; using better driving techniques; efficient warehouse lighting systems; supply chain optimisation; and energy-use reporting to management.
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Options to reduce light vehicle emissions and improve energy efficiency, such as standards, will be considered given their potential to deliver abatement and economic benefits. Heavy vehicle efficiency standards will also be considered in the context of G20 work to improve heavy vehicle energy efficiency and emissions performance.

Technology improvements may increase the uptake of electric vehicles and other alternatives. The main barriers to the uptake of electric vehicles appear to be the high upfront costs of an electric vehicle, concerns about driving range and the ability to quickly and easily recharge.

The land sector (agriculture, forestry and other land uses)

The land sector accounted for 17 per cent of Australia’s greenhouse gas emissions in 2013. Of this, most emissions came from agriculture processes. Business as usual land sector emissions are projected to increase 44 per cent by 2030.

Australia’s competitiveness in agricultural production depends on a sustainable natural resource base. Our farmers have always known this; they are active stewards of 53 per cent of Australia’s landmass. Indigenous landowners and farmers have voluntarily made a significant contribution over time to carbon sequestration (e.g. through the ERF), such as better pasture, soil and fire management. In setting policies to meet the post-2020 target consideration should be given to how to encourage future voluntary activities.

The Government supports research and development, its demonstration and other activities to encourage ongoing improvements in productivity that also reduce emissions. The Government will also consider whether any additional action is required.

There are opportunities for farmers to reduce energy consumption, saving money and reducing emissions. Options include switching from diesel to electric pumps, using renewable energy (box 6.3) and battery storage where connecting to the grid is costly, or improving the efficiency of farm vehicles and buildings.

Box 6.3: Pig poo power

Berrybank Farm (located at Windermere in south-west Victoria) began producing electricity from its piggery effluent over two decades ago. The waste from 20,000 Berrybank pigs generates roughly the same sewage output as a town with 50,000 people. Berrybank launched several new agribusinesses using the energy it now generates on site while saving over $200,000 in avoided energy costs from the grid and 5,750 tonnes of CO₂-e.
**Fugitives**

Fugitives accounted for seven per cent of Australian emissions in 2013. Business as usual fugitive emissions are projected to increase 79 per cent by 2030. This is due to projected significant expansion of natural gas production and continued growth in coal mining.

With Australia’s expected leap in gas production over the next 10 years, there is an opportunity to encourage best practice in new operations. Consideration could be given to policies to increase the flaring and capture of fugitive emissions from coal mining and natural gas production (box 6.4).

As key industry players are multinational operators, changes to operational procedures are more likely to occur if there are similar policy drivers in other countries. The Government could consider working with G20 and international partners to encourage industry to improve operations and reduce emissions leakage.

**Box 6.4: Australia to host the world’s largest greenhouse gas storage project**

The Gorgon CO₂ injection project will reduce greenhouse gas emissions from the Chevron operated Gorgon project in Western Australia by approximately 40 per cent. It is planned to inject 3.4 to 4 million tonnes of CO₂ annually in a deep reservoir more than two kilometres beneath Barrow Island. Over the life of the project emissions are anticipated to be reduced by 100 million tonnes. This will make the Gorgon project the world’s largest greenhouse mitigation project undertaken in the private sector. The Australian Government has committed $60 million to the Gorgon CO₂ injection project.

**Industrial processes and product use**

In 2013 emissions from Industrial Processes and Product Use (IPPU) accounted for approximately six per cent of greenhouse gas emissions. Business as usual IPPU emissions are projected to increase 21 per cent by 2030. The main drivers of IPPU emissions into the future are increases in chemical production (e.g. production of ammonium nitrate for explosives in the mining industry) and synthetic greenhouse gases (contained in new air conditioners and refrigerators).

Australia is a Party to the Montreal Protocol on Substances that Deplete the Ozone Layer and supports the international proposals to phase down hydrofluorocarbons. A review of the Government’s ozone protection and synthetic greenhouse gas legislation is assessing whether a phase down could be brought forward in Australia with deeper initial reduction steps. The review is also assessing additional opportunities to reduce emissions of hydrofluorocarbons by improving the practices of technicians and building owners. This is consistent with actions proposed under the Montreal Protocol by countries in North America and Europe. Reducing the use of hydrofluorocarbons is estimated to reduce emissions by 60 to 80 million tonnes between 2020 and 2030.
Direct combustion

Direct combustion accounted for 17 per cent of Australia’s greenhouse gas emissions in 2013. Business as usual direct combustion emissions are projected to increase 39 per cent by 2030, due mainly to the significant expansion in LNG and other mining production. Direct combustion emissions are produced from almost all sectors of the economy including energy, mining, manufacturing, buildings and agriculture.

The ERF and National Energy Productivity Plan are likely to drive emissions reductions from direct combustion. Businesses, supported by customer demand, are also taking action (box 6.5).

Box 6.5: Carbon neutral bricks manufactured through fuel switching

Brickworks is producing carbon neutral bricks at its Longford facility in Launceston, Tasmania. The plant uses sawdust (a biomass by-product from the local timber industry) as a fuel source with total greenhouse gas emissions of approximately 215 tonnes per year. This compares with approximately 8,000 tonnes if the kiln was traditionally fired with natural gas. The outstanding emissions are offset by Brickworks under arrangements complying with the Government’s National Carbon Offset Standard to achieve the carbon neutral status.

Waste

Waste emissions accounted for two per cent of Australia’s greenhouse gas emissions in 2013. Business as usual waste emissions are projected to increase 8 per cent by 2030, mainly because of population growth.

The Government could work with the States to develop options to build upon the existing waste management and waste reduction strategies through:

- expanded awareness and information programmes currently undertaken by State governments; and
- further work building on the National Waste Policy (2010-2020) targeted at decreasing organic waste generation, increasing diversion of organic waste from landfill and ensuring that landfill gas emissions are appropriately managed.

Facilitating emissions reductions in other countries

The Kyoto Protocol allows countries to use emissions reductions achieved in other countries towards their emissions reduction target. In general terms, this occurs through the trade in ‘units’ representing emissions reductions or removals, which can be used against a country’s target, subject to various rules. The new post-2020 global climate change agreement, including the role of units, remains under negotiation.

The Australian Government’s policy to achieve the 2020 target is to support domestic emissions reductions through the Direct Action Plan.
The role of international units beyond 2020 needs to be assessed in the light of the Paris agreement and key issues. These issues include the scope for fraud and the policing of claimed emissions reductions to ensure these have actually occurred and are sustained.

Harnessing technology to support emissions reductions

Technology is expected to underpin large reductions in global greenhouse gas emissions over the coming decades.

Australia’s framework for technological innovation includes strong financial markets, efficient regulatory systems, and fiscal responsibility. Small business taxation measures in this year’s Budget and the Government’s deregulation agenda support investment and innovation. The Government’s new science and research priorities ensure a proportion of the $9 billion funding for science research and innovation is directed towards research in areas such as energy efficient production and new low emissions energy sources.

The Government’s Industry, Innovation and Competitiveness Agenda is improving linkages between industry and research and better facilitating commercialisation by business.

Global action with predictable future climate policies should facilitate business investment in emissions reduction technology and make capital markets more willing to lend for those investments. The Government could also consider options for continuing R&D technology and commercialisation grant and lending programmes that reduce emissions.

To help guide development and uptake of low emissions technology, the Government will develop a roadmap. The roadmap will:

- provide Australia-specific analysis on technological trends, markets and challenges;
- identify action options required by all levels of government, business and the community to remove barriers and optimise opportunities to develop, commercialise and deploy low emissions technologies;
- guide decision-making processes by existing low emissions technology development, deployment and diffusion organisations; and
- be reviewed at regular intervals and used to set and trigger criteria to cease support for technologies (e.g. when the technologies become commercial, or are no longer prospective).

Australia will work with partners in our region to encourage the deployment of the latest low emissions technologies, including new efficient coal-fired generation technologies.

Actions that can be developed now

The development of some policy options is already underway. These include the National Energy Productivity Plan and the review of the ozone protection and synthetic greenhouse gas legislation, which is looking at options to phase down hydrofluorocarbons. Development of some other options could be progressed, for example, consultation on vehicle efficiency, a low emissions technology roadmap and developing a strategy to improve the utilisation of solar power (including large scale power) and other renewables.
6.4 Policies to support climate change adaptation

Adaptation policies and measures to build climate resilience are also an important part of any suite of climate change policies to maintain our national productivity and wellbeing. Good adaptation planning is an investment in a strong and responsive economy.

Future priorities for adaptation policies and measures

The Australian Government supports a range of actions to deliver climate resilience including through funding of $9 million for adaptation research under National Climate Change Adaptation Research Facility, scientific research through the National Environmental Science Programme and additional work through the Bureau of Meteorology and CSIRO. In addition the Government has provided $2 billion over the next decade under the Great Barrier Reef 2050 plan, to ensure the Great Barrier Reef continues to improve on its Outstanding Universal Value every decade between now and 2050 to be a natural wonder for each successive generation to come.

In addition, priorities for future Australian Government adaptation action include:

- ensuring a strong economy to provide the resources for adaptation and resilience;
- developing a National Climate Resilience and Adaptation Strategy to demonstrate the considerable adaptation action happening across all levels of Government, business and the community and better coordinate actions and remove unnecessary regulation;
- providing public good information including: climate projections enhanced by a new super computer for the Bureau of Meteorology (around 20 times faster) to better forecast the climate, working with States and insurers to develop the Australian Flood Risk Information Portal and adaptation research including to support farmers;
- protecting and repairing the natural environment including the 20 Million Trees, National Landcare and Green Army programmes and the National Reserve System;
- improving disaster resilience and risk management by better balancing mitigation and recovery funding to States, supported by the joint Australian Government/State Natural Disaster Resilience Program and the Australian Government’s National Emergency Management Projects Program; and
- with the States, improving the interaction between land use planning and building regulations so building standards align with hazard risk and do not restrict adaptation.

The roles of individuals, businesses and communities in adaptation

Individuals, businesses and communities all have a role in adaptation. They are best placed to make decisions that will reduce climate related risks to their assets and livelihoods, particularly as climate impacts and adaptation responses depend highly on local conditions.

Individuals, businesses and communities are taking adaptation actions that offer net benefits under any climate change scenario. For example, some people in regions prone to flooding are building flood proofing structures and purchasing appropriate insurance.
Farmers are responding to changing weather patterns by modifying crop planting time, crop types and choice of fungicides and fertilisers. Indigenous communities in the Kimberley are using traditional knowledge and creating detailed reports on changes to country to help decide when to conduct on-ground natural resource and conservation activities.
Farmers are responding to changing weather patterns by modifying crop planting time, crop types and choice of fungicides and fertilisers. Indigenous communities in the Kimberley are using traditional knowledge and creating detailed reports on changes to country to help decide when to conduct on-ground natural resource and conservation activities.
Appendix 1: Target parameters

Australia and other UNFCCC member countries agreed at the UNFCCC Lima 2014 meeting to provide information on the parameters of their post-2020 target including the target year, base year, the scope and coverage of the commitment, and assumed approaches for measuring and accounting for performance towards the target.

**Target year:** A target year of 2030 better suits Australia’s national circumstances. A 2030 target, compared to a 2025 target, is more likely to allow a smoother economic transition given investment timeframes and the current oversupply of electricity generation capacity in the Australian market. Many businesses supported a 2030 target year in their submissions. Technology changes are likely to help reduce the abatement task and costs.

**Base year:** A 2005 base year facilitates comparability of effort by aligning Australia with the base year of Canada, New Zealand and the US. The base year affects the presentation of a target, not the actual abatement required.

**Scope and coverage:** An absolute emissions reduction that covers all sectors of the economy and the seven greenhouse gases covered by the Kyoto Protocol is appropriate. This is consistent with the approach Australia took for its 2020 target and the international expectation that the approach Australia’s takes to its 2030 target will be at least as rigorous as that applied to our 2020 target.

**Measurement and accounting:** An emissions budget approach should be used – that is, achievement of our target should be measured in terms of emissions over the period 2021-30, and not simply our emissions at a point in time in 2030. This approach provides flexibility to manage variability in emissions over time and is consistent with current target accounting, including under the Kyoto Protocol.

Australia will also need to decide what accounting rules to apply to its 2030 target. The Kyoto Protocol includes a detailed set of accounting rules and guidelines. The post-2020 agreement is not likely to be as prescriptive and needs to be suitable to a broader range of countries at different levels of capability. Given this, key aspects of an accounting approach for Australia’s target might include:

- using UNFCCC reporting categories, which are more comprehensive than the Kyoto Protocol, align with national inventory reporting and are more likely to be used by countries;
- measuring achievement of the target by comparing net emissions in the base year to net emissions in the end year of the commitment (i.e. a ‘net-net’ approach) across all reporting categories; and
- using agreed IPCC guidelines, noting the guidelines may need to be updated, including to address established Kyoto Protocol accounting treatments such as the natural disturbance provision (e.g. removing the effect of extreme fire seasons).
Appendix 2: International analysis

This appendix summarises the drivers of projected emissions in Canada, the US, Japan, the EU, New Zealand, Republic of Korea and China and their major policies and associated costs to achieve emissions reductions post-2020.

Canada

Canada has set an economy-wide target to reduce its emissions by 30 per cent below 2005 levels by 2030.

Canada has projected a 10.5 per cent increase in emissions in 2030 on 2005 levels under their current policies scenario (Canadian Government 2013). Canada’s emissions from electricity generation and from its emissions-intensive trade-exposed sectors have declined since 2005. However, like Australia, Canada is a net fossil fuel exporter and its exports are expected to drive up future emissions. Increases in emissions from bitumen production from oil sands is the largest contributor to emissions growth. Canada’s population growth (0.8 per cent per year from 2015 to 2030) will drive emissions up, but the growth rate is less than in Australia (1.5 per cent per year). Like other developed economies, structural changes in the economy and technological improvements are expected to lower the energy intensity of Canada’s economy.

Figure A2.1: Canada’s major policies and associated costs

<table>
<thead>
<tr>
<th>Policy</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Coal-fired power generation regulations will set a performance standard for new coal-fired power plants and those that have reached the end of their useful life. These regulations are estimated to result in a net reduction of approximately 214 Mt CO₂-e of emissions between 2015 and 2035 and around 25 Mt CO₂-e in 2030. Additionally the Canadian Government intends to develop regulations for natural gas electricity generation.</td>
<td>The present value of the costs from 2015 to 2035 is estimated to be $16.1 billion. Overall, the regulations are estimated to provide a net benefit of $7.3 billion. (2010, Canadian Dollars) (Canadian Government 2012).</td>
</tr>
<tr>
<td>Light-vehicle regulations have been introduced and are projected to deliver 35 Mt CO₂-e in 2025 and 174 Mt CO₂-e in abatement between 2017 and 2025. Canada also intends to regulate emissions from post 2018 model-year on-road heavy vehicles.</td>
<td>The present value of the costs from 2017 to 2025 is estimated to be $11.2 billion. Overall, the regulations are estimated to provide a net benefit of $49 billion.(2012, Canadian Dollars). (Canadian Government 2014).</td>
</tr>
<tr>
<td>Regulations are planned to reduce emissions of methane from the oil and gas sector and emissions from hydrofluorocarbons. Canada’s provinces have taken a number of different approaches to reduce emissions. For example, phasing out coal-fired power (e.g. Ontario), fuel standards (e.g. British Colombia), supporting innovation and R&amp;D of technologies aimed at reducing emissions (e.g. Quebec) and participation in emissions trading (e.g. Quebec).</td>
<td>Published cost estimates not yet available from the Canadian Government.</td>
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</tbody>
</table>
United States

The US has set an economy-wide target to reduce its emissions by 26-28 per cent below its 2005 level in 2025.

The US estimated that emissions would be between 1.5 per cent below and 4.5 per cent above 2005 levels in 2030 with policies implemented before September 2012 (US Department of State 2014). Economic growth and population are expected to drive US emissions upwards. Increases in the use of shale gas (Box A2.1) and renewables have been important influencers in reducing US emissions. US energy emissions in 2030 are projected to be eight per cent below 2005 levels even though energy consumption will grow by two to three per cent over the period (US EIA 2015). Structural changes and improved energy efficiency, including from motor vehicles, will continue to contribute to lower emissions growth.

Box A2.1: Shale gas revolution in the US

The largest factor in the 10 per cent decline in US emissions between 2005 and 2013 has been the increased use of natural gas replacing more emissions intensive sources of energy. This has accounted for over 40 per cent of the decline.

The increased use of gas has resulted from successful exploration for unconventional sources applying alternative extraction technologies and a supportive regulatory environment. With new supply coming on line quickly, prices fell by 50 per cent from 2007 to 2013. However, alternatives like coal and oil prices increased more than 30 per cent over the same period. The proportion of US energy consumed from natural gas increased from 23 per cent in 1990 to 27 per cent in 2013 and is projected to increase to 29 per cent in 2040 (US EIA 2015).

Figure A2.2: US' major policies and associated costs

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<th>Policy</th>
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<tr>
<td>The Clean Power Plan aims to reduce emissions from the electricity sector by 32 per cent below 2005 levels by 2030. The federal regulator proposes emissions standards to each state for their power sector as well as guidelines to achieve them. It is estimated this will reduce emissions by 376 Mt CO₂ annually by 2030.</td>
<td>The projected compliance cost is $8.4 billion in 2030. The regulations are projected to produce between $34 and $54 billion in annualised benefits in 2030 (2011 US dollars; EPA 2015).</td>
</tr>
<tr>
<td>Light vehicle regulations (second-generation of standards) commence in 2017. They are projected to result in around 270 Mt CO₂-e of abatement annually in 2030, in addition to abatement from first-generation standards.</td>
<td>The projected annualised compliance cost is $6.5 billion in 2025 (the last year of the program). The regulations are projected to produce $26 billion in annualised benefits (2010 US dollars; EPA 2012).</td>
</tr>
<tr>
<td>Standards planned to address methane emissions from landfills and the oil and gas sector, and to stem the growth of hydrofluorocarbon emissions. The US has estimated these policies could reduce emissions by 125-225 Mt CO₂-e in 2020.</td>
<td>Published cost estimates are not yet available from the US Government.</td>
</tr>
<tr>
<td>Individual states are taking a number of different approaches to address emissions. For example, some subsidise individuals installing household solar (e.g. Texas), some support agricultural R&amp;D that reduces emissions (e.g. Oregon) and some have emissions trading schemes (e.g. California).</td>
<td></td>
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</tbody>
</table>
Japan

Japan has committed to reduce emissions by 26 per cent below 2013 levels by 2030 (equivalent to 25 per cent below 2005 levels by 2030).

The IEA projected that Japan’s business as usual CO₂ emissions from energy (the source of over 90 per cent of Japan’s emissions) will be around 17 per cent below 2005 levels in 2030 (IEA 2014b). Major drivers which will keep emissions down are Japan’s negative population growth and Japan’s plan to bring its nuclear power plants back online following the 2011 Fukushima disaster.

Figure A2.3: Japan’s major policies and associated costs

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<th>Policy</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Over 80 per cent of the abatement task in 2030 is projected to come from CO₂ emissions reductions in the energy sector. Japan’s electricity mix for 2030 calls for a doubling of the share of renewables to 22 to 24 per cent and for nuclear to generate 20 to 22 per cent.</td>
<td>Published cost estimates are not yet available from the Japanese Government.</td>
</tr>
<tr>
<td>Energy efficiency improvements to reduce energy demand by over 15 per cent by 2030.</td>
<td></td>
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<tr>
<td>Increased international abatement under the Joint Crediting Mechanism.</td>
<td></td>
</tr>
<tr>
<td>Japan has been trialling a wide array of trading and crediting schemes, at both the sub-national and international levels. Three Japanese cities (Tokyo, Saitama and Kyoto (voluntary) operate emissions trading schemes, covering 2 per cent of Japan’s emissions.</td>
<td></td>
</tr>
</tbody>
</table>
European Union

The EU has committed to reduce emissions by at least 40 per cent by 2030 compared to 1990 (equivalent to 34 per cent below 2005 levels by 2030).

The EU has projected that with adopted and implemented policies its emissions would decrease by 24 per cent by 2030 compared with 1990; this is equivalent to a decline of 18 per cent compared with 2005 levels (European Commission 2014a). Drivers of lower emissions include relatively stagnant population growth, existing policies, structural change in the economy, fuel switching to natural gas and renewables and declines in the energy intensity of the economy. In 2012, the EU already generated 27 per cent of electricity from nuclear and 24 per cent from renewables (IEA 2014b).

Figure A2.4: EU’s major policies and associated costs

<table>
<thead>
<tr>
<th>Policy</th>
<th>Cost</th>
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<tbody>
<tr>
<td>The EU’s emissions trading scheme covers around 45 per cent of the EU’s greenhouse gas emissions, including heavy energy-using installations in the electricity generation and manufacturing industries. To achieve the 2030 target the emissions trading ‘cap’ will be lowered by 2.2 per cent a year from 2021, compared with 1.74 per cent a year currently.</td>
<td>A 40 per cent reduction in emissions is estimated to result in a loss of between 0.10 and 0.45 per cent in GDP in 2030, compared to the reference scenario (European Commission, 2014b). When a 30 per cent renewable energy target and an energy efficiency target are included, the impact is estimated to be 0.46 per cent in 2030.</td>
</tr>
<tr>
<td>The EU also has an:</td>
<td></td>
</tr>
<tr>
<td>• energy efficiency target of at least 27 per cent improvement on business as usual by 2030</td>
<td></td>
</tr>
<tr>
<td>• renewable energy target of at least 27 per cent by 2030.</td>
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</tr>
<tr>
<td>The EU intends to announce further proposals to meet its 2030 target in 2015-16.</td>
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</tbody>
</table>
New Zealand

New Zealand has set an economy-wide target to reduce its emissions by 30 per cent below 2005 levels by 2030 (equivalent to 11 per cent below 1990 levels).

New Zealand has estimated that, with current policy measures in place, its emissions would increase by 38 per cent above 1990 levels (New Zealand Government 2013). Its emissions are affected by sustained population and economic growth and its agricultural exports. New Zealand has lower electricity generation emissions as almost 80 per cent of its electricity comes from renewables including its hydro and geothermal resources (New Zealand Government 2015a).

Figure A2.5: New Zealand’s major policies and associated costs

<table>
<thead>
<tr>
<th>Policy</th>
<th>Cost</th>
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<tbody>
<tr>
<td>New Zealand will meet its 2030 target through a mix of domestic policies and participation in international carbon markets. New Zealand will develop these policies beginning with a review of its Emissions Trading Scheme.</td>
<td>The projected cost of a 29 per cent target are NZ$3.7 billion per annum or around 0.6 to 1.2 per cent reduction in GNI a year by 2030 (New Zealand Government 2015b). Projections for a 30 per cent target are not publicly available.</td>
</tr>
<tr>
<td>New Zealand has also set a renewable energy target of 90 per cent by 2025 and is investing around NZ$90 million over the next four years for research to reduce agricultural emissions.</td>
<td></td>
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</tbody>
</table>
Republic of Korea

Republic of Korea (Korea) has set a target to reduce its emissions by 37 per cent below business as usual by 2030 (4 per cent below 2005 levels excluding LULUCF). The target is economy-wide; however Korea has deferred its decision on how to account for land sector emissions.

Korea’s emissions have increased over time as the country developed and are projected to increase further. Energy accounts for the vast majority of Korea’s total greenhouse gas emissions and has been the key driver. Korea has a large manufacturing base and has already achieved high levels of energy efficiency in its major industries (which include car manufacturing, electronics, phones and refined petroleum oils).

Figure A2.6: Korea’s major policies and associated costs

<table>
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<tbody>
<tr>
<td>Korea will meet its 2030 target through a mix of domestic policies and participation in international carbon markets.</td>
</tr>
<tr>
<td>Power generator standards require Korean generators to source a portion of their electricity from renewables (up to 10 per cent by 2022) with additional moves to increase renewable energy use and reduce fossil fuel use. Korea is also planning to increase its nuclear generation capacity.</td>
</tr>
<tr>
<td>Building standards seek to improve building energy efficiency.</td>
</tr>
<tr>
<td>Vehicle fuel efficiency and emissions standards are being introduced to improve 2015 efficiency levels by around a third by 2020, with additional incentives for the uptake of electric and hybrid vehicles.</td>
</tr>
<tr>
<td>Korea also launched its ETS in 2015.</td>
</tr>
</tbody>
</table>

Cost

Published cost estimates are not yet available from the Government of Korea.

China

China’s emissions trends and actions are also important to consider. China is Australia’s largest trading partner and both the world’s largest energy consumer and largest emitter. China has announced it will peak CO2 emissions around 2030, and will make best efforts to peak earlier. China will seek to reduce the emissions intensity of GDP by 60-65 per cent on 2005 levels by 2030.

Before the announcement of China’s post-2020 target, the IEA projected China’s business as usual emissions would peak around 2040. Emissions will be shaped by China’s attempts to shift its economy towards value-added technology, services and a focus on domestic consumption. These shifts are necessitated by an ageing population, a subdued global economy, and increased international competition which means China can no longer rely on low-cost labour-intensive exports as its primary driver of economic growth. Lower rates of energy and emissions-intensive growth will be counterbalanced by increasing urbanisation and personal wealth. Each year, 10 to 20 million people move to cities in China. This results in an estimated three-fold increase in each individual’s emissions.

Figure A2.7: China’s major policies and associated costs

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<td>Emissions will be shaped by China’s attempts to shift its economy towards value-added technology, services and domestic consumption and improve air quality.</td>
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<td>Since 2013, China has been pursuing regulatory actions and instructions supporting the objectives in the Twelfth Five-Year Plan: to control greenhouse gas emissions, adjusting industry, saving energy, increasing energy efficiency, optimising the energy structure and increasing carbon sinks.</td>
</tr>
<tr>
<td>Specifically, China has a non-fossil fuel target of 20 per cent of primary energy by 2030. China’s current levels of non-fossil fuel energy are around 11 per cent, with a target of 15 per cent by 2020.</td>
</tr>
<tr>
<td>China has also announced it will increase forest stock volume by around 4.5 billion cubic meters by 2030 on 2005 levels.</td>
</tr>
<tr>
<td>China is operating a number of pilot emissions trading schemes at the sub-national level including in the cities of Shanghai and Beijing and the provinces of Guangdong and Hubei.</td>
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Published cost estimates are not yet available from the Chinese Government.
**China**

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Appendix 3: Assumptions and limitations of economic modelling

Economic modelling results always need to be used with caution given the number of assumptions required to run a model. Results are indicative and a guide only. Accordingly, the review has drawn on a wide range of work to analyse relative economic impacts.

The McKibbin modelling report 1 indicates that “There is considerable uncertainty in the assumptions used in the modelling. Given the difficulty of predicting future economic conditions and countries’ actions, all results should be understood to be an expected outcome with a relatively large band of uncertainty around the point estimates. The estimates should be treated as indicative of the orders of magnitude of policy impacts and the likely relative size of impacts across sectors and countries, and should be used with caution.”

The McKibbin modelling uses a G-cubed model, which considers CO₂ emissions from the energy sector (around two-thirds of Australia’s and global emissions). While the G-cubed model only covers CO₂ emissions from the energy sector it is one of the best models available to assess global action commitments and their economic impact on other countries and Australia.

For Australia, the modelling assumes around two-thirds of Australia’s domestic abatement comes from CO₂ reductions from electricity generation investment in the energy sector. It estimates the cost of this abatement for the Australian economy.

The model assumes investment in Australia’s electricity generation reduces the share of coal-powered electricity and increases the shares of gas and renewable energy, along with investments to improve energy efficiency of electricity generation. The model took this approach to adopt a simple and conservative assumption, acknowledging that the Government’s post-2020 emission reduction policies are still to be finalised (see chapter 6).

The modelling does not account for potential reductions from energy efficiency measures (outside electricity generation), non-energy industrial process emissions (such as CO₂ emissions from cement manufacturing and aluminium production), non-CO₂ emissions (e.g. from livestock), or potential emissions and sequestration from land use change.

It is likely less than two-thirds of the abatement would actually come from the energy sector (e.g. former Treasury modelling in 2013 estimated under half the domestic abatement came from the energy sector and even less from electricity generation). Given this, the modelling estimates provide a conservative (i.e. high) estimate of average abatement cost.

However, the modelling does not estimate the cost of achieving the remaining one-third of abatement for a given target. Estimated costs would be higher if the average cost of abatement for the two-thirds of the abatement modelled is the actual average cost for the whole target.
The modelling undertakes sensitivity analysis, which estimates economic costs could also be significantly lower. It shows the economic impacts are sensitive to assumptions about future technology costs as well as the type of abatement chosen. For example, if technology advancement on emissions reductions is faster than assumed, economic impacts could plausibly be as much as one third lower than under the core assumptions.

Ultimately the cost and impacts, including sectoral impacts, will depend on the policies chosen and how they are implemented. The Australian Government’s post-2020 emissions reduction policies are still to be finalised (see chapter 6).
Appendix 4: Sector by sector examination of the Australian economy

This appendix conducts a sector by sector examination of Australia’s economy. It summarises current and projected emissions growth and opportunities for further abatement. It identifies Australia’s major competitors in the global market for each sector. The reported sectors are:

- Coal
- Gas including liquefied natural gas
- Other mining
- Aluminium and alumina
- Petroleum refining
- Cement
- Steel
- Other manufacturing
- Land sector (agriculture and forestry)
- Services
- Electricity
- Construction
- Transport

Stakeholders have requested specific sectoral analysis to better understand how international and domestic actions may impact upon each sector of the Australian economy.

Given the expected impact on emissions intensive sectors of the economy, this appendix covers each of these sub-sectors separately rather than considering them as part of their mining and manufacturing aggregates.
Coal

In 2012, Australia had a 9.2 per cent share of known global coal reserves. Black coal resources and production are mostly located in New South Wales and Queensland. Brown coal resources and production is mainly in Victoria.

In 2013-14, coal mining contributed $40 billion to our exports (12 per cent of Australia’s total export value) (DFAT 2014b). Australia is the world’s largest exporter of metallurgical coal (primarily used to make steel) and second largest exporter of thermal coal (used for electricity generation). The Australian coal industry directly employs around 40,000 people (ABS 2015a).

Australia’s metallurgical coal exports (almost all production) are projected to increase by three per cent a year to $26.1 billion (2014-15 dollars) by 2019-20. Australia’s thermal coal exports (80 per cent of our production) are projected to increase at an average annual rate of 0.4 per cent to $16.1 billion (2014-15 dollars) by 2019-20 (DIS 2015a).

**Emissions:** Coal mining emissions account for around seven per cent (38 Mt CO$_2$-e in 2013) of Australia’s greenhouse gas emissions. Most are fugitive methane emissions from coal layers released during extraction, transport and handling. Emissions intensity has declined from a shift to less gassy open cut coal mines and from flaring and capturing methane at underground coal mines.

**Competitors:** Australia’s main export competitors for metallurgical coal are Canada, Russia and the US. Major competitors for thermal coal exports are Indonesia, Colombia, South Africa and Russia as well as domestic production in China and India.

**Abatement:** There are opportunities for Australia to reduce global emissions from coal use because Australia has large deposits of high energy coal which means that smaller volumes of coal are combusted to achieve the same level of electricity generation. Adoption of low emissions coal generation technology could make a big difference to emissions in countries that plan to build new coal generation due to the imperative to bring people out of poverty. In addition, the IEA suggests that in the longer term large-scale coal-fired power generation remains compatible with climate goals through use of carbon capture and storage technology (IEA 2014b).

Within Australia, most abatement opportunities are associated with the oxidation of ventilation air methane. ClimateWorks (2015) found these capture technologies could abate around 70 per cent of emissions from gassy mines, which represents around 60 per cent of all coal mining fugitive emissions. A number of coal mines are capturing methane, including the West Cliff mine which has already abated an estimated 250 kt CO$_2$-e a year.

*There is a global environmental benefit where Australian LNG and coal, which has lower greenhouse gas emissions than many other competitors, replaces poorer quality and more greenhouse gas emissions intensive energy inputs* (Business Council of Australia)
Gas including liquefied natural gas

In 2013-14, Australia exported $16.3 billion of natural gas; around half our production (DIS 2015a). Around $200 billion is being invested in gas and oil projects including seven major liquefied natural gas (LNG) export projects (APPEA 2015). Deloitte (2012) estimates current investment in gas and oil projects will increase Australian GDP by up to 2.2 per cent a year during the investment phase, creating over 100,000 jobs across our economy.

Australian gas production is projected to more than double to 145.6 billion cubic metres by 2019-20. Australia is projected to become the world’s largest LNG exporter over the next five years with export volumes reaching 76.6 million tonnes in 2019-20 and export values growing 21 per cent a year to $46.7 billion in 2019-20 (in 2014-15 dollars).

\[\text{contribution of the combined oil and gas and exploration sectors is projected to double to approximately }\$53\text{ billion in 2019-20}\]

(Australian Petroleum Production & Exploration Association)

**Emissions:** Emissions associated with the production of LNG include: fugitive emissions from extracting and transporting the natural gas; combustion of natural gas for energy in the gas processing and liquefaction process; and upstream emissions from electricity consumption at the LNG facility. Australia’s LNG production emissions are projected to increase out to 2030, driven by export demand. The Government is working with industry to reduce fugitive emissions associated with LNG production which are projected to more than triple between 2014 and 2030.

**Competitors:** Australia’s current major LNG competitors include Qatar, Malaysia, Nigeria and Indonesia and in the future they are likely to include the US, Papua New Guinea and countries in East Africa.

**Abatement:** In addition to greenhouse gas storage activities, such as the Gorgon project, there are a number of abatement opportunities in the gas extraction sector from efficiency measures (e.g. replacing and improve maintenance of compressor seals, improved gas network maintenance and improved planning).

Natural gas makes it possible for Australia to meet the world’s growing energy needs over the coming decades while incorporating a strategy to curb emissions and address the risks posed by climate change

(Australian Petroleum Production & Exploration Association)
Other mining

In 2013-14, other mining (including metals like iron ore, copper, nickel, zinc and uranium) contributed around $79 billion to Australia’s GDP (ABS 2014b). Mining of coal and gas are covered in other parts of this appendix (and oil extraction, a small part of our mining exports, is covered under petroleum refining). The entire mining sector employed 229,200 people in May 2015 (ABS 2015a).

Mining has been a key contributor to the Australian economy, underpinned by large export earnings and capital investments. As the investment and construction phase concludes with declining commodity prices, the Australian mining sector is transitioning to a period of higher commodity production and mining exports. Growth in exports will be supported by the recent depreciation of the Australian dollar.

**Emissions:** Emissions from the other mining sector account for around four per cent (22 Mt CO₂-e in 2013) of Australia’s greenhouse gas emissions, mainly from diesel combustion at the mine and electricity use.

**Abatement:** Opportunities include improving mining equipment (e.g. light weight dump truck bodies) and improved operational actions (e.g. reduced idle time of shovels and trucks).

Nuclear energy is a low emissions technology. Australia’s uranium exports can help the global economy grow (including major emerging economies in Asia) while managing emissions. Australia has the world’s largest proven uranium reserves and is the world’s third largest producer (Geoscience Australia 2014). In September 2014, the Australian and Indian Governments signed a bilateral Civil Nuclear Cooperation Agreement to enable the sale of Australian uranium to support India’s growing energy needs.

*Minerals and energy exports, for example, account for nearly 60 per cent of Australia’s merchandise exports, compared with the OECD average of around 11 per cent. Moreover, nearly one third of Australia’s emissions are generated in agricultural and minerals production the majority of which are exported. This distinctiveness needs to be taken fully into consideration by Australia’s policy makers in considering the review of Australia’s emissions targets* (Minerals Council of Australia)
Aluminium and alumina

Aluminium is the second-most produced metal in the world and Geoscience Australia estimates Australia has the second largest known bauxite resources (used in aluminium).

In 2014-15, forecast Australian exports of aluminium are $3.6 billion and alumina are $6.4 billion (DIS 2015c). The sector employs around 14,000 people (Australian Aluminium Council 2014). Four aluminium smelters remain in Australia (after closures of Point Henry, Geelong in July 2014 and Kurri Kurri, NSW in October 2012). Australia’s aluminium smelters have been competing against newer overseas facilities during lower world aluminium prices (halved since the global financial crisis), a higher Australian dollar and higher electricity prices (energy comprises 30-40 per cent of total aluminium input costs).

Australia’s aluminium production to 2020 is projected to decrease 1.9 per cent a year on average, including from lower domestic demand (e.g. automotive industry closure). Alumina production to 2020 is projected to decline 0.3 per cent a year on average (DIS 2015a).

**Emissions:** Emissions from non-ferrous metals manufacturing (which includes aluminium and alumina manufacturing) account for eight per cent (47 Mt CO$_2$-e in 2013) of Australia’s greenhouse gas emissions. Producing aluminium requires substantial electricity (about 12 per cent of all Australia’s electricity consumption in 2012) and Australia’s electricity sector is emissions intensive. Emissions which arise from the chemical reaction in aluminium production have trended down since 1990 from process control improvements. Alumina emissions come from fuel combustion and chemical processes refining the ore.

**Competitors:** The main export competitors for aluminium include Russia, China and Canada and for alumina include China and Brazil.

*The impact of climate policy on Australian facilities is dependent on the costs imposed on those facilities by domestic policy, relative to the costs imposed on competing facilities by policies in their country* (Australian Aluminium Council)

**Abatement:** There are further energy efficiency opportunities that also reduce costs. In contrast, use of new technologies (e.g. inert anode technology and combinations with existing technologies) could cost between $75 to $300 per tonne of abatement. It may be challenging for local manufacturers to make such technology investments in current market circumstances without assistance.
Petroleum refining

In 2012, Australia had seven refineries but only four now remain: Lytton, Queensland; Geelong & Altona, Victoria; and Kwinana, Western Australia. The Australian Institute of Petroleum estimates the Asian region will remain oversupplied until around 2020. Australia’s existing refineries face strong competitive pressures from mega-refineries recently built in Asia.

Export earnings of crude oil and condensate are projected to grow to $10.1 billion in 2017-18, before falling to $9.2 billion by the end of the decade. Imports of refined products are projected to increase by 8.0 per cent a year, to reach 796 thousand barrels a day in 2019-20 (DIS 2015a).

**Emissions**: Petroleum refining accounts for around one per cent (eight Mt CO₂-e in 2013) of Australia’s greenhouse gas emissions.

**Competitors**: In the Asia-Pacific region, larger scale refineries competing for sales in Australia have been built in Taiwan, Malaysia, Singapore and Vietnam.

**Abatement**: With little new planned capital investment and competitive pressures in Australia’s refining industry there may be limited scope for abatement in this sector in the short to medium term.
Cement

In 2013-14 the Australian cement industry recorded a turnover of $2.3 billion with production mainly for domestic use. It employs around 5,000 people. There are five integrated clinker and cement manufacturing sites, in addition to stand-alone cement mills and limestone mines.

In 2012–13 Australia produced 6.3 million tonnes of clinker and imported 1.9 million tonnes (65 per cent from Japan and 30 per cent from China) (CIF 2013). Clinker imports have been increasing due to rising domestic input costs and excess world production capacity and are expected to continue to 2020.

**Emissions:** Cement, lime, plaster and concrete production account for two per cent (11 Mt CO$_2$-e in 2013) of Australia’s greenhouse gas emissions. Emissions come from combusting fuel, releasing CO$_2$ as a by-product from a chemical process and electricity use. Australian cement plants have reduced their emissions intensity by producing blended cements and recycling cement kiln dust as a raw feedstock in the kiln to reduce the need for limestone. Emissions have also declined due to clinker facility closures.

*Our industry has reduced the carbon intensity of its product by over 30 per cent* (Cement Industry Federation)

**Competitors:** Australian production is already subject to import competition. There are significant cement and clinker producers in our region including Japan, China, Indonesia, Thailand, Malaysia and the Philippines.

**Abatement:** Around half of all cement manufacturing emissions cannot be avoided, unless there is technological innovation, as they are produced from a chemical process in changing limestone in the first stage of cement production. The remainder of cement manufacturing emissions are from burning fuels to create heat (32 per cent) and indirect emissions from electricity use (13 per cent) mainly to grind cement.

Opportunities include equipment and process improvements (e.g. conversion to modern grate cooler, high-efficiency roller mill, and monitoring and controls of kiln and crusher).

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Steel

By 2014, Australia's share of world crude steel production fell to 0.3 per cent of total global production (WSA 2015). According to IBIS World (2014), limited demand from downstream markets, falling steel prices and import competition have led to overcapacity and caused firms to reduce production.

Australia has two vertically integrated steel producers, BlueScope Steel Ltd (BlueScope) and Arrium Ltd, which produced 4.6 million tonnes of steel in 2014. In 2014 employment in iron and steel manufacturing was estimated to be 17,000 (IBIS World 2014).

**Emissions:** Emissions from the manufacture of iron and steel account for two per cent (14 Mt CO$_2$-e in 2013) of Australia’s greenhouse gas emissions. Iron and steel manufacturing involves the transformation of iron ore into solid steel products. Emissions per tonne of iron and steel produced vary according to changing quantities of reductants used. In Australia there has been a general declining trend in the emissions per unit of iron and steel produced due to the increased use of pulverised coal injection into blast furnaces in lieu of coke.

**Competitors:** Australia’s steel production is small by world standards, with China, the US, Japan and India being the major producers.

**Abatement:** A range of fuel switching (coke substitution using biomass) and cogeneration opportunities (capturing and reusing blast furnace gases) exist in steel making.
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Other manufacturing

The Australian Industry Group estimates total manufacturing value added was around $99 billion in 2014 (AIG 2015). The ABS reports over 900,000 jobs for the manufacturing sector (ABS 2015a).

Although a declining share of our economy, manufacturing production and employment is still projected to be large out to 2050. Remaining suppliers continue to evolve and innovate to find niche market opportunities overseas and supply the local economy.

*Any future greenhouse gas emission target needs to allow for the fact that traditional manufacturing States such as South Australia are already facing major structural adjustment over the next five to ten years (Business SA 2015)*

**Emissions:** Other manufacturing accounts for seven per cent (40 Mt CO₂-e in 2013) of Australia’s greenhouse gas emissions. The largest sources of other manufacturing emissions are electricity consumption, fossil fuel combustion at the manufacturing plant (mainly natural gas and liquid fuels) and industrial process emissions from manufacturing chemicals, metals and minerals. Emissions have declined in recent years partially reflecting the closure of some large manufacturing facilities.

**Abatement:** There are opportunities to reduce emissions from chemical manufacturing (e.g. investment in better motors to reduce energy consumption) and fertilisers and plastics manufacturing processes. Lower emissions electricity will also reduce this sector’s indirect emissions. Opportunities across a range of manufacturing sectors to implement co-generation and improve control systems, reduce oversized or duplicate equipment and improve boilers and steam distribution systems could deliver further abatement.
Land sector (agriculture and forestry)

In 2013-14, the value of farm production was $53 billion and farm exports increased 8.2 per cent to $41 billion or 12 per cent of all exports (ABARES 2015). The main exports were beef, wheat, wool, dairy, cotton, barley, canola, wine, lamb and sugar (ABARES 2015). Around 271,000 people (2.4 per cent) are employed in the agriculture sector (Department of Agriculture 2014a). Global income growth, particularly in Asian markets, is projected to lead to increased demand for Australian agricultural exports.

In 2012–13 the forestry and forest products manufacturing industries contributed $7 billion to GDP and $2 billion in wood product exports. Employment from forestry and wood, pulp and paper manufacturing was 70,500 in 2013-14 (Department of Agriculture 2014b).

**Emissions:** The agriculture, forestry and fishing sector accounts for 19 per cent (102 Mt CO₂-e in 2013) of Australia’s greenhouse gas emissions. Agriculture emissions are projected to increase by 12 per cent (largely driven by beef exports) from 82 to 92 Mt CO₂-e by 2030.

Net emissions from land use, land use change and forestry account for one per cent of Australia’s total emissions (8 Mt CO₂-e in 2013). Emissions have declined since 1990, driven by reduced rates of deforestation, but are projected to increase to 41 Mt CO₂-e in 2030.

**Competitors:** Our agricultural exports compete with a range of countries (e.g. India, Brazil and the US for beef and the EU, Canada, Russia and the US for wheat). Australia’s major forestry competitors for woodchip exports include Vietnam, Chile, the US and Thailand.

**Abatement:** ClimateWorks estimate 79 Mt CO₂-e of abatement in 2030 from forestry due to increased sequestration from carbon forestry and a reduction in deforestation. ClimateWorks estimate 34 Mt CO₂-e of abatement in 2030 from agriculture which could be largely achieved from a reduction in the emissions intensity of livestock. This reduction in methane from cows and sheep could be achieved through active livestock feeding and changes in livestock management systems including dietary additives, breeding, herd selection and vaccinations.

*R&D that focuses on mitigation options that concurrently reduce emissions and improve productivity and profitability will be more readily adopted by farmers as it makes business sense to do so* (National Farmers’ Federation)
Services

The services sector accounted for around 70 per cent of Australia’s GDP in 2013-14. In 2013-14, Australia exported around $57 billion of services accounting for 17 per cent of total exports (DFAT 2014b). It directly employs around nine million people, more than three-quarters of total employment (ABS 2015a).

The Australian economy is increasingly becoming a service-oriented economy, but still lags other OECD countries in terms of exports (OECD 2014). Australian spending on services as a percentage of household disposable income increased from 37 per cent in 1959-60, to more than 63 per cent in 2013-14. The long term shift towards a service economy is expected to continue. Our services industries (e.g. education and tourism) can also take advantage of the growing middle class in Asia.

Emissions: The services sector accounts for 14 per cent (76 Mt CO₂-e in 2013) of Australia’s greenhouse gas emissions. The largest sources are from electricity consumption (e.g. for office buildings), transport, waste management and direct fuel combustion within the sector (e.g. natural gas heating).

Abatement: While services-oriented sectors tend not to be emissions intensive, there are opportunities for the sector to lower its emissions and costs from energy efficiency measures, such as for office buildings (see examples under the construction section).

Australian companies have the potential to unleash a wave of innovation in low carbon technologies, creating new products and services, generating employment, reducing energy consumption and increasing savings if the right policies are in place (Sustainable Business Australia)
**Electricity**

Access to reliable, affordable electricity is important for the economy and consumers and also impacts on the competitiveness of trade-exposed industries. Electricity prices increased by 72 per cent (48 per cent in real terms) in the six years to 2014-15, largely due to increases in network costs (ABS 2015b).

**Emissions:** Electricity generation emissions are projected to grow from 180 Mt CO₂-e in 2014 to 224 Mt CO₂-e in 2030. In 2014, a third of total Australian emissions were from power stations and the electricity generation mix comprised 61 per cent coal, 22 per cent natural gas, 15 per cent renewables and 2 per cent liquid fuels (DIS 2015b). Meeting the renewable energy target will result in more than 23 per cent renewables by 2020.

**Abatement:** ClimateWorks estimates Australia’s electricity emissions intensity can be reduced quickly (from 0.79 t CO₂-e/MWh in 2012 to between 0.16 and 0.28 t CO₂-e/MWh in 2030) if a high abatement incentive is applied.

In the short-term, introducing new capacity into a market that does not need it will be costly. It would affect existing generator businesses and comes at an opportunity cost in terms of capital that could be used for other productive purposes. A lower cost and smoother approach could be for energy companies to transition and retire their older generation assets over the long term. ClimateWorks (2015) modelling suggests there could be various generation mix scenarios to achieve near zero electricity generation emissions over the extended period and more demand as vehicles and industry switch from other fuels to electricity.

> Delaying abatement is likely to be at lower costs in some circumstances .... The energy sector requires very little new investment out to 2025 but beyond this period ...significant investment will be required (Origin)

> AGL specifically notes that in [a 2°C] scenario, continued use of coal and gas for power generation by mid-century is likely to be dependent upon cost-effective deployment of very low emissions technology, such as Carbon Capture & Storage (AGL)
Construction

In 2012-13, the construction industry represented around seven per cent of GDP (Department of Industry 2014). More than one million Australians are employed in the construction sector (ABS 2015a). Construction supporting the mining sector has softened, but housing construction is responding positively to low interest rates, population growth and higher housing prices.

**Emissions:** Emissions from the construction sector account for around two per cent (nine Mt CO₂e in 2013) of Australia’s greenhouse gas emissions predominantly from transport in the sector.

**Abatement:** The construction sector could play a role in a number of building energy efficiency abatement opportunities. Over the period to 2030, ClimateWorks estimates opportunities to improve: central building heating and cooling efficiency of between 28 to 45 per cent; hot water efficiency of between 21 to 33 per cent; lighting efficiency of between 35 to 50 per cent; and appliance efficiency of between 23 to 29 per cent.
Transport

Transport is a critical enabler of productivity with more than 600,000 people in 2014 involved in the movement of people and goods by road, rail, water and air. Industry data from 2011-12 shows the transport sector supports more than 50,000 businesses which generated over $100 billion in revenue (AIG 2012). In Australia in 2011-12, domestic freight is made up of rail (48.5 per cent), road (34.6 per cent), coastal shipping (16.8 per cent) and air freight (0.05 per cent) (BITRE 2014c).

The transport sector closely follows activity in the broader economy. Total freight volumes have quadrupled over the past four decades with strong growth in road freight and in mining export related rail freight volumes. Total domestic freight tonne-kilometres are projected to grow by about 80 per cent between 2010 and 2030 (BITRE 2014c).

Emissions: Emissions from transport account for 17 per cent (93 Mt CO$_2$-e in 2013) of Australia’s greenhouse gas emissions. The majority of these emissions are for passenger vehicle transport by households or direct transport by other economic sectors. Over the last two decades, transport vehicles have substantially reduced average emissions intensity levels, with technical innovations contributing to falls.

By 2030, transport emissions are projected to increase by 24 per cent to 115 Mt CO$_2$-e.

Abatement: ClimateWorks modelling suggests 488 Mt CO$_2$-e of cumulative abatement from transport energy efficiency, electrification and fuel switching can be accessed by 2030, increasing from 15 Mt CO$_2$-e annually in 2020 to 72 Mt CO$_2$-e annually in 2030. The modelling is based on transport energy efficiency continuing current rates of improvement to 2020, and accelerating thereafter including through improvement in: passenger vehicle efficiency after 2020 due to increasing electrification (47 per cent of passenger vehicle fleet is electric or hybrid by 2030); and truck internal combustion efficiency of 15 per cent by 2030.

A whole-of-Government approach is required that incorporates all associated issues, including fuel quality standards (Federal Chamber of Automotive Industries)
### List of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>BAU</td>
<td>business as usual</td>
</tr>
<tr>
<td>BOM</td>
<td>Bureau of Meteorology</td>
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<tr>
<td>CCA</td>
<td>Climate Change Authority</td>
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<tr>
<td>CO₂</td>
<td>carbon dioxide</td>
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<tr>
<td>CO₂-e</td>
<td>carbon dioxide equivalent</td>
</tr>
<tr>
<td>COAG</td>
<td>Council of Australian Governments</td>
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<tr>
<td>CSIRO</td>
<td>Commonwealth Scientific and Industrial Research Organisation</td>
</tr>
<tr>
<td>ERF</td>
<td>Emissions Reduction Fund</td>
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<tr>
<td>G20</td>
<td>Group of 20</td>
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<tr>
<td>GDP</td>
<td>gross domestic product</td>
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<tr>
<td>GNI</td>
<td>gross national income</td>
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<tr>
<td>Gt</td>
<td>gigatonne (one billion metric tonnes)</td>
</tr>
<tr>
<td>IEA</td>
<td>International Energy Agency</td>
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<tr>
<td>INDC</td>
<td>Intended Nationally-Determined Contribution</td>
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<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
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<tr>
<td>IPPU</td>
<td>Industrial Product and Product Use</td>
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<tr>
<td>LNG</td>
<td>liquefied natural gas</td>
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<tr>
<td>LULUCF</td>
<td>land use, land use change and forestry</td>
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<tr>
<td>Mt</td>
<td>megatonne (one million metric tonnes)</td>
</tr>
<tr>
<td>NGO</td>
<td>non-government organisation</td>
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<tr>
<td>NSW</td>
<td>New South Wales</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>PV</td>
<td>photovoltaic</td>
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<tr>
<td>R&amp;D</td>
<td>research and development</td>
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<tr>
<td>UN</td>
<td>United Nations</td>
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<tr>
<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
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<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>Abatement</td>
<td>An activity that leads to reducing greenhouse emissions</td>
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<tr>
<td>Adaptation</td>
<td>Adjustment in systems to actual or expected climate-related effects moderating adverse consequences or exploiting beneficial opportunities</td>
</tr>
<tr>
<td>Anthropogenic</td>
<td>Resulting from or produced by human beings</td>
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<tr>
<td>Commitment period</td>
<td>The time period in which UNFCCC participant countries are required under the Kyoto Protocol to meet their emissions reduction targets</td>
</tr>
<tr>
<td>Deforestation</td>
<td>Conversion of forest to non-forested land</td>
</tr>
<tr>
<td>Emissions</td>
<td>The amount of greenhouse gas emitted by an activity</td>
</tr>
<tr>
<td>Energy efficiency</td>
<td>The ratio of energy required to produce a certain level of good or service (e.g. kilowatt hours per unit of heat or light)</td>
</tr>
<tr>
<td>Energy intensity</td>
<td>A measure of the amount of energy used or consumed in relation to macro-indicators like gross domestic product. It can be a measure of the efficiency of a nation’s economy</td>
</tr>
<tr>
<td>Emissions intensity</td>
<td>The amount of emissions per unit of output; for example, emissions per unit of gross domestic product</td>
</tr>
<tr>
<td>Energy production</td>
<td>The total amount of primary energy produced in the economy before export, consumption or transformation into other products such as electricity</td>
</tr>
<tr>
<td>Global warming potential</td>
<td>An index creating a comparison between greenhouse gases in relation to their influence on the energy balance of the climate system</td>
</tr>
<tr>
<td>Greenhouse gas</td>
<td>Gases that absorb infrared radiation in the atmosphere. Gases considered are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride, and nitrogen trifluoride</td>
</tr>
<tr>
<td>Intended nationally determined contributions</td>
<td>Documents that participant countries will submit to the UNFCCC to communicate their post-2020 target (see box 2.3)</td>
</tr>
<tr>
<td>Kyoto Protocol</td>
<td>An international climate treaty under the UNFCCC that, amongst other things, involves developed countries committing to emission reduction targets</td>
</tr>
<tr>
<td>Mitigation</td>
<td>A reduction in the source of greenhouse gases or in the enhancement of sinks for greenhouse gases</td>
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<tr>
<td>Primary energy</td>
<td>Energy in a form obtained directly from nature like coal, natural gas, wind or solar</td>
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<tr>
<td>Sink</td>
<td>A process, mechanism or activity that removes a greenhouse gas from the atmosphere</td>
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<tr>
<td>Sequestration</td>
<td>Capture and storage of carbon. For example, plants absorb carbon dioxide from the atmosphere, release the oxygen, and store the carbon</td>
</tr>
<tr>
<td>Trade exposed, emissions intensive</td>
<td>Industry sectors where prices are set by world markets and release significant emissions during their production processes</td>
</tr>
<tr>
<td>United Nations Framework Convention on Climate Change</td>
<td>The international agreement setting framework and rules to address climate change for member countries</td>
</tr>
</tbody>
</table>
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