ClimateWorks Australia
Submission to the
Review of Australia's climate change policies

8th May 2017

ClimateWorks Australia is an expert, independent adviser, committed to helping Australia transition to net zero emissions by 2050. It was co-founded through a partnership between Monash University and The Myer Foundation and works within the Monash Sustainable Development Institute.

This submission draws on ClimateWorks Australia’s research and engagement with key stakeholders across government, business, academia and customers. The introduction covers the main issues ClimateWorks considers are important for the submission, followed by a more detailed response on many of the questions from the discussion paper.
## Introduction

Australia has committed to considering a potential long-term emissions reduction goal for Australia beyond 2030. What factors should be considered in this process?

- A net-zero emissions target should form the basis of all policy decisions.
- Australia can reach net zero emissions by 2050 alongside economic growth.
- Setting a long-term target increases the cost-effectiveness of shorter term action.
- Delay is costly.
- The transition to a zero carbon world is underway - Australia should catch up.

## Australia’s Paris Target

What are the issues in the transition to a lower emissions economy with respect to jobs, investment, trade competitiveness, households (including low income and vulnerable households) and regional Australia?

- Australia has many cost-effective options to reach net zero emissions, which could create a new competitive advantage.
- Deep decarbonisation is affordable.
- Decarbonisation has the potential to reduce energy bills for householders.
- Australian incomes can continue to rise and jobs can continue to grow while reaching net zero by 2050.

What process could Australia use to implement its Paris commitment to review targets every five years?

- Five yearly targets should be based on a long-term pathway to net zero.
- Interim targets and policy strategies should recognise the need to increase climate action ambition in the future.
- Different policy approaches will be needed depending on degree of certainty.
- Australia should choose to focus its short and medium term action in line with a goal of achieving net emissions by 2050.

## Electricity Sector

What are the opportunities and challenges of reducing emissions from the electricity sector? Are there any implications for policy?

- The electricity sector has a key role to play in achieving deep decarbonisation.
- Decarbonisation of the electricity system can be achieved while reducing overall system costs.
To unlock the emissions reduction potential in the electricity sector, significant policy and regulatory change will be required.

Good policy increases business confidence and improves long-term planning. This will tend to increase notice about any closures of power plants and therefore the government’s ability to support communities in transition and to plan for a secure and appropriate energy system.

How can energy and climate policy be better integrated, including the impact of state-based policies on achieving an effective national approach?

Are there particular concerns or opportunities with respect to jobs, investment, trade competitiveness, households and regional Australia that should be considered when reducing emissions in the electricity sector?

Australia’s energy system is highly emissions intensive.

Energy efficiency and demand response can contribute significantly in creating a secure, affordable electricity system with low emissions.

Substantial investment is needed, however the scale is not unprecedented and the age of our generators means that investment is essential irrespective of decarbonisation.

New technologies should be integrated in an efficient way into the electricity system to lower business costs.

**Households, SMEs and the built environment**

What are the opportunities and challenges of reducing emissions for households, SMEs and the built environment? Are there any implications for policy?

Are there particular concerns or opportunities with respect to jobs, investment, trade competitiveness and regional Australia that should be considered for households, SMEs and the built environment?

Energy efficiency can bring net cost benefits as well as substantial emissions reductions.

There are many existing options to reduce emissions from buildings, but government action is needed.

**Resources, manufacturing and waste**

What are the opportunities and challenges of reducing emissions from the resource, manufacturing and waste sectors? Are there any implications for policy?

There are substantial cost-effective emissions reductions available in industry.

Government can unlock cost-effective emissions reductions in industry.

Are there particular concerns or opportunities with respect to jobs, investment, trade competitiveness, households and regional Australia that should be considered when reducing emissions in the industrial sector?

Improving energy efficiency performance can deliver significant cost benefits, minimise energy related risks and improve competitiveness for companies.

**Transport**

What are the opportunities and challenges of reducing emissions in the transport sector? Are there particular concerns or opportunities with respect to jobs, investment, trade competitiveness, households and regional Australia associated with policies to reduce emissions in the transport sector?
Transport emissions are growing, but has some of most cost-effective opportunities 27
Introducing light vehicle fuel efficiency standards saves money and reduces emissions 27
Complementary measures will support additional emissions reductions 29
Electric Vehicles can substantially reduce transport emissions 30

**Land and agriculture** 30

What are the opportunities and challenges of reducing emissions from the land and agriculture sectors? Are there any implications for policy? 30
Are there particular concerns or opportunities with respect to jobs, investment, trade competitiveness, households and regional Australia associated with policies to reduce emissions in the land and agriculture sectors? 30

Australia’s potential for carbon offsets is substantial 30
The transition required in the land sector is significant, but there are large benefits 31
What can be done to realise further benefits from emissions reduction activities beyond carbon abatement? 31

**Research and development** 33

What is the role of research, development, innovation and technology in reducing Australia’s emissions? Are there any implications for policy? 33
Are there particular concerns or opportunities with respect to jobs, investment, trade competitiveness, households and regional Australia that should be considered in relation to research, development, innovation and technology? 33

Government has a role to play to support emerging low carbon technologies at all stages of development 33

**International units** 35

What is the potential role of credible international units in meeting Australia’s emissions targets? Are there any implications for policy? 35
Australia can and should do as much domestically as possible 35

**References** 36
Introduction

Australia has committed to the Paris Agreement that sets out collective global action to avoid dangerous climate change. Countries have agreed to reach net zero emissions in the second half of this century, to limit global warming to well-below 2°C and to aim to limit warming to 1.5°C. In practice this means that Australia, and all developed economies, will need to undertake deep decarbonisation to reach net zero emissions around or before 2050.

Australia should set a long-term goal of net-zero emissions by 2050. While it is a challenge, research demonstrates that deep decarbonisation can be achieved by 2050 using technologies already known today (ClimateWorks & ANU 2014), and rising to the challenge is possible alongside economic growth and growth in jobs. Change is inevitable to avoid dangerous climate change. The transition to a net-zero emissions world is underway. If Australia doesn’t catch up we will miss out on business opportunities and potential economic growth.

Setting a net-zero emissions target under a long-term plan will help identify the policy measures and interventions that are needed now to make an effective transition to net-zero. A net-zero target provides business with a clear policy signal to encourage cost-effective actions and inform investment decisions to prevent lock-in of emissions intensive investments and stranded assets. Delay in setting targets to help Australia reach net-zero increases will increase costs. And policy uncertainty can also be a significant cost.

Australia has a range of options to decarbonise thanks to its natural resources. Australia is rich in renewable energy opportunities and has huge technical potential for carbon forestry and increasing soil carbon. These resources and potential could create a new competitive advantage. Our modelling projects that Australia can reach zero emissions by 2050 and meet its recommended carbon budget while maintaining economic growth.

A portfolio of actions is needed if the Government is to meet current emissions reduction targets and the stronger targets to come under our international commitments. ClimateWorks’ research shows that while opportunities exist to substantially reduce emissions, delay will increase the cost of implementing them. Our research shows there are many pathways for Australia to cost-effectively reach net zero emissions through four pillars: ambitious energy efficiency; low carbon electricity; electrification & fuel switching and reducing non-energy emissions.

The transition to net-zero emissions is affordable and has the potential to reduce energy bills. Decarbonisation in Australia would result in deep transformation in only a small number of sectors, but requires Australia’s economy to meet new opportunities and challenges. The transition to a decarbonised economy will require investment in new low-carbon capital assets across the economy, particularly in transportation, electricity generation, industrial equipment, and buildings. In many instances this investment can reduce expenses such as fuel costs and reduce overall operating costs in the economy.

To ensure Australia can contribute to the global climate goal, the Government should make sure that its interim emissions reduction targets are sufficient to transition to deep decarbonisation. Government should: accelerate action now to reduce emissions; avoid lock in of emissions intensive technologies and prepare for the future.

These issues are discussed in full in our submission below, along with the implications for the sectors highlighted by the discussion paper.
Australia’s Paris Target

Australia has committed to considering a potential long-term emissions reduction goal for Australia beyond 2030. What factors should be considered in this process?

A net-zero emissions target should form the basis of all policy decisions.

Australia, along with more than 190 countries, has committed to aim to reach global peaking of greenhouse gas emissions as soon as possible and to achieve a balance between emissions and removals of greenhouse gases in the second half of this century. The Paris Agreement also set the global goal to limit the global average temperature increase to well below 2 degrees and pursue efforts to keep warming below 1.5 degrees above pre-industrial levels. The world agreed to the stricter goal to avoid the worst impacts of climate change (such as reduced economic productivity, negative health outcomes, loss of biodiversity including coral reefs and the disappearance of small island states).

In practice this means that Australia, and all developed economies, will need to undertake deep decarbonisation to reach net zero emissions around or before 2050. Indeed, the Climate Change Authority recommended that a carbon budget for Australia in line with the 2 degrees goal would need to see emissions reduced by about 40 to 60% below 2000 levels by 2030, and to reach net zero emissions around 2050. The 1.5 degrees goal would mean that emissions in Australia need to decrease even more rapidly. In addition, any delay in early rates of emissions reductions will require a steeper pathway to net zero emissions in the future.

Australia’s economy needs to change to meet the opportunities and challenges that this will create. Setting a net zero emissions target under a long-term plan will help identify the new policy measures and interventions that are needed now to make this transition effective. Targets are signals of intent and future direction. Targets do not directly reduce emissions, rather, they guide the emissions reduction policies that governments implement and inform business expectations regarding the future. They play an important role in linking near-term decisions with longer-term timeframes and with global climate objectives.

Leading countries have developed long-term decarbonisation strategies - including Germany, Canada, Mexico and the United States. Australia should learn from how they are proposing to deliver these strategies. The German government has agreed a commission to work with industry and trade unions to help deliver the plan, which is due to start in 2018. This commission will consider economic development, structural change and social compatibility to accompany climate action.

With many Australian states having already adopted net zero emissions goals or targets by 2050 - South Australia, Victoria, NSW and the ACT have pledged targets of zero net emissions by 2050 - the Commonwealth government has an opportunity to build on state policy and aspirations and provide better consistency on national climate policy by adopting this goal itself.

Australia can reach net zero emissions by 2050 alongside economic growth.

ClimateWorks, with ANU and CSIRO, modelled decarbonisation pathways for Australia focusing on the largest emissions reductions for the lowest cost, within a four pillars approach. ‘Pathways to Deep Decarbonisation in 2050: How Australia can prosper in a low carbon world’ shows it is possible for Australia to achieve zero emissions by 2050 while still growing the economy, using technology that is already proven. A portfolio of actions is needed if the Government is to meet
current emissions reduction targets and the stronger targets to come under our international commitments. This research shows there are many pathways for Australia to cost-effectively reach net zero through the following four pillars:

- **Ambitious energy efficiency** – undertake ambitious energy efficiency across all sectors of the economy. Halving of final energy use per $ GDP by 2050 through greatly improved energy efficiency in all energy end-use sectors including passenger and goods transportation, residential and commercial buildings and industry. Catalysing actions that could bring early and particularly cost-effective reductions include vehicle emissions standards, strengthening building standards and industrial energy efficiency best practice.

- **Low Carbon Electricity** - phase out coal power and switch to low carbon electricity. Our research shows low carbon electricity can be supplied by renewable energy but alternatively it can be supplied by a mix of renewable energy and carbon capture and storage (CCS) or nuclear power at similar costs.

- **Electrification and fuel switching** – Increase electrification across transport, buildings and industry. As electricity generation switches to low carbon energy sources it becomes the least emissions intensive energy source. There are already many examples: electrical vehicles are with us, the first solar powered flight has been trialled and solar PV is powering many homes. In addition we need to switch from fossil fuels to bioenergy and gas for freight and commercial aircraft.

- **Non-Energy Emissions** – reduce emissions from non-energy sources through process improvements and Carbon Capture Storage in industry, farm improvements and increase carbon forestry to offset remaining emissions.

**Setting a long-term target increases the cost-effectiveness of shorter term action.**

A long-term target helps businesses understand the opportunities that will arise and the obligations they will face. Setting a clear policy signal allows governments and businesses to make sensible investment decisions - to avoid lock-in of high emissions or stranded assets. And a low emissions strategy with a clear long-term goal of net zero by 2050, as requested under the Paris Agreement, will help governments and businesses put in place enabling actions for deep decarbonisation. Setting a long term target guides decisions, including investment, and reduces costs.

Policy uncertainty can also be a significant cost. For example, modelling for the Federal Government indicated that the impact of climate policy uncertainty on Australia’s real GDP could be around three times larger than the impact of international action to reduce emissions (McKibbin 2014).

**Delay is costly.**

Delaying a shift to the zero carbon economy can increase costs at the global (Stern 2006) and national level. ClimateWorks’ 2011 update to the Low Carbon Growth Plan shows that delay increases the cost of meeting national targets (ClimateWorks 2011b).

For example, the most cost effective opportunity to reduce emissions identified in the *Low Carbon Growth Plan* is an improvement to the fuel efficiency of new vehicles. When this is delayed, new cars will be purchased with lower fuel efficiency. Given that new cars will stay on the roads for 10 years on average, potential emissions savings from new, more efficient vehicles are lost in the absence of the regulation. In these cases extra emissions are locked-in, and finding this lost abatement potential elsewhere comes at a higher cost.
In the built environment, recent analysis by ClimateWorks Australia for ASBEC, presented in the *Low Carbon High Performance buildings* report identifies that just 5 years of delay would lead to $24 billion in lost energy savings for households and businesses to 2030 and the cumulative loss of 176 MtCO2e reduction opportunities. A further five years of delay would lead to the loss of an additional 221 MtCO2e (bringing the total loss to 397 MtCO2e) of emissions reductions.

The opportunities that are lost are primarily those relating to the construction of new buildings (which exist for many decades) and installation of long-lived equipment such as hot water and heating, ventilation and air conditioning systems. Both of these are hard to retrofit in the short term, resulting in the lock-in of high emissions for decades.

**The transition to a zero carbon world is underway - Australia should catch up.**

The Paris Agreement signals the world will move towards a net zero carbon future and that this is inevitable and irreversible. Many countries, including the United States, Canada, UK, Germany and Mexico have already put in place long-term targets and enabling policies to make substantial emissions reductions. Transitioning to a net zero carbon world is the new normal – Australia should make most of changes in the world economy as our trading partners shift to decarbonise their economies. This change is happening at all levels, including cities and regions and our future economic prosperity will depend on our ability to keep up.

However, the world is not yet on track to meet the Paris Agreement – all countries, including Australia, need to take further action to reduce emissions. Australia requires new policies and government action to fulfil our obligations under the Agreement. This includes setting an overarching goal to reach net zero emissions by 2050.

*What are the issues in the transition to a lower emissions economy with respect to jobs, investment, trade competitiveness, households (including low income and vulnerable households) and regional Australia?*

**Australia has many cost-effective options to reach net zero emissions, which could create a new competitive advantage**

Australia is rich in renewable energy opportunities. The potential for generating energy from renewable resources in Australia is far greater than Australia’s total energy use today. (ClimateWorks 2014). The challenge for Australia is not the availability of renewable resources, but harnessing the potential it has. Australia also has technical potential for geological carbon storage with large storage basins across the country, including a number in close proximity to fossil fuel reserves and major industrial areas.

Australia has vast technical potential for carbon forestry and soil carbon, to mitigate residual emissions. We discuss this further in the section on land and agriculture. In summary research suggests that carbon plantings could profitably deliver significant carbon abatement between today and 2050, but it would also require many challenges to be overcome (Bryan et al. 2014). If the challenges were overcome, this could potentially enable Australia to become a net exporter of carbon offsets by 2050 (ClimateWorks 2014). Australia’s substantial potential for carbon forestry, bioenergy generation and bio-sequestration could also contribute to the economic revitalisation of regional and rural communities, biodiversity protection, and improved water quality. (Brodie et al., 2013)

In a decarbonised world, Australia’s abundant renewable energy resources as well as its geological storage potential could form the basis of a new comparative advantage in low carbon electricity generation, replacing the existing comparative advantage derived from fossil fuels. The realisation of this comparative advantage could eventually result in a revival of energy-intensive
manufacturing industries such as aluminum smelting, and the potential to develop renewable energy carriers for export markets, such as biogas or hydrogen.

Our work on deep decarbonisation pathways found that prerequisite for these opportunities is that major producing economies face strong carbon constraints, either through their domestic frameworks or through import demand favoring products from zero or low carbon sources. International obligations under the Paris Agreement will create these carbon constraints.

Prospects for the extraction, refining and export of minerals such as non-ferrous metals and ores, uranium, lithium, and other precious metals are also good.

**Deep decarbonisation is affordable.**

The transition to a decarbonised economy will require investment in new low-carbon capital assets across the economy, particularly in transportation, electricity generation, industrial equipment, and buildings. In many instances this investment can reduce expenses such as fuel costs and reduce overall operating costs in the economy.

Our modeling results suggest that while the overall investment in electricity, road transport and energy efficiency in industry and buildings grows significantly over time, it remains fairly consistent throughout the pathway as a proportion of GDP. Investment levels vary by only 0.1% of GDP for each decade between 2012 and 2050, see Figure 1. Investment levels in those sectors in recent years is likely to have been about 0.3% or 0.4% of GDP lower. This is a very small variation when considering the overall level of investment in the economy, which in 2012 amounted to 27.1% of GDP.

Figure 1 - Average annual capital investment in electricity generation, road transport and energy efficiency in industry and buildings, $b (ClimateWorks & ANU 2014)

Investment levels vary significantly within sub-sectors - investment in energy efficiency and electricity generation increases strongly, while investment in road transport equipment grows at a smaller pace than GDP.

This relative decrease in road transport investment occurs despite investment in technologies such as electric and hybrid vehicles. A continued trend towards smaller vehicles, increased urban density driving some shift to public transport and telecommuting, as well as operational improvements in road freight leading to increased vehicle utilization drives this decrease which also results in a significant reduction in fuel use.

The increase in capital investment required for decarbonisation is strongest in the electricity generation sector. While the increase will be significant, experience shows that it can be achieved if the right financial incentives are in place. Larger increases in investment have been achieved in
the energy sector in Australia over shorter periods of time, see Figure 2. Indeed from 2009 to 2013 investment in oil and gas extraction increased from 0.5% of GDP to 3.4% from the development of several major Liquefied Natural Gas (LNG) projects.

Figure 2 - Average annual capital investment modelled in Deep Decarbonisation Pathways Projects scenarios compared to current value of completed generation projects (ClimateWorks & ANU 2014)

Decarbonisation has the potential to reduce energy bills for householders.

By undertaking ambitious energy efficiency while decarbonising energy use in residential buildings and personal transport, the Australian DDP finds that substantial emissions reductions can be achieved while also reducing the net cost of energy for households.

As a result of energy efficiency the costs of energy and transport for households could be reduced by 13% per household, despite increased capital costs and electricity prices, see Figure 4. As income is expected to increase by over 50 percent over this period, this reduction in costs would represent a near halving in the energy and transport spend as a proportion of household income (this assumes household income increases in line with GDP per household).

Figure 4 - Average annual energy and personal transport costs per household, 2012 A$ (ClimateWorks & ANU 2014)

For homes, significant energy savings are available in residential buildings. This will offset the expected increase in the unit costs of electricity from a decarbonized electricity sector. The
emissions reductions can therefore be achieved without increasing the costs of energy as a proportion of income per household. Our modelling results show that the cost of energy per household decreases by 22% even with an increase in unit costs of electricity. When the capital costs to improve the efficiency of buildings, appliances and equipment are considered, the overall costs to households increase by nearly 30%, although these energy costs fall by 17% as a proportion of income per household.

For cars, the Australian DDP projected that costs of owning and running vehicles can be reduced by 21% by employing more advanced efficient technology such as electric and plug in hybrid vehicles with an overall trend to shift to smaller vehicles. (ClimateWorks 2015)

This is consistent with recent CSIRO and ENA modelling for their Electricity Network Transformation Roadmap project, which found that electricity bills in 2050 would be lower for householders under a decarbonised electricity system than under a counterfactual scenario.

Figure 5 - Residential bill outcomes for selected Australian household types in 2050 under the counterfactual and Roadmap scenarios (CSIRO & ENA, 2017)

Australian incomes can continue to rise and jobs can continue to grow while reaching net zero by 2050

Additional analysis of the Australian Deep Decarbonisation Pathway showed employment (measured in hours worked) would increase by over 28% and real wages increase by just under 13% by 2030, as the economy transitions towards net-zero emissions by 2050 (analysis by ClimateWorks for WWF 2015).

This analysis shows that some sectors contribute less to our economy but this is offset by growth in others, such as renewable electricity generation. Twice as many jobs in renewable electricity generation are created than are lost from the coal-fired electricity generation sector.

Shifting to a net zero carbon economy will create significant opportunities for new jobs are likely to be created through decarbonisation. Global Green Growth Institute found that investment in clean energy creates more jobs than investment in fossil fuel industries (UNIDO and GGGI, 2015). Estimates published under the International Energy Agency suggest investment in energy efficiency creates high levels of job creation (Ryan, L, & Campbell, N, 2012).
There are also opportunities to transition technologies within industries, to ensure jobs continuation (such as switching from fossil-based fuels to biofuels in the transport industry) as well as the potential for whole new industries capable of retraining workers formerly engaged in carbon-intensive roles. For example, there are emerging industries in the energy efficiency space, ranging from a need for retrofitting expertise to the design, building, installation and service of efficiency technologies.

The Low Carbon Growth Plan for Greater Geelong presents opportunities for the regional centre to move towards a net zero carbon economy (ClimateWorks 2011a). In addition to delivering a plan for significant emissions reductions, the plan also identifies over $1 billion in investments in the local economy around cleaner local power generation, energy efficiency building retrofits and improvements to the energy efficiency of industrial infrastructure.

**What process could Australia use to implement its Paris commitment to review targets every five years?**

**Five yearly targets should be based on a long-term pathway to net zero.**

It is more cost-effective to set targets with a long-term target in mind.

The review of targets should be based on independent advice and based on a carbon budget. Table 1 outlines the different ways in which countries and Australian states have chosen to set their targets.

**Table 1 Approaches to target setting (prepared by The Climate Institute - ClimateWorks TCI 2016)**

<table>
<thead>
<tr>
<th>Approach</th>
<th>Description</th>
<th>Examples</th>
<th>Strength</th>
<th>Weakness</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point targets</td>
<td>Define an indicative national long-term emission trajectory or target based on a 2050 target. This 2050 target is set based on the objectives of international agreements.</td>
<td>Nation states: EU, Japan, Jordan, Liechtenstein, Monaco, Norway, South Korea, South Africa, Switzerland, USA Under 2 MoU Within Australia, the ACT, South Australia and Victoria have broadly taken this approach</td>
<td>Provides a signal (often long term) to guide investment decisions on emitting activities as the desired end point is known. Politically more palatable as equitable contribution to global action is not transparently defined.</td>
<td>Less scientifically robust when not strongly linked to the global carbon budget. Potentially allows for emissions over time to be inconsistent with broader climate goals and global carbon budgets.</td>
<td>Many of these targets are based on limiting warming to &lt;2°C. Some countries are now re-examining their long-term targets in light of the Paris Agreement e.g. Canada, Norway, UK, USA External stakeholders can be able to assess the carbon budget implications of this choice by examining the emissions pathway it implies.</td>
</tr>
<tr>
<td>Carbon budgets</td>
<td>Define the total allowable cumulative emissions over a long-term period based on a judgement of an equitable contribution to a global carbon budget. In other words, calculate the total amount of emissions that can be ‘spent’ over the long term. Scientists and climate policy groups generally support this approach.(^1) Based on a global carbon budget consistent with the objectives of international agreements.</td>
<td>The Climate Change Authority’s 2013-2050 carbon budget for Australia of 10 billion t CO2e for staying below 2 C. More scientifically robust as limiting long-term cumulative emissions is a strong indicator of respecting an agreed global temperature limit (or other goal). Provides a strong link between short-term emissions and longer-term climate goals, i.e. provides a frame against which to assess the adequacy of short-term targets and ensure that they don’t prohibit the achievement of the long-term goal. Provides a clearer longer-term investment signal to guide investment decisions on emitting activities.</td>
<td>Politically more difficult. Defining a national carbon budget based on a global budget requires an explicit analysis of how emissions are allocated across countries and generations. This requires policy makers to make judgements about the needs of future generations and the impact on people in other countries. These judgements may be viewed very differently in the domestic and international contexts. Potential to lock in a suboptimal climate change outcome if the budget is not set with regard to credible temperature goals. However this point applies to any approach adopted if low-ambition options are enshrined. To guide policy, the long-term budget can be broken down into smaller budgets for specific periods of time (particularly in the near term) or sectors. e.g. South Africa and the UK.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Per capita targets

| Define a per capita benchmark (e.g. 1t CO2/person) consistent with the objectives of international agreements and translate to overall emissions reduction target |
| Nation states: Albania, Bangladesh, Barbados, Cambodia, Central African Republic, Colombia, Ethiopia, Israel, Jamaica, Kyrgyz Republic, Nigeria, Solomon Islands Under 2 MoU |
| Based on transparent assessment of equity considerations. Total per capita emissions of the most common metric used to measure the fairness of climate change action. Provides a clearer signal to guide investment decisions on emitting activities as the desired end point is known. |
| See Point Targets above. |
| These targets are based on a mix of assumptions around limiting warming to 1.5 C or <2 C |


**Interim targets and policy strategies should recognise the need to increase climate action ambition in the future**

To ensure it can increase its ambition in the future in line with the well below 2 degrees climate goal, the Government should make sure that its interim emissions reduction targets are sufficient to get started on the transition to deep decarbonisation:

- **Accelerate action now to reduce emissions** - Business and Government have to accelerate the implementation of energy efficiency and other profitable opportunities. This reduces long term costs and provides greater options for achieving zero net emissions.

- **Avoid lock in of emissions intensive technologies** - Take the long-term into account for investment decisions to avoid lock-in of carbon intensive assets and long-lived assets such as buildings, industrial plant and infrastructure.

- **Prepare for the future:**
  - policy settings and other government interventions needed now to prepare for deeper decarbonisation beyond Australia’s first NDC
  - Accelerate investment in research and development of technology that will be needed in the future to make deeper emissions reductions
Examples of government action needed under the three categories are presented below.

**Implications for investors:** assess asset readiness for a decarbonised world; identify growth sectors

**Key success factors to enable deep decarbonisation**

- **Accelerate action now to reduce emissions**
  - Implement profitable opportunities e.g. energy efficiency
  - Will reduce the cost of action and provide flexibility in future

- **Avoid lock in of emissions intensive technologies**
  - Provide clear long-term signals to inform investment decisions
  - Ensure new assets are compatible with the long-term pathway

- **Prepare for the future**
  - Invest in R&D to fill technology gaps and reduce costs
  - Build the supply chains, skills and capabilities
  - Develop country, region and sector pathways to help transition

**Implication for government**

- Incentives for early action
- Increased 2030 target
- Standards on vehicles, buildings, new developments
- 2050 emissions reductions target
- R&D and pilot programs
- Support pathways development

Different policy approaches will be needed depending on degree of certainty.

The government will need to make sure that its intermediary emissions reduction targets don’t result in closing the door to technologies or activities which will be required for a transition to net zero emissions by mid-century. This will require a flexible approach to policy development, especially in sectors where significant uncertainty exists as to which technology will be the best option to achieve net zero emissions at lowest cost.
Australia should choose to focus its short and medium term action in line with a goal of achieving net emissions by 2050

ClimateWorks’ data suggests that there is more than enough abatement available domestically to achieve the 2030 emissions reduction target. Figure 6 illustrates the total technical potential compared to the size of the task at hand. Please note that the analysis has not been updated to reflect the recent change in government emissions projections (which will affect the economic assumptions underlying the modelling, reducing the frozen baseline and the abatement in the related sectors), and the lost abatement from the delay accumulated since 2014.

Figure 6 - Australia’s emissions projections to 2030 and the government emissions reduction target compared to the technical emissions reduction potential
As shown in Table 2, abatement will need to increase significantly between 2030 and 2050 in certain sectors-technologies. Choosing which actions to prioritise by 2030 should include considerations of what abatement will be lost if not captured in the short term, what actions are best to be undertaken in parallel and what actions will need to be started today so they can be accelerated at scale in the future. For example,

Table 2 - Technical abatement potential by sector and technology

<table>
<thead>
<tr>
<th>Sector (MtCO₂e abatement in 2030)</th>
<th>Technologies</th>
<th>Abatement by technology (MtCO₂e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity (137)</td>
<td>Solar PV and solar thermal</td>
<td>101</td>
</tr>
<tr>
<td></td>
<td>Wind and other renewables</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Improvement in fossil fuel generation</td>
<td>13</td>
</tr>
<tr>
<td>Agriculture &amp; Forestry (111)</td>
<td>Afforestation and avoided deforestation</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>Best practice agriculture</td>
<td>29</td>
</tr>
<tr>
<td>Transport (72)</td>
<td>Energy efficiency in new passenger and freight vehicles</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>Increased uptake of Evs, PIHs, FCVs</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Switch to gas and bioenergy for freight transport</td>
<td>12</td>
</tr>
<tr>
<td>Industry (71)</td>
<td>Energy efficiency of industrial practices, assets and equipment</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Electrification of for industrial equipment and processes</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Switch to cleaner fuels</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Develop CCS and implement best practice to reduce industrial process and fugitive emissions emissions (oil &amp; gas, metals, cement, refrigerants)</td>
<td>8</td>
</tr>
<tr>
<td>Buildings (39)</td>
<td>Energy efficiency in new builds, retrofits, appliances and equipment</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Electrification of building equipment</td>
<td>3</td>
</tr>
<tr>
<td>Totals (includes other small categories)</td>
<td></td>
<td>430</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1199</td>
</tr>
</tbody>
</table>
Electricity Sector

What are the opportunities and challenges of reducing emissions from the electricity sector? Are there any implications for policy?

The electricity sector has a key role to play in achieving deep decarbonisation

The electricity sector underpins emissions reductions across the economy. Taking the carbon out of electricity is the backbone of a decarbonisation strategy for Australia, and will be easier than in many other countries that lack Australia’s plentiful potential for renewable energy.

Our modelling shows that in order for Australia to be able to achieve deep decarbonisation, low carbon electricity will need to become the largest fuel source in the Australian economy. Electricity’s share of final energy use would increase from 22% today to 46% by 2050. As can be seen in Table 2, low carbon electricity combined with electrification is expected to contribute 38% of total abatement potential by 2030, and 31% by 2050.

Decarbonisation of the electricity system can be achieved while reducing overall system costs

The DDPP research, provides least-cost, plausible projections for electricity generation that almost completely decarbonise the electricity system by 2050. Decarbonisation of the electricity sector, was modelled in three different scenarios - 100% renewables, renewables and CCS, and renewables and nuclear:

- All scenarios achieve around 50-70% emissions reduction by 2030 on 2012 levels.
- All scenarios include a dominant share of renewables, driven by the decrease in cost of renewable technologies, such as solar and wind, over recent years with a minimum penetration of 48% by 2030 and 71% by 2050. They are expected to be the lowest-cost technologies to achieve decarbonisation until their penetration requires significant additional costs for the management of variability.
- Even when associated with CCS, the role of coal is expected to be very limited in decarbonising the electricity sector.
- Gas can play a supporting role to renewables, but this role is expected to be limited.

Figure 7 - Generation for three electricity scenarios, TWh

![Figure 7 - Generation for three electricity scenarios, TWh](image-url)
Recent CSIRO modelling (using the same model as the *Pathways to Deep Decarbonisation*) calculated overall system cost in a net zero emissions scenario compared to a counterfactual scenario and found that it would be about $100b lower to 2050, or about 10% lower (see Figure 8)

Figure 8 - Cumulative electricity system total expenditure to 2050 (in real terms) under the Roadmap and counterfactual scenarios

To unlock the emissions reduction potential in the electricity sector, significant policy and regulatory change will be required

There is disruptive change already happening through the roll out of new technologies such as energy storage systems including solar thermal, batteries integrated with renewables at the small or large scale, grid scale storage (e.g. pumped hydro and large scale batteries); frequency control and other ancillary services from non-traditional sources e.g. the management of use of electric vehicles to provide storage.

The policies governing the electricity system – market and infrastructure – must respond to these changes to ensure that the necessary emissions reductions are matched with reliability and affordability. Variable supply from increasing renewables will need to be supported by flexible demand management as well as battery and other forms of storage.

Government should update regulation and policies in the energy market to support innovative technologies and make the most of the additional services that these can bring. The Government should:

- Set a long term target for electricity sector emissions to drive short term decision making. The power of market momentum can better address the energy trilemma if there is clear signal of future intention and that the Paris Agreement requires net zero emissions.
- Introduce a mechanism to ensure that all new generation is compatible with the net zero emissions goal by 2050 in a cost-effective manner
- Make no further changes to the federal Renewable Energy Target and its use of tradeable renewable energy certificates before 2020
- Adjust energy market rules to facilitate the best use of distributed energy and storage and the additional services these can bring, as well as to enable demand management
- Support R&D and pilots for solar, batteries, demand management etc (e.g. through ARENA)
- Introduce policy to support the predictable, phased retirement of inefficient generators
Good policy increases business confidence and improves long-term planning. This will tend to increase notice about any closures of power plants and therefore the government’s ability to support communities in transition and to plan for a secure and appropriate energy system.

**How can energy and climate policy be better integrated, including the impact of state-based policies on achieving an effective national approach?**

It is not ideal for state regulation to intervene with a national system. However, in the absence of national policy to ensure effective transformation of the energy system and drive emissions reductions, states will be under pressure to take action themselves. States and territories are acting to reduce emissions, improve energy security for their business and households and to benefit from jobs and investment arising from the shift to renewable energy.

National or harmonised policy, that creates equivalent conditions across jurisdictions, is preferred.

**Are there particular concerns or opportunities with respect to jobs, investment, trade competitiveness, households and regional Australia that should be considered when reducing emissions in the electricity sector?**

**Australia’s energy system is highly emissions intensive**

According to the Intergovernmental Panel on Climate Change, a country’s average electricity emissions intensity needs to be between 0.05tCO2e/MWh and -0.03tCO2MW/h by 2050 (IPCC, 2014). For Australia, one of the countries with the highest electricity emissions intensity today, this means reducing emissions from the electricity sector by at least 94 per cent from today’s levels. If decarbonisation of the electricity sector was to happen in a straight line between today and 2050, emissions intensity in 2030 would need to be about 45% below 2005 levels.

Failure by Australia to act quickly to reduce its emissions could lead to a reduction in its international competitiveness in a decarbonising world.

**Energy efficiency and demand response can contribute significantly in creating a secure, affordable electricity system with low emissions**

In a deep decarbonisation scenario for households using electricity only, with strong energy efficiency, and taking into account a projected increase in average per capita incomes to 2050, the share of electricity expenditure in household income is halved on average.

Our modelling shows that Australia could halve the amount of final energy it uses per $ of GDP by 2050 through profitable energy efficiency improvements primarily across buildings, industry and transport sectors. This will significantly reduce the need for new electricity infrastructure, and help lower energy costs for end users.

- Our recent research for ASBEC in the Low Carbon, High Performance report, shows that as a whole, buildings can deliver over $20 billion in energy savings to 2030.
- Our research on industrial energy efficiency shows that many opportunities to improve energy efficiency remain untapped in that sector, even with paybacks lower than 2 years, due to a large number of impeding factors.

Greatly improved energy efficiency in all energy end-use sectors including passenger and goods transportation, through improved vehicle technologies, smart urban design, and optimized value chains; residential and commercial buildings, through improved end-use equipment, architectural design, building practices, and construction materials; and industry, through improved equipment, material efficiency and production processes, re-use of waste heat.
As previously mentioned, CSIRO modelling for the Electricity Network Transformation Roadmap (ENA and CSIRO, 2017) also shows that a net zero emissions electricity sector is achievable by 2050 whilst lowering total system cost and household bills in comparison to business-as-usual.

Our research also found that a significant untapped potential exists for Demand Side Response in Australia’s industry sector. Based on interviews with industrial companies, it was found that activities to reduce demand could amount to about 42% of the peak electricity load of industrial sectors (3.8 GW), which is equivalent to 10.5% of all grid-connected electricity demand during system peak.

**Substantial investment is needed, however the scale is not unprecedented and the age of our generators means that investment is essential irrespective of decarbonisation**

The transition will require a significant increase in capital investment in the electricity sector, however that increase is much lower than that which has been achieved in the past, with the right economic incentives in place. Our analysis shows that electricity generation investments would need to increase from about 0.2% of GDP today to about 0.9% of GDP at its peak in the 2030s (ClimateWorks & ANU 2014). While this is a significant increase, it is much lower than the recent increase in investment in gas production, which went from 0.5% to 3.4% of GDP in just 4 years. In addition, a large part of this investment would be required in any scenario, given that a large share of current generation capacity is expected to retire in the early to mid 2030s.

**New technologies should be integrated in an efficient way into the electricity system to lower business costs**

**Distributed generation and storage**

Businesses looking at rolling out new technologies nationally find that there are different approval processes and requirements across different networks. Network requirements differ across states and distribution networks within states (and even within networks), imposing costs on customers and delaying customers’ uptake of new technologies. ClimateWorks and Seed summarised our findings in a recently released consultation report (ClimateWorks and Seed, 2017) following discussions with stakeholders from the property sector, energy service providers, manufacturers and suppliers of equipment, and funders of renewable energy projects.

New institutional solutions could replace the current network-by-network process. These solutions should minimise delay and reduce up front and transaction costs of installation as far as is practical, while maintaining safety and security of the network. This would offer a substantial public benefit – installing embedded generation and storage can help Australia transform our energy system and reduce emissions. Harmonised requirements will make this easier, cheaper and more equitable.

We have identified some characteristics of an approach which can deliver on these objectives more so than the status quo:

- **Consistent national standard: rare exceptions**: A consistent, clear and transparent national connection standard would reduce the cost and market impacts of the current arrangements, provide benefits to customers and the economy, and unblock uptake of new technologies. State-based solutions offer easier steps forward, but do not fully address the issue - especially for businesses with a national footprint, and in relation to competition in the equipment market.
Minimum performance standards, set independently: Consistent technical standards for equipment would be best supported, as in other industries, by common standards supported by independent and cost effective testing with certification accepted across Australia.

Responsiveness to technological change: The development, adoption and revision of standards in the electricity sector would benefit from being revised to allow for more rapid turnaround times. Alternatively, the process could focus on establishing minimum requirements or performance-based requirements, rather than mandatory requirements. This would allow customers to benefit from innovative technological developments.

Electric vehicles

Electric vehicles are likely to be the last major load added into the NEM, and as a demand source they are relatively flexible and responsive to price signals. They have the potential to benefit the entire energy market, and substantially reduce transport emissions, but only if managed in a suitable manner.

For the energy market, electric vehicles need flexible regulatory arrangements, with dynamic pricing regimes, to maximise benefits and avoid the negative consequences of electric vehicle charging if not managed. Conversely, inflexible arrangements – such as controlled load mandates – impair the ownership experience and will place Australia at a competitive disadvantage relative to more EV-friendly economies.

According to the recent CSIRO and ENA Electricity Network Transformation Roadmap, uptake of electric vehicles, with appropriately managed charging, can deliver efficient capacity utilisation of electricity system assets. This growth in managed demand, which comes with lower than average ratio of peak demand, can deliver significant financial savings of up to $162, or an 8% decrease, in residential electricity bills for the net zero emissions electricity scenario compared to the counterfactual scenario in 2050.

Households, SMEs and the built environment

What are the opportunities and challenges of reducing emissions for households, SMEs and the built environment? Are there any implications for policy?

Are there particular concerns or opportunities with respect to jobs, investment, trade competitiveness and regional Australia that should be considered for households, SMEs and the built environment?

Energy efficiency can bring net cost benefits as well as substantial emissions reductions

Households, small & medium businesses and the built environment produce an important proportion of Australia’s emissions. And there are substantial opportunities to reduce emissions and provide co-benefits in this area. Buildings, whether for homes or businesses, are long lived assets. Decisions about their construction or renovation will affect performance over many years.

ClimateWorks research identified 39 MtCO2e of potential emissions reductions in the building sector (ClimateWorks 2014). The majority of these reductions are through improved energy efficiency in new buildings, retrofits, appliances and equipment.

ClimateWorks has since updated this work which now projects that cost-effective energy efficiency measures and switching to clean fuels can reduce projected emissions by around a quarter by 2030, Figure 9. Adding in distributed renewables bring potential emissions reductions
to two-thirds by 2030. These are projected to reduce emissions by around 80 MtCO2e in 2030 (ASBEC 2016). By 2050 the building sector can be net positive in terms of carbon emissions.

Figure 9 Emissions reductions in the building sector (ASBEC 2016 LCHP)

The research found that energy savings associated with these measures could deliver cumulative net financial savings of $20 billion to the households, businesses and governments that invest in them.

As shown in Figure 10, buildings could contribute up to one tenth of the government’s emissions reduction target through implementation of energy efficiency measures, and more than a quarter of the national emissions target with high levels of uptake of distributed energy.

In addition, buildings can contribute more than half of the national energy productivity target through NPV positive energy efficiency measures identified in the report.

Figure 10 - Contribution of buildings emissions reductions to Australia’s 2030 emissions reduction target (MtCO2e)

*This chart shows the lower end of the 2030 target, which is for a 26-28% reduction below 2006 levels. This equates to 77 to 57 MtCO2e emissions reductions. Source: ClimateWorks team analysis based on data from Department of Environment (2015a & 2015b)*
The full benefit of these opportunities will not be implemented under existing policy settings or likely government proposals for changes to the National Construction Code.

There are many existing options to reduce emissions from buildings, but government action is needed

Building energy efficiency can be improved through changes to design or materials used in building itself, use of improved appliances and equipment or through building management. Indeed, the technology already exists to achieve zero carbon buildings through improved design, more efficient materials and products and through on-site renewables. Gas use in buildings can be largely eliminated through a switch to electrical alternatives as appliances reach the end of their life and are replaced.

There are also major opportunities to reduce emissions through distributed renewable energy, particularly solar PV, on buildings. While this has considerable momentum for homes, deployment on commercial buildings is still slow. Battery storage increases the potential benefits of distributed renewables, as discussed in the section on the electricity sector.

However the building sector is subject to market failures due to issues such as asymmetrical information and split incentives. This may means that households and businesses fail to make use of opportunities even where there are positive cost benefits. Policy to encourage energy efficiency can unlock these opportunities, reduce energy costs and improve health and well-being. To unlock emissions reductions in the built environment sector, Government should:

- Provide clear long-term signals to inform investment decisions
- Ensure new buildings are compatible with the long-term pathway to net zero emissions
- Create enabling conditions and support for retrofits to existing buildings

To do so, Government interventions could include introducing or strengthening:

- Minimum standards for appliances & new buildings and a long term trajectory to guide updates to these standards. These long-term signals will provide existing businesses with the time to meet new standards cost-effectively and make the most of major opportunities in new goods and services.
- Energy performance reporting program at point of sale or lease
- Minimum performance requirement for buildings at renovation or extension
- Incentives for retrofits that improve energy efficiency (e.g. white certificates, grants, tax deductions)
- Providing consumer information and rewards for innovation/leadership (e.g. rating schemes, Government procurement standards)
- Government property upgrades
- Funding for low-income household retrofitting programs
- Ensuring that energy market reform supports the uptake of energy efficiency and renewable energy measures in buildings.

The National Energy Productivity Plan (NEPP) is a good mechanism for coordination of built environment, energy efficiency and renewables policy. The Energy Council could work to improve this role by: ensuring more regular public reporting; ensuring better coordination between portfolios and jurisdictions; and stronger public and industry communication and engagement.

ClimateWorks analysis supported the Australian Sustainable Built Environment Council (ASBEC) in developing proposed National Plan towards zero carbon buildings by 2050 that sets out a policy
Resources, manufacturing and waste

What are the opportunities and challenges of reducing emissions from the resource, manufacturing and waste sectors? Are there any implications for policy?

There are substantial cost-effective emissions reductions available in industry

Industry can achieve strong emissions reductions with known technologies through existing best practice in energy efficiency and low emissions processes. Industry has opportunities spread across five areas of improvement: energy efficiency of industrial practices, assets and equipment (including reuse of waste heat); material efficiency and production processes; electrification of industrial processes; switch to cleaner fuels; develop CCS and implement best practice to reduce industrial process and fugitive emissions (oil & gas, metal, cement, refrigerants).

Through energy efficiency alone, ClimateWorks found that industry has the potential to reduce the energy intensity of production by approximately 40% by 2050. In addition, there is a significant potential to shift from coal and oil use towards electricity, bioenergy and gas, which could drive a nearly two third reduction in energy emissions. Finally, non-energy emissions could be reduced by about 50%, resulting in a 60% reduction in total industry emissions. The modelling projected a small shift from manufacturing towards commercial services at the broad economic level.

Improvements in energy efficiency in manufacturing include reducing thermal losses from heating processes such as furnaces, kilns and boiler systems, or capturing waste heat to preheat materials,
reducing the fuel inputs required to perform other industrial processes (CWA & DRET 2013). Our work suggests that the emissions reduction from efficiency improvements can generate financial savings and reduce production costs for companies. The improvement modelled corresponds to maintaining the recent level of energy efficiency implementation for the next two decades, and accelerating it slightly to 2050 (CWA 2013c).

In mining, similar levels of energy efficiency are achieved. In the short term, energy savings are achieved through operational improvements such as changing the gradient of the slope upon which vehicles travel, reducing the amount of time vehicles stop and start and improving load management (CWA & DRET 2013). In the longer term, improvements in technology such as geological analysis and early ore and waste separation, or effective crushing and high pressure grinding rolls, can deliver significant additional savings (CWA 2010). Mining energy efficiency improvements are counterbalanced by a structural increase in energy intensity due to mines extracting more difficult resources.

**Government can unlock cost-effective emissions reductions in industry**

Although ClimateWorks has identified a broad range of cost-effective emissions reductions, many of these will not be brought forward under current policy. Our research on industrial energy efficiency shows that many opportunities remain untapped in that sector, even when payback periods are lower than 2 years, due to a large number of impeding factors (ClimateWorks 2013). These include constraints on capital, risk of disruptions to operations, competing business priorities and lack of information about the potential for improvement and the associated benefits. Policy that acts on these non-price barriers can therefore unlock economic benefits. Government intervention can therefore make sure that industry is making the most of opportunities that save money and emissions. Other opportunities may not create cost benefits for the investor or business itself, but may be the most cost effective way towards deep decarbonisation. Government action will be required to bring forward these emissions reductions.

Government interventions in the industrial sector include introducing or strengthening:

- Energy efficiency / low emissions technology loans (e.g. through the CEFC)
- Standards for new industrial assets and equipment
- Voluntary industry program (e.g. benchmarking, targets, skills/capacity)
- Research and development, including pilots, for improved processes and equipment
- Research and development and pilots for CCS in industry
- Set standards for new industrial assets, with a future pathway for improved standards
- Incentives for equipment and process upgrades (e.g. through the ERF, or alignment of states’ energy efficiency certificates)
- Support to identify and assess improvement opportunities
- Incentives or support to improve energy management capabilities in companies
- Establish Demand Side Response programs for industry participants to reduce peak electricity load; and
- Support accelerated uptake of the recommendations of the FSB’s Taskforce on Climate-Related Financial Disclosures.

The government could also implement initiatives to accelerate the uptake of the recommendations from the FSB’s Task Force on Climate-related Financial Disclosures, encouraging companies to develop and implement internal strategies in line with the Paris Agreement.
Are there particular concerns or opportunities with respect to jobs, investment, trade competitiveness, households and regional Australia that should be considered when reducing emissions in the industrial sector?

Improving energy efficiency performance can deliver significant cost benefits, minimise energy related risks and improve competitiveness for companies

Research based on company reported data to the former Energy Efficiency Opportunities program indicates that there is a large variation in the amount of energy savings implemented by industrial companies, with the top 20% implementing around four times more energy savings than the average, and the bottom 20% implementing on average 0%.

Similar trends were found to apply across different sectors and different levels of energy intensity. This suggests that internal company factors, such as energy management and strategic approaches to energy efficiency performance might have a large impact on energy efficiency uptake.

Analysing a sample of 50 typical large listed industrial companies in Australia, our research found that this gap in energy efficiency performance has a significant financial impact on companies:

- For around 72% of the sample of companies, energy costs are greater than 10% of the companies’ EBITDA
- In particular, Metals, Minerals and Transport sectors are very exposed to changes in energy costs, with energy costs on par or larger than their EBITDA on average
- Most exposed companies could increase their EBITDA by around 5% if they improved their energy performance to best practice
- Based on illustrative future energy price scenarios, 58% of companies in the sample were likely to be highly impacted by future energy price rises, with increases in energy expenditure equivalent to more than 3% of their EBITDA
- Improving the energy performance of the highly impacted companies could help alleviate the increase in energy costs by about half on average

This analysis was conducted in 2014, before the recent large increases in electricity and gas prices experienced by industrial companies, which means financial benefits would be even larger today.
Transport

What are the opportunities and challenges of reducing emissions in the transport sector? Are there particular concerns or opportunities with respect to jobs, investment, trade competitiveness, households and regional Australia associated with policies to reduce emissions in the transport sector?

Transport emissions are growing, but has some of most cost-effective opportunities

The transport sector is one of the fastest growing sources of emissions within Australia, increasing by 47.5 per cent between 1990 and 2012, however it also represents the most financially attractive emissions reduction opportunity across the Australian economy (ClimateWorks 2010). The sector’s emissions are still growing and have been projected to reach over 100 MtCO2e in 2020 (DoEE 2016), driven primarily by population and income growth for passenger travel and economic growth for freight transport.

The light vehicle and freight transport sectors provide the greatest energy efficiency potential across the economy out to 2030, and can be achieved using technologies readily available today. These represent some of the lowest cost opportunities across the economy, and can deliver significant co-benefits in terms of providing cost savings to consumers and businesses, and enhancing Australia’s fuel security.

Government interventions that can reduce emissions effectively in this sector include introducing or strengthening:
- Vehicle fuel efficiency standards (including fuel efficiency, noxious emissions and fuel quality)
- Government fleet upgrades (including public transport and outer agencies like Australia Post) to include a proportion of low emissions vehicles (including electric vehicles, plug-in hybrids and fuel cell vehicles)
- Electric Vehicle infrastructure investment, and
- Research and development and pilots for alternative technologies and advanced biofuels to encourage longer term prospects

Introducing light vehicle fuel efficiency standards saves money and reduces emissions

Australia is one of the few remaining developed countries without light vehicle CO2 emission standards in place, with standards covering over 80 per cent of the global automotive market (International Council on Clean Transportation 2015). In comparison to our global peers, Australia scores poorly in the energy efficiency of its land transport sector. Australia is ranked last out of 16 major OECD countries for the energy efficiency of our transport sector (American Council for an Energy-Efficient Economy International Scorecard 2014). Light vehicles represent a major opportunity for cost-effective emissions reductions because cars and light commercial vehicles contribute around two-thirds of the sector’s emissions (based on DoEE 2016).

Research conducted by a number of organisations, including ClimateWorks, RepuTex(2015) and Energetics (2016), shows that abatement in the light vehicle sector is the cheapest across the economy. Light vehicle fuel efficiency standards are a particularly cost-effective measure, with
recent work for Government calculating a net benefit of AUD$48-52 for every tCO2e abated (DIRD 2016).

Best practice light vehicle CO2 emissions standards and relevant complementary measures should be designed to maximise the range of positive outcomes - financial savings for vehicle owners, improved energy security, and least cost emissions reductions. These range of benefits means there are significant negative economic, social and environmental implications of implementing less stringent standards or delaying implementation of standards.

ClimateWorks joint submission (with Future Climate Australia and the International Council for Clean Transportation) to the Ministerial Forum concludes:

- The introduction of CO2 emissions standards can be achieved without immediately improving fuel quality.
- A short lead-time (less than two years) provides ample time to prepare for the introduction of the standard.
- A more stringent standard beyond the targets currently being considered is achievable and likely to provide greater net benefit due to technology advancements and cost reductions.
- There are significant implications of implementing less stringent standards or delaying implementation of standards from an economic, social and environmental perspective.
- Complementary measures are important to drive consumer uptake.
- Irrespective of the discrepancies between on-road and in-lab performance, a standard will still provide significant savings to consumers and the environment. Standards require an improvement against a baseline. On-road fuel testing may mean that the baseline and the standard reflect higher emissions per km than if laboratory testing were used. However, implementing standards will still require fuel use to be more efficient and create net energy and emissions savings.
- Australia is a ‘technology taker’ with an increasingly large proportion of our fleet sourced from markets with standards. Australia can therefore expect to have a more rapid rate of improvement than other jurisdictions that have introduced standards, such as the United States and Europe.

ClimateWorks supports the implementation of Target A (105 gCO2e/km) being considered by the Ministerial Forum on Vehicle Emissions. However, we recommend a more ambitious vehicle emissions target of 95 gCO2/km by 2025, because it will deliver greater net benefits and is technically feasible based on achievements in other markets. Analysis for the Forum shows that Target A provides the opportunity to deliver approximately over 6 per cent of Australia’s 2030 emissions reduction target at the lowest cost of abatement across the economy, whilst delivering AUD$13.9 billion to 2040 in net benefits (2016). This target provides greater emissions reductions (41 MtCO2e more than Target C by 2030) and financial net benefits (including $6.7m more fuel savings to 2030 than Target C). Introducing a target of 105 gCO2e/km, or a stronger, would create significant benefits as Australia looks to achieve its emissions reduction objectives at least cost, while reducing cost of living expenses to Australian households and operating costs to Australian businesses.

As is the case in the buildings sector, delay in implementation of standards is costly. Any delay results in emissions and fuel use lock-in. Delaying the introduction of Target A by two years would result in the loss of over 17 MtCO2e of emissions reductions by 2030 due to an additional 2.2 million vehicles being sold without a standard in place. This reduces the potential by which vehicle emissions standards can contribute emissions reductions and the potential fuel savings these
vehicles will have over their lifetime. Given that the costs savings from more efficient vehicles are substantial, delay also brings financial impacts - new light vehicle owners would face an additional AUD$4.9 billion in cumulative fuel costs to 2030. With vehicle fuel costs in the order of two-thirds total household energy costs (Australian Bureau of Statistics 2012) the cost savings can represent a reduction of 7-10% of the household energy budget (CWA & FCA 2017).

ClimateWorks notes that deployment rates for new technologies and decreases in costs of technology often far exceed projections. The assessment of the net benefits from standards is therefore expected to be conservative: ‘in ex-ante estimates, production costs are often largely overestimated’ (BEUC 2013); ‘[under the EU’s light vehicle CO2 regulation] costs of deploying technologies for new vehicles have been lower than anticipated’ (Ricardo-AEA 2014); and ‘[progress towards the US light vehicle CO2 standards finds] a wider range of technologies exist for manufacturers to use to meet the MY [Model Year] 2022-2025 standards, and at costs that are similar or lower, than those projected in the 2012 rule’.

This is likely to be particularly true given the developments in zero emissions vehicles, particularly electric vehicles, have advanced significantly in recent years. The cost of electric vehicles has been falling faster than previous forecast and Bloomberg New Energy Finance estimated that they could reach parity with conventional internal combustion vehicles as early as 2025 (BNEF 2016), further reducing costs to achieve the standard.

**Complementary measures will support additional emissions reductions**

**Government procurement** could represent a major demand in the lower emission vehicle market, consequently developing supply chains and influencing the decisions of other fleet operators. Federal and State governments could also establish voluntary agreements or set binding targets on manufacturers or suppliers to increase model availability in Australia and contribute to the development of specific supply chains.

Fleet purchasing policies will be crucial to the support and uptake of low and zero emission vehicles. In 2015, approximately 46 per cent of new vehicle purchases in Australia were by fleets (FCAI 2015) with fleets typically turning vehicles over in three to five years. Fleet operators also generally have a good understanding of the total cost of ownership, duty cycle and are more understanding of issues stemming from the deployment of new technology. A high proportion of fleet purchases are novated or ‘user chooser’ leases where an individual nominates the make and model of car that they wish to obtain. Fleet managers, with their level of knowledge, can potentially be great advocates for efficient vehicles. (Wikstrom 2014).

**Consumer interest, especially for fleets, could be motivated by setting incentives for the purchase of fuel efficient and lower emissions vehicles including both financial and non-financial mechanisms.** Financial incentives could be in the form of annual (including tax rebates, registration and stamp duty reductions, parking fee deductions and vehicle emission taxes) or punctual incentives (including differential road tolls and pricing, free or reduced parking fees, higher fuel prices) (ClimateWorks 2016). Non-financial incentives can include benefits such as priority lanes and reserved parking spaces.

Other taxation policies measures include: exemption of low or zero emissions vehicles from Luxury Car Tax or the replacement of this scheme with an Emissions Tax for Luxury Vehicles; exemption of low or zero emissions vehicles from Fringe Benefits Tax (FBT) to account for their higher capital costs in the period through to their expected pricing parity with internal combustion engine vehicles; and consideration for the extension of the FBT exemption to novated leasing arrangements and beyond the sunset period for the business fleet vehicle exemption.
Government should support the development of infrastructure. The deployment of alternative fuelled vehicles requires the right infrastructure. Federal, state and local governments could utilise urban planning powers coupled with grant programs towards businesses to stimulate the installation of infrastructure dedicated to lower emissions vehicles.

Electric Vehicles can substantially reduce transport emissions

As mentioned in the discussion on the electricity sector, electric vehicles can provide major emissions reductions, especially for light vehicles. In our research, Passenger and Light Commercial Vehicle account for almost half of available emissions reductions in transport by 2050 (ClimateWorks & ANU 2014).

At present, the lack of policy and coordination across portfolios and jurisdictions is a major barrier. Implications of electric vehicles span across energy, industry, transport and infrastructure departments - and national and state jurisdictions. Government support, leadership and coordination in the short term is needed to increase model availability and coordinate infrastructure deployment. Implementation of strong Light Vehicle Standards, investment in electric vehicles as part of Government fleet upgrades and in charging infrastructure will help achieve efficiency gains in this sector, and drive electric vehicle uptake.

For the energy market, electric vehicles need flexible regulatory arrangements, with dynamic pricing regimes, to maximise benefits and avoid the negative consequences of electric vehicle charging if not managed.

Land and agriculture

What are the opportunities and challenges of reducing emissions from the land and agriculture sectors? Are there any implications for policy?

Are there particular concerns or opportunities with respect to jobs, investment, trade competitiveness, households and regional Australia associated with policies to reduce emissions in the land and agriculture sectors?

Australia’s potential for carbon offsets is substantial

Australia has abundant land available for carbon forestry and for increasing soil carbon levels, as discussed under the section on Australia’s cost-effective options for decarbonisation.

Australia has more arable land per capita than any other G20 country (based on data from The World Bank & FAO 2014). This represents a significant opportunity for a range of carbon forestry plantings that could offset residual emissions from electricity generation, industrial processes and agriculture. Modelling by CSIRO has found that carbon plantings could profitably deliver significant carbon abatement between today and 2050, dependent on the value of emissions reductions. Realising this potential significantly increases land sector incomes, but it also requires a number of challenges to be overcome, such as establishing supply chains, as well as supporting services and managing impacts on water availability and food production (Bryan et al. 2014).

There are significant opportunities across a range of land uses, particularly in avoided deforestation and afforestation, while carbon forestry offers profitable projections in the presence of price incentives. The abatement brought forward through the Emissions Reduction Fund also suggests that there is good potential for soil carbon in Australia.

Demand for carbon offsets can come from voluntary or mandatory obligations, and from either private or public sources. Current demand in Australia comes from Government purchasing.
through the Emissions Reduction Funds and voluntary action. Government contracts for purchasing offsets have accounted for the majority of the ERF allocated budget. This, combined with the absence of mandatory regulation linked to offsets, is creating uncertainty around the level of future demand. Australia has an established market and well-developed systems for ensuring carbon offsets are credible. The Government should ensure that this momentum is not lost.

If challenges are overcome and there is strong demand for emissions offsetting from other countries, Australia could establish itself as a net exporter of carbon offsets by 2050 (ClimateWorks 2014).

Australia also has good opportunity to reduce agricultural emissions, including through measures that can provide net cost benefits for farmers such as improved energy efficiency. There is opportunity for support of best practice farming techniques such as intensification of breeding and improving feeding and pasture practices for beef cattle, to reduce the production of methane.

The transition required in the land sector is significant, but there are large benefits

The land sector faces a number of challenges that require addressing, before the substantial potential in Australia can be unlocked. There can be long lag times before land carbon storage builds momentum, or for widespread adoption of new agricultural practices. In particular, it is necessary to:

- provide an policy platform that gives long-term confidence for investors, as well as developments in accounting to recognise this new asset class
- support rapid development of the required supply chains and labour force
- improve existing knowledge on the best species for each type of landscape and which provide good performance and stability over the long-term
- understand the actual risks related to water and bushfire management, so that appropriate mitigation plans can be developed
- assess social impacts and proactively manage potential challenges, and
- understand the strategies that are required to optimise the volume of abatement delivered (e.g. active management of forests).

The Government should bring forward enabling actions to unlock both current and future potential. Australia’s substantial potential for carbon forestry, bioenergy generation and bio-sequestration could also contribute to the economic revitalisation of regional and rural communities, biodiversity protection, and improved water quality (See for instance Eady et al. 2009; Stucley et al. 2012).

What can be done to realise further benefits from emissions reduction activities beyond carbon abatement?

The Government should take into account that well-designed carbon offsets can unlock multiple benefits beyond carbon sequestration - for biodiversity, farm productivity, and reductions in other pollutants and sediment loads in waterways. Policies include:

- Afforestation and avoided deforestation regulations and incentives (including through the ERF)
- Use of integrated approaches that connect sustainable development outcomes (eg. biodiversity, water, indigenous employment) and carbon offset markets e.g. through native vegetation planning rules
• Support for research and development including pilots for low emissions agricultural practices

Australia can build upon the work done internationally to integrate sustainable development outcomes in carbon offset markets. This should be integrated into framework of the UN Sustainable Development Goals. The work by the Gold Standard Foundation is a good example of how this can be achieved.
Research and development

What is the role of research, development, innovation and technology in reducing Australia’s emissions? Are there any implications for policy?

Are there particular concerns or opportunities with respect to jobs, investment, trade competitiveness, households and regional Australia that should be considered in relation to research, development, innovation and technology?

Government has a role to play to support emerging low carbon technologies at all stages of development

Countries around the world are already transforming their economies – if Australia doesn’t evolve to a low carbon economy then it will be left behind. Many of the technologies required for decarbonisation are available or under development, however further efforts in commercialisation, enhancement and integration will improve cost competitiveness and performance. Government support can assist our economy to develop and grow in the new technologies and services.

The rate of development of low emissions technologies has progressed rapidly in recent years, with some technologies now mature in Australia. These technologies can offer cost savings without any support measures. Solar PV systems are one example where costs have declined rapidly and are now mature. Battery storage is on a similar cost path, but not yet cost-comparable. Others would require further development to improve performance or reduce costs.

In particular, government can help accelerate the learning rate associated to new technologies to accelerate associated cost reductions and bring forward the “tipping point” at which technologies become cost competitive with incumbents. This is necessary to enable the rates of decarbonisation needed to achieve the Paris climate agreement.

It is worth noting that, even when technologies are the same price as or cheaper than other more highly emitting technologies, they may still not be widely deployed. This may be due to the advantage of incumbency for the existing technology, or other non-price barriers. While these technologies do not require research and development support, encouraging their deployment may still need government intervention to (such as regulation or incentives).
Where technologies are not yet mature, pilot projects will demonstrate the potential of the technology to be deployed at a large scale. Deployment allows continuous improvement through “learning by doing” in the manufacturing, supply and operation of the technology. Government can help to prepare for the future, it should:

- Invest in R&D to fill technology gaps and reduce costs
  - run pilot programs to understand key barriers/drivers etc in early years
  - Invest or incentivise the enabling infrastructure required (e.g., EV charging network, intermittency management technologies, carbon forestry supply chain).
- Build the supply chains, skills and capabilities.
- Develop national and sector pathways to help transition.

See table below (from Figure 22 ClimateWorks & ANU 2014).

<table>
<thead>
<tr>
<th>Element of pathway (implementation / improvement modelled)</th>
<th>Current technology status</th>
<th>Improvement required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewables (70% to 90% of generation by 2060)</td>
<td>Variable (wind, solar P/V, wave)</td>
<td>Renewable provided 14.8% of Australia’s electricity, 20% of Danish electricity in 2010. 2 geothermal &amp; wave energy plants operating in Australia. On Kang Island, batteries allow a renewable penetration of over 50%.</td>
</tr>
<tr>
<td>Nuclear (up to 27% generation from nuclear, 11% from gas, remaining renewables)</td>
<td>Baseload (geothermal, solar thermal and storage)</td>
<td>388 GW installed worldwide. 75% generation in France is from nuclear.</td>
</tr>
<tr>
<td>Coal or gas with CCS (up to 21% with CCS, 9% gas, remaining renewables)</td>
<td></td>
<td>First CCS coal power plant expected to start operating in 2014 in Canada.</td>
</tr>
</tbody>
</table>

- Energy efficiency (~7% for cars, 20%-33% for other modes)
  - Electric vehicles & plug-in hybrids (~35% car/CVs by 2050 each)
  - Energy efficiency (~0.1% improvement p.a.)

- Fuel shift to gas and biofuels (~7% for road freight and 50% biofuels for air transport by 2050)
- Bioenergy production (additional 1050 TJ primary energy per year)

- Energy efficiency (1.0% to 1.2% improvement p.a.)
- Fuel shift (Electricity share ~30%, bioenergy ~50% in mining and 55% in manufacturing, coal to gas)
- CCS (50%-70% capture of non-CO2 emissions in sectors)

- Mitigation of highly potent GWP (90% reduction in 2050, very strong reduction in methane)

- Productivity substitution (shift to nature renegades, increases clinic substitution, 50% bio-oil in iron & steel)

- Efficiency of central buildings services (50% to 50% improvement in most technologies)
- Efficiency of appliances and equipment (~50% improvement in energy intensity)
- Electrification of energy use (~full electrification of buildings)

International units

What is the potential role of credible international units in meeting Australia’s emissions targets? Are there any implications for policy?

Australia can and should do as much domestically as possible.

- Our research shows we can achieve deep decarbonisation in Australia alongside economic growth.
- Achieving decarbonisation domestically will deliver a range of benefits - improved competitiveness for businesses from reduced energy costs, modernisation of our energy system, improved productivity, better resilience to future energy price rises, energy security, jobs creation, and improved air quality.
- To meet commitments under the Paris Agreement, we know developed countries need to get to net zero around 2050, and that all countries will have to decarbonise. This means that in the coming decades there may not be any international offsets left. As a consequence, delayed action means that the trajectory towards zero will need to be steeper later. This will come at great economic cost. It will then require early retirement of emissions intensive assets and higher cost improvements as much of the low cost potential would have been lost to delay.
References

Australian Sustainable Built Environment Council (ASBEC) 2016 Low Carbon, High Performance: How buildings can make a major contribution to Australia’s emissions and productivity goals, Sydney, NSW


ClimateWorks Australia, 2011a, Low Carbon Growth Plan for Greater Geelong, Melbourne Australia

ClimateWorks 2011b, Low Carbon Growth Plan for Australia: Impact of the carbon price package revised edition, Melbourne, Australia

ClimateWorks Australia, 2012a, How to Make the Most of Demand Management, Melbourne Australia

ClimateWorks Australia, 2013, Tracking Progress Towards a Low Carbon Economy, Melbourne Australia (National progress report, 4 sectoral reports and summaries, Special report on factors influencing large industrial energy efficiency, Supplementary analysis: electricity scenarios)

ClimateWorks Australia (CWA) and Department of Resources, Energy and Tourism (DRET), 2013, Industrial Energy Efficiency Data Analysis Project: Detailed project results. Melbourne, Australia

ClimateWorks Australia, 2014a, Industrial demand side response potential, Melbourne Australia

ClimateWorks Australia, 2014b, Energy management and company competitiveness, Melbourne Australia

ClimateWorks Australia & Australian National University, 2014, Pathways to deep decarbonisation in 2050: How Australia can prosper in a low carbon world, Initial project report, Melbourne Australia

Department of Infrastructure and Regional Development (DIRD) 2016 Improving the efficiency of new light vehicles Draft Regulation Impact Statement Canberra ACT

Eady, S, Grundy, M, Battaglia, M & Keating, B 2009, An Analysis of Greenhouse Gas Mitigation and Carbon Sequestration Opportunities from Rural Land Use. CSIRO, St Lucia, Queensland.


ClimateWorks Australia is an expert, independent adviser, committed to helping Australia transition to net zero emissions by 2050. It was co-founded through a partnership between Monash University and The Myer Foundation and works within the Monash Sustainable Development Institute.