

REPORT

JULY 2017

Power Up

Australia's electricity sector can
and should do more to deliver
on our climate commitments



ClimateWorks
AUSTRALIA

About us

ClimateWorks Australia is an expert, independent adviser, acting as a bridge between research and action to enable new approaches and solutions that accelerate Australia's transition to net zero emissions by 2050. It was co-founded in 2009 by The Myer Foundation and Monash University and works within the Monash Sustainable Development Institute.

Since launch, ClimateWorks has made significant progress, engaging key decision makers from all tiers and sides of politics and business. Their collaborative, end-to-end approach to solutions that will deliver greatest impact is informed by a thorough understanding of the constraints of governments and the practical needs of business. This, combined with philanthropic funding and university ties, has earned the organisation an outstanding reputation as a genuine and impartial adviser.

In the pursuit of its mission, ClimateWorks looks for innovative opportunities to reduce emissions, analysing their potential then building an evidence-based case through a combination of robust analysis and research, and clear and targeted engagement. They support decision makers with tailored information and the tools they need, as well as work with key stakeholders to remove obstacles and help facilitate conditions that encourage and support Australia's transition to a prosperous, net zero emissions future.

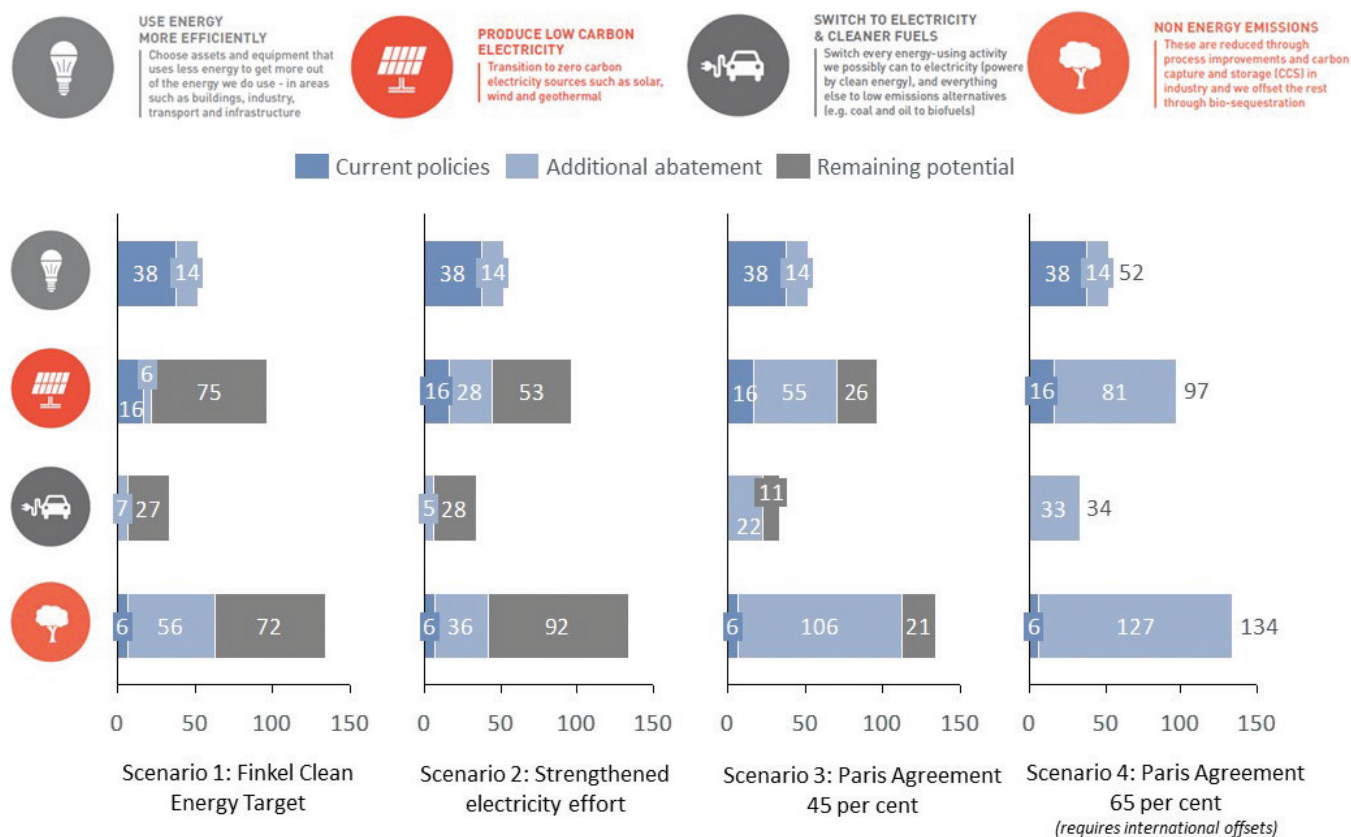
Executive Summary

Australia's Chief Scientist, Professor Alan Finkel, recently completed the *Independent Review into the Future Security of the National Electricity Market*. The Review identified a range of recommendations in order to deliver on four key outcomes for the National Electricity Market: increased security, future reliability, rewarding consumers, and lower emissions. It also highlighted that "(a)ll governments need to agree to an emissions reduction trajectory to give the electricity sector clarity about how we will meet our international commitments."

As a signatory to the Paris Agreement, Australia has committed to global action to limit global warming to well below 2 degrees, aiming for 1.5 degrees. For a developed economy such as Australia, this means we must reach net zero emissions by or before 2050 (based on analysis for the Intergovernmental Panel on Climate Change including Höhne et al 2014). ClimateWorks Australia's earlier research, the *Pathways to Deep Decarbonisation in 2050*, undertaken in partnership with Australian National University (ANU), has shown that we can reach net zero emissions by 2050 in parallel with continued economic growth.

In this report ClimateWorks has modelled four scenarios with differing levels of emissions reductions undertaken in the electricity sector, and the implications this has for the level of effort required across other sectors to meet our current target, and targets in line with achieving net zero emissions by 2050. Using the 4 Pillars of Decarbonisation (energy efficiency, low carbon electricity, fuel switch & electrification and non-energy emissions), we are able to identify the implications of the various levels of effort in the electricity sector for other pillars and sectors.

Figure 1: Expected abatement under four electricity sector scenarios in 2030 by decarbonisation pillar (MtCO₂e).



Whilst Australia currently has a 2030 emissions reduction target of 26-28 per cent below 2005 levels, our analysis shows that with current policy in place, there is still a minimum gap of 82 MtCO₂e of abatement required to meet this target. On top of this, it is anticipated that this target may need to increase over time in order for us to meet our commitments under the Paris Agreement; the Climate Change Authority recommends a 2030 target of between 45-65 per cent on 2005 levels for Australia to contribute its equitable share to limit global warming to 2 degrees.

We know that the electricity sector is well placed to deliver emissions reductions across Australia's economy, and ensure that we can deliver on our Paris commitments at lowest cost and in an orderly manner. ClimateWorks' research, as well as research by others, has shown that the electricity sector plays a key role in achieving net zero emissions, and the technical potential exists today to decarbonise the electricity sector by 2050. In addition, research by others, such as the ENA and CSIRO, has shown that achieving a net zero emissions electricity sector by 2050 can cost less than 'business as usual'.

This analysis reveals the following key findings:

The demand side is important: In order to meet any of the targets at lowest cost, Australia's 2030 energy efficiency technical potential needs to be met. This requires an additional effort to unlock a further 14 MtCO₂e of abatement, or another third beyond current expectations from the National Energy Productivity Plan.

The electricity sector needs to deliver more than its proportionate share: If the electricity sector were to only deliver a proportionate amount of abatement under Australia's existing 2030 target as modelled under the Finkel Review, this would leave a gap of 77 MtCO₂e abatement to be delivered by other sectors. In addition to the full potential of energy efficiency, this would require an additional 62 MtCO₂e of abatement from fuel switching, electrification and non-energy emissions in the buildings, transport, industry, waste and land sectors. This corresponds to achieving about 40 per cent of the full technical potential in those areas. For example, the increased level of afforestation modelled beyond current policy corresponds to 36 MtCO₂e by 2030, or over 3 times the amount estimated to be delivered by afforestation through the ERF in 2018.

The electricity sector can do more: Our research, along with research by others, has shown that the electricity sector is well placed to deliver emissions reductions well beyond a proportionate share of the 2030 target. The sector can reduce emissions whilst still delivering on the affordability and reliability requirements of the energy trilemma. If the electricity sector were to achieve just under half of its technical abatement potential, this would reduce the abatement required by the other sectors by 22 MtCO₂e given our current 2030 target. This means less abatement from the more costly sectors throughout the economy. The technical potential exists to reduce emissions in the electricity sector by over 60 per cent below 2005 levels by 2030. This potential would allow Australia to achieve its current 2030 target without additional action in other sectors.

To deliver net zero emissions by 2050, the electricity sector must be well on its way to decarbonisation by 2030: Our analysis shows that in order to meet a 2030 emissions reduction target in line with the Climate Change Authority's recommended targets to meet our carbon budget, emissions reductions in the electricity sector need to be between approximately 45-60 per cent below 2005 levels. The technical potential exists to achieve this level of abatement. This in turn unlocks the substantial amounts of abatement through electrification in buildings, transport and industry, which are key to meeting our net zero goal.

Key recommendations for policy makers

In summary, this analysis shows further policy is required to deliver on Australia's current 2030 target under any scenario, but even more ambition is needed if we are to deliver on a 2030 target that is aligned with delivering on the Paris Agreement. ClimateWorks has developed the following net zero emissions climate policy principles which policy makers and decision makers can use to guide policy making for the electricity sector, and we have provided a range of recommendations for the electricity sector under these.

Principle 1: Australia's Climate policy should contribute a fair share to global action

- The Commonwealth Government should build on state policy and aspirations by announcing a national goal of net zero emissions by 2050.

Principle 2: Climate policy should provide clear long term direction to support investment and decision making

- The Commonwealth Government should develop a net zero emissions strategy to show how Australia will meet this goal.
- Governments should set a goal of near zero emissions by 2050 for the electricity sector.

Principle 3: Climate policy should ensure that decision making to 2030 is compatible with reaching net zero emissions by 2050

- Governments should ensure that any policy making in the electricity sector is cognisant of the long term objective of net zero emissions by 2050.
- Governments should ensure that policy to meet objectives on reliability and affordability does not compromise the ability to reach net zero emissions by 2050.

Principle 4: Climate policy should be flexible so that it can scale to meet future targets and allow a range of solutions - known and novel

- The Commonwealth Government should establish a national policy mechanism to achieve emissions reductions in the electricity sector. This policy needs to ensure that it is flexible enough to allow for increased ambition from the sector in the future.
- Governments should consider how to take existing emissions intensive generation out, as well as bring new clean generation in.

Principle 5: Climate policy should ensure each sector plays an appropriate part in emissions reductions to create a least cost pathway to net zero emissions

- The COAG Energy Council should adopt the recommendation in the Finkel Review that the COAG Energy Council should set an emissions reduction trajectory for the electricity sector.
- Governments need to ensure that this policy enables the electricity sector to do more than its proportionate share of 2030 target. Governments should set emissions trajectory for the electricity sector that reaches near zero emissions by 2050, with a target of at least 45 per cent below 2005 levels by 2030.
- Governments should implement additional policy to drive energy efficiency and demand side response to ensure the transition can be made at lowest cost.

Principle 6: Climate policy should provide enabling conditions for uptake of emerging technologies to make the transition faster and cheaper

- Governments should work to implement the recommendations of the Finkel Review which support better regulation and management of new technologies.

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Strong policy for the electricity sector is integral to meeting the long term goal of reaching net zero emissions.

In this report ClimateWorks Australia focuses on how governments should respond to the *Independent Review into the Future Security of the National Electricity Market* lead by Australia's Chief Scientist, Professor Alan Finkel, in the context of key principles to make effective decisions on climate policy. This report builds on the analysis undertaken for the *Pathways to Deep Decarbonisation in 2050* report developed in partnership with Australian National University (ANU), and subsequent modelling to update that analysis. It aims to provide policy makers and decision makers with an overview of the implications of varying levels of emissions reductions in the electricity sector to meet the emission reductions required under our current and potential future climate targets.

Robust climate change policy will be key to ensuring that Australia's transition to a net zero emissions economy is achieved at lowest cost and in an orderly fashion. The importance of electricity emissions for Australia means that key principles for climate policy will also be crucial for electricity policy decisions.

Australia should commit to net zero emissions by 2050, and a corresponding target of near zero emissions for the electricity sector.

Australia has committed to the Paris Agreement that sets out collective global action to avoid dangerous climate change. Countries agreed to reach net zero emissions in the second half of this century, recognising that any net anthropogenic emissions are damaging. As part of the Agreement, countries committed to limit global warming to well-below 2°C and to aim to limit warming to 1.5°C. As an influential middle-power and the world's 15th largest emitter (WRI 2017), with a wealth of clean energy resources, Australia's actions to reduce emissions are important in the global context.

ClimateWorks Australia also supports the Climate Change Authority's recommendation of a carbon budget approach for Australia. The Authority calculated a budget for 2013-2050 based on Australia's fair share of action to the 2°C goal of 10.1 GtCO₂e. Under current emissions rates, the budget would require Australia to reach net zero before 2050. Given that the Paris Agreement targets well below 2°C, aiming for 1.5°C, this would mean that emissions in Australia need to decrease even more rapidly. A budget approach takes into account that the climate system is affected by cumulative emissions over time rather than emissions in any one year.

In this report, ClimateWorks Australia focuses on the electricity sector because this sector makes up such an important part of our emissions, accounting for around a third of total emissions. This context is behind our first policy principle, which sets out the test to determine whether policy is in line with achievement of the Paris Agreement.

Principle 1: Australia's Climate policy should contribute a fair share to global action

The Paris Agreement signed by 195 countries means Australia, and all developed economies, will need to undertake deep decarbonisation to reach net zero emissions around or before 2050.

Many Australian states have already pledged to reach net zero emissions by 2050. South Australia, Australian Capital Territory, Victoria, New South Wales, Tasmania and Queensland have set targets or goals of net zero emissions by 2050.

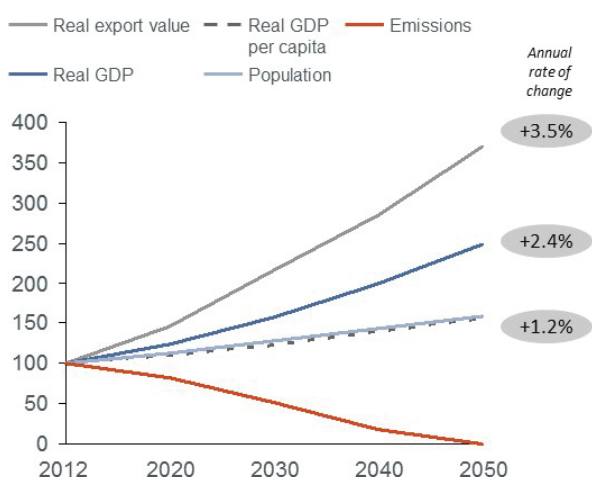
The Commonwealth Government should build on state policy and aspirations by announcing a national goal of net zero emissions by 2050.

Research by ClimateWorks Australia and ANU shows that decarbonisation of the electricity sector is a key element of reaching net zero emissions. Essentially this means shifting from coal and other fossil fuels to zero or near zero carbon energy sources such as renewables. Coal or gas will only be feasible if fitted with carbon capture and storage. According to the Intergovernmental Panel on Climate Change average electricity emissions intensity needs to be near zero emissions by 2050, to keep global warming below 2°C. For Australia, this means reducing emissions from the electricity sector by at least 94 per cent on today's level.

Our research shows Australia can reach net zero emissions by 2050, fulfil its Paris Agreement commitments, and grow the economy.

Our research, in partnership with ANU, shows that Australia can reach net zero emissions by 2050 and fulfil our commitments under the Paris Agreement - while growing the economy (ClimateWorks et al 2014).

Figure 2: Key economic indicators and emissions trajectory to 2050



Australia can reach net zero emissions by 2050 while growing the economy if we make best use of our clean energy resources. We can decarbonise our economy through acting on four pillars: energy efficiency, low carbon energy, fuel switch and non-energy emissions - including increasing land carbon storage. Government can and should harness the ingenuity and drive of businesses if it provides the right policy signals which would make the transition more cost effective. This underpins our second principle.

Principle 2: Climate policy should provide clear long term direction to support investment and decision making

Targets are signals of intent and future direction. Setting a long-term target helps businesses and investors understand opportunities that will arise and the obligations they will face. Targets play an important role in linking near-term decisions with longer-term timeframes and with global climate objectives. They allow governments and businesses to make sensible policy and investment decisions to avoid lock-in of high emissions and stranded assets. This reduces costs.

A net zero emissions target under a long-term plan will help identify policy, interventions and investment needed now for the transition to net zero emissions. Countries are invited to submit a low emissions strategy by 2020 under the Paris Agreement, and the Finkel Review recommended that Australia responds to this invitation.

The Commonwealth Government should announce that they will develop a low emissions strategy to show how Australia will meet the goal of net zero emissions by 2050 and grow its economy. They should also set a near zero emissions goal by 2050 for the electricity sector.

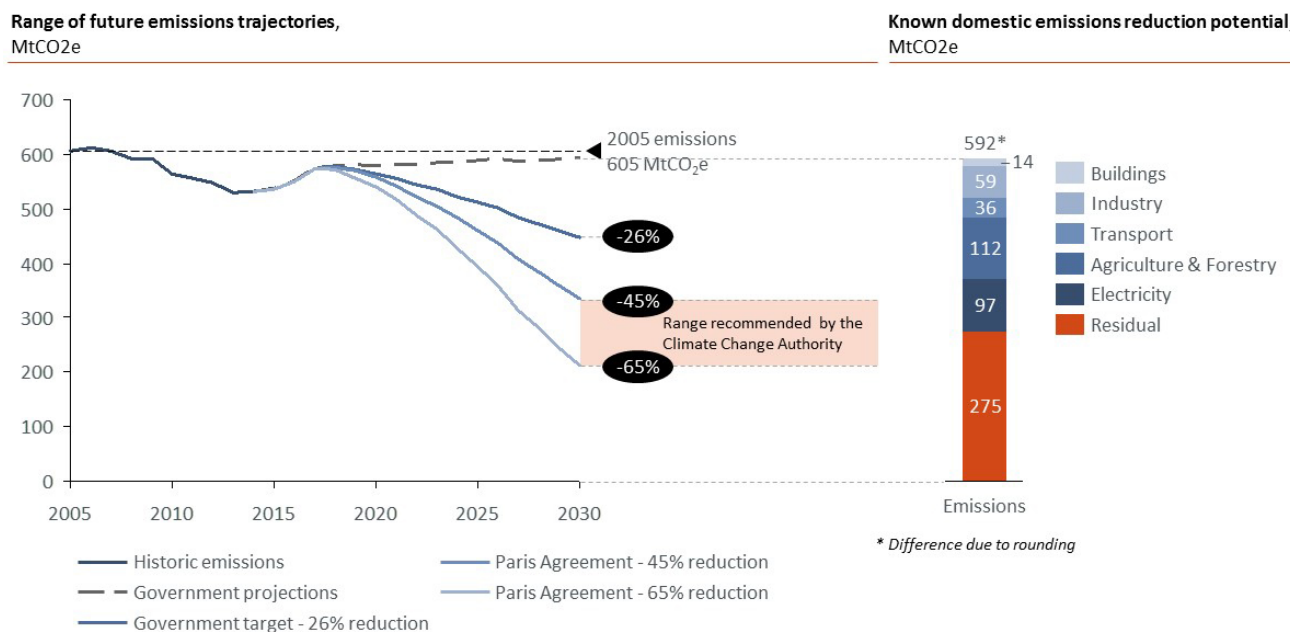
Long-term direction for investment is particularly crucial in the electricity sector where assets can have life spans of over 40 years. Substantial numbers of assets are ageing. The Commonwealth Government's Energy White Paper in 2015 estimated that three quarters of coal-fired power stations were operating beyond their original design life. Nine principal fossil fuel generators, totalling around 6 GW capacity, will be more than 50 years old by 2030. This long-term direction can also ensure a just transition for regions dependent on coal generators for employment. Such a signal will assist regions and governments to have adequate time to plan for the required economic transition and encourage engagement with communities.

Australia's 2030 target matters. More ambition now will provide an economically responsible transition to net zero by 2050 - and there are many opportunities to reduce emissions.

There are many options to reduce emissions in the Australian economy. Australia has the potential to achieve more ambitious targets, in line with the Paris Agreement, and go beyond the current target of 26-28 per cent below 2005 by 2030. Delay has meant that some opportunities have been lost, but these have been balanced by lower growth in industrial activity and further advancements in low and zero emission technologies. We can tap into the potential, despite policy delays, but we have to take action now.

ClimateWorks supports the Climate Change Authority's recommended target range of around 45 to 65 per cent below 2005 levels by 2030. Setting a trajectory through this target range would put Australia on an economically responsible path to net zero emissions by 2050 and avoid excessive use of our carbon budget over the next fifteen years.

Figure 3 Emissions trajectories and technical potential to 2030



As discussed, ClimateWorks supports a carbon budget approach. Delaying action results in rapid use of the fair carbon budget recommended by the Climate Change Authority, and can influence what reductions are possible in the future. This underscores the importance of our third principle.

Principle 3: Climate policy should ensure that decision making to 2030 is compatible with reaching net zero emissions by 2050.

Given that net zero emissions is the ultimate goal, policy and investment decisions to meet the 2030 target should allow Australia to meet this aim and stay within our carbon budget.

This principle is important to two main aspects of policy. Firstly the Government will need to make sure interim emissions reduction targets provide a sensible path to net zero. And secondly government policy will need to prevent investment or decisions that lock in high emissions, even if they do not prevent an interim target being met. Policy should assist governments and businesses to choose actions that:

- would otherwise result in lost abatement opportunities in the short to medium term;
- need to occur in parallel to unlock the full opportunities for emissions reductions. Two important examples are: the electricity sector needs to be decarbonised in order to unlock the full potential of switching from petrol to electric cars, and energy efficiency and other demand side actions should occur alongside decarbonisation of electricity;
- need progress today so that they can be accelerated at scale in the future;
- do not hamper technologies or activities that will be required for transition in later years.

In the electricity sector this also means that policy to meet objectives on reliability and affordability should not compromise the ability to reach net zero emissions. Policy which guides investment in the generation required to replace our ageing power plants should ensure we meet our full commitments under the Paris Agreement. In the electricity sector, this also means avoiding inefficient equipment on the demand side. This is discussed in further detail below.

The Paris Agreement objectives, and the global carbon budget it implies, indicate that any delay in climate mitigation must still be made up at a later date. In other words, the emissions reduction trajectory for Australia would be steeper if strong action is delayed in the short to medium term. Sharper reductions later would risk highly disruptive structural and economic adjustments for Australia. Economic analysis (Stern 2007) shows that there are costs to inaction and delay, including lost commercial opportunities. ClimateWorks' update to the Low Carbon Growth Plan shows that delay increases the cost of meeting national targets (ClimateWorks 2011).

The global transition has significant implications for emissions-intensive resource based economies such as Australia's. Even if Australia were to take no further action on climate change, the economy will be affected by the mitigation efforts of other countries. This is likely to be felt through reductions in exports of fossil fuel resources, and the risk of locking in emissions from related infrastructure. This is also seen through capital markets factoring in higher investment risks because of the relatively high emissions intensity of the economy.

Current and proposed policies at the Commonwealth level are insufficient to meet the current 2030 target, despite the opportunities available.

Our research indicates that current policy is not expected to be sufficient to meet the 2030 target - with the modelling suggesting emissions would fall to 12 per cent below 2005 level by 2030 - a gap of 82 MtCO₂e. ClimateWorks modelled the impact of including the Renewable Energy Target, state renewable energy targets, the Emissions Reduction Fund, HFC regulation and the National Energy Productivity Plan, including its likely impact on building efficiency and potential policy on light vehicle fuel efficiency (some of which were excluded from the most recent government projections). Commonwealth Government analysis in 2016 projected a greater gap to the current 2030 target. Both pieces of research suggests Australia will not meet our climate commitments unless governments can unlock emissions reductions across the economy.

Australia will also be required to contribute stronger emissions reduction targets under the Paris Agreement in the future. Our next principle sets out the importance of government policy which can meet targets as they are strengthened and without aiming to pick winners between technologies. This will be especially important in sectors where significant uncertainty exists as to which technology will be the best option to achieve net zero emissions at lowest cost.

Principle 4: Climate policy should be flexible so that it can scale to meet future targets and allow a range of solutions - known and novel.

Government policy development should adopt policy frameworks and mechanisms that can respond effectively to increasingly ambitious targets. Policy should be able to be scaled up and should not focus on existing technologies or exclude currently untested technologies.

Strong action in the electricity sector is essential to a cost-effective pathway to emissions reductions.

The electricity sector accounts for around a third of Australia's emissions, around 190 MtCO₂e in 2015. The sector also presents enormous opportunities for emissions reductions. Our research shows the sector has the highest potential to reduce emissions to 2030 (see Table 1). A near carbon-free electricity system can enable deep emissions reductions in other sectors, such as transport and buildings, through electrification. Action in the electricity sector can therefore reduce the amount of abatement which needs to be sourced from more expensive opportunities. Modelling by CSIRO for ENA's *Electricity Network Transformation Roadmap* suggests that achieving 100 per cent renewable energy by 2050 will be more cost-effective than a Business-as-Usual scenario (CSIRO & ENA, 2017) while delivering high levels of energy security and reliability thanks to storage and demand side management.

Table 1: Technical abatement potential across the Australian economy to 2030 and likely abatement under current policy settings

| SECTOR (MtCO ₂ e abatement in 2030) | TECHNOLOGIES | 2030 Abatement by technology (MtCO ₂ e) | | |
|---|--|--|-------------------------|--------------------|
| | | Technical abatement potential | Current policy settings | Untapped potential |
| Buildings (25) | Energy efficiency in new builds, retrofits, appliances and equipment | 12 | 7 | 5 |
| | Electrification of building equipment* | 2 | 0 | 2 |
| Industry (58) | Energy efficiency of industrial practices, assets and equipment | 24 | 19 | 5 |
| | Electrification of industrial equipment and processes* | 4 | 0 | 4 |
| | Switch to cleaner fuels | 9 | 0 | 9 |
| | Implement best practice to reduce industrial process and fugitive emissions (oil & gas, metals, cement, refrigerants) and develop industrial carbon capture and storage | 22 | 6 | 16 |
| Transport (50) | Energy efficiency in new passenger and freight vehicles | 16 | 12 | 5 |
| | Increased uptake of electric vehicles , plug in hybrids, fuel cell vehicles* | 12 | 0 | 11 |
| | Switch to gas and bioenergy for freight transport | 8 | 0 | 8 |
| Waste, Agriculture & Forestry (102) | Afforestation and avoided deforestation | 87 | 0 | 87 |
| | Best practice agriculture | 15 | 0 | 15 |
| | Reduction in waste emissions | 10 | 0 | 10 |
| Electricity (119) | Low carbon electricity | 97 | 16 | 81 |
| TOTALS (includes other small categories) | | 316 | 60 | 256 |
| Emissions reductions below 2005 levels | | -55% | -12% | N/A |

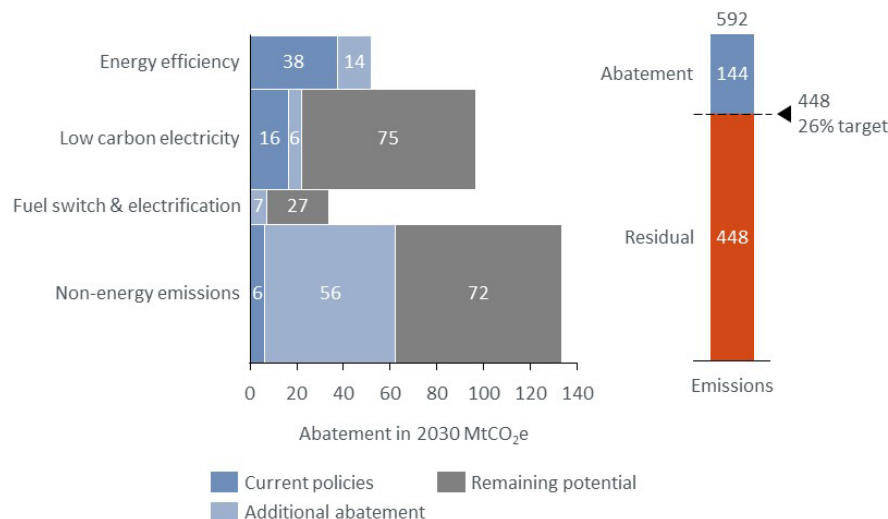
* The electrification potential is conditional on achieving sufficient emissions reductions in the electricity sector. Under current policy settings, the potential would be equal to zero MtCO₂e by 2030.

In our modelling for this report, ClimateWorks has built on our research with ANU that identified the technical potential for emissions reductions opportunities in different sectors. First, we updated the analysis to align with the government's emissions projections, and to account for the impact of delay since we conducted the original modelling. Then, we modelled a series of scenarios which show how the current government's emissions reduction target, and targets in line with the Climate Change Authority's recommended 2030 range, could be achieved via different levels of effort in different sectors of the economy. This analysis focuses on emissions reductions in 2030. This updated modelling shows the potential to achieve more ambitious targets, and that a target in line with the Paris Agreement remains within reach.

Scenario 1: Finkel Clean Energy Target (40 per cent renewables, beyond 50 year coal closure)

The first scenario explored in our modelling was designed to meet the lower bound of the 26-28 per cent 2030 target and to meet a proportional share of the target in the electricity sector. This is comparable to the level of effort for the electricity sector analysed in the Finkel Review – an emissions reduction of 28 per cent reduction below 2005 by 2030, and renewable energy reaches 40 per cent of generation by 2030.

Figure 4 Analysis from Scenario 1: Finkel Clean Energy Target



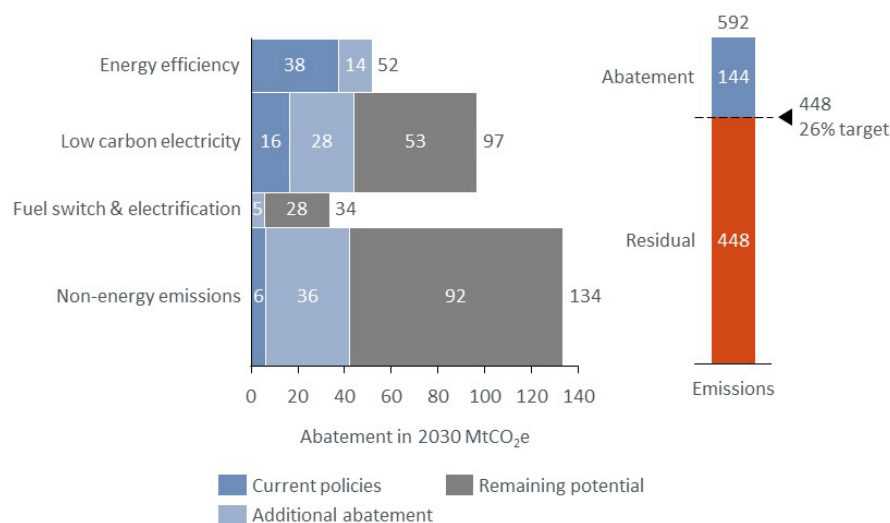
If the electricity sector were to deliver a proportionate amount of emissions reductions under the current target, this would leave a gap of 77 MtCO₂e to be delivered by other sectors. Our analysis shows that achieving the full technical potential for energy efficiency could help deliver an additional 14 MtCO₂e or 18 per cent of the gap.

In addition to this, we would also need to deliver an additional 62 MtCO₂e of abatement from fuel switching, electrification and non-energy emissions in the buildings, transport, industry, waste and land sectors. This corresponds to achieving about 40 per cent of the full technical potential in those sectors, which for example in increased afforestation corresponds to 36 MtCO₂e by 2030, or over 3 times the amount estimated to be delivered by afforestation through the ERF in 2018, its peak year. This scenario uses 94 per cent of the Climate Change Authority's recommended carbon budget to 2050.

Scenario 2: Strengthened electricity effort (50 per cent renewables, 50 year coal closure)

ClimateWorks has modelled the second scenario with increased abatement in the electricity sector. In our view this scenario better reflects the sector's technical potential and more reasonable share of abatement, and its ability to unlock emissions reductions in other sectors. This scenario uses 94 per cent of the Climate Change Authority's recommended carbon budget to 2050.

Figure 5 Analysis from Scenario 2: Strengthened electricity effort

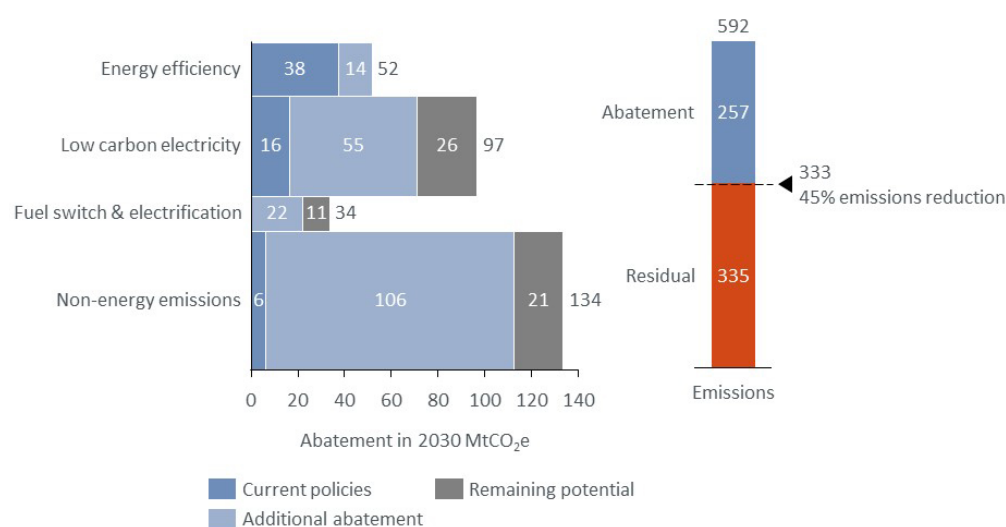


The electricity sector reduces emissions by 40 per cent below 2005 levels, delivering an additional 22 MtCO₂e abatement by 2030 compared to Scenario 1. All technical potential from energy efficiency is brought forward and a balanced proportion of potential available under the other pillars. Under this scenario, because there are greater emissions reductions in the electricity sector, less abatement is required from industry, agriculture and forestry in the non-energy emissions pillar. Whilst the emissions benefit of electrification increases due to a lower emissions intensity of electricity sector, a lower rate of other types of fuel switching is required.

Scenario 3: Paris Agreement scenario - target of 45 per cent below 2005 levels in 2030 (50 per cent renewables, 40 year coal closure)

Our analysis shows there are substantial opportunities for further emissions reductions across the Australian economy. This means that Australia still has the technical potential to meet our commitments under the Paris Agreement and reach the Climate Change Authority's recommended range for the 2030 emissions target.

Figure 6 Analysis from Paris Agreement scenario - 45 per cent target in 2030

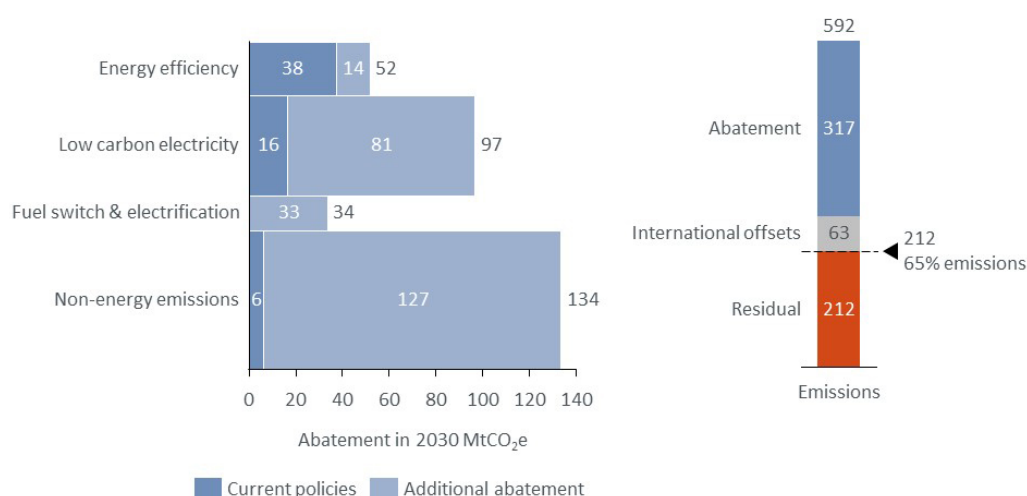


The first of our two scenarios compatible with the Paris Agreement shows that not all technical potential is needed to reach the lower end of the Climate Change Authority's recommended target range. This scenario uses 88 per cent of the Climate Change Authority's recommended carbon budget to 2050.

There are also further emissions reductions in the electricity sector, reaching 45 per cent below 2005 levels by 2030. This assumes similar levels of renewable energy to the previous scenario, reaching 50 per cent of generation in 2030. Existing coal exits the system earlier than is assumed for analysis in the Finkel Review - after a 40 year lifespan, and is being replaced by renewables and gas. The more rapid decline in emissions intensity of electricity allows greater abatement from fuel switching and electrification, especially in industry and transport. To reach the 45 per cent target also requires a greater use of the technical potential from non-energy emissions - from industry and land.

Scenario 4: Paris Agreement scenario - target of 65 per cent below 2005 levels in 2030 (70 per cent renewables, 40 year coal closure)

Figure 7 Analysis from Paris Agreement scenario - 65 per cent target in 2030



Using all technical potential identified by ClimateWorks brings emissions in 2030 to 55 per cent below 2005 levels. Using international offsets could complement domestic abatement and help reach the stronger end of the Climate Change Authority target range. The electricity sector reduces emissions by 61 per cent below 2005 levels and reaches 70 per cent renewable energy generation. This scenario uses 84 per cent of the Climate Change Authority's recommended carbon budget to 2050, the least of the range of scenarios, allowing for a slower transition to net zero emissions after 2030.

ClimateWorks analysis clearly shows that not all sectors have equal opportunities to reduce emissions, or costs (ClimateWorks and ANU 2014). A wealth of modelling on climate policy for Australia also supports these findings (including CCA 2014, Garnaut 2008). This leads to our fifth principle.

Principle 5: Climate policy should ensure each sector plays an appropriate part in emissions reductions to create a least cost pathway to net zero emissions.

Governments should consider all sectors of the economy and the opportunities different sectors present for cost-effective emissions reduction. Sectors vary not only in their technical potential for emissions reductions, but also in the flow on effect of those reductions.

Climate policy will be most effective, economically and environmentally, if governments consider opportunities and cost-effectiveness across the economy in order to determine policy for each sector.

Targets for the electricity sector should reflect the greater role the sector should play in the transition to a net zero emissions economy. ClimateWorks considers that governments should:

1. Agree to the recommendation in the Finkel Review that COAG Energy Council should set an emissions reduction trajectory for the electricity sector
2. Agree an emissions trajectory for the electricity sector that reaches near zero in 2050 with a target of at least 45 per cent below 2005 levels by 2030
3. Introduce policy that creates orderly transition in the electricity system

ClimateWorks Australia supports technology neutral policy for the electricity sector. However, technology neutral policy must consider affordability, reliability and environmental considerations. As mentioned, a number of Australia's power stations are approaching the end of their economic life. Investment to replace these generators will be required regardless of the need to reduce emissions to limit our impact on climate change. Governments will influence the investment decisions made about the kind of new generation that is built, either through direct investment or through policy that governs our electricity system and markets. ClimateWorks considers these investment decisions must ensure that the electricity sector can support an orderly transition to net zero emissions.

Should reverse auctions be considered a useful policy to bring in new generation, it will be important to consider the impact of emissions across the expected life of the power station. A modern ultra supercritical coal fired power plant with a capacity of 2GW (about the size of Liddell due for closure in the 2020s) would be expected to generate 10 MtCO_{2e} per annum. This is equivalent to two-thirds of abatement potential for all of agriculture in 2030. Its emissions between 2030 and 2050 would add up to about 2 per cent of Australia's carbon budget, or about a third of the total remaining carbon budget for Australia under a 26-28 per cent target in 2030.

Strong action on the demand side will decrease the costs of decarbonising our electricity supply.

Policy and decisions on whether new supply is needed should consider how demand, and its variability, are likely to change in a net zero economy. This will be a balance between two trends - increasing energy efficiency and increasing electrification. Our analysis shows the important role that energy efficiency can play in reducing emissions - with potential emissions reductions of 52 MtCO_{2e} by 2030.

Governments and organisations managing the electricity sector should consider how demand can be reduced or shifted to better match supply. If our electricity system can be reformed to more effectively manage demand, especially peak demand, it will not only reduce emissions but also reduce costs as less investment in new generation, storage and transmission and distribution assets will be needed.

Demand response measures can reduce risk of blackouts by significantly easing peak demand on extreme days. For example, companies or households can be incentivised to turn off non-essential power during peak periods. This could be through a capacity market, such as in Western Australia. ClimateWorks' previous research into the industrial sector found that

demand response measures could reduce commercial electricity demand on Australia's east coast by as much as 42 per cent during peak periods, which would reduce the overall peak demand by 10 per cent (ClimateWorks 2012).

Transformation of our energy system will require moving to renewable energy supply and managing demand. If we improve energy efficiency, better manage commercial and domestic demand and actively encourage electric vehicles, we can avoid building unproductive infrastructure, avoid unnecessary increases in energy prices, and address dangerous climate change. Our research and the recent work on the *Electricity Network Transformation Roadmap* (CSIRO & ENA 2017) shows this is possible with currently known technologies, but also that there needs to be new approaches and policies.

Innovation should be supported to ensure the provision of clean, reliable and affordable electricity.

Policy and regulation should be adjusted to enable the uptake of renewables, storage technologies and electric vehicles which are expected to make key contributions to a cost effective transition in the future.

Principle 6: Climate policy should provide enabling conditions for uptake of emerging technologies to make the transition faster and cheaper.

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 new technologies and services.

In particular, government can help accelerate the learning rates associated with new technologies to accelerate cost reductions and bring forward the 'tipping point' at which clean technologies become cost competitive with high emitting established ones. This is necessary for the rates of decarbonisation required to achieve the Paris Agreement.

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 (such as regulation or incentives).

ClimateWorks would like to underscore the importance of the Finkel Review recommendations that support better regulation and management of new technologies (including storage), so that these can meet the need for reliable, affordable electricity.

The electricity sector must do more to deliver on our climate commitments.

The electricity sector plays a crucial role in helping Australia deliver on its commitments under the Paris Agreement. The analysis presented in this report shows that under our current 2030 target, the electricity sector can, and needs to, deliver more than a proportionate share of abatement under that target. Otherwise, further abatement effort will be needed from more expensive opportunities in the buildings, transport, industrial, forestry and agricultural sectors.

Our analysis has shown that if we are to deliver on our Paris Agreement commitments, which means to stay within the carbon budget put forward by the Climate Change Authority and ultimately reach net zero emissions by 2050, the electricity sector needs to go well beyond abatement levels analysed in the Finkel Review. This requires electricity sector policy that reflects the principles outlined in this report.

The time for Australia to act on electricity sector abatement is now, and a principled approach is needed to ensure that the energy trilemma can be addressed, and dangerous climate change avoided.

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Contact

For further information contact:

ClimateWorks Australia
Level 16, 41 Exhibition St Melbourne
Victoria 3000
PHONE +61 3 9902 0741
EMAIL: info@climateworksaustralia.org

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