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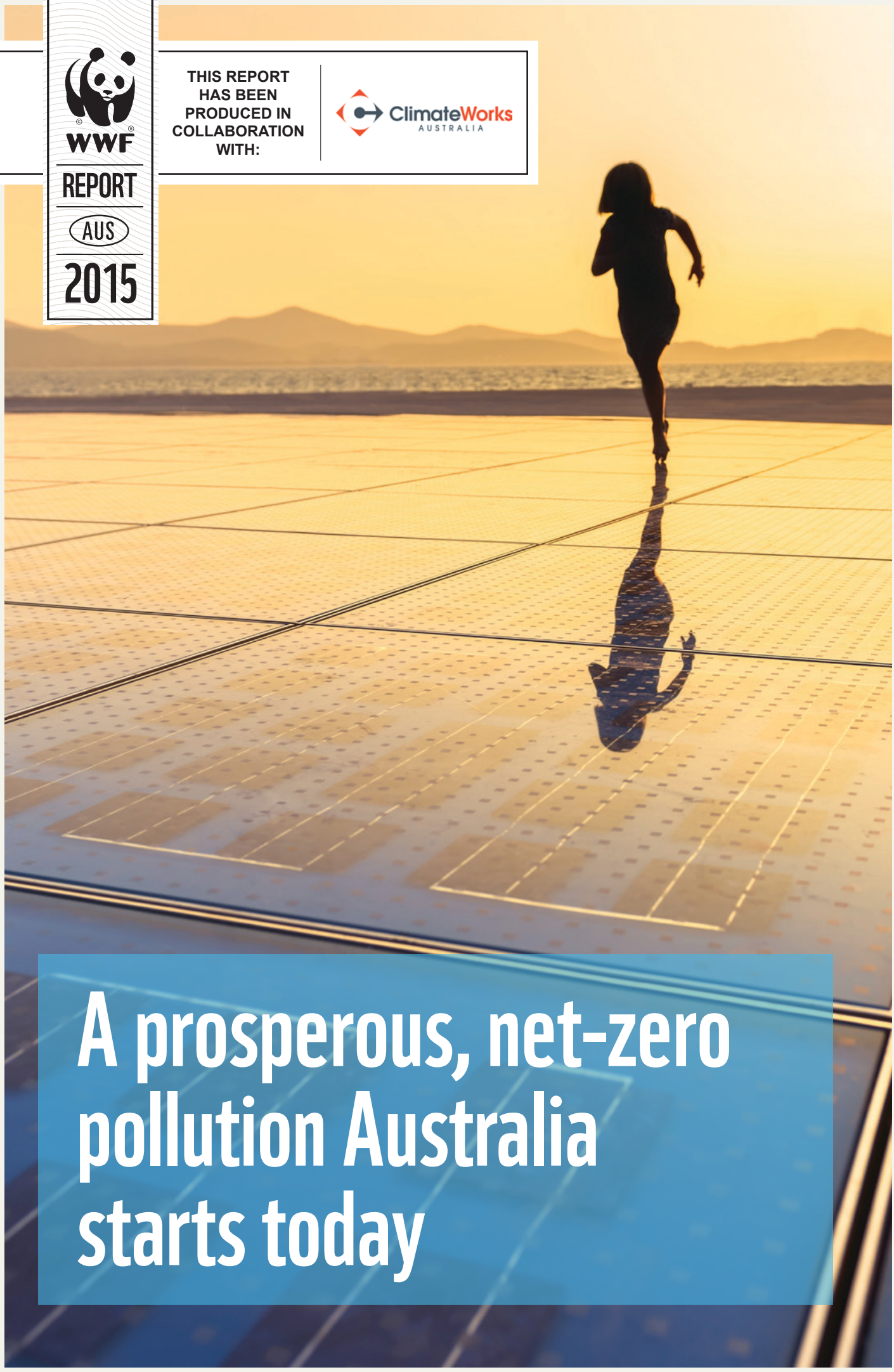

A prosperous, net-zero pollution Australia starts today

Acknowledgement:

This report focuses on potential pathways to decarbonisation in Australia for the period to 2030 and was commissioned by WWF-Australia. Prepared by ClimateWorks Australia, the report draws on findings from *Pathways to Deep Decarbonisation in 2050*: How Australia can prosper in a low carbon world, released 23 September 2014 and authored by ClimateWorks Australia and Australian National University.

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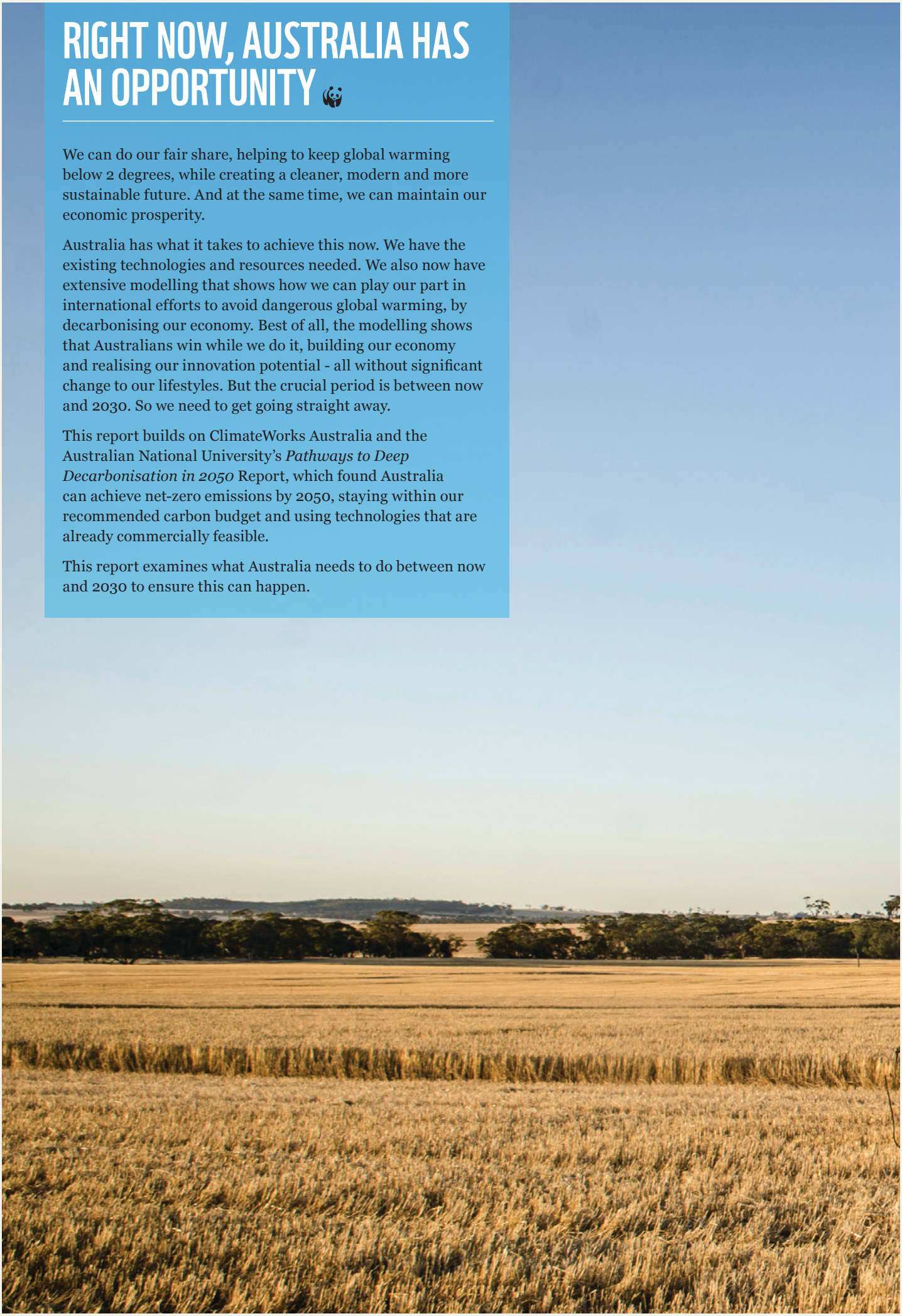
RIGHT NOW, AUSTRALIA HAS AN OPPORTUNITY

We can do our fair share, helping to keep global warming below 2 degrees, while creating a cleaner, modern and more sustainable future. And at the same time, we can maintain our economic prosperity.

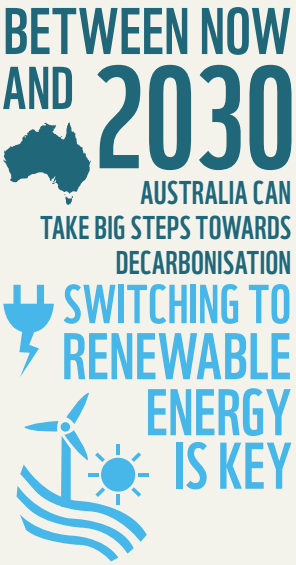
Australia has what it takes to achieve this now. We have the existing technologies and resources needed. We also now have extensive modelling that shows how we can play our part in international efforts to avoid dangerous global warming, by decarbonising our economy. Best of all, the modelling shows that Australians win while we do it, building our economy and realising our innovation potential - all without significant change to our lifestyles. But the crucial period is between now and 2030. So we need to get going straight away.

This report builds on ClimateWorks Australia and the Australian National University's *Pathways to Deep Decarbonisation in 2050* Report, which found Australia can achieve net-zero emissions by 2050, staying within our recommended carbon budget and using technologies that are already commercially feasible.

This report examines what Australia needs to do between now and 2030 to ensure this can happen.



SUMMARY POINTS



A net-zero pollution future for the Australian economy must start today

- For Australia to play its role in keeping global warming below 2 degrees, the economy will need to achieve net-zero emissions by 2050.
- We will completely use up our carbon budget by 2028 if we follow current 'business as usual' projections modelled by government, but if we act now, Australia can stretch its carbon budget out to 2050 to enable a smooth transition to a net-zero carbon future.
- The good news is, the ClimateWorks Australia's *Pathways to Deep Decarbonisation in 2050* report shows this transition is possible using the technology available today and will involve continued strong growth across the Australian economy.
- However, we cannot afford to wait. The next 15 years are critical to laying the groundwork for a decarbonised Australian economy.

Between now and 2030 Australia can take big steps towards decarbonisation, including achieving at least 50% renewable energy

- Australia could achieve over 50% domestic emissions reductions on a 2005 baseline between now and 2030. This is well beyond the draft emissions reduction target proposed by Australia of 26-28%.
- A near doubling in Australia's energy productivity by 2030 would make the biggest contribution to these emissions reductions. It would be achieved by investing in the modernisation of our energy system and by taking advantage of recent technological developments.
- Switching to more renewable energy is key; achieving at least 50% renewable energy across the Australian electricity sector by 2030 is well within reach.
- Based on current demand projections, 140 TWh[1] of renewable energy generation in the electricity sector will be required to meet the 50% goal. The demand for electricity could increase if there is substantial electrification of transport, which would increase the renewable electricity generation required by about a quarter. This increased generation can be delivered by adding roughly the same volume of wind capacity built in 2013 plus one large-scale solar project each year out to 2030.
- While all scenarios modelled for achieving at least 50% renewable energy by 2030 require greater investment in electricity, this is still far less than historical investments in oil and gas.

Australia's economy, wages and jobs can grow under deeper emissions cuts to 2030

- Our economy has a history of successful adaptation to global economic trends. In recent times we have met global economic challenges by evolving towards a highly skilled knowledge-based economy.
- Australia can decarbonise while real GDP grows at 2.6% per annum to 2030 -

similar rates of growth to the past five years.

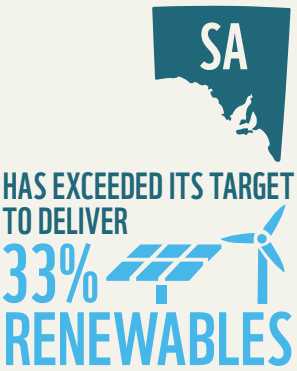
- Real wages would increase by almost 13% by 2030 as the economy transitions towards net-zero emissions by 2050.
- Oil and coal sectors contribute less to our economy but this is offset by growth in other sectors, such as renewable electricity generation and growth in the land sector. Twice as many jobs in renewable electricity generation are created than are lost from the coal-fired electricity generation sector.

Australia can achieve this without significant lifestyle changes

- We will notice changes to the source of our electricity but not the availability of supply. We will still heat and cool our buildings, but it will be done more efficiently. We will still drive and fly but, heading towards 2050, we will do it using lower carbon fuels.
- As a result of energy efficiency in the home and car, overall household energy costs could be reduced by more than 11% in 2030 despite increased up-front costs and higher electricity prices. As income is expected to increase by over 20% during this period (in line with GDP), this roughly equates to a 25% reduction in energy and transport spend as a proportion of household income.

There's no time like the present - innovate and prosper

- The shift to zero carbon growth is happening through strong public and private sector commitments to reducing emissions and shifts in investments from high carbon to low carbon assets.



- Clean technology is also becoming cheaper and more reliable. Battery technology cost predictions for full automotive lithium-ion (Li-ion) based residential battery storage systems in 2030 are expected to fall to one-fifth of their price in 2013. They have already decreased by about a third between 2013 and today.
- The potential in Australia is clear; South Australia has exceeded its target to deliver 33% renewables and in 2014, wind and solar energy have provided more than 100% of the state's electricity needs for a full working day.
- Australia has an opportunity to be a global leader in innovation through investing in science and ensuring effective commercialisation.
- By beginning our transition to a net-zero emissions economy now, we build resilience into Australia's economy, and buy options for the future. Strong action now will also provide clear, long-term signals to inform investment.
- Australia will benefit from realising the full value of our renewable and human assets to create an advantage as a low-emissions competitor in a carbon-constrained world.
- Renewing current carbon intensive assets would lock us into outdated and non-competitive technologies and significantly reduce the cost-effective opportunities for decarbonising the Australian economy.

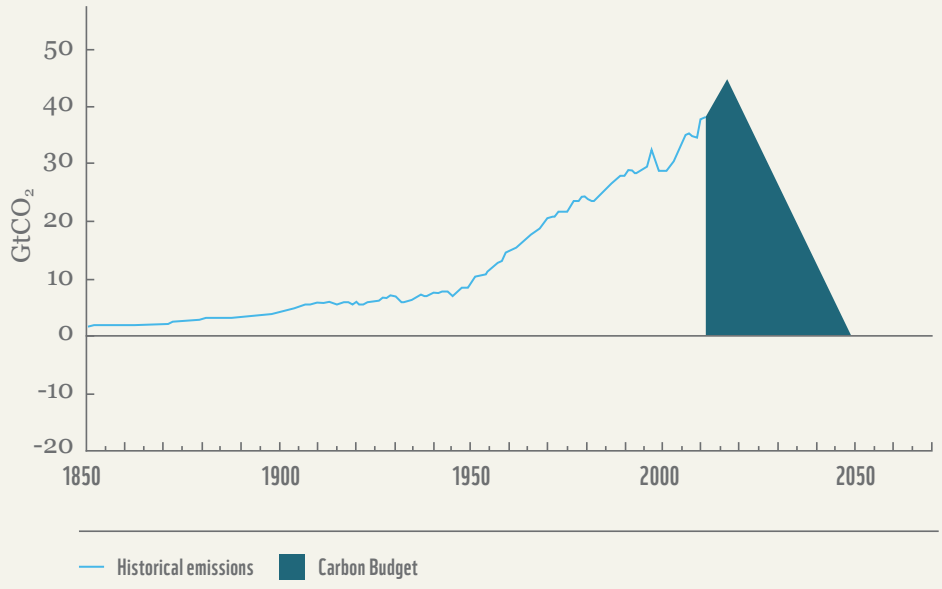
AUSTRALIA'S PATHWAY TO A NET-ZERO POLLUTION FUTURE

For Australia to play its role in keeping global warming below 2 degrees, our economy will need to transition to net-zero emissions by 2050 at the latest. Achieving 'net-zero emissions' means balancing our greenhouse gas (GHG) output so the amount of GHG humans produce is the same or less than the amount we remove from the atmosphere.

Net-zero emissions requires Australia to prepare and act now: we will completely use up our carbon budget[2] by 2028 if we follow current 'business as usual' projections modelled by Government.[3] Conversely, by acting now, Australia can stretch its carbon budget out to 2050 to enable a smooth transition to a net-zero carbon future, and avoid relying heavily on international offsets.

The Figure below shows the history of global carbon dioxide (CO_2) emissions from human activity added to the atmosphere since the Industrial Revolution, and how we can live within our carbon budget by progressively reducing those emissions from now.

Figure 1: Global annual CO_2 emissions[4] (non-cumulative)



In their October 2015 Annual report, PricewaterhouseCoopers asserted "Australia will need to nearly double its historic rate of decarbonisation, to 4.4% annually, if it is to meet its goal of a 26% decrease in carbon emissions on 2005 levels by 2030."[5] While this is the official emissions reduction target of the Australian Government, it remains below the minimum recommended by the Climate Change Authority (45-63% below 2005 levels by 2030).

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KEEPING WITHIN AUSTRALIA'S CARBON BUDGET IS ACHIEVABLE, BUT REQUIRES INVESTMENT NOW

Every plausible carbon budget for Australia involves deep reductions in emissions before 2030, even with relatively modest global climate action. A 15 year delay in action by Australia and the rest of the world would effectively push the 2 degree target out of reach.

The next 15 years to 2030 give us the opportunity to lay the groundwork by investing in research and development, low carbon assets and infrastructure, and encouraging businesses, regions and the broader Australian economy to reposition themselves for prosperity in a carbon constrained future.

The great news is, this is all achievable and comprehensive analysis shows how.

ClimateWorks Australia's *Pathways to Deep Decarbonisation in 2050* found Australia can achieve net-zero emissions by 2050, staying within our recommended carbon budget and maintaining economic prosperity. Further, we can achieve the transition using technologies that are already known today.

The ClimateWorks report is part of a global project comprising 16 countries who represent 74% of global greenhouse gas emissions. It was convened under the auspices of the Sustainable Development Solutions Network (SDSN) and the Institute for Sustainable Development and International Relations (IDDRI). Offering just one of many possible pathways for Australia, this analysis shows our economy is well placed to deliver deep emissions cuts over the next decade, alongside continued economic growth.

WHAT AUSTRALIA CAN ACHIEVE BY 2030

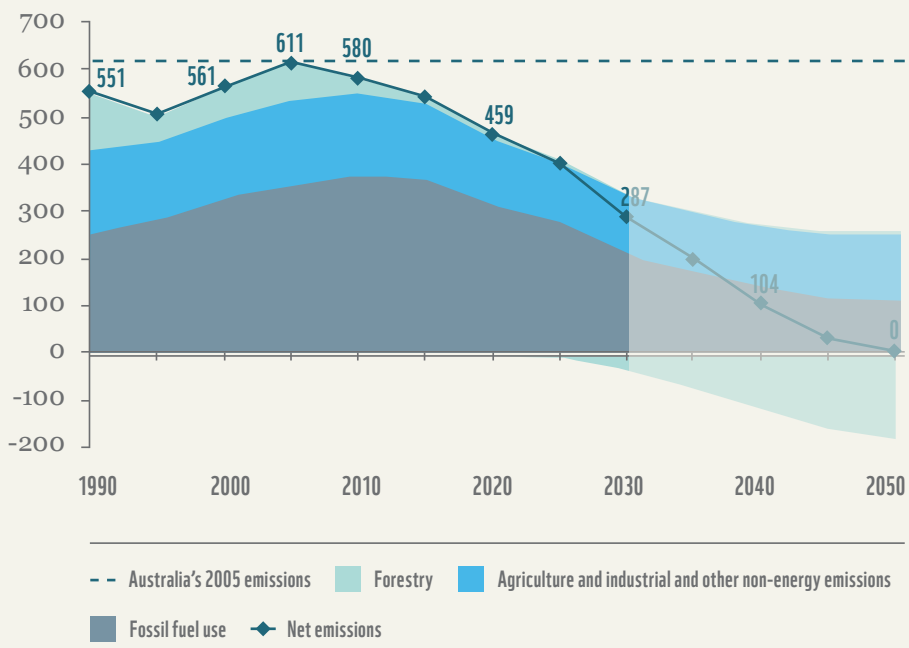
Using the analysis from the *Pathways to Deep Decarbonisation in 2050* report we can take a look at some of the key possibilities for Australia over the next 15 years.

This includes significant possibilities in the expansion of clean energy technology. The analysis also suggests that Australia's economy will grow strongly alongside deep emissions cuts and that the way we go about our lifestyles will not be significantly impacted. Other co-benefits will also flow to areas including to public health if Australia puts the right frameworks in place now.

Domestic emissions can decrease by over 50%[6*] by 2030

The graph below shows the trajectory for emissions reduction by sector[7], highlighted to 2030 and modelled to net-zero by 2050. It shows a domestic emissions decrease of at least 25% below 2005 levels by 2020, and over 50% below 2005 levels by 2030. Higher national pollution reduction targets (Australia's fair share of the global carbon budget) could be achieved by including internationally recognised high quality offsets. [8]

Figure 2: Emissions reductions by type of opportunity to 2030 and 2050



Significant emissions reductions are possible if we pursue the four pillars of decarbonisation

Over the coming fifteen years, government and business can contribute to additional emissions reductions, following ClimateWorks Australia's 'four pillars of decarbonisation' approach.

Figure 3: ClimateWorks Australia's four pillars of decarbonisation

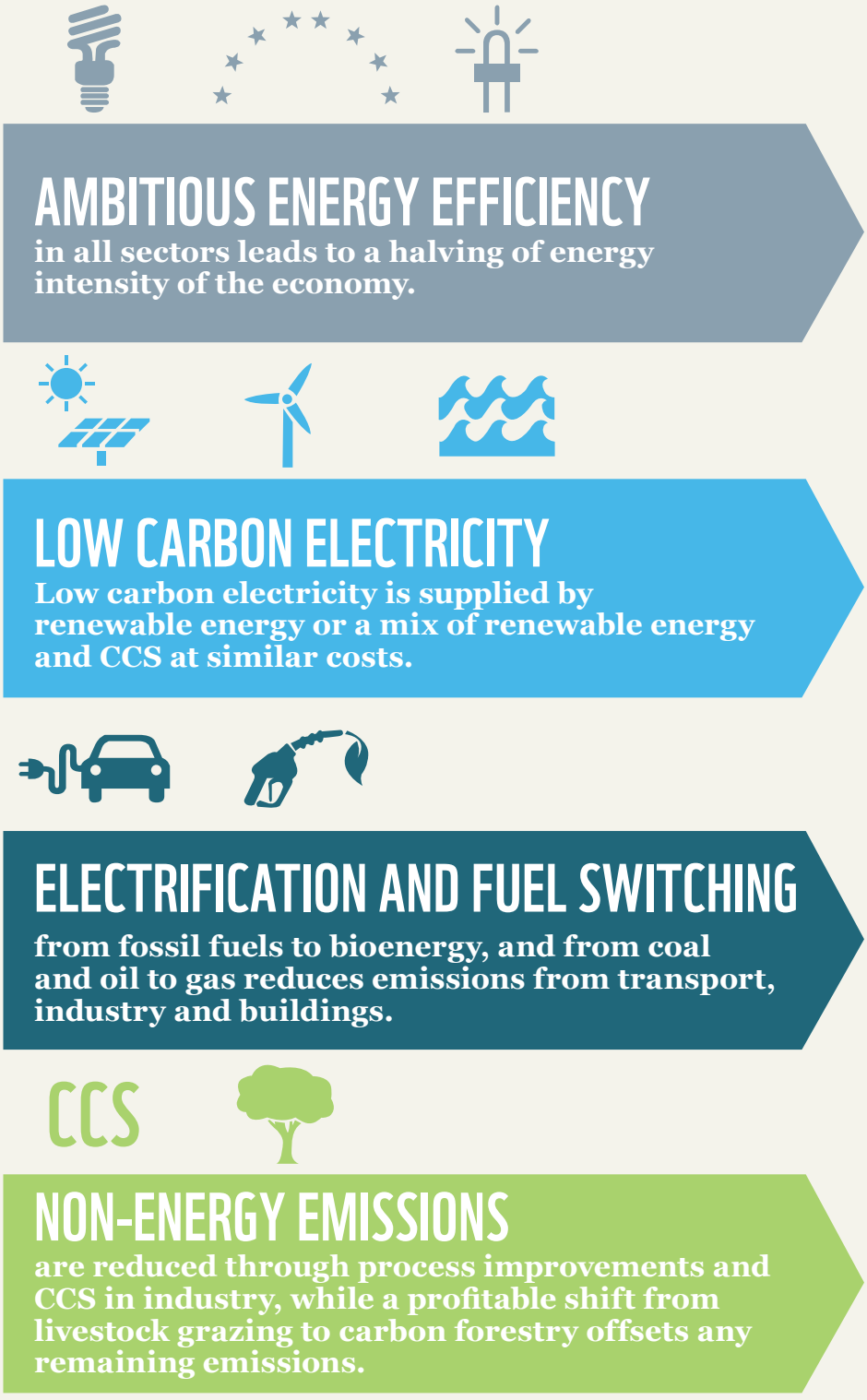
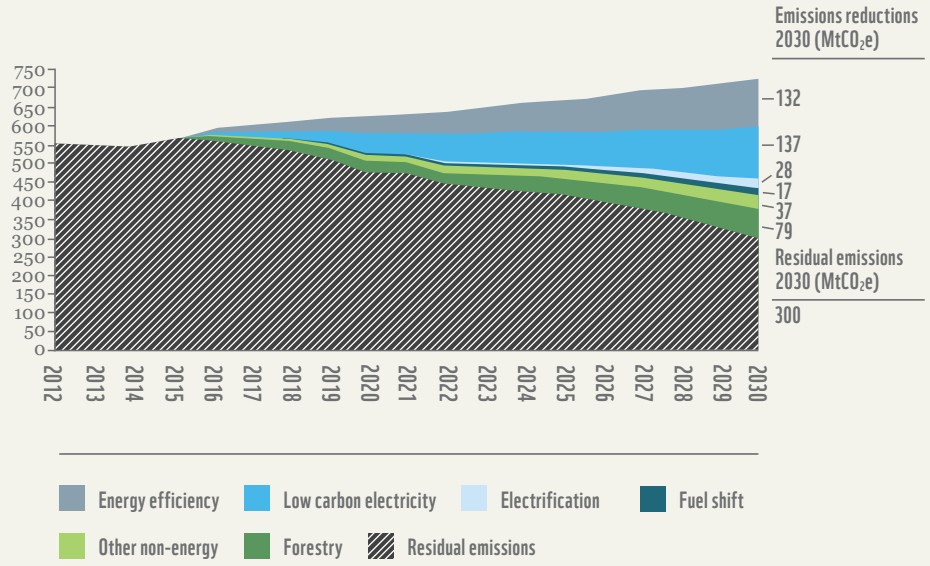


Figure 4 below shows the potential contribution to emissions reductions of each of the four pillars of decarbonisation up to 2030 and is consistent with a pathway to net-zero emissions by 2050. The top of the wedge graph shows total emissions if there was no technological improvement and the economy continues to grow as expected. With the abatement identified, emissions could be 59% less than this level by 2030. This represents the same abatement potential as the >50% of domestic emissions reductions illustrated earlier which is expressed relative to Australia's 2005 emissions.

Figure 4:
Potential for abatement through the pillars to 2030 ($MtCO_2e$)



1. Improving our energy efficiency

As shown in Figure 4, energy efficiency accounts for a large proportion of abatement to 2030 (132 $MtCo_2e$[9]), including 44 $MtCo_2e$ from industry, 35 $MtCo_2e$ from residential and commercial buildings and 51 $MtCo_2e$ abatement from transport.

We can build on current momentum to greatly improve energy efficiency in all energy end-use sectors. In the first years the focus should be on accelerating emissions reduction activities which are already profitable. These include improving vehicle technology (such as emission standards) for passenger and goods transport, improving efficiencies in residential and commercial buildings, encouraging and adopting smart urban and architectural design, building practices and construction materials, optimising value chains, improving industry equipment, material efficiency and production processes (such as cogeneration through reuse of waste heat).

Households have an opportunity for significant energy savings which could help offset the increased unit cost of electricity. Through better building design and construction, heating and cooling, costs can be decreased while at the same time, room temperature is made more comfortable. Simple actions such as replacing light bulbs and showerheads with more efficient ones, installing an energy saving plug to cut down the use of standby power of appliances and reducing clothes dryer use can already save typical households between $120 and $590 a year depending on the state they live in and their house type.[10] The *Pathways to Deep Decarbonisation in 2050* Report showed decreasing costs of transport per household while emissions were reduced to almost zero through energy efficiency, electrification and decarbonised electricity. More efficient cars might come at a higher initial cost, but they cost less to run and this usually reduces the total cost of ownership.

As a result of energy efficiency in the home and car, overall household energy costs could be reduced by more than 11% in 2030 as shown in the figure below, despite increased up-front costs and higher electricity prices. As income is expected to increase by over 20% during this period (based on GDP per capita), this roughly equates to a 25% reduction in energy and transport spend as a proportion of household income.

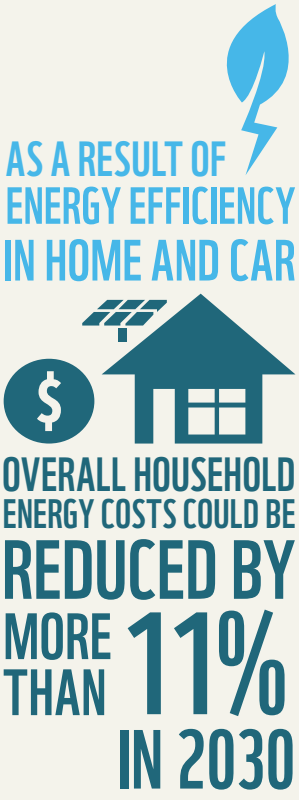
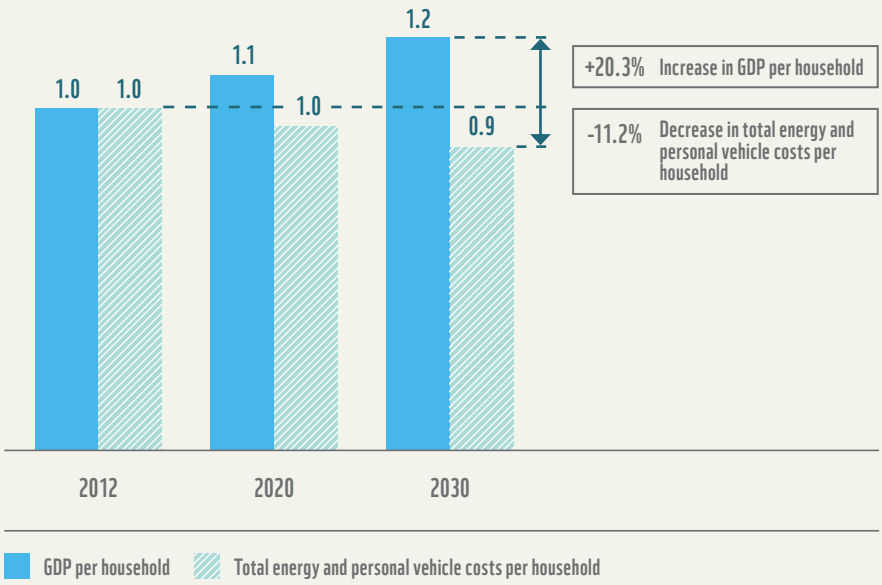


Figure 5: Average energy and personal transport costs per household and change in GDP per household to 2030 (Index 2012 = 1.00)

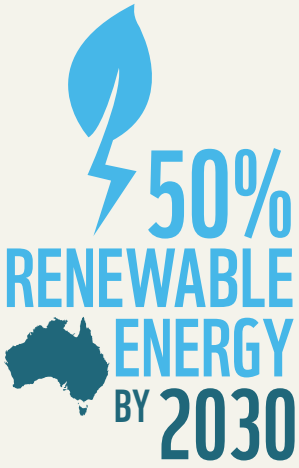


2. Moving towards low carbon electricity

As presented in Figure 4 above, low carbon electricity is an essential part of the necessary transition as it contributes around 30% of abatement. A further 5% of abatement is facilitated through switching to low carbon electricity use in sectors such as transport.

From now, we must take the long-term into account when making investment decisions, particularly around fossil fuel based electricity.

The key here is to shift from carbon intensive assets to low carbon assets. With most of Australia's power generation assets in the second half of their economic life, and many approaching the need for renewal, replacing these with renewable technologies is logical: Renewing current carbon intensive assets would lock us into outdated and non-competitive technologies and significantly reduce the cost-effective opportunities for decarbonising the Australian economy. In the years to 2030 we therefore have an opportunity to further shift from coal generation through increased large-scale renewable energy and to encourage a reduction in energy demand in other sectors.

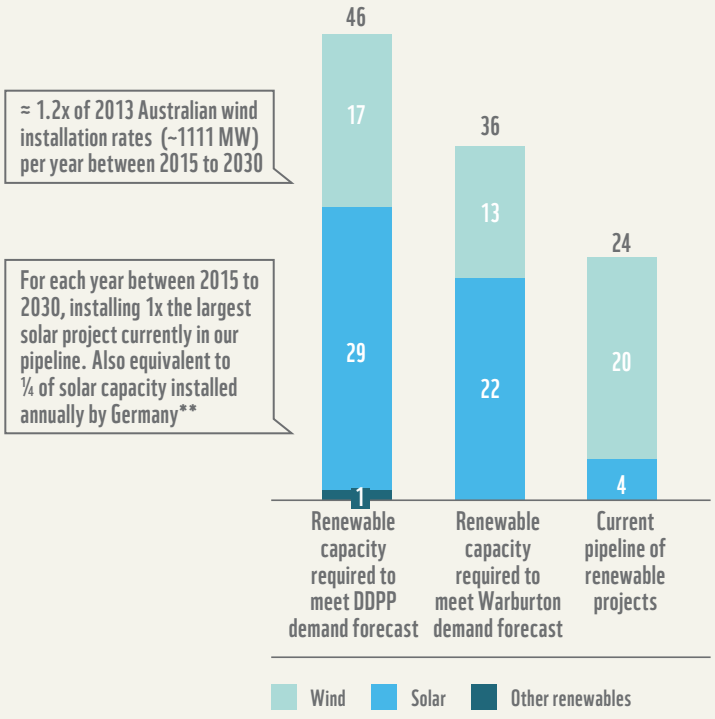


Switching to more renewable energy is key; achieving at least 50% renewable energy across the Australian electricity sector by 2030 is well within reach

In all scenarios modelled in the *Pathways to Deep Decarbonisation in 2050* report[11], Australia can easily reach a minimum of 50% renewable energy by 2030.

In order to reach 50% renewables by 2030, at least 140 TWh of renewables will be required. As the figure below shows, existing identified projects would meet two-thirds of the Warburton Review demand forecast.[12] These same projects fulfil more than half of the highest demand scenario. We have already seen installations occurring at similar rates in Australia and abroad – we now just need to see this roll out over a longer timeframe.

Figure 6: Renewable capacity required to meet DDPP demand forecast to meet 50% renewables in 2030 under several demand forecasts, total new investments from 2012-2030, GW



**Annual solar capacity installed in Germany ~7.5 GW from 2010 to 2012 (note Australia has roughly one-quarter of Germany's population) http://www.reuters.com/article/2013/01/05/us-germany-solaridUSBRE90406C20130105

CLEAN TECHNOLOGY IS BECOMING CHEAPER AND MORE RELIABLE

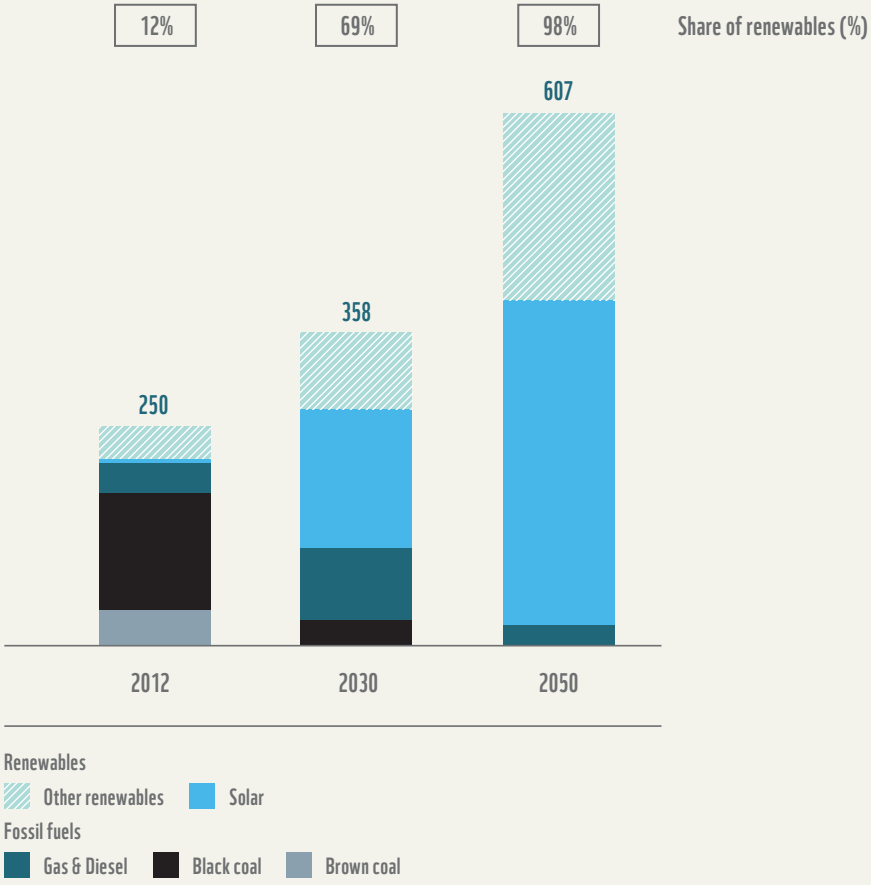
BATTERY TECHNOLOGY COST PREDICTIONS

for automative lithium-ion based residential battery storage systems in 2030 are expected to fall to one-fifth of their price in 2013. They have already decreased by about a third between 2013 and today

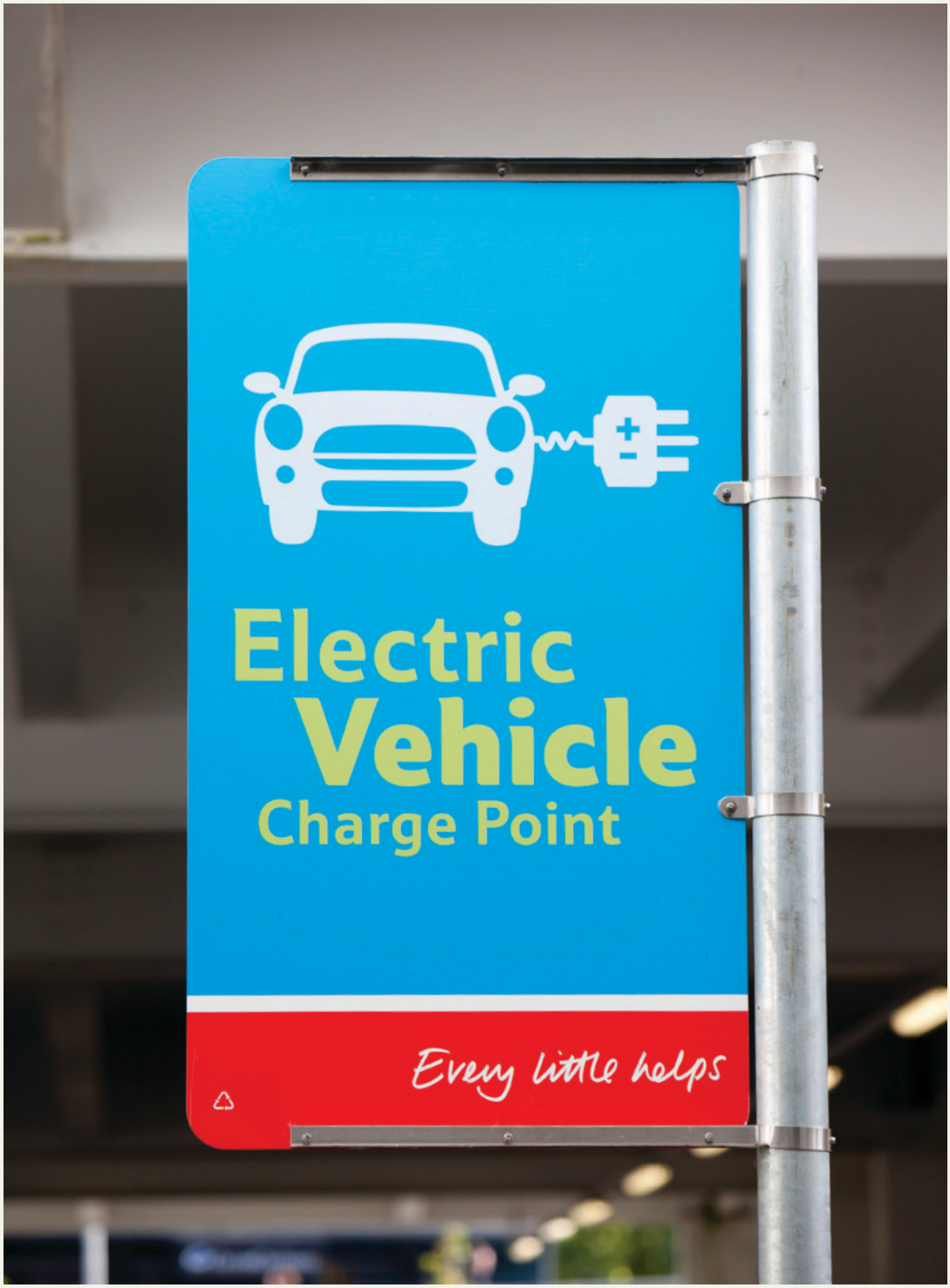
Renewable technologies can already deliver reliable and stable electricity at levels above 50%. South Australia provides an example where generation on given days has even approached 100% of demand (see later section). The King Island Renewable Energy Integration Project has been able to provide 100% of the island's energy needs from renewables for sustained periods.[13]

The expansion of renewable energy across Australia could be even higher by 2030 if more ambitious assumptions are made around technological advancement, cost reductions and the rate of uptake of renewable energy relative to other competing sources. For example, the pathway in Figure 7 below shows how 69% generation from renewables in 2030 is possible, rising to 100% in 2050. Importantly, in each scenario modelled to achieve a 2 degree pathway, renewables contributed at least 50% of the generation to 2030 regardless of the technology mix used to achieve this goal.

Figure 7: Generation technology mix for 100% renewable energy grid scenario, (TWh)



While all scenarios modelled for achieving at least 50% renewable energy by 2030 require greater investment in electricity, this is still far less than historical investments in oil and gas.



An electric car charging point provided free of charge in a Tesco Supermarket car park for their customers, near Earls Court, London, UK.

3. Getting ready for electrification and fuel switching

Once electricity supply has been decarbonised it can be used to substitute other fuels, providing emissions free energy. Petrol and diesel fuel use in cars is a considerable source of emissions in Australia. With electric vehicles (EVs) running on emissions free electricity, this could be reduced to virtually zero.

Electric vehicles are today within striking distance of conventional vehicles thanks to improvements in battery technology, lightweight vehicle design, growing environmental awareness and cost reductions afforded by growing the manufacturing scale of core EV systems. The costs of owning and running vehicles could be further reduced by employing more advanced efficient technology such as electric and plug in hybrid drivetrains with an overall trend to shift to smaller vehicles.

Tesla Motors is quickly winning fans across the world for their electric vehicles, achieving record sales in the first quarter of 2015.[14] In Australia, Tesla has targeted buyers willing to pay a premium for luxury, performance and sustainability. This is to allow the company to build experience and scale before introducing lower cost models in the future. The company is also developing supercharger and battery swap stations along major traffic corridors in key markets – with first stage plans connecting Australia's key east coast cities - to improve the practicality of their cars for wider markets.

Electric vehicle momentum has not been overlooked by well-known traditional vehicle manufacturers such as Nissan-Renault Alliance, Ford, GM and BMW who have each developed all-electric vehicles of their own to secure a foothold in this emerging market.

In the *Pathways to Deep Decarbonisation in 2050* Report most electrification and fuel switching happens post-2030, however significant work needs to be done over the next 15 years to prepare the market for the shift in skills, building of new infrastructure and development of supply chains that this transition requires.[15]

Importantly, shifting to more efficient and electric vehicles can be achieved over time at the rate of natural turnover; that is, when people or businesses would normally purchase new vehicles. Enabling greater uptake of efficient cars requires good policy support such as emissions standards to ensure that new vehicles are realising their potential to contribute to Australia's emissions reductions and the creation of an infrastructure for vehicle charging.

4. Pursuing opportunities in non-energy emissions and forestry

Non-energy

By 2030 around 37 $MtCo_2e$ in abatement can be achieved from non-energy emissions resulting from industry and agriculture, which accounts for about 10% of the solution. Most of the potential from this pillar of decarbonisation is realised post-2030, however, significant work is required now in order to prepare the market to capture this opportunity.

More immediately, process improvements can begin to reduce emissions such as switching to natural refrigerant gases to significantly reduce the energy consumption of cooling processes and eliminate use of potent greenhouse gases. Industry can be encouraged to decrease fugitive emissions from gas extraction or coal mines through the implementation of innovative technologies.

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, a potent greenhouse gas.

Forestry

By 2030 around 80 $MtCo_2e$ in abatement can be achieved from non-energy emissions resulting from forestry which accounts for 18% of the solution.

CARBON SEQUESTRATION PROVIDES A SIGNIFICANT OPPORTUNITY FOR A RANGE OF CARBON FORESTRY PLANTINGS TO OFFSET RESIDUAL EMISSIONS

Carbon sequestration provides a significant opportunity for a range of carbon forestry plantings to offset residual emissions, as trees absorb or sequester carbon from the atmosphere while they grow. Realising this potential could provide improved environmental outcomes and an additional source of income for landowners. Managed well, this could also deliver environmental co-benefits such as reduced land degradation and salinity, and increased areas for wildlife habitats. Of course it also means we need to address challenges such as establishing supply chains and supporting services as well as managing impacts on water availability and food production.[16]

It is also worth noting that carbon forestry should be considered as a transition strategy rather than a long-term solution. Indeed, to keep emissions reduction levels stable over time, new trees need to continually be planted. Carbon forestry can provide a cost effective solution to get emissions to net-zero before technologies are commercially available to achieve net-zero energy systems in all sectors of the economy.

In addition, if challenges are overcome and there is strong demand for emissions offsetting from other countries where the cost of reducing their residual emissions is higher than the cost of planting carbon forests in Australia, Australia could establish itself as a net exporter of carbon offsets by 2050.

AUSTRALIA'S ECONOMY CAN GROW ALONGSIDE DEEP EMISSIONS CUTS OVER THE NEXT DECADE

The adage is true for Australia: There is no time like the present. Our economy is strong and growing, interest rates are low, investors are keen, large emitters are publicly announcing their commitments to reduce emissions, the public are supportive of action and technologies required for decarbonisation are currently available or on the path to commercialisation.

Australia can maintain economic prosperity and simultaneously decarbonise, using technologies that exist today. We have an abundance of renewable energy resources, capable of delivering 500 times our current power generation capacity. We have the knowledge and resources required to invest in and produce low carbon innovation and technology across areas such as smart grid software, commercial and industrial retrofits, solar cell efficiency, low carbon water systems and wind energy.

Even with stronger emissions reduction commitments, Australia's economy can continue to grow over the next decade

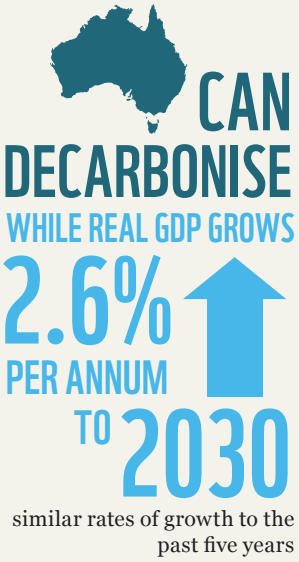
Several economic analyses provide a strong case for a faster transition to a net-zero emissions global economy.[17] Although there are differences in modelling methodologies, the findings of these various reports is consistent with the findings of the *Pathways to Deep Decarbonisation in 2050* research.

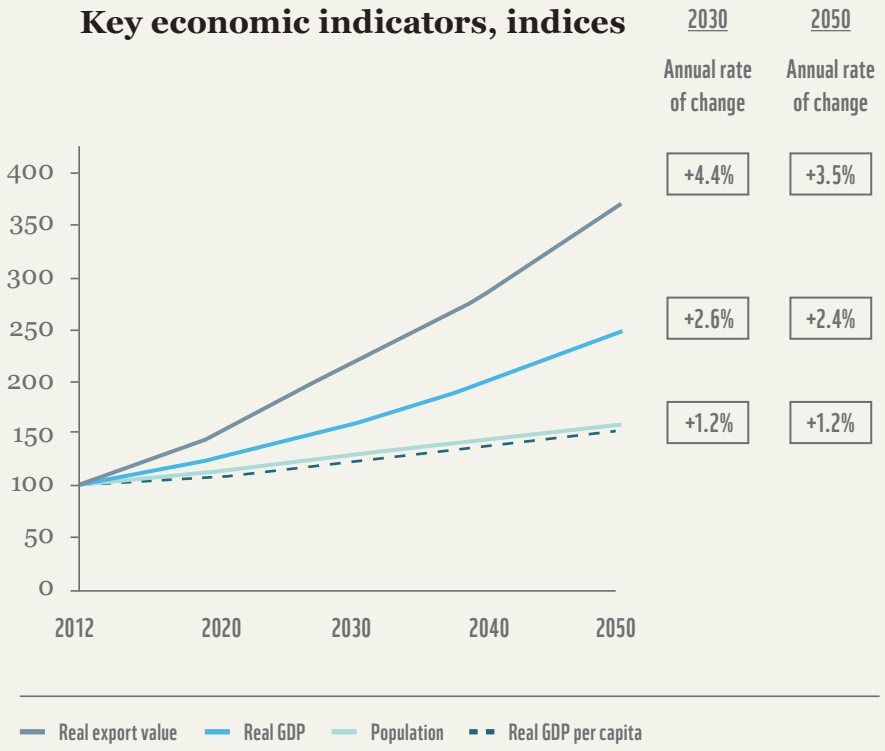
A recent report released by the Australian Government investigating the macroeconomic impacts of different emissions reduction targets concluded that Australia's economy continues to perform strongly (>2% growth) regardless of emissions reduction targets out to 2030.[18]

This result is consistent with findings in many other reports such as Edenhofer et al. (2014), Garnaut (2008), PwC (2013) and Stern (2006), which show that decoupling GDP growth from CO_2 emissions growth is achievable.

As the graph below shows, Australia can decarbonise while real GDP grows at 2.6% per annum to 2030 - similar rates of growth to the past five years

Figure 8: Australia's projected economic performance under a decarbonisation pathway - to 2030 and 2050





Vitally, our economy will not respond well to policy uncertainty. Modelling indicates this leads to inefficient investment decisions in the energy sector due to perceived policy change risk which has a flow on impact of increasing power prices. This supports findings by the Mercer Financial Group in June 2015 which showed that Australian equities are more sensitive to climate policy shock than other regions, given higher exposure of our equity markets to carbon-intensive sectors.[19] Therefore, domestic climate policy is the major driver of the costs of climate action, rather than the level of the emissions reduction target.

It is worth noting that economic models, including the *Pathways to Deep Decarbonisation in 2050* and the McKibbin[20] analysis, do not include examples of many economic benefits which would result from avoiding an increase in climate change impacts over time. These include direct economic effects, benefits from reducing the risk of extreme climate impacts or crossing global tipping points, and non-market values such as protecting iconic ecosystems such as the Great Barrier Reef and Kakadu.[21]

Some sectors change but Australia's overall economic structure remains largely the same

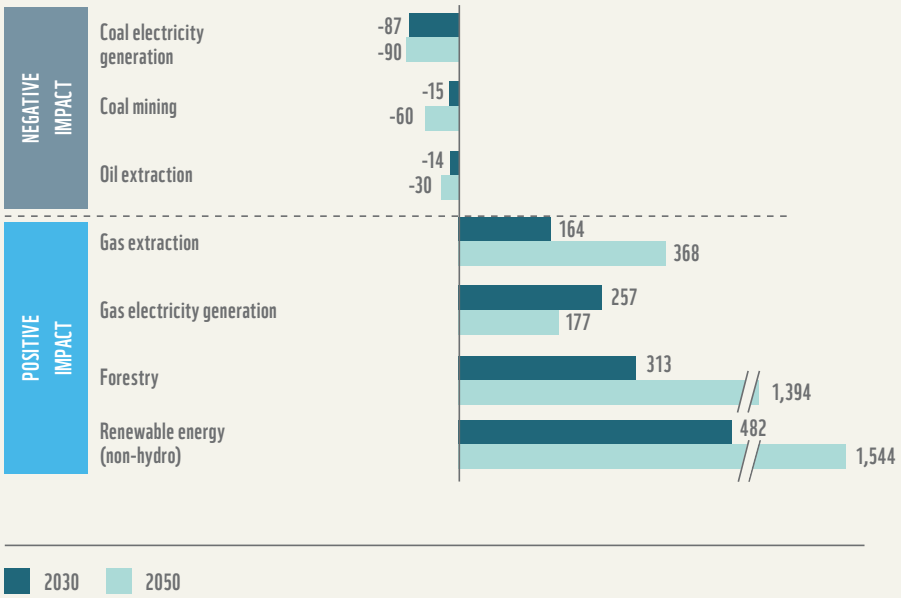
Although the overall structure of the economy is expected to remain largely the same, significant changes occur within some sectors. Some technologies and activities would decline while others rise and contribute to continued economic growth.

Major technological transitions are needed in some industries, but no fundamental change to Australia's economy is required. Primary industries, such as mining, agriculture and forestry are expected to retain a significant share of the Australian economy. The commercial sector can continue to grow at a similar rate to the past four decades. Manufacturing will likely continue to decrease as a share of the economy, however traditional mining and manufacturing continue to grow in terms of real value added.

This is achieved without significant lifestyle changes and includes logical transitions such as retiring polluting equipment and replacing it with clean energy technology. AGL recently reported the useful life of a thermal power plant is 25-30 years and that approximately 20% of current plants in Australia are already more than 40 years old.[22]

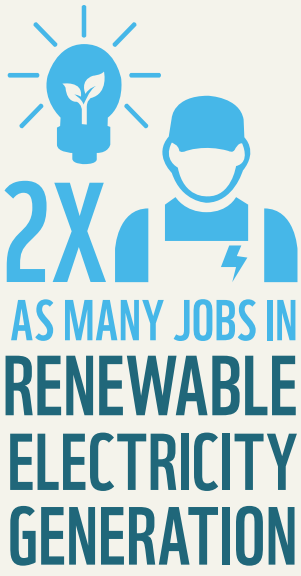
The figure below shows sectors most likely to be impacted in terms of output, both positively and negatively

Figure 9: Percentage change in output from 2012 across sectors (as measured by growth in valued added) for 2030 and 2050



However, the decline in the contribution of some sectors to the Australian economy is largely offset by growth in industries associated with renewable electricity generation and forestry. The usefulness of forestry in offsetting non-energy greenhouse gases could see this becoming a major industry in rural Australia.

Although coal mining would decrease, global demand for minerals needed for the production of renewables - such as lithium - would increase[23], leading to an overall increase in mining production in Australia. In addition to lithium, Australia has an abundant supply of minerals that will be in high demand in a carbon-constrained world, such as rare earth and platinum group elements.



than are lost from the coal-fired electricity generation sector

Australian incomes can continue to rise and jobs can continue to grow

ClimateWorks' *Pathways to Deep Decarbonisation in 2050*, economic modelling showed employment (measured in hours worked) increasing by over 28%. Real wages increase by just under 13% by 2030, as the economy transitions towards net-zero emissions by 2050.

Some sectors contribute less to our economy but this is offset by growth in others, such as renewable electricity generation (excluding hydro).

Twice as many jobs in renewable electricity generation are created than are lost from the coal-fired electricity generation sector.[24]

Significant opportunities for new jobs are likely to be created through decarbonisation. A recent report by the Global Green Growth Institute found that investment in clean energy creates more jobs than the same value of investment in countries' fossil fuel industries[25]. Estimates published under the International Energy Agency (IEA) also suggest that a million euros of government finance invested in energy efficiency could create in the order of 90 jobs. This is over four times more than the number of jobs created by this amount of investment in the US.[26]

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 (in Victoria) presents opportunities for the regional centre to move towards a low carbon economy.[27] 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.

LIFESTYLES CAN REMAIN LARGELY UNAFFECTED AS WE MOVE TO A DECARBONISED ECONOMY

Because deep decarbonisation does not drive major structural shifts to our economy, employment can remain focused on the services sector and industrial sector as it is today.

Given the greatest changes are technological, our everyday needs continue to be met much as they are today. We will notice changes to the source of our electricity but not the availability of supply. We will still heat and cool our buildings but it will be done more efficiently. We will still drive and fly, but we will do it using low carbon fuels.

We could also see societal changes like more widely available public transport, less emissions intensive consumer products and services, smaller houses and greater use of business teleconferencing over business travel - all driven by a combination of social, economic and environmental influences.

There are significant added benefits to decarbonisation

Transitioning to a net-zero carbon economy offers a suite of significant environmental, health, and economic benefits. Direct benefits include improved buildings, transport and infrastructure, electricity generation and land management. For example, more efficient buildings deliver better internal temperature regulation and airflow. Additionally, their electrical systems don't impose carbon monoxide, methane and other harmful fuel-burning particulates on inhabitants. Research suggests these factors improve productivity, reduce absenteeism and improve staff retention.[28]

Increasing the use of domestic resources in our energy systems will boost energy security by reducing the risk of interruptions along the energy supply chain, reducing reliance on oil imports and stabilising energy costs.[29] We'll also reduce risk and uncertainty around variable operating expenditure (associated with traditional fossil fuel power generation) by moving to fixed capital expenditure (such as renewables, where the cost of generation is virtually zero once the infrastructure has been built). This provides greater long-term energy price certainty and fewer price shocks.

We will see job creation around renewable technologies in industries such as construction, deployment, component manufacture and supply, hybrid and enabling technologies and services, and renewable energy prediction and integration services.

Co-benefits will also include improved capital productivity, such as a higher returns on investment produced by energy efficient buildings. Overall productivity also improves through benefits such as greater output for the same number of human hours worked, due to more efficient manufacturing equipment and processes.[30]

Health and social benefits include the avoidance of indirect impacts caused by environmental and ecosystem changes (such as shifts in patterns of disease-carrying mosquitoes and ticks or waterborne diseases) and those mediated through societal systems, where food insecurity could lead to under-nutrition and population displacement which can, in turn, lead to violent conflict.

We can also benefit from avoiding economic losses due to environmental stressors such as heat exhaustion impacts on the workforce and damage to health care systems through extreme weather events, as well as the toll these events take on infrastructure. When we consider the 2007 summer bushfires in Victoria were estimated to have cost the electricity sector alone around $500 million dollars, and Melbourne's 2014 heatwave is estimated to have cost the city's businesses $37 million in lost revenue, the economic case for decarbonisation is also clear.[31]

While not all direct, these benefits each contribute in some way to long-term economic growth, business competitiveness and real per capita income growth; factors that in turn, drive Australia's prosperity.

Reducing fossil fuel driven pollution benefits human health directly through reduced exposure and indirectly through benefits such as a greater focus on active transport (walking, cycling). To exemplify the impacts of fossil fuel pollution, consider the Hazelwood coal mine fires of 2014. Over a 45 day period, airborne particulate matter reached levels 28 times the recommended safe levels causing immediate human health impacts, some of which have persisted.[32]

RENEWABLE TECHNOLOGY IS FAST BECOMING COST COMPETITIVE - MANY ARE CATCHING ON

Faster than expected decreases in the cost of renewables along with growing confidence in their competitiveness has created a 'virtuous cycle', driving further cost reductions and a revolution in uptake.[33] [34] The Bureau of Resource and Energy Economics predicts that renewable energy technology, particularly solar and wind, will continue to fall rapidly in price over the next decade. They project it will be among the lowest cost of all types of electricity generation within 10 to 20 years.[35]

The cost of batteries has recently fallen significantly. Between 2007 and 2014, prices fell an average of 14% per year and research suggests their costs will continue to fall to 2030 .

In 2012, the Australian Government's Australian Energy Technology Assessment (AETA) Report noted the increase in the global production of photovoltaic modules was driving a dramatic drop in the costs of solar photovoltaic technologies.[36]

By the end of 2014, over 1.42 million small-scale residential solar power systems were installed around the country. Australian businesses have installed over 15,000 solar power systems, helping them save a collective $64 million on power bills every year.[37]

Estimates suggest battery storage capacity will be 50 times greater than today, within a decade. Australia's high electricity costs, excellent solar access and growing solar panel coverage set us up to become a major market for battery storage, with the potential to grow into a $24 billion market for battery systems.[38]

Battery technology cost predictions tell a similarly positive story, as the per kilowatt hour (kWh) price for full automotive lithium-ion (Li-ion) based residential battery storage systems is tracking to drop to $US150 per kWh by 2030 (compared with costs of $US600-800 kWh in 2013). Battery technology can play a key role in overcoming intermittency issues for renewables and the performance of electric vehicles. There is already evidence that cost reductions in this technology are outperforming the predictions of industry experts as evidenced through the release of Tesla's Powerwall which have exceeded industry expectations for the cost effectiveness of battery storage in the home.

The 2012 AETA report notes solar photovoltaic and on-shore wind are expected to be among the lowest cost generation technologies (including from traditional fossil fuels) from mid- 2030 onward - around the time much of Australia's generation assets are set to retire. [39] [40]

Further, it stated that biogas and biomass electricity generation technologies are some of the most cost competitive forms of electricity generation today. These technologies are expected to remain cost competitive out to 2050.

More cost effective renewables can then provide a larger proportion of our energy use and make other clean technologies, such as electric vehicles, more affordable. It is anticipated that within two decades, electric cars will achieve price parity with fossil fuel powered cars and that the continued drop in battery storage prices will make household solar PV and battery generated electricity cost competitive with grid electricity by the early 2020's.

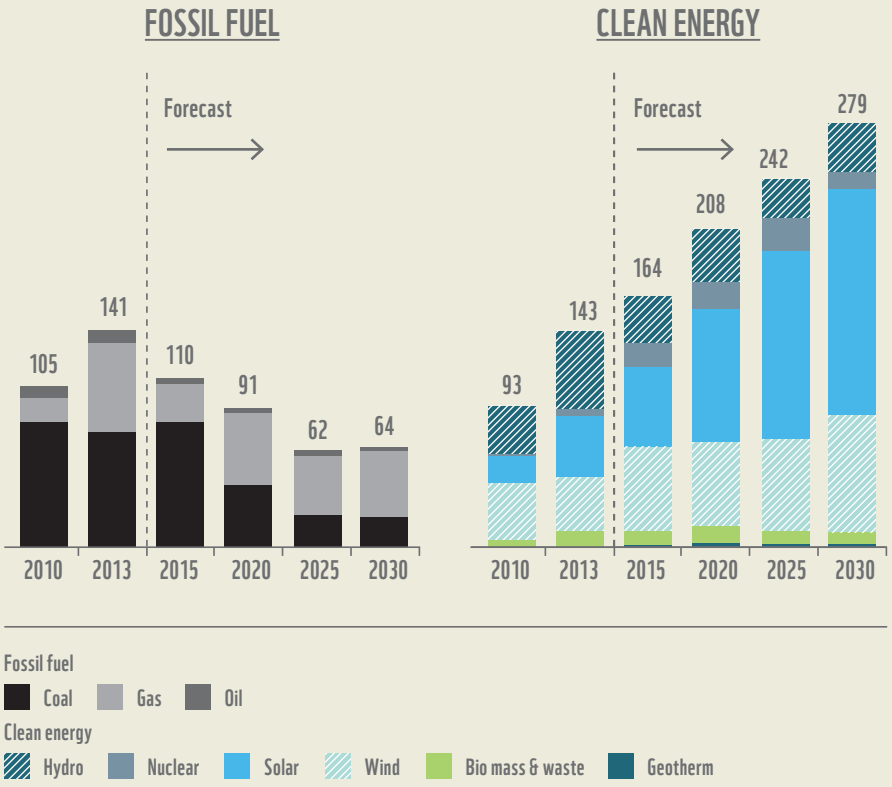
Finally, global investment trends into new capacity suggest a recent dominance of

renewables over fossil fuels. In particular, Figure 10 shows that the world is now adding more capacity for renewable power each year than coal, natural gas, and oil combined. This is expected to continue.

RENEWABLE TECHNOLOGY IS ALREADY PROVING ITSELF THROUGH MANY EXAMPLES

- The King Island Renewable Energy Integration Project has been able to provide 100% of the island's energy needs from renewables for sustained periods by integrating renewable technologies with storage and enabling solutions such as smart devices that shed and restore loads based on customer preferences[41]
- South Australia has exceeded its target to deliver 33% renewables and in 2014, wind and solar energy provided more than 100% of the state's electricity needs for a full working day
- The ACT has committed to 100% renewable energy by 2025[42]
- Geothermal and solar thermal plants have already proven their potential to deliver baseload electricity in the US and Spain
- Renewable energy now delivers 30% of Germany's electricity demand on average, while solar and wind deliver close to 80% of peak demand on some days

Figure 10:
Global power capacity additions, GW[43]



AUSTRALIA STANDS TO GAIN FROM PUTTING IN PLACE THE RIGHT MEASURES AND JOINING THE GLOBAL MOMENTUM

The *Pathways to Deep Decarbonisation in 2050* report indicates we cannot afford to wait: the years between now and 2030 are critical to a smooth transition to a clean economy. The longer that our emissions increase or plateau, the faster the required reductions later on – and the harder and more costly the task would be.

Australia has an opportunity to be a global leader in innovation through investing in science and ensuring effective commercialisation. There are many opportunities for financial return which Australia could pursue if we move quickly, such as renewable energy, technology development and exporting to other countries who favour products from low or zero carbon sources.

Acting now will avoid locking us into another generation of emissions intensive technologies by retiring and replacing them with new assets compatible with a long term transition to net-zero emissions, such as renewable energy generation assets and energy efficient transport systems. We avoid significant additional costs required to address inefficiencies at a later date through retrofitting or early retirement, and the potential of having to rely on emerging technologies before they are fully commercialised or cost competitive. We also play our part to minimise 'future shocks' such as sudden changes to the global political climate, associated with an urgent need to completely decarbonise in order to remain within 2 degrees.

It would also allow Australia to properly prepare for the future by building supply chains, skills and capabilities, developing national, regional and sector transition pathways which identify key opportunities for Australia in the global transition to net-zero emissions, and supporting investment in R&D to fill technology gaps and reduce costs. This could also position Australia to capitalise on emerging opportunities that build on Australia's assets, such as advanced manufacturing powered by clean energy.

By beginning our transition to a net-zero emissions economy now, we build resilience into Australia's economy, and buy options for the future. Strong action now will also provide clear, long term signals to inform investment decisions. Australia will benefit from realising the full value of our renewable and human assets to create an advantage as a low-emissions competitor in a carbon-constrained world.

The global transition to decarbonisation has begun among businesses

The rapid shift to zero carbon growth can be seen in the number of leading global and Australian businesses now taking action. These include Bank Australia, Ikea, Origin, Infigen, BT, H&M, Infosys, Marks & Spencer, Mars, Nestlé, Philips and Unilever signing up to RE100 and We Mean Business (global initiatives driving business uptake and investment in renewables and a low carbon economy). Goldman

Sachs, Johnson & Johnson, NIKE Inc, Procter & Gamble, Starbucks, Steelcase, Voya Financial, and Walmart have also pledged to source 100% of their electricity from renewable energy.

- Worldwide investments in renewable generation capacity tripled from US$100 billion in 2001 to nearly US$300 billion (AU$137 billion - AU$412 billion approx) in 2011[44].
- Since 2007, clean energy investment originating from countries outside the Organisation for Economic Cooperation and Development (OECD) grew at 27% per year while investments from OECD countries grew at 10% per year[45].
- Energy efficiency investments enabled IEA (International Energy Agency) economies to reduce their 2014 fuel import bill by US$80 billion (AU$110 billion), boosting trade balances.[46]

The Sustainable Energy Development Authority Office's in Sydney's business district has installed solar panels on their roof.

Global momentum to reduce emissions is growing across Government

Leading up to the United Nations Climate Conference in Paris in December 2015 (COP21), 140 countries have adopted emissions reduction policies and announced pledges. To date, commitments have often been driven by domestic issues such as the US and China's push for economic growth as well as China's pollution reduction efforts to address serious health issues:

- The United States has implemented its 'Clean Power Plan' which imposes emissions standards on power generation and is enforced through the Environmental Protection Agency (EPA). They have also announced an economy-wide target to reduce their greenhouse gas emissions by 26% below 2005 levels by 2025.
- China has announced plans to launch a nationwide cap-and-trade program in 2017. They have pledged to lower carbon dioxide emissions per unit of GDP by 60% to 65% from 2005 levels by 2030.

Looking at recent comparisons, Australia remains one of the highest per capita emitters globally - even after meeting our current 2030 carbon reduction pledge of 26-28 percent below 2005 levels.[47]

Increasing risks to investing in fossil fuel related industries

We are currently witnessing the fastest growing divestment movement in history[48], with Norway's sovereign wealth fund seeing $900 billion divested from fossil fuels in 2015[49]. With a fortune built on oil, the Rockefeller Brothers Fund has also committed to divest $50 billion from fossil fuels.[50] In Australia, the City of Newcastle Council, whose electorate is home to the world's biggest coal port, has voted to exit holdings in the big four banks if they continue to fund fossil fuel projects[51], while the Australian National University has begun to divest its stock interests in seven mining and resource companies in response to their Environmental, Social and Governance ratings.[52] Recently, the French Government owned Engie (formerly GDF-Suez), which owns Victoria's Hazelwood Power Station, announced it will cease building any coal-fired generators, instead choosing to focus on renewables.[53]

There is also the risk of fossil fuel generation and energy resources becoming stranded assets as a result of market and regulatory changes. This is already beginning to play out in markets such as the US, where the coal industry is estimated to have lost 76% of its value over the past five years and the world's largest private coal company has lost 80% of its share price.[54]

A scientific experiment by scientists from Sydney University, Australia, in the Snowy mountains. The study is monitoring C02 exchange between the atmosphere and the soil on a grassland plot.

UNDERPINNING 2030 EMISSIONS REDUCTIONS

Finally, there are some lessons we can learn from analysis of Australia's emissions reduction efforts to date:

- Price signals offer a powerful incentive and drive activity in sectors which can easily respond to effective price signals. The Renewable Energy Target operates as a price signal in the electricity market while funding support has stimulated activity in companies and households.
- Ensuring stable and sufficient policy drivers and incentives over the long-term is essential. Forestry activities, for example, are a long term investment with high initial capital costs. Uncertainty is a major drag on business and investor confidence in committing to such significant opportunities.
- Regulation is reliable. It has been proven repeatedly that setting minimum standards or requirements, with a clear improvement trajectory over time, leads to ongoing abatement activity.
- Investment is needed in research and development to prepare for technologies that will be needed in the future. Australia not only risks lost opportunity or being caught on a technological back foot through delays to R&D and upscaling technologies to commercial readiness, we also risk losing human resources and innovation assets to foreign investment.

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WWF has over 5,000 staff worldwide

+5M

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