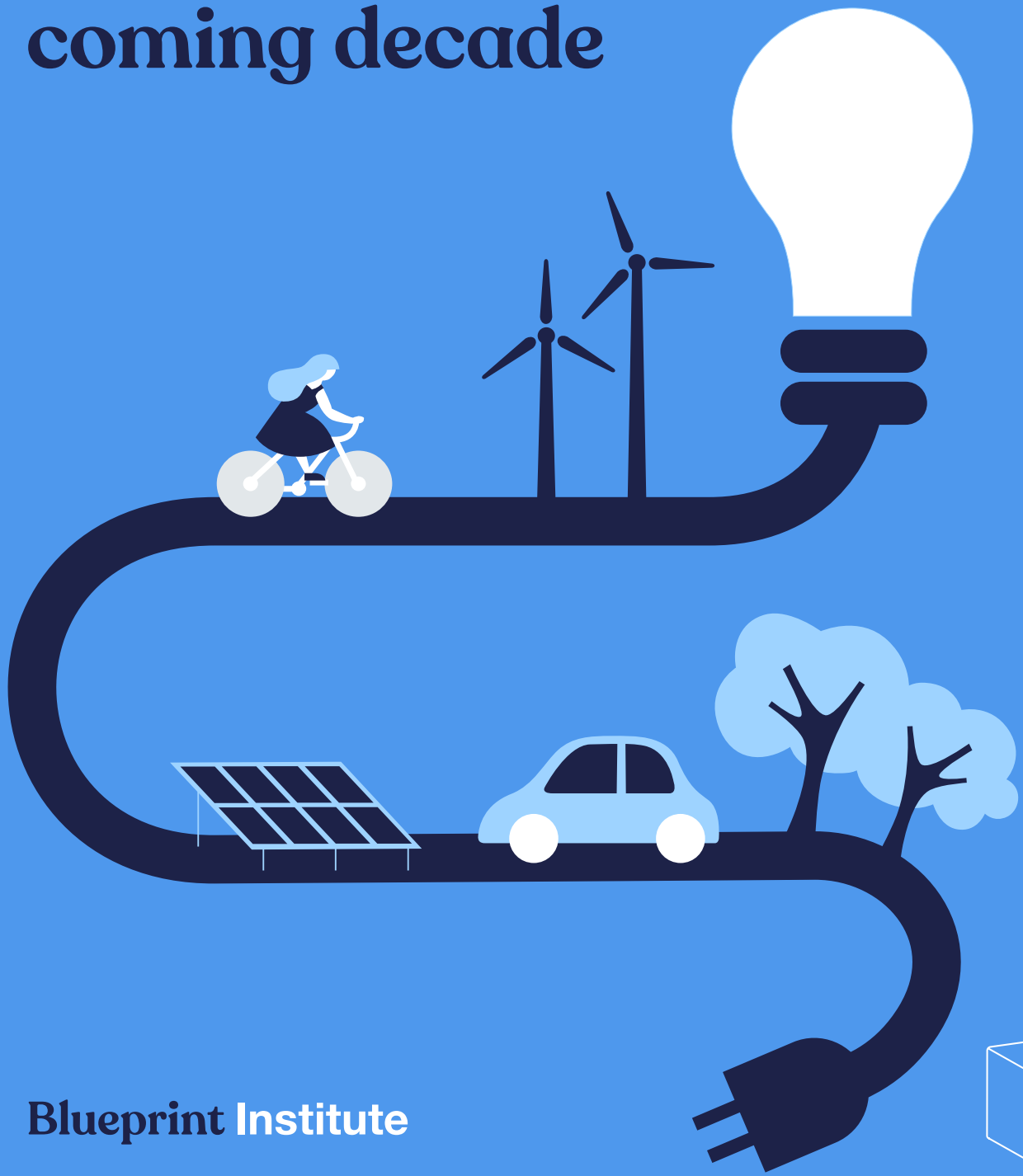
Powering the next boom

Priorities for energy reform in the coming decade



Blueprint Institute

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About this paper

This consultation paper is the first under Blueprint Institute's new energy policy initiative—*Powering the next boom*. It sets out the decarbonisation challenge we face in the decades ahead, and how we might confront it. Under this initiative, we will produce research and analysis on priority reform areas to help get Australia on a path to net-zero emissions. We recently hosted a series of expert roundtables to discuss our research agenda, with an earlier draft of this paper forming the basis of those discussions.

If you would like to comment on this paper, please email admin@blueprintinstitute.org.au with the subject line 'Consultation—Energy Policy' by November 21, 2020.

Acknowledgements

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Guiding principles

Blueprint Institute is guided by the following principles:

- to strive for economically efficient solutions, respecting the power of markets to help drive good outcomes;
- to be conscious of the practical and political realities, which prompt solutions different to those we would advocate in an ideal world;
- to recognise and afford due respect to those who would be harmed by reform, or who face challenges in adapting to the new environment they create; and
- to rely on, and contribute to, a strong evidence base.

Attribution

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Summary

Australia has committed to full decarbonisation by some point this century. But if we don't commit soon to rapidly decarbonise, the decision may be forced upon us. Japan, South Korea, the UK, and the EU, among others, have already committed to net-zero by 2050. China has pledged net-zero by 2060. The Biden campaign in the US has committed to net-zero by 2050 and $2.4 trillion in climate initiatives. Canada has a nation-wide carbon price. Failing to commit soon to net-zero by 2050 will diminish our international standing, and harm our competitiveness.

But a net-zero commitment isn't enough. We're due to reduce our emissions by just 4.2% over the coming decade. On our current trajectory, we will only meet our Paris commitment by using carryover credits from the soon-defunct Kyoto Protocol. We should commit today to meet our Paris target without using our Kyoto credits. This can be achieved by halving our emissions from electricity within 10 years, as the UK did to 2018.

Reforming our energy sector can unlock the economic potential of our abundant natural resources, create new industries, and propel our economy into the future. We will need to overcome barriers to the transition, including disincentives to investment in transmission, the negative impacts on coal communities, and threats to the reliability of our electricity supply. Our goal should be to transition at minimum economic cost.

This consultation paper launches Blueprint Institute's new energy policy initiative—*Powering the next boom*. It sets out the decarbonisation challenge we face in the decades ahead, and how we can confront it.

We canvas five topics critical to this effort:

- **AUSTRALIA'S INTERNATIONAL STANDING.** To protect our reputation and trade prospects, we should meet our Paris targets without Kyoto credits, and commit to net-zero by 2050.
- **TRANSMISSION.** We should remove the impediments to new transmission investment that exist, and accelerate projects that enable reliable decarbonisation.
- **A FAIR TRANSITION FOR COAL COMMUNITIES.** A path to net-zero must receive broad community support, which means supporting those harmed by the transition.
- **CLEANTECH FINANCE.** Further support for energy RD&D and commercialisation can help accelerate global decarbonisation, drive economic growth, and foster new industries.
- **GREEN HYDROGEN.** To unlock our natural advantage in green hydrogen, the Government should advance feasibility studies, pilot projects, and green aluminium and steel.

Electricity is the low-hanging fruit of decarbonisation. The path to net-zero extends far beyond the electricity sector. The Government should also consider investments to support decarbonisation through soil carbon, the lithium value chain, electric vehicles, energy IT, energy efficiency, and conservation and restoration, among others. Our future research will produce evidence-based recommendations to advance these solutions at lowest cost.

Introduction

The warm weather of late has carried with it a distant reminder. The 2019-20 Australian bushfires ignited one year ago. They cost at least 43 Australians their lives, razed over 17 million acres of land, destroyed more than 3,000 homes, and killed more than a billion vertebrate animals. With economic and property losses in the billions, the bushfires are among the most expensive natural disasters in Australian history. The whole nation stopped aghast—for not the last time this year—at the scale of destruction wrought upon us.

It's true that no single event can be pinned on the warming of our atmosphere. Bushfires occurred long before humankind, and they'll continue long after us. But the science is clear that extreme weather events, including bushfires, along with Australia's other old foes of drought, floods, and cyclones, will occur much more frequently and with greater intensity if the earth continues to warm. The bushfires were a stark reminder of what may be to come.

And then came COVID-19. As our nation reels from its biggest shock since World War II, our leaders have quickly refocussed on the here and now. Hundreds of billions have been spent and extreme restrictions on civil liberties imposed to avert dual health and economic catastrophes. Our governments might be forgiven for allowing the coronavirus crisis to distract from climate change. But given the delay in comprehensive action to this point, we don't have that luxury. While the virus spreads across the globe, the globe continues to warm.

Rather than an impediment, we should in fact see the pandemic as a catalyst for change. Leaders in many of our peer nations and major trading partners have pledged ambitious climate action during the crisis. Australia's leaders should harness the sense of community built this year to tackle this other great collective action problem. And they should leverage the fact that many investments in clean energy will generate new economic activity through what is likely to be a long period of subdued employment and wage growth.

New investments hold the promise of a triple dividend. Government spending on climate generates economic activity and jobs today. It lowers carbon emissions, which will lessen the severity of extreme weather events tomorrow. And it drives new industries and trade opportunities.

With capital markets lending at record-low rates, projects with high social returns have become all the more desirable. While some potential projects may not be shovel ready today, a period of subdued activity is likely to persist long after the crisis. Investment in our energy infrastructure can put our idle resources to work for years to come.

If we don't decide soon to rapidly decarbonise, that decision may be forced upon us. For a time, we've been able to trail behind our peers with little consequence for us or global temperatures. But the tide is turning. The UK and Japan have pledged net-zero by 2050, and China by 2060. Canada has an economy-wide carbon price. A Biden administration would spend US$1.7 trillion on climate. Maintaining our heading will increasingly marginalise us.

Australia has a bipartisan commitment to fully decarbonise its economy. An economy-wide carbon price would achieve this at the lowest possible cost. But past policy failures cast doubt over the viability of that path for Australia. Regardless, we will need to achieve the emissions-reduction targets we have committed to, and we should also commit to more ambitious targets. Doing so is in our national interest.

Our goal should be to achieve those targets at the lowest possible cost, while supporting the communities directly affected and maintaining the reliability of our electricity supply. The path of least resistance would be to halve electricity emissions in a decade, as the UK has done. Through our energy work, we will develop a series of blueprints to inform a comprehensive transition plan. We have identified five areas likely to be critical to our decarbonisation efforts, but there are a variety of other promising areas of further study that we are keen to dig into.

Context for action

We need to do more this decade

For the 800,000 years prior to industrialisation, atmospheric carbon dioxide (CO_2) had never risen above 300 parts per million. Over the past 170 years, it has skyrocketed to 415 parts per million. This has already yielded a significant increase in global temperatures. The average global temperature has risen by more than 1 degree since records began in the 19th century, with nine of the ten hottest years occuring within the last 15 years. On our current trajectory, CO_2 concentrations will continue to increase, causing ever more rapid warming.

Strong action to reduce carbon emissions is clearly in our interests. Failing to further reduce greenhouse gas emissions will see an increase in global temperatures of 4.3 degrees by 2100, compared to preindustrial levels. Fulfilling existing commitments is still not enough; under current 'nationally determined contributions', warming is still expected to reach 3 to 4 degrees by the end of the century.

We need to take decarbonisation seriously to avoid the worst effects of climate change. Reaching net-zero by 2050 gives us a chance to limit the temperature rise this century to 1.5 degrees. If we miss that target, we could still meet the Paris Agreement aim of keeping warming below 2 degrees by hitting net-zero before 2070.

Unmitigated warming will have severe environmental and social impacts. But the economic consequences will be just as dire. The global cost of damage to coastal infrastructure and agricultural land is estimated to exceed US$9.87 trillion by 2050. Australia will bear a particularly heavy cost. Unmitigated climate change is already expected to reduce Australia's economic output per person by 0.64% over the next decade—three times the output of the Australian dairy industry. And this is set to rise more than tenfold by 2100.

In Paris in 2015, 196 parties—including Australia—committed to reduce emissions to limit global temperature rise to well below 2 degrees above industrial levels. While imperfect, the Paris Agreement offers our best chance to avoid the worst impacts of climate change. If the world acts to meet its Paris targets, we will avoid much of these economic consequences. Under these targets, Australia's economic output per person will be only 0.53% lower by 2100 due to climate change. The economic case for Australia to do its part to address climate change in line with its Paris obligations is clear.

While reducing carbon emissions will come at a cost, moving too slowly may decrease the competitiveness of our goods and exports. If Australia decreases emissions more slowly than other nations, we risk damaging our international standing. This may constrain our capacity to exercise soft power in the Asia Pacific at a time of strategic uncertainty for the region, and exclude us from signing free-trade deals with nations committed to net-zero. A failure to act weakens our credibility with our Pacific neighbours, for many of whom rising sea levels are an existential threat. The Government has stated the Pacific is a key diplomatic focus; credible action on climate change can be another tool to improve relations and advance our strategic interests.

Furthermore, as other nations accelerate their decarbonisation, they may begin to put pressure on their trading partners to do their fair share. This could entail the introduction of carbon tariffs and a rapid decline in demand for carbon-intensive exports. The EU, for example, has shown interest in introducing a carbon tariff at its border to meet emissions-reduction goals. Other countries may follow suit. Our three biggest export markets, China, Japan, and South Korea, collectively accounting for half our total exports (and 62% of our coal exports and 96% of our iron-ore exports), have all committed to net-zero—China by 2060, and Japan and South Korea by 2050.

Consumer preferences are changing, too. Customers are increasingly concerned about their carbon footprint, which has translated into commitments by corporations to bolster their environmental credentials. Carbon neutrality is now viewed as a competitive advantage. Apple is a prominent mover, committing to be 100% carbon neutral in both its supply chain and products by 2030. The company already utilises significant recycling, with all its major devices released in the past year including components made from recycled content.

Net-zero pledges by China, Japan, and South Korea sound alarm bells for our coal exports

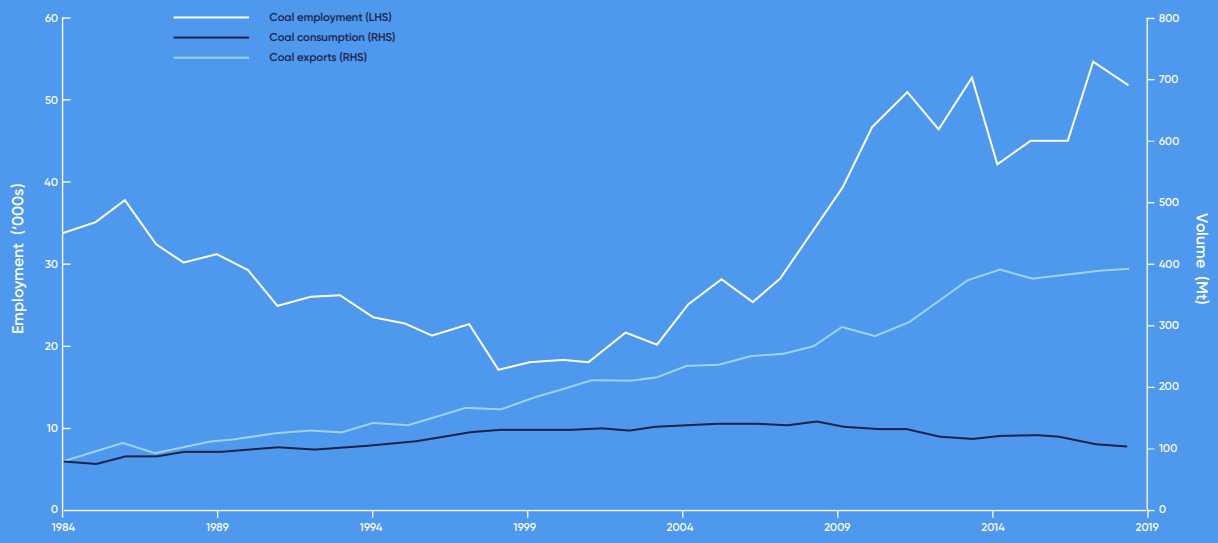
China's declaration that it will achieve net-zero by 2060 should be of particular concern to Australia. While this might be viewed with some scepticism, the boldness of the commitment portends a grave future for our coal exports. A fall in our coal export volumes would have significant economic consequences. The value of our coal exports fell from $70 billion to $55 billion between 2018 and 2019, and is expected to fall further to $38 billion in 2020 due to a collapse in demand during the crisis. But even that level amounts to almost 2% of our national economic output.

Chinese companies have reportedly received notice to stop importing Australian coal, which is worrying given a quarter of our coal exports go to China. The recent pledges by Japan and South Korea to achieve net-zero by 2050 are similarly concerning given they together import more than a third of our coal exports.

The surge in coal-sector employment over the past two decades has been driven by the boom in our exports (see Figure 1). Prior to that boom, coal-sector employment had declined gradually despite rising domestic coal production, driven mainly by labour-saving technological progress in mining. The vast majority of coal jobs are not tied to our domestic consumption of coal—instead, their viability will be determined by the willingness of our trading partners to continue to buy Australian coal.

The role of thermal coal, used in electricity generation, is likely to decline globally over the next two decades. But changes are also occurring in steelmaking and other industrial processes, which raises uncertainty about the future for metallurgical coal. Significant investments in clean technologies, such as green hydrogen, could see metallurgical coal displaced as an industrial feedstock in the decades ahead.

A decline in domestic coal mining seems inevitable in the years ahead. Neither side of politics has set out a plan to transition up to 50,000 coal workers to new occupations as demand for our coal declines. Doing so is critical to any net-zero pledge.



Even if clean metal products have a cost premium in the short term, this is likely to be reduced or eliminated in the future; carbon-neutral metals will likely reach cost parity between 2030 and 2040. The major cost drivers that will make green metals cost competitive are the price placed on carbon dioxide and the cost of green hydrogen. In turn, the price of green hydrogen is driven by the cost of electricity, which is expected to fall as renewable generation grows. This underlines the value in Australia investing in green hydrogen—not only for its direct export potential, but also as a feedstock to increase the share of our iron-ore value we capture domestically.

How Australia is tracking

Under the Paris Agreement, Australia has committed to reduce our emissions by 26–28% below 2005 levels by 2030. After the agreement was ratified in 2016, emissions rose until 2018. The Government projects that our emissions will fall by 4.2% between 2020 and 2030 (see Figure 2). These same projections show that we'd instead need to reduce our emissions by 15.4% to meet the lower bound of our Paris target.

This undershooting of our projection relative to our Paris commitment is made possible by the use of carryover credits from the Kyoto Protocol (due to end this year), reflecting the degree to which we exceeded our Kyoto targets. Our emissions-reduction task when using these credits is made easier by the modesty of our Kyoto targets relative to those of many other countries, and the fact that our Paris target is measured in reference to 2005, a strong year for our emissions. Our carryover credits more than cover our additional emissions reductions required over the next decade.

Australia saw strong growth in renewables investment between 2017 and 2019. If this trend were to continue, the growth in renewables would go some of the way to closing the gap between our projected emissions and our Paris target (without Kyoto credits). Continuing reductions in the cost of renewables would provide further support for new investment. But further growth in capacity may also put downward pressure on electricity prices, which would slow new investment. Further, as we note later, the regulatory arrangements governing new transmission infrastructure represent a significant barrier to new renewables investment. And the 15% reduction in emissions required to meet our Paris target (without Kyoto credits) would require additional renewables capacity to replace well over half the capacity currently provided by coal generation, which is significant. Regardless, a substantive policy intervention will be needed soon in order for us to meet our Paris target without using Kyoto credits.

But the more important question is not whether we could use Kyoto credits, but rather whether we should. The moral case is not clear cut. On the one hand, an increase in emissions isn't in the spirit of the overall agreement. On the other hand, the emissions reductions we achieved in excess of our Kyoto commitments have contributed to lowering the stock of global emissions, which is what matters for the climate.

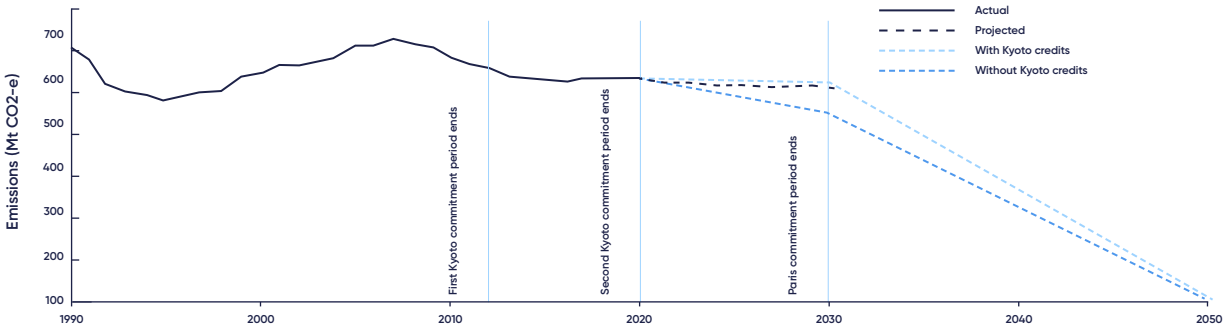


Figure 2 Australia's emissions 1990-2030, with projected paths to net-zero (with and without Kyoto credits)

Source Department of the Environment and Energy; Blueprint Institute analysis.

Note The "Without Kyoto credits" extrapolation plots a linear emissions trajectory from 2020 to 2030 that hits our lower-bound Paris target of a 26% emissions reduction on 2005 levels by 2030. The "With Kyoto credits" extrapolation adds to this additional emissions that would be allowed given our 411Mt "overachievement" under Kyoto, apportioning it between 2021 and 2030 to achievea maximum linear emissions trajectory.

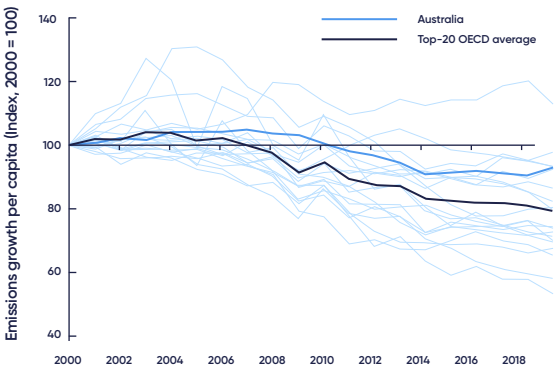


Figure 3a Growth in per-capita emissions, 2000–2019, Top-20 OECD by per-capita GDP

Source European Commission, Joint Research Centre.

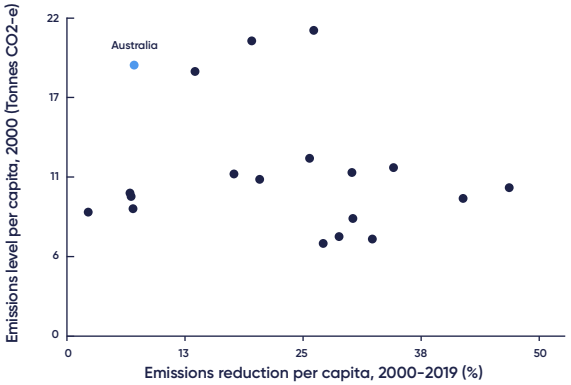


Figure 3b 2000 per-capita emissions vs emissions reduction in 2000–2019, Top-20 OECD by per-capita GDP

Note Figures include the top-20 OECD nations by per-capita GDP in 2018. Figure 3b excludes Iceland, the only such nation for which per-capita emissions rose in 2000–2019.

But there are much more important strategic and economic issues to consider. Our international standing depends not on our emissions offset by carryover credits, but rather on the tangible actions we take to lower emissions in the coming decade. It's not in our strategic interests to be a global laggard on climate change. Our capacity to execute free-trade agreements, as we have done so successfully in recent years, could well become contingent on our emissions-reduction efforts.

At this stage, we're lagging behind our peers. Most other rich, developed nations achieved much larger reductions in per-capita emissions over the past two decades (see Figure 3a). We began the new millennium as one of the world's highest per-capita emitters, and we will end its first two decades having made among the least progress (see Figure 3b). Over the 2000–2019 period, Australia's total per-capita emissions were higher than every other advanced nation other than Luxembourg, a country of 600,000 people occupying a land area roughly a fifth the size of Sydney (see Figure 4). Over that time, our per-capita emissions exceeded even those of Canada and the US, the other two global outliers.

Our use of carryover credits simply delays the inevitable. The debate today is about how and when we reach net-zero, not if. If at some point we commit to net-zero by 2050, as our peers such as Japan, South Korea, and the UK have done, then a further decade of inaction will only make that task more urgent and thus more costly. As it is, we're due to have abated just 13% of our emissions over the two decades to 2030; to hit net-zero, we'd need to abate the other 87% of our emissions over the two decades to 2050. Instead, we should get our economy onto a shallower glide path as soon as possible.

It's true that there may be some economic benefit to delaying the transition due to uncertainty over technological advances. But, equally, there is uncertainty over how bad the implications might be of domestic and global inaction on climate change. Regardless, none of this would justify a less-than-5% reduction in emissions over the decade to 2030. And yet this is how we're tracking.

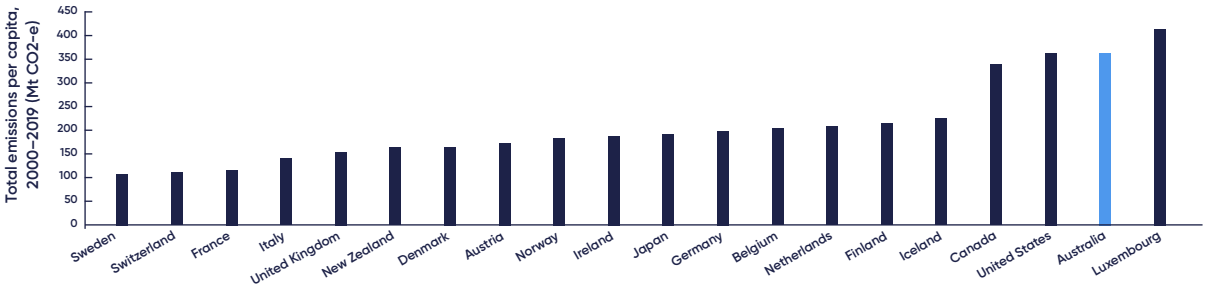


Figure 4 Total per-capita emissions 2000–2019, top-20 OECD countries by GDP per capita

Source European Commission, Joint Research Centre.

Australian climate change policy to date

RENEWABLE ENERGY TARGET (RET)

From 2001–2020, the scheme required energy retailers to purchase a certain share of their energy from renewable sources, both large and small scale. The Second RET Review (2014) concluded the schemes were "effective in reducing emissions (at reasonable cost)". However, this same review noted that it was unlikely to achieve the 2020 Large-scale Renewable Energy Target (LRET). In 2015, the Australian Parliament legislated a reduction of the target from 41,000GWh to 33,000GWh in 2020, with interim and post-2020 targets (out to 2030) adjusted accordingly.

THE PHOTOVOLTAIC REBATE PROGRAM (PVRP)

The first rooftop solar subsidy was introduced in 1999 and allocated $10 million to provide up to $8,250 to households installing an accredited system (the average cost of a solar system was about $15,000 at the time). By 2009, these subsidies cost more than $800 million per year. They were replaced in 2001 with increased support under the RET, which decreased proportionally as solar costs fell. State governments provided additional support.

CLEAN ENERGY ACT 2011

A carbon pricing mechanism was introduced in 2011 before being repealed in 2014. Under the policy, the nation's top 500 polluters were required to purchase 'carbon units' from the Clean Energy Regulator to cover their emissions. The price of a unit started at $23/t with unlimited units available (making it initially a carbon tax), but the scheme was set to transition to a cap-and-trade system in 2015. Large sectors of the economy, such as road and air transport, were excluded. And large numbers of permits were granted for free as industry assistance. Revenue was used to fund income tax cuts and support for R&D, among others. The mechanism was repealed in 2014.

EMISSIONS REDUCTION FUND (ERF)

Replacing the carbon pricing mechanism from 2015, the ERF uses 'reverse auctions' to pay businesses to reduce their emissions or to purchase emissions reductions. To date, the ERF has secured 200 million tonnes of abatement for $2.4 billion in the 11 auctions held, and 42% of the pledged reductions have so far been delivered. Given its limited budget, the ERF tends to support low-cost projects—primarily by avoiding land clearing, tree regeneration, and using methane waste gas from landfill for energy. The Morrison Government has committed almost $2 billion in additional funding over 15 years to the ERF.

SAFEGUARD MECHANISM

This mechanism is intended to ensure abatement funded by the ERF isn't offset by increased emissions elsewhere. It applies only to very large facilities, and caps emissions at a pre-ERF baseline level (with a more generous baseline applying to the electricity sector). The system generates an explicit price for emissions that exceed baseline levels, with the requirement to purchase and surrender credits to achieve emissions targets. In 2020, the limits will switch from total emissions to emissions intensity (expected emissions per unit of production), allowing for increased pollution without penalty so long as it matches production.

TECHNOLOGY ROADMAP

Released in September 2020, the Roadmap outlines five priority technologies and economic stretch goals to reduce the cost of decarbonisation: hydrogen production under $2 per kilogram; long-duration energy storage (6–8 hours or more) dispatched at less than $100 per MWh; low carbon materials—low emissions steel production under $900 per tonne, low-emissions aluminium under $2,700 per tonne; CCS—$CO_2$ compression, hub transport, and storage under $20 per tonne of CO_2; and soil carbon measurement under $3 per hectare per year. The Government has stated it expects to invest more than $18 billion in low-emissions technologies over the decade to 2030.

The energy transition

All sectors will eventually decarbonise. But most of our carbon abatement measures to date have focused on the energy sector. This is because it accounts for the largest share of emissions, those emissions come from relatively few sources, and zero-emissions alternatives are available at fairly modest cost. So far, the move to lower-emissions energy sources has mainly offset what would have been an increase in emissions due to growing electricity demand. The share of the energy sector in total emissions has remained fairly stable over more than two decades despite bearing a disproportionate share of the abatement burden (see Figure 5).

Coal has dominated our energy mix for decades. The share of coal generation peaked at 84% in 2001 before declining to 56% by 2019 (see Figure 6). Coal generation peaked in absolute terms in 2008-09, declining thereafter following a series of coal plant closures. Tasmania, the Northern Territory, and South Australia have no functioning coal-fired power stations. In NSW, Victoria, Queensland, and Western Australia, no new coal-fired power stations have been commissioned in the past decade.

Large quantities of existing coal-fired generation is scheduled to go offline in the next two decades, and this capacity will need to be replaced. Over 63% of Australia's coal generation will reach the end of its technical life and likely retire by 2040. This amounts to around a quarter of the National Electricity Market's (NEM) capacity in 2020 (see Figure 7a). To replace retired coal generation, meet growing demand, and ensure reliability, the Australian Energy Market Operator (AEMO) predicts we will require at least 26GW (and potentially up to 50GW) of variable renewable generation to be online by 2040—more than 40% of the NEM's current capacity.

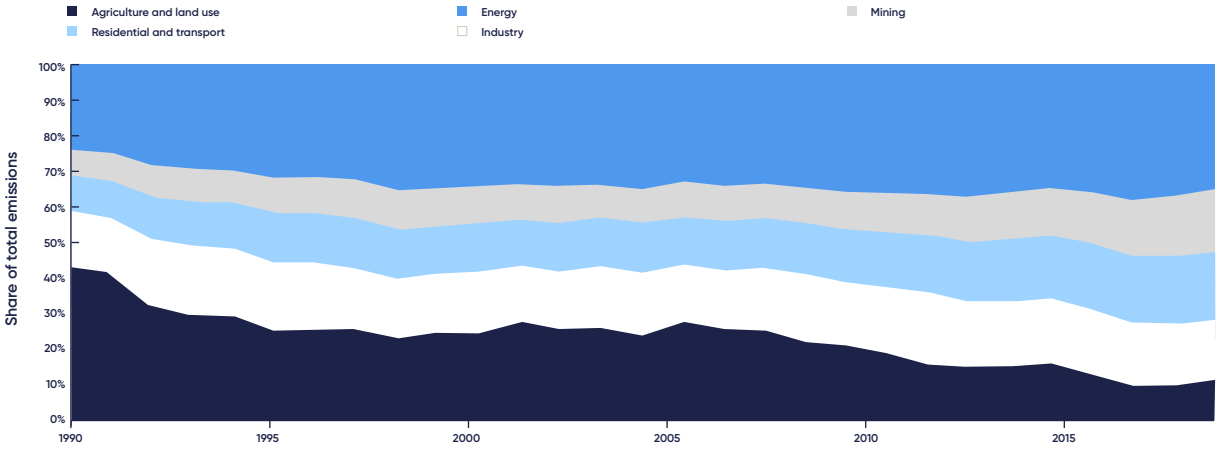


Figure 5 Australia's emissions by sector, 1990 to 2019 Source Department of Industry, Science, Energy, and Resources.

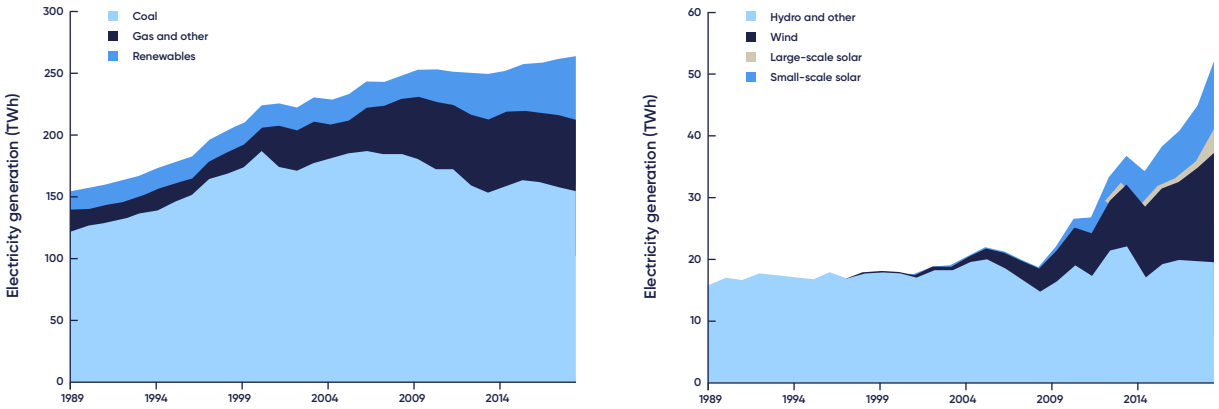


Figure 6 Share of total electricity generation by energy type (left) & total renewable electricity generation (right), 1989 to 2018 Source Australian Energy Update, Department of Industry, Innovation, Science, Energy and Resources.

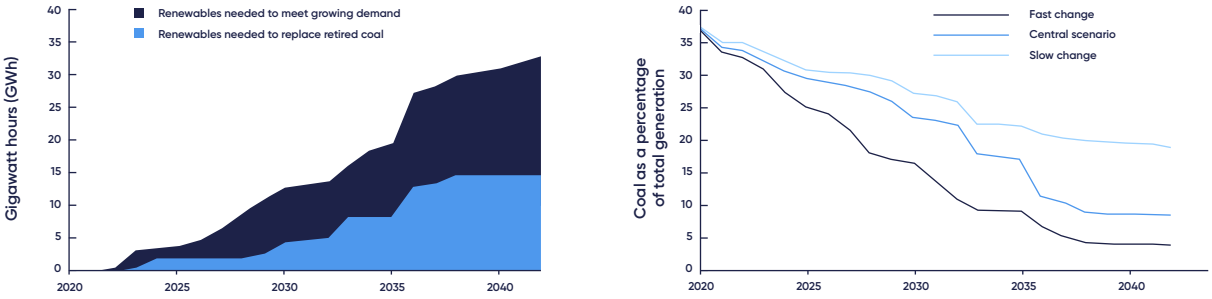


Figure 7 Replacing coal-fired generation with renewable energy, 2020–2042

Source AEMO 2020 Integrated System Plan.

Note In AEMO's modelling, the central scenario is determined by understanding market forces and assuming current federal and state government policy. Thus, without further interference in the market by governments, just under 15 GW of coal generation will retire before 2040. Under the central scenario, 31 GW of renewable generation is required to come online by 2040.

Just over half the reduction in coal's share of energy generation since its peak has been replaced by gas, with the rest coming from renewables (see Figure 6a). Australia has a long history of renewable energy supply via hydro, with renewable generation beginning to grow strongly from 2001 following the introduction of the RET (see Figure 6b). Almost all of this growth came from wind and rooftop solar, but large-scale solar has recently grown in importance. Australia's extremely high solar irradiance means we are ideally positioned to capitalise on the rapidly falling costs of large-scale solar projects.

In 2009, renewables contributed 21% of Australia's total energy generation. Wind provided 7.3% of total generation, solar 6.7%, and hydro 5.4%. In the same year, a record 2.2GW (or 3%) of installed capacity was added through 34 projects, led by rooftop solar. A decade later, by the end of 2019, 101 wind farms provided 35% of Australia's renewable energy generation. Rooftop solar remains immensely popular, with over 2.3 million households installed. For a little over an hour on the 11th of October 2020, South Australia became the first major jurisdiction globally to be powered wholly by solar energy, with 77% from rooftop systems, and 23% from large-scale solar farms.

But as significant as this growth is, it is an order of magnitude less than what is required to decarbonise our grid over the coming decade. Our energy sector on its own can get us to our Paris targets without the use of Kyoto credits. With emissions in all other sectors held constant, we would need to roughly halve our emissions from electricity by 2030. This could be achieved by replacing a little over half of all coal generation with renewables, as shown in the 'fast change' scenario in Figure 7b. This would require a credible commitment by the Government to meet the target. But it would also require a significant planning effort to ensure the various impediments to the transition, including transmission, reliability, and community support, are overcome. If you think this can't be achieved, then think again: the UK reduced electricity emissions by 54.7% between 2005 and 2018 via a near-elimination of coal (see Figure 8).

Were we to succeed in this effort, less than 20% of our energy generation would be sourced from coal in 2030. While the energy sector might offer the lowest-hanging fruit for carbon reduction over the coming decade, subsequent abatement will have to come from other sectors, where the going will be tougher. The transport transition appears to face relatively lower barriers. But the abatement task across industry, mining, and agriculture is likely to be more difficult to achieve, and will require significant technological advances. Government investment in priority technologies, such as soil sequestration and green hydrogen, can help. But much stronger incentives and greater support for green RD&D will be needed to generate greater momentum.

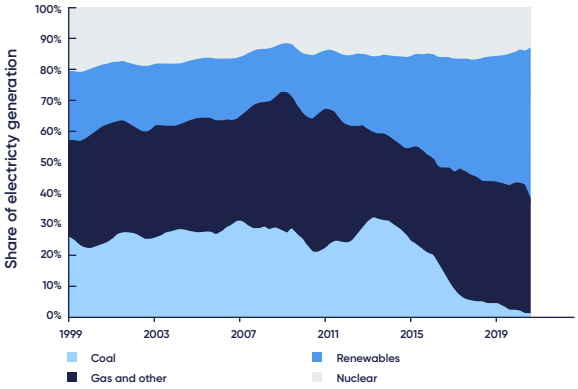


Figure 8 Share of total UK electricity generation by energy type, 1999 to 2020

Source UK Office of Gas and Electricity Markets.

Carbon pricing is the lowest-cost path to decarbonisation

Every measure to reduce emissions puts a price on carbon. Indeed, we have a whole raft of carbon prices, both explicit and implicit, in place today. We can hide the price. Or we can decide who will and will not pay it. But we cannot escape the simple fact that our emissions reductions will come at a price, and someone will have to pay.

In devising a plan to achieve our emissions-reduction target, our goal should be to do so at the lowest-possible price, relying on the tax and transfer system to spread it fairly across the population. There is broad agreement among economists that an economy-wide carbon price, via a carbon tax or cap-and-trade system, is the lowest-cost way to decarbonise our economy.

An economy-wide carbon price provides a uniform incentive to all market participants to reduce emissions. Those able to reduce emissions for less than their cost (the carbon price) will do so; those that aren't will choose instead to pay the carbon price. The result is that the marginal cost of reducing emissions is uniform across the whole economy, ensuring those that can more easily reduce their emissions bear more of the load. Without a uniform price, our emissions-reduction task will be unnecessarily costly.

Carbon pricing is also the least intrusive way of reducing emissions. The Government simply determines the permissible amount of emissions (or under a carbon tax their price) and leaves it up to the market to determine the least-cost way of hitting the target. The Government is not well placed to know where the cheapest emissions-reduction options lie, or the opportunities that might be unlocked by future technological advancements. A carbon price obviates the need for the Government to pick winners—just as in business, the market picks the winner for you.

Carbon pricing is neither new nor radical. As of 2019, 47 countries had a carbon price; 25 with a carbon tax and 40 with a cap-and-trade scheme. The UK is a prominent example, where a carbon price of US$25/t has led to a rapid drop in emissions, primarily via a switch from coal to gas, with coal's share of electricity generation falling from 40% to just 3%.

Canada recently introduced a nation-wide carbon price beginning at US$15/t. The scheme exempts various industries subject to fierce competition, such as steel and chemicals, and is part of Trudeau's plan to reduce emissions to 30% below 2005 levels by 2030—just a little higher than Australia's target without the use of Kyoto credits. 70% of the revenue raised will be returned to consumers to offset the expected increase in power bills.

Carbon pricing with broad economic coverage has twice been tried in Australia—in 2009 and again in 2012—and both times failed to receive enduring political support. Even inferior but systemic solutions, such as the National Energy Guarantee, have failed the political test. An economy-wide solution to climate change won't be possible in Australia without broad community support. And experience suggests a bipartisan approach is needed to achieve durable policy outcomes on contentious issues.

One option for achieving a functional cap-and-trade system would be to build on the existing ERF Safeguard Mechanism, which binds Australia's largest emitters to keep net emissions below their 2016 baseline levels, aided by a tradable permit system. The system could be expanded to cover all or more companies (203 facilities were covered in 2016-17), and the permitted emissions reduced to align with emissions reduction targets.

With or without an economy-wide carbon price, action is unavoidable. There is a stated bipartisan commitment to decarbonise our economy. Doing so in a way that minimises economic costs is in everyone's interest. Further delaying action only raises the price that we will eventually pay. But in the absence of a carbon price, we should seek out the impediments to decarbonisation that exist today, and design "no-regrets" solutions to overcome them, leaving the door open to economy-wide solutions in the future.

Transitioning reliably

Customers might be disappointed if a store runs out of a certain product and they have to wait for shelves to be restocked. But electricity is different. No one is willing to accept the lights going out before dinner, or the air conditioner not cooling the living room on a hot summer day.

With more coal-fired power stations scheduled to go offline over the next two decades, policy makers and energy experts are rightfully concerned about reliability and supply. The vast majority of new generation will be filled by intermittent solar and wind. Gas, batteries, and hydro will all play a crucial, secondary role in 'firming' variable renewables.

Ensuring reliability in the NEM is a complex task. Increasing levels of wind and solar generation are putting pressure on the NEM's infrastructure and processes, which were not designed to handle high degrees of variable renewable penetration. These challenges are not insurmountable. But they do require careful planning, engagement, and reform.

AEMO's Renewable Integration Study showed the NEM could support 75% instantaneous renewable penetration by 2025. And it found no reason why we can't go even higher in the future. Despite concerns that growth in renewables would cause the system to falter in the face of high demand, only 0.1% of outages over the past decade have been caused by a lack of generation capacity on hot days. A much more common cause is failure in transmission networks, which accounts for 97% of outages.

To maintain Australia's recently increased reliability standards—unserved electricity demand is required to be no more than 0.0006%—supply and demand must always be in equilibrium. This can be understood on two scales: resource adequacy (power supply), and frequency and voltage control (power quality).

Frequency and voltage control are conducted on the millisecond level to keep each within firm technical margins. 'Synchronous' generators such as coal, gas, and hydro have typically provided frequency control and inertia services to the grid, something renewables aren't capable of. This has prompted regulatory reform. For example, the primary purpose of South Australia's Tesla battery is to provide instantaneous frequency control services to the grid. Despite being the world's largest lithium-ion battery, if called upon to make up for a drop in supply, the battery has only enough capacity to power 4500 homes for 2-3 hours.

Resource adequacy concerns are harder to solve and require more creative solutions, along with some mundane ones. It's essential that we manage the energy system to ensure adequate supply despite the variability of renewable energy. Both supply and demand must be considered.

At present, energy storage isn't up to the task of ensuring consistent supply. Projects like Snowy 2.0 contribute to reliability in the event of major supply shortfalls, but currently its effectiveness is limited by transmission concerns. This means there is likely to be a 'firming' role for gas while large-scale batteries come down the cost curve.

To ensure generators are adequately incentivised to build firmed capacity at the most important locations (e.g., gas peaking plants or batteries), it may be prudent to revisit whether scarcity and other network constraints and services are adequately priced in the NEM. Such a review may consider introducing more granular pricing rules across the network (to provide incentives for projects to site in the most suitable locations in the network given their generation or storage technology), or an increase in the market price cap in the NEM (so that costs can be recouped if their firming capacity is utilised sparingly).

Regulators are increasingly investigating options for unlocking flexible demand. Providing incentives for energy end-users to reduce their energy use during conditions where the network is stressed can help deliver a more efficient sector and a better ability to integrate large amounts of intermittent renewable energy. The forecast uptake of electric vehicles (EVs) means households may also benefit from policies that

encourage flexible demand; consumers can be discouraged from charging their EV at times of high demand and instead be incentivised to charge them when supply is plentiful.

Adequate transmission infrastructure is essential for a reliable energy system. Built in an era dominated by centrally located coal-fired generation, our transmission infrastructure needs to adapt to the new decentralised generation mix to ensure electricity is available when and where it's needed. High capacity transmission will become an increasingly important part of grid reliability as the geographic diversity of renewable resources is leveraged to stabilise NEM-wide generation. Currently, many Australians with rooftop solar are unable to export their surplus generation due to constrained networks. Viable grid-scale wind and solar projects cannot connect to the NEM in several locations due to a weak network. Additional transmission capacity is crucial to getting electricity from states with surplus generation or storage to regions who need it. Strategic investment in our transmission infrastructure is a prerequisite for grid reliability.

Taking stock

Australia has committed to full decarbonisation of our economy by some point this century. But we should commit today to achieve net-zero emissions by 2050. And we should meet our Paris target by 2020 without using Kyoto credits to get us on a path to decarbonisation right away. This can only be achieved by halving our emissions from electricity within 10 years. Reforming our energy sector can unlock the economic potential of our abundant natural resources, create new industries, and propel our economy into the future. There are barriers to this transition that we will need to overcome, including disincentives to investment in transmission, the negative impacts on coal communities, and threats to the reliability of our electricity supply. Our goal should be to achieve all of this at minimum economic cost. Blueprint Institute intends to conduct detailed research into areas with strong potential to aid the transition. We canvas some of these in the following section. But energy alone will not be enough; we conclude by looking at areas beyond electricity that can help us achieve comprehensive decarbonisation.

Priorities for action

Australia's international standing

- **Commit to meeting our Paris targets without Kyoto credits.** This will ensure that domestic climate policy doesn't harm our international reputation nor our trade relationships.
- **Commit to achieve net-zero emissions by 2050.** This will align us with the commitments made by our major trading partners and international peers, and the direction in which many countries are likely to go in future.
- **Realise the potential for green energy to underpin our energy security.** Renewable energy and green hydrogen, both rapidly falling in cost, offer strong potential to secure our domestic energy supply.
- **Consider strategic benefits of decarbonisation to Australia's role in the Pacific.** Decarbonisation would complement the Government's 'Pacific Step-Up', which recognises our shared interest in a stable, secure, and prosperous region. This is an imperative in key relationships frayed by our perceived inaction and insensitivity to the climate threats facing Pacific nations.

COVID-19 is precipitating a step change in climate commitments. In addition to the usual leadership from Europe, US Presidential candidate Joe Biden has promised to spend US$1.7 trillion over 10 years to achieve net-zero by 2050. Even more significantly, Chinese President Xi Jinping recently announced that China—a country with greater total emissions than the US, Europe, and Japan combined—will achieve net-zero by 2060, which will demand a more rapid decarbonisation than in any other nation. And Japan and South Korea have followed suit, pledging net-zero by 2050.

The EU has outlined that much of its €750 billion Next Generation EU stimulus package will be used for green initiatives consistent with the Paris Agreement and the "do-no-harm" principle of the European Green Deal. The Just Transition Mechanism will mobilise at least €150 billion to support communities adversely affected by the transition. France just announced €30 billion in green spending—a third of its stimulus—on energy efficiency, green hydrogen, and low-emission vehicles.

As our peers intensify their climate action despite the costs, they will become increasingly intolerant of free riders. The EU is planning to legislate a carbon border adjustment mechanism in 2021 to minimise the risk of carbon leakage—where companies transfer production to countries with less strict emissions reduction policies. In the US, the Biden campaign has promised carbon adjustment fees or quotas on countries failing to meet their climate obligations, and pledged to condition future trade agreements on partners' commitments to meet their enhanced Paris targets. In our region, a Biden Presidency may mean the rekindling of US involvement in the Trans-Pacific Partnership Agreement on trade. Given recent commitments from Korea and Japan it's entirely possible that participation could be contingent on action on climate change. Being frozen out of a reworked TPP would be catastrophic for our export industries.

Climate contingent trade access makes sense for our major trading partners; ambitious domestic climate policy means little if companies move operations offshore to pollute at will. Decarbonisation of our electricity grid will be important to ensure the competitiveness of Australian manufacturing, industry, and other goods in the new world order.

Australia has secured an impressive suite of free-trade agreements over the past two decades, directly benefiting Australians and advancing our strategic interests. If we are to continue to grow our trade partnerships, we must face up to our international commitments. We cannot afford to be viewed as a laggard on climate change. This issue is likely to impact Australia's ongoing free-trade talks with the EU given their aforementioned commitments.

In addition to potential threats to our trading relationships, inaction on climate change also threatens our diplomatic standing with our immediate neighbours. For many Pacific nations rising sea-levels are an existential threat. Failure to show meaningful intention to reduce our carbon emissions will hold back our plans for greater regional leadership.

Pressure to decarbonise is also increasingly coming from businesses keen to protect their own future profits from climate risks and from consumer backlash. Concerns about climate change and sustainability are growing amongst powerful consumer groups, whose investment and spending decisions ultimately determine a company's success or failure. But there is only so much businesses can do independently of government. Without national coordination to reduce the carbon footprint of industry, the competitiveness of Australian businesses may suffer in international markets.

Transmission

- **Reform the Regulatory Investment Test—Transmission (RIT-T).** Expedite a review of the RIT-T, incorporating carbon emissions into the decision calculus. This would be the simplest and cheapest way to fast-track transmission infrastructure.
- **Speed up the environmental approval process.** The Government should streamline environmental approvals for transmission infrastructure projects (but not weaken the environmental approval process itself) by combining the state and federal approval processes and providing additional resources.
- **Form a government entity to coordinate and fund transmission expansion.** A government-owned corporation, endowed with the right objectives, could overcome market failures in transmission arising from network effects, the lack of a carbon price, and cumbersome and slow regulatory processes.

A key barrier to a clean and reliable energy transition is that much of our transmission infrastructure will need to be replaced or upgraded to support it. To minimise transmission costs, every transmission project must pass a RIT-T intended to select "the [most] credible option that maximises the present value of net economic benefit to all those who produce, consume and transport electricity". But the current RIT-T is too narrow. Emissions reductions and other social benefits brought about by a new line aren't considered. In contrast, the criteria used by Infrastructure Australia include social and environmental criteria alongside economic considerations.

The RIT-T also results in long lead times, taking 1.5 years on average. And other regulatory barriers, including environmental approvals, add a further 2.5 years on average after a RIT-T is passed. The Government has expressed interest in fast-tracking environmental approvals for priority infrastructure projects, and transmission should form part of any effort. The Commonwealth and state environmental decision processes could be combined. Regardless, the agencies running approvals need to be adequately resourced.

A third layer is community consultation and planning. There is a power imbalance between landowners and governments, and rushing that process could engender a feeling of disempowerment, as occurred in Western Victoria, where farmers have voiced discontent with transmission upgrades. Community support will be critical to maintain momentum in the transition.

Much of the new renewable generation will be built in Renewable Energy Zones, which requires coordination of generation and transmission investment. A generator may not commit to funding a new line to support a single project, and a transmitter might not want to commit in case the additional generation fails to materialise. A transmission partnership between a generator and transmitter would be obligated to allow subsequent generators to connect without contributing to the cost. This issue is a focus of the Coordination of Generation and Transmission Investment (COGATI) reforms under consideration by the Australian Energy Market Commission.

Urgent redesign of transmission coordination and the RIT-T process is needed to allow the market to build transmission in a timely manner. An alternative would be for the Government to establish a corporation to coordinate and fund critical transmission infrastructure directly. If endowed with the appropriate incentives, it could operate outside the RIT-T approval process without inflating costs. This could hasten the construction of priority transmission lines outlined by AEMO. The entity could rely on open tenders to minimise costs.

In his 2020 Budget reply speech, Federal Opposition Leader Anthony Albanese committed $20 billion to fund the AEMO's Integrated System Plan under Labor's 'Rewiring the Nation' initiative. But the proposal is light on detail. A more modest investment, spent more efficiently, is likely to be sufficient to ensure the necessary transmission investment over the next 10 years. It's also prudent to minimise risk to taxpayers. Unfettered public funding of the entirety of AEMO's priority transmission infrastructure raises the spectre of white elephants. Investments should be limited only to those that cannot be delivered expeditiously by the private sector. Finally, minimum requirements for locally made inputs are an expensive and inefficient means of supporting Australian jobs that will ultimately burden taxpayers or electricity consumers.

The Federal Government has made commitments to support transmission, recently authorising the $1 billion Grid Reliability Fund administered by the CEFC. The Government also recently announced $250 million to progress three key transmission lines: the Marinus Link, Project Energy Connect, and VNI West Interconnectors (see Table 1). This funding is welcome, but it does not address the key barriers holding back our energy transition. More comprehensive action is needed.

TRANSMISSION LINE	GOVERNMENT SUPPORT	COST ($B)	EXPECTED COMPLETION
South Australia System Strength Remediation	N/A	0.166	2021
Western Victoria Transmission Network Project	N/A	0.370	In two stages, by 2021 and 2025
QNI Minor	$102 million underwritten by Federal and NSW governments.	0.218	2021–2022
VNI Minor	Unknown.	0.137	2022–23
HumeLink	$2 billion underwritten by Federal and NSW governments.	2.730	2025–26
Project EnergyConnect	Up to $250 million.	2.587	2024–25
Marinus Link		4.102	Conditional
VNI West		2.250	Conditional
Central-West Orana REZ	$5 million committed via ARENA towards $16.2m feasibility study.	0.850	2024–25

Table 1 Government Support for Priority Transmission Projects

A fair transition for coal communities

- **Provide generous financial support to those directly affected by the transition.** Financially supporting the workers and communities affected during the transition is the right thing to do. But it would also help broaden community support for decarbonisation. When job losses result from a significant change in government policy, the Government should offset the dislocation caused.
- **Support job transition and retraining for retrenched fossil fuel workers.** For many communities, a coal plant is the dominant local employer. And many coal-related jobs require specific technical skills that may not be transferable to other occupations. The Government should offer targeted retraining and job search support to displaced workers.
- **Consider the location of existing coal plants in planning renewable expansions.** The development of renewable generation employs a large number of workers during the construction phase. Where feasible, locating renewables in close proximity to existing coal plants offers potential alternative employment opportunities for displaced workers.

The Government has a stated commitment to achieve net-zero emissions, but only at an indeterminate point within the second half of the century, implying a wide range of potential lifespans for the coal industry. Current government policy does not signal a reduction in demand for coal-fired electricity in the near future. Currently, only a single coal plant, representing less than 10% of coal generation capacity, is scheduled to close in the 2020s. But six plants, representing around 50% of coal generation capacity, are scheduled to close in the 2030s.

Bringing forward those closures by a decade, as would be necessary to achieve our Paris commitments without Kyoto credits, would represent a significant change in outlook for the workers and communities affected. The real, direct costs of decarbonisation are not evenly shared. All Australians have shared in the benefits provided by economic booms in coal exports; mining company tax revenues have funded higher public spending and lower taxes, among other positive economic spillovers.

But in many regional communities, coal represents something more than an item on a government balance sheet. In the Hunter Valley and Central Queensland, coal is a critical part of local economies, providing workers who may not have a tertiary education with the means to earn high wages and support their families—as well as the small businesses that rely upon their trade. The loss of a coal plant means the loss of a dominant local employer, and reduced activity for other businesses and workers in the community. If we are to accelerate the energy transition we must also smooth the economic transition for those affected.

We have a moral responsibility to consider these communities as we plan to decarbonise our economy. But they also play an outsized role in our political process. This is particularly true in Queensland, home to more coal plants than any other state (see Figure 9). No plan to accelerate our decarbonisation is politically feasible without support in the electorates set to lose out. Those who gain from decarbonisation are in a good position to compensate the relatively small number set to be significantly adversely affected.

But we must be honest about the prospects for these industries. And we must avoid the temptation to prop them up with subsidies, or use the transition as a front for protectionism. Such moves would be counterproductive and unnecessarily costly. For decades, Australia subsidised its now-defunct car industry, at a cost to taxpayers of $30 billion between 1997 and 2012. Subsidising these industries simply delayed the inevitable—tying workers to a dying industry did them no favours in the end.

Construction of renewable energy can to some degree offset job losses in the short term. Where it would not unduly compromise the longer-term viability of a project, we should consider the proximity to coal communities in planning the placement of new Renewable Energy Zones. The job match between coal and renewables will be imperfect; some job displacement will be inevitable. To support displaced workers, the Government should devote significant effort to retraining, job searching, and provision of generous financial support.

The EU offers a model for how this could be implemented with its Just Transition Mechanism, which will provide €150 billion to support the communities most affected by the transition from 2021–2027. This includes a €40 billion Just Transition Fund to support diversification and productive investments in small businesses, research and development, renewable energy projects, up-skilling and retraining initiatives, job search assistance, and the retrofitting of existing carbon-intensive installations where such investment is likely to lead to emission reductions and support jobs.

Figure 9 Location of Australian coal-fired generators
Source Blueprint Institute analysis.

Cleantech finance

- **Increase energy RD&D.** The Government should build on its committment to refinance ARENA by increasing energy RD&D, in per-GDP terms, to align with comparable OECD nations such as Canada.
- **Boost the Clean Energy Finance Corporation (CEFC).** The Government should provide additional funding to, and lower the required rate of return of, the venture capital arm of the CEFC to drive investment in technologies to support decarbonisation.
- **Clean energy superclusters.** In order to spur energy RD&D, the Government could fund the development of areas for academics, non-profits, and private companies to collaborate on ambitious projects that promote innovation in priority clean technologies.

Research, development, and demonstration (RD&D) has elements of what economists call 'public goods'—there are spillovers onto other firms, with new ideas starting a virtuous cycle spawning yet more new ideas. This means RD&D will be underprovided by the market, justifying government support. ARENA and the CEFC have supported research, development, deployment, and commercialisation in decarbonisation for almost a decade.

There are important breakthroughs still to come in clean technology areas like batteries and green hydrogen. If successful, this could unlock new export opportunities, decarbonise industry, and enable reliable firmed power in the grid as more variable solar and wind resources come online. We welcome the recent announcement by the Government to refinance ARENA with $1.62 billion in baseline funding over the next 10 years. During this period, ARENA's independence should be protected, and funds allowed to roll over if needed.

In the energy sector, Australia's public spending on RD&D is significantly lower than comparable nations (see Figure 10). According to the International Energy Agency (IEA), in 2019 the Australian Government spent just US$75 million compared to an average of US$820 million for other IEA members. Canada, a country with a similarly dominant energy sector, spends four times more on energy RD&D than we do in per-GDP terms.

To improve the effectiveness of existing RD&D spending and 'crowd in' private capital, the Government could establish clean energy superclusters for priority technologies. In 2018, the Canadian Government asked business leaders to collaborate with research institutions and universities to develop 'job-creating superclusters of innovation'. Canada pledged over AU$1 billion to develop these superclusters with matched funding from the private sector. They are expected to increase Canada's GDP by more than AU$54 billion over 10 years.

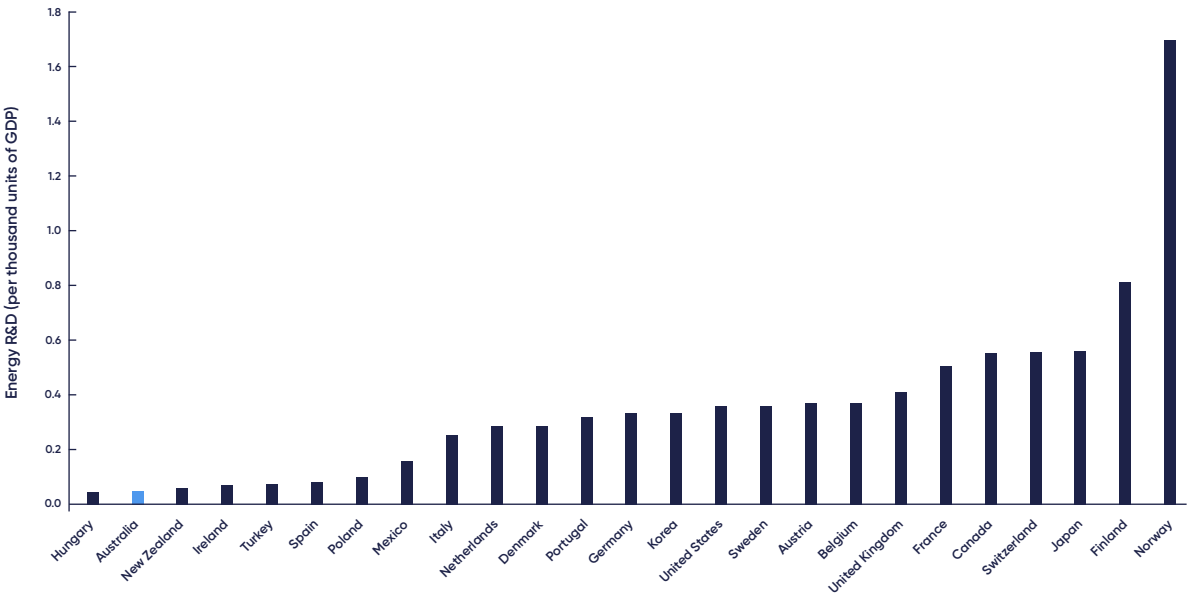


Figure 10 Energy RD&D, Australia vs OECD countries, 2019
Source IEA.

The COVID-19 crisis has precipitated a step change in public spending on cleantech finance. Governments have committed AU$49 billion to clean RD&D as part of COVID-19 recovery efforts. But in Australia, no such additional commitment has been forthcoming. Energy RD&D declined substantially in both 2014 and 2019 (see Figure 11). It's particularly concerning to see a contraction in hydrogen RD&D—an area of intense global interest—from 2018 to 2019. While refinancing ARENA represents a step in the right direction for energy RD&D in Australia, the new funds are not sufficient to bridge this gap. The most recent budget has pledged $628.5 million as part of the refinancing of ARENA and other investments in new technologies over the next four years. This represents just over $157 million per year on average—less than one fifth of Canada's annual spend on energy RD&D as a proportion of GDP.

Commercialisation funding works hand in hand with RD&D. The Government should provide additional funding to the Innovation Fund, the CEFC's venture-capital arm, which currently has $200 million available for equity investments. This 'pull-through' mechanism would complement the Government's Technology Investment Roadmap. Any additional funding could be paired with a reduction in the mandated rate of return (e.g., to a weighted average of the 5-year long-term Government bond rate plus 2–3%, from plus 4–5% currently), and providing greater flexibility for the CEFC to pursue high-risk/high-return investments.

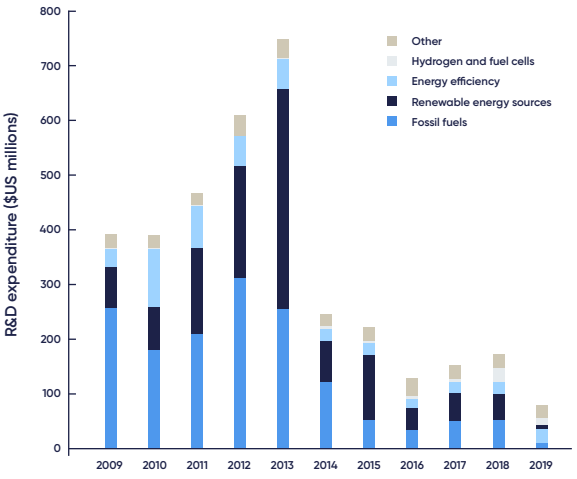


Figure 11 Australian public energy RD&D by spend by energy type, 2009 to 2019

Source IEA.

Green hydrogen

- **Green hydrogen feasibility studies.** The future of hydrogen as an energy vector and store is promising, but uncertain. In order to better inform policy, the Government should investigate hydrogen's potential in the Australian context across a variety of use cases.
- **Pilot projects and market development.** The Government could work with private companies to facilitate deployment of hydrogen in areas where it is likely to have an advantage over alternative fuels.
- **Green aluminium.** Green hydrogen could provide low-cost energy to Australian aluminium producers, increasing their competitiveness in making green aluminium, and unlocking a role for them in modulating demand-response in the electricity grid.

Green hydrogen has featured heavily in international stimulus packages. With one of the world's greatest endowments of renewable energy resources, the economic potential for green hydrogen in Australia is strong—cheap and abundant renewable energy is the biggest driver of cost-competitive hydrogen.

Green hydrogen, which is carbon neutral, could be used to decarbonise transport and heavy industry—two carbon-intensive but difficult-to-decarbonise sectors—to set us on a path to net-zero by 2050. Furthermore, it could open up new opportunities in green steel and green ammonia. Green hydrogen can also help ameliorate trade risks by decarbonising Australia's export industries. This will better position them to compete in a green global marketplace.

In Australia, the areas with the strongest potential for green hydrogen production are in Queensland, Western Australia, and the Northern Territory, on account of strong renewable energy resources and existing trade routes to Asia. Australia could become a supplier of hydrogen to countries aiming to realise a "hydrogen-based society", such as Japan, South Korea, and potentially the EU. The Government's Technology Roadmap is committed to a vision of Australia as a top-three green hydrogen supplier to Asia.

By 2050, according to the National Hydrogen Strategy, an Australian hydrogen industry may generate more than 7,600 jobs and add more than $11 billion to GDP. But there is no guarantee that Australia will capture its potential market share. The race for cost-competitive green hydrogen is well underway. Most notably, Germany has invested AU$14.5 billion in hydrogen and Saudi Arabia has invested AU$7 billion. These recent investments dwarf the Australian commitment of AU$300 million in hydrogen RD&D. To better inform whether further government support for green hydrogen is justified, the Government should commission formal studies of its potential in a range of areas.

Pilot projects might focus on developing and scaling hydrogen applications. One example is hydrogen-powered mining trucks in the Pilbara (Fortescue Metals is already developing such a project). More broadly, the Government could build upon existing support to scale industry efforts to blend green hydrogen into gas networks. By supporting such projects, governments can send a clear signal to the market while the industry is in its infancy, foster the development of new hydrogen applications, and stimulate private investment. Pilot projects could be transformative to Australia's hopes of becoming a world leader in green steel, green aluminum, and green fertiliser. Each of these applications will require technological advances to help them achieve cost competitiveness and scale.

Indeed, cheap green hydrogen could help keep Australian aluminium competitive. We are the world's sixth-largest producer of aluminium, exporting 1.45 million tonnes per annum. The vast majority goes to South Korea and Japan—both of which have committed to net zero by 2050. Australian aluminium producers are currently struggling due to low aluminium prices and high power costs. Green hydrogen could provide clean, low-cost energy that enables aluminium smelters to produce low-carbon aluminium. This will only be possible if we have an aluminium industry that can also capitalise on our comparative advantage in green hydrogen.

The aluminium industry has called for greater certainty over firmed electricity prices, as well as compensation for their role in modulating 'demand-response' during periods of high consumption. Such moves would recognise the critical role of aluminium smelters in providing stable demand and certainty for electricity generators, help producers to stay viable, and ensure that human capital within the industry is maintained.

Any analysis or investment decision on hydrogen should leverage the Stakeholder Advisory Panel. This panel, established in February 2019, helps to support the Steering Committee of the Government's National Hydrogen Strategy. Its 23 members include a breadth of experts from business, government and academia, providing guidance to ensure that government resources are allocated efficiently. Public investment comes with trade-offs. We cannot invest in every

new clean energy technology, and government involvement can impact private investment and confidence. Governments should keep these trade-offs in mind when considering further commitments to hydrogen.

Public investment can drive down costs and bring hydrogen technologies to maturity. But governments can also send important market signals by simply expressing support for key hydrogen projects and fast-tracking regulatory approvals. This is exemplified by the Federal Government granting Major Project Status to the Asian Renewable Energy Hub, a $50 billion hydrogen project in Western Australia's Pilbara region involving up to 26GW of renewable energy generation. The Federal Government's move followed environmental approvals from the WA Government, and received attention across domestic and international media.

Beyond electricity generation

The path to net-zero extends far beyond the decarbonisation of our electricity sector. Electricity generation is the low-hanging fruit. Further decarbonisation will be more costly, more complex, and more dependent on uncertain technological breakthroughs. While an economy-wide carbon price is critical to this further transition, it will not be sufficient. The Government should make investments now to support the decarbonisation of our economy beyond the electricity sector, and beyond the coming decade.

Blueprint Institute plans to conduct research on some of these promising opportunities, including:

Soil Carbon

Soil acts as a store of carbon. Over time, crop cultivation and erosion reduce soil carbon levels. Soil carbon sequestration offers a promising opportunity to reduce emissions and create more arable soil for our agricultural industry. There is growing interest in the technical methods to achieve soil carbon sequestration at scale. The Soil Carbon Research Program, run by the CSIRO, has demonstrated early success by introducing perennial grasses into pasture grasslands. The Government should continue to support steps to measure total soil carbon, and fund RD&D of different storage technologies. This would be an effective hedge against any stalled progress in carbon capture, utilisation, and storage.

The lithium value chain

Australia has natural advantages in a world embracing clean technologies. Because we export lithium as unrefined ore, we capture only 0.5% of the entire value added of the refined lithium used in batteries—nearly four times greater than Australia's annual coal exports. Global consumption of lithium-ion batteries is expected to increase five-fold in the next 10 years. Australia has a significant opportunity to capture value from this growing market by expanding its participation in the supply chain. Similar opportunities exist for other minerals, including cobalt, nickel, and rare earth elements—all of which are present in Australia, and will be in high demand as countries invest in clean technologies. While we won't compete at the scale of China, we could consider moving even further up the value chain to produce batteries domestically, which would aid energy security.

Electric vehicles (EVs)

Just 3% of our emissions come from road transport, but a net-zero economy will nevertheless require the full decarbonisation of our vehicles. In addition to carbon pollution, internal-combustion vehicles produce particulates with damaging health effects. As we no longer produce our own vehicles, the Government's role falls to mandating the orderly transition of the vehicle fleet and promoting the development of charging infrastructure. This kind of transition has been managed before with the introduction of unleaded petrol.

Australia is well behind the curve in terms of EV uptake. Just 0.2% of cars on Australian roads are electric, compared to 10.7% in Norway, the world leader. And our charging infrastructure is woefully unprepared for the EV transition relative even to comparable countries like Canada (see Figure 12).

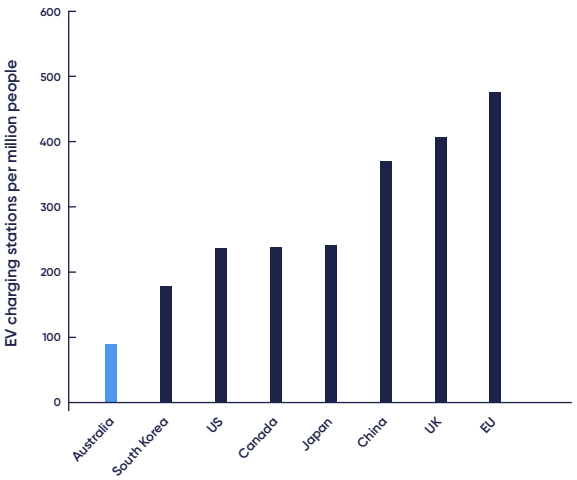


Figure 12 Electric vehicle charging stations per capita, Australia vs select OECD countries, 2020

Source Data has been collated from numerous sources to determine the number of public charging stations in each country. Countries included are those highlighted in the IEA Report: Global EV Outlook 2020. The most up to date data for Australia has been collected from the Australian Electric Vehicle Council. Population Data is taken from the World Bank.

Energy IT

The Government is rightly concerned with grid security; increased security will not only come from increased generation capacity, but also from intelligent and world-leading energy IT systems. Investments could be made in 'micro-grid' technologies and virtual power plants to capitalise on Australia's expansive household rooftop solar penetration, making it simpler for Australian consumers to commoditise the excess energy they produce while improving grid reliability. Investments in such technologies could be coupled with improvements in cybersecurity. This would be consistent with the Australian Energy Sector Cyber Security Framework, and would help to protect the grid against interference from sophisticated state and non-state actors.

Energy efficiency

Energy efficiency measures have formed a key part of countries' stimulus packages, such as in France, and in Australia following the Global Financial Crisis. Climate Council and AlphaBeta have found that government support for retro-fitting buildings for energy efficiency could help create 15,000 jobs as part of a green recovery from COVID-19. Some have claimed that it would be a cost-effective stimulus measure. On the other hand, some energy efficiency policies have been shown to have an annual rate of return of -9.5%, despite positive projections from engineering models. Any policy to drive energy efficiency must avoid inefficient and costly outcomes, as well as policy mistakes of the past. It's worth exploring how an energy efficiency policy might best be implemented.

Conservation and restoration

Reforestation, forest restoration, and afforestation can achieve multiple benefits—combating desertification and land degradation; improving land conditions and value; and ameliorating salinity, wind erosion, and biodiversity decline. But the potential for carbon mitigation is also significant, estimated at up to 10 Gt CO_2-e per year—around twice the annual emissions of the US. Reforestation and afforestation projects are rightly included in the Federal Government's ERF; in 2017-18, more than 60 per cent of all Australian Carbon Credit Units were issued to projects involving revegetation. Australia should continue to expand the success of this program and champion the further use of carbon credit schemes to advance reforestation at home and abroad. With Australian unemployment approaching 10%, there are opportunities for job seekers to engage in conservation and restoration efforts that advance environmental protection. These programs offer opportunities for people receiving welfare to learn new skills and contribute to their community.

Blueprint Institute