



CLIMATE
CHANGE
AUTHORITY

Economic Recovery, Resilience and Prosperity after the Coronavirus

JULY 2020



Australian Government
Climate Change Authority

Published by the Climate Change Authority

www.climatechangeauthority.gov.au

© Commonwealth of Australia 2020

This work is licensed under the Creative Commons Attribution 3.0 Australia Licence. To view a copy of this license, visit <http://creativecommons.org/licenses/by/3.0/au>

The Climate Change Authority asserts the right to be recognised as author of the original material in the following manner:



© Commonwealth of Australia (Climate Change Authority) 2020.

IMPORTANT NOTICE – PLEASE READ

This document is produced for general information only and does not represent a statement of the policy of the Commonwealth of Australia. The Commonwealth of Australia and all persons acting for the Commonwealth preparing this report accept no liability for the accuracy of or inferences from the material contained in this publication, or for any action as a result of any person's or group's interpretations, deductions, conclusions or actions in relying on this material

Acknowledgements

The Climate Change Authority consulted widely as part of the report *Prospering in a low-emissions world: An updated climate policy toolkit for Australia*, which was released in March 2020. The Authority received 67 written submissions and held meeting with individuals from over 50 organisations that provided the foundations of the analysis for this report. For the purposes of this research report, further consultation was conducted in May and June this year to seek input from government agencies involved in the stimulus response and with a cross section of industries and civil society affected by the crisis (Appendix B).

The Climate Change Authority would like to thank the many individuals and organisations who participated in consultations and contributed time and expertise to this report. These contributions have improved the quality of the report and provided evidence to help inform the Authority's findings. The views expressed in this report are the Authority's own and should not be taken as the views or positions of any of the stakeholders listed in Appendix B.

Contents

Acknowledgements	2
Contents	3
Executive Summary	4
1. Impacts of COVID-19 and paths to recovery	7
2. Economic stimulus framework for a sustainable recovery	10
3. Economic stimulus measures	14
Appendix A – About the Authority	23
Appendix B – Public consultation	23
Appendix C – Evaluating stimulus attributes of the updated climate policy toolkit	24
References	32

Executive Summary

Australia's swift emergency response to the start of the COVID-19 pandemic, based on the advice of scientists, chief medical officers and other experts, has been one of the most successful in the world. Governments, businesses and communities are working together to minimise the impacts of the pandemic. Field hospitals were rapidly installed, manufacturers have pivoted to produce medical supplies and researchers are working on a vaccine. Across the country Australians are adopting physical distancing and enhanced hygiene practices. Education has switched to home-schooling when appropriate and workforces have adjusted where they could. The Government has acted to preserve the fabric of the Australian economy, maintaining employee-employer relationships and keeping Australia ready to rebound once the worst of the pandemic has passed.

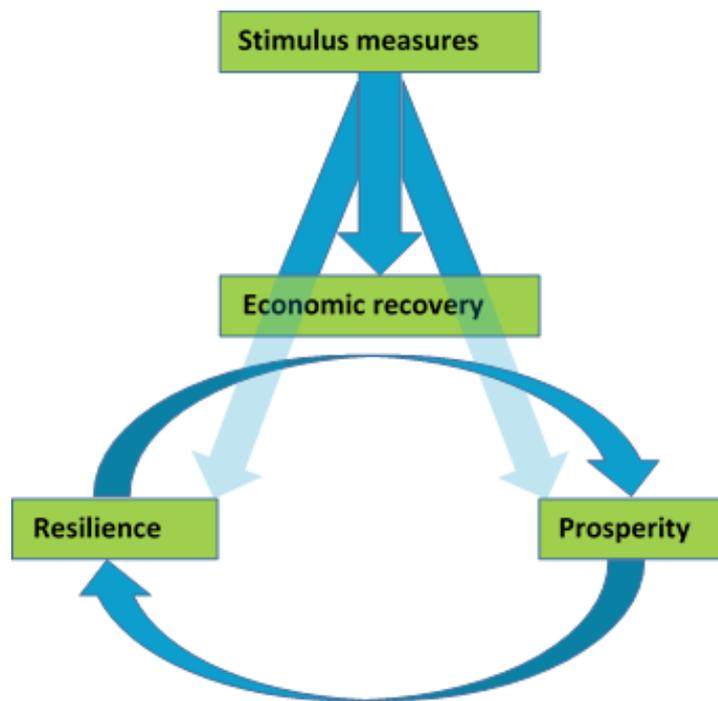
Tragically, lives have been lost due to the virus. Australia's actions to prevent its spread are saving many more lives, though these actions come with unavoidable costs. The Government's \$259 billion emergency response was effective in sheltering Australians from the initial impacts of the economic downturn. However, many people have lost their jobs, businesses have been forced to close and industries have been curtailed by the disruption of trade routes. Gross Domestic Product could decline by around 8.5 per cent in the June quarter 2020 and the unemployment rate hit 7.4 per cent in June, the highest it has been since November 1998.

Some emergency response measures remain in place and vigilance must be maintained to ensure the risk of further spread of the virus is managed appropriately. The Government is now also considering and implementing the next phases of its economic policy response. Measures such as HomeBuilder and the JobMaker plan are being put in place to jump-start the economic recovery. As the Treasurer has said, the economic stimulus involves a "significant increase in Government debt which will take many years to repay".

A stimulus package of this magnitude offers a once-in-a-lifetime opportunity to not only jump-start Australia's economic recovery but also set Australia up to prosper for generations to come. By taking account of risks and opportunities in sight, stimulus measures could build Australia's resilience to the economic impacts of a changing climate and position Australia to take advantage of our abundant clean energy resources and emerging low-emissions technologies. It's a "win-win-win" opportunity for economic recovery, resilience and prosperity in a low-emissions world.

Furthermore, a triple-win stimulus package could stimulate a virtuous cycle for Australia's future. The more prosperous the economy, the greater our capacity to enhance resilience, and the greater our resilience the better placed we are to maintain our prosperity in the face of difficult challenges.

Australia's successful emergency response to the initial outbreak and the ongoing efforts to suppress the spread of the virus have been made possible through co-operation between the Australian Government and state and territory governments. The decision to establish a new National Federation Reform Council (NFRC) around the National Cabinet provides a great opportunity to coordinate national efforts for successful economic recovery, resilience and prosperity, now and into the future. The Government's forthcoming Long-Term Emissions Reduction Strategy, for example, is an opportunity to coordinate state and territory transition plans and industry roadmaps within a cohesive framework. Cooperation between levels of government, government agencies like the Clean Energy Finance Corporation (CEFC) and the private sector also provides opportunities to leverage co-investment and bolster the potential productivity benefits of a triple-win stimulus effort.



Investments for short-term economic stimulus can have long-term consequences. Long-lived assets, including infrastructure, will need to contend with a changing climate and new technologies and/or changes in global demand could render them obsolete in a low-emissions world. The Government’s Technology Investment Roadmap, informed by future industry pathways, could help guide strategic investments to ensure we avoid investing in assets that risk becoming stranded. Australian Government agencies have begun using the Climate Compass framework (CSIRO and DoEE 2018) to identify and manage climate-related risks in decision making about government programs and assets. This framework could be applied in the development of strategic economic stimulus investments.

Despite the immediate challenges of the pandemic, business groups consulted for this report have emphasised the continuing importance of longer term, strategic considerations relating to the global transition to net-zero emissions. They noted these considerations remain an important priority in their immediate decision making, and welcomed the direction offered by government strategies such as the Technology Investment Roadmap.

Importantly, sustainable economic investments could offer substantial economic returns for government spending. For example, there is potential for investment in energy efficiency to deliver up to \$20 billion in financial savings by 2030 and improve the health and productivity of people who live and work in a built environment.

The Climate Change Authority’s report, *Prospering in a low-emissions world: An updated climate policy toolkit for Australia*, contains a number of recommendations that could contribute to the three pillars of a triple-win economic stimulus package: **recovery** through rapid employment and economic activity in regions and sectors that need it most; **resilience** by targeting activities that build and strengthen Australia’s resilience to future economic shocks; and **prosperity** by investing now in activities and pathways that will lead to prosperity for future generations. The opportunities that exist across six key areas are summarised below and discussed further in this report. The suggestions range across a wide array of instruments available to Government to support business and household-led activity, such as taxation measures, regulatory changes, research and development support, co-investment and outright investment.

Boosting jobs and reducing costs with energy productivity

Energy efficiency programs can be deployed rapidly, through tax and grant incentives, targeting low-income households and small businesses, and with fast-start jobs in labour-intensive sectors like construction and manufacturing.

Energy productivity improvements can reduce power bills at a time when business revenues and household incomes are under pressure.

For Government owned and leased buildings, energy efficiency investments reduce energy related budget expenditure.

Transitioning to clean, reliable and affordable electricity

Solar and wind generation have strong employment and economic activity benefits, and can be rapidly deployed in regional areas.

Accelerating investment in major network infrastructure and in technologies such as batteries and pumped hydro to firm variable renewable electricity will boost jobs and support the development of renewable energy zones.

With our excellent solar and wind resources, clean energy will be fundamental to Australia's export success, and can help underpin our prosperity in a low-emissions world.

Supporting the growth and competitiveness of our industries

Electrification and industrial energy efficiency projects can be deployed quickly in regional areas and sectors affected by recent job losses.

Circular economy projects could deliver job prospects in the near term and improve supply-chain resilience in the longer term.

Long-term benefits will flow from support for innovation in harder-to-abate, emissions-intensive, trade-exposed industries, and for industries with low-emissions goals, targets and pathways.

Investing in electric vehicles

Investment in electric vehicle charging infrastructure on highways and regional routes would remove barriers to uptake, could be rapidly deployed and will create jobs.

Targets for government electric vehicle fleets could accelerate national uptake, leading to lower ownership costs, grid firming and improvements in air quality.

Enhancing agriculture and natural environments

A CEFC equivalent for the land sector and integration of programs across jurisdictions to deliver multiple benefits could allow projects to be deployed rapidly.

Measures to incentivise multiple benefits on the land can encourage access to diverse revenue streams and enhance resilience.

Fostering innovation, technology, research and development

Increased funding for innovation and research and development, including partnering with industry and researchers, can contribute to stimulus.

Stimulus could be deployed rapidly through ARENA and CEFC and create jobs, including in universities severely affected by the COVID crisis.

The Government's Technology Investment Roadmap is intended to set out priorities to leverage Australia's competitive advantages.

1. Impacts of COVID-19 and paths to recovery

How COVID-19 is affecting Australia

The coronavirus pandemic is estimated to lead to the biggest fall on record in Australia's Gross Domestic Product (GDP) (Frydenberg J 2020). Physical distancing and isolation measures have reduced people's working hours. Businesses—particularly those in hospitality, retail, arts and entertainment and tourism—have temporarily closed as a result of the physical distancing rules that were imposed and some industries experienced disruptions to their supply chains.

A recent business indicator survey by the Australian Bureau of Statistics (ABS) revealed that overall, 74 per cent of actively trading businesses in Australia reported they were operating under modified conditions due to the coronavirus pandemic. This was much higher in the accommodation and food services (92 per cent) and education and training (91 per cent) industries (ABS 2020b). 72 per cent of all businesses reported a decrease in revenue, while only 7 per cent said they experienced an increase. More than half of all businesses reported they had accessed wage subsidies like the Government's JobKeeper or apprenticeship wage subsidy, 16 per cent reported a deferment in loan repayments and 11 per cent reported that they have sought to access additional funding through loans, personal credit lines or their own savings (ABS 2020b).

These conditions are now starting to show in the latest economic statistics.

- The unemployment rate hit 7.4 per cent in June, a twenty-two year high (ABS 2020a).
- Australian retail turnover fell 17.7 per cent in April 2020 on a seasonally adjusted basis. While there was a significant rebound in May, as the COVID-19 restrictions eased, expenditure on clothing and personal accessory retailing, and cafes, restaurants and food services remains well down compared to May 2019 figures (ABS 2020c; 2020g).
- There was a 48.5 per cent decline in cars sales for the month of April (a fall of 36,624), compared to the corresponding month last year – the biggest decline for any month since figures were first recorded in

1991. This was preceded by a 17.9 per cent decline in March 2020. May car sales were down 35.3 per cent compared to 2019 (Martin 2020; Zachariah and Murphy 2020).

- International student arrivals decreased 16 per cent (11,790 student) in March 2020, compared with the same month in the previous year (ABS 2020d).

Even before the pandemic, parts of the Australian economy were struggling. Australia experienced its warmest and driest year on record in 2019 – a key factor driving the past summer's extreme bushfire season. According to preliminary estimates by the Reserve Bank of Australia (RBA), the direct economic effects of the 2019–20 bushfires likely reduced Australia's GDP growth across the December 2019 and March 2020 quarters by 0.2 percentage points, and the indirect effects were much greater. The RBA also estimates that the record severe and prolonged drought has caused a decline in farm GDP of up to 30 per cent since 2017 (RBA 2020a).

The GDP figures for the March 2020 quarter show the Australian economy contracted 0.3 per cent over that period, reflecting the impact of the bushfires, drought and initial impacts of the coronavirus, although the large-scale closure of Australia's borders and imposition of social distancing laws only came into operation in late March 2020 (ABS 2020e). The Australian Treasury expects unemployment to reach around 8 per cent in September 2020 (Commonwealth of Australia 2020).

Notwithstanding the impacts they face, many businesses remain focused on the challenges and opportunities of the global transition to net-zero emissions. These considerations remain an important strategic priority in the immediate decision making of industry groups consulted for this report, as demonstrated by the Minerals Council of Australia's release of its Climate Action Plan in June (MCA 2020).

Private investments in Australian industries, from domestic or international financiers, could contribute to Australia's economic recovery and longer term prosperity. A number of business groups consulted for this report welcomed

government strategies such as the Technology Investment Roadmap for the direction and confidence they could provide. To further build confidence to invest, a number of sectors—including built environment, food and grocery packaging and cement manufacturing—called for industry standards aligned with a low emissions trajectory. Complexity was identified as another barrier to investment. Effective, clear and consistent regulation across jurisdictions was seen by some as a higher priority than deregulation. Business groups also called for improved climate-related information, along with consistent standards and transparency to improve confidence in climate risk management and the future insurability of assets.

Australia's response to the pandemic

To date, Australia's public health response to the coronavirus pandemic has been successful – the country's mortality rate from COVID-19 calculated in June 2020 is one of the lowest in the developed world, at around 4 people per one million of the population. This is much lower than in other advanced economies over the same period, such as the United Kingdom (597 per million), France (447 per million) and the United States (340 per million) (Worldometer 2020).

The Government's initial economic response, particularly the JobKeeper program, has been lauded by some international economists because it has enabled the connection between employer and employee to be maintained during the economic shutdown (Gerber J 2020).

Australia's response to the coronavirus pandemic has demonstrated that it is possible to act swiftly on the latest scientific advice and for Australian governments, the private sector, not-for-profit sector and organised labour movement to work together to achieve outcomes for the public good. The Government was quick to mobilise the expertise and experience of the private sector through the appointment of a business-led National COVID-19 Coordination Commission advisory body. The National Cabinet process involving federal, state and territory leaders facilitated crucial collaboration and coordination across Australia on the immediate health response.

As at 25 May, the Government has committed an estimated \$259 billion in fiscal and balance sheet support, which is equivalent to around 13.3 per cent of annual GDP (Australian Government 2020a).

- For individuals the measures include: the JobKeeper program which helps businesses significantly impacted by the coronavirus cover the costs of their employees' wages up to \$1500 per fortnight for a period of time; the temporary expansion of the eligibility for the existing JobSeeker program and a new, time-limited coronavirus supplement to be paid at a rate of \$550 per fortnight; targeted one-off payments to eligible income support recipients; reduced social security deeming rates and time-limited free childcare support.
- For businesses the measures include - tax-free cash-flow boosts of between \$20,000 and \$100,000 to eligible businesses; increasing the instant asset write-off threshold from \$30,000 to \$150,000 and expanded access to include businesses with aggregated annual turnover of less than \$500 million (up from \$50 million) for a period of time, accelerating depreciation deductions over a time-limited 15 months; a time-limited wage subsidy of 50 per cent of the apprentice or trainee's wage; and a guarantee of 50 per cent to small and medium enterprise (SMEs) lenders to support new short-term unsecured loans to SMEs.

The Government also recently announced one of the first sector specific post-crisis stimulus measures: the HomeBuilder program. The program will provide eligible owner-occupiers with a grant of \$25,000 to build a new home or substantially renovate an existing home where the building contract is between \$150,000 and \$750,000, and where the value of the existing property does not exceed \$1.5 million.

The aim of the program is to assist the residential construction market by encouraging the commencement of new home builds and renovations (Australian Government 2020b). As part of the Government's "JobMaker" plan, \$1 billion has been committed to immediately start work on small shovel-ready priority infrastructure projects identified by the states and territories and an additional \$500 million is earmarked for road safety works. The Government has flagged that there are further investment announcements forthcoming (Morrison 2020).

Australian state governments have also put in place economic measures to assist businesses in the short term. For example, the NSW government has deferred payroll tax for

businesses with payrolls over \$10 million for six months and deferred rents for six months for non-profits and commercial tenants with less than 20 employees (NSW Government 2020). Similarly in Victoria, businesses with taxable wages of \$3 million or less will receive a full refund of any payroll tax paid or payable for the 2019–20 financial year and commercial tenants in government buildings will be entitled to apply for rent relief (Business Victoria 2020).

How COVID-19 is affecting emissions

The societal disruption from the coronavirus pandemic is unprecedented. For communities around the world, normal daily life ground to a virtual standstill. Entire populations have been isolated at home, cars have been left in garages, overseas and other holiday plans have been cancelled and families have quickly had to become “tech-savvy” as school lessons and office meetings moved online.

As a result, new patterns of consumption emerged – demand for basic groceries and online shopping soared and the need for medical supplies increased while demand for some commodities and manufactured products plummeted. The net effect of the physical distancing restrictions in response to the pandemic was a severe contraction of economic activity resulting in an expected fall in global emissions of as much as 8 per cent from 2019, six times greater than the impact of the global financial crisis in 2008/9 (IEA 2020a).

One immediate benefit has been the reduction in air pollution, particularly nitrogen dioxide, which is emitted from vehicle exhaust, and the burning of coal, oil, diesel fuel and natural gas. Cities and industrial areas around the world experienced a substantial drop in levels of nitrogen dioxide as a result of global coronavirus lockdown policies.

For example, in the United Kingdom air pollution fell by as much as 60 per cent two weeks after the nationwide lockdown compared to the same period in 2019, and in New York air pollution dropped by 30 per cent in March compared to the monthly average over the 2015–19 period (Monks 2020).

The World Health Organization estimates that around three million people die each year from ailments caused by air pollution (Lelieveld et al 2015). A recent national study by Harvard University on long-term exposure to air pollution and COVID-19 mortality in the United States found that an increase of only 1 microgram per cubic meter ($\mu\text{g}/\text{m}^3$) in PM2.5 particles¹ in the air is associated with an 8 per cent increase in the COVID-19 death rate (Xiao W, Nethery R 2020). Improved air quality provided a glimpse into what a low-emissions world could mean for improved health and wellbeing.

However, the reduction in emissions from the coronavirus pandemic is likely to be short lived as countries restart their economies after lockdown policies are wound back. Moreover, according to the United Nations Emissions Gap Report, the level of reduction in global emissions resulting from the coronavirus pandemic needs to be sustained every year between now and 2030 if the world wants to limit global warming to 1.5°C above pre-industrial levels (UNEP 2019). This highlights the momentous size of the global decarbonisation challenge and underscores the need for structural changes to ensure lasting emissions reductions.

Preliminary analysis of the impact of the pandemic on Australia’s emissions has found that although there will be a decrease in emissions flowing from reduced consumption of petroleum products used for transport and aviation fuel, demand for electricity, which accounts for around a third of Australia’s emissions, was relatively stable over the period of the pandemic (Australia Institute 2020). Official data on the impact of COVID-19 on Australia’s emissions will be published later this year.

¹ Particulate matter (PM) is a term that describes extremely small solid particles and liquid droplets suspended in air. PM2.5 refers to particles with a diameter of 2.5 micrometres or less. These particles

are so small they can get deep into the lungs and into the bloodstream. There is evidence that exposure to PM2.5 over long periods (years) can cause adverse health effects (NSW Health n.d.).

2. Economic stimulus framework for a sustainable recovery

Effective economic stimulus measures should achieve the desired economic **recovery** in the near term, build **resilience** to future impacts, and set the economy up for long-term **prosperity**.

When designing economic stimulus, governments usually focus on two key questions. First, how quickly and effectively will stimulus measures generate economic activity that creates jobs and utilises existing assets? Second, what effect will the measures have on longer term national income per dollar spent? Researchers from the University of Oxford, including Nobel Prize winner Joseph Stiglitz and leading climate economist Nicholas Stern, have found evidence to suggest sustainable stimulus measures could offer the best economic returns for government spending (Hepburn et al 2020). Some governments, including in the European Union, New Zealand and South Korea, are actively choosing emissions reduction and climate resilience objectives in their stimulus decisions.

In response to the pandemic, Australian businesses have adapted where they can to address the challenges of assisting the direct response to the health emergency, significantly reduced (or heightened) consumer demand, disrupted domestic and international supply chains, interstate border closures and enforced shutdowns.

Despite these immediate challenges, and for many the prospect of difficult trading conditions ahead for some time, business groups consulted for this report remain focused on the challenges and opportunities of the global transition to net-zero emissions. They noted these considerations remain an important strategic priority in their immediate decision making, and welcomed the direction offered by government strategies such as the Technology Investment Roadmap. Several referred to the increasing relevance of climate change policy trends overseas for trade and investment and low- or zero-carbon supply chains for brand value.

Recovery

Recovery is about getting people back to work and businesses back to business. To kick-start economic activity, projects should increase employment, boost economic activity, be ready to start or already established and be capable of being scaled up. When projects are using local supplies, stimulus can flow to local manufacturers. Measures should target sectors and regions where recovery is most needed and expenditure is most likely.

For example, many renewable energy projects in Australia, together with investment in the transmission grid and technologies to firm variable renewable energy generation, could make a strong contribution to economic recovery. According to the Clean Energy Council, bringing forward the pipeline of renewable energy projects could create over 50,000 new direct jobs, help drive down power prices, triple the amount of large-scale renewable energy capacity in the country and stimulate private investment into rural and regional areas where projects are located (Clean Energy Council 2020) (see Chapter 3).

Like the projects themselves, the programs through which they are funded should also be readily deployable. The International Energy Agency (IEA) recently set out several principles for the design and implementation of energy efficiency programs for economic stimulus, including: leveraging existing programs, guidelines and regulatory frameworks; prioritising retrofits and upgrades over complex projects that require planning and development regulation; and reducing complexity by using widely applicable interventions that can be standardised as far as possible (IEA 2020b).

Questions to assess the contribution of stimulus decisions to economic recovery

Recovery

Timeliness: Are projects operational and scalable, ready to commence, and/or can they be fast-tracked?

Employment: Would projects offer strong employment opportunities?

Economic activity: Would projects increase economic activity, for example through the manufacture, distribution, consumption and/or trade of goods or services?

Local: Would projects support domestic production?

Targeted: Would fiscal stimulus be directed where it is needed most?

Resilience

The coronavirus is not the only shock Australia has faced recently or will face in the future. Regions have been impacted by drought and bushfire. Some industries, like aviation, hospitality and tourism, have been affected by the emergency response to the coronavirus and people's choices as they reacted to the measures, and manufacturers have suffered from supply-chain disruption. Producers have been impacted by trade barriers like China's recent import tariff on Australian barley.

Economic stimulus measures could help build Australia's resilience to future shocks, such as the physical impacts of a changing climate and economic impacts of a global transition to net-zero emissions. Managing climate risks effectively and enhancing the preparedness of households and businesses can deliver better health, environmental, economic and social outcomes, and could mitigate the need for future stimulus in certain contexts.

Australians are already experiencing the effects of a variable and changing climate. 2019 was Australia's warmest and driest year on record – a key factor driving this summer's catastrophic bushfire season, which caused widespread loss and devastation to Australian communities and natural ecosystems. At the same time Australians have endured a record severe and prolonged drought. Among developed nations, Australia is one of the most vulnerable to the impacts of climate change (Kompas et al

2018), and as an open trading economy, Australia will also feel the full force of the global transition to net-zero emissions (CCA 2020).

Enhancing our preparedness for future climate impacts—both physical and transition-related—will protect the resilience, health and wellbeing of Australians and help sustain Australia's economic productivity and the natural systems that support us.

Investors, including governments, have a systemic exposure to climate change risk (RBA 2019; IGCC 2020b). In a submission to the Royal Commission into National Natural Disaster Arrangements ('Bushfire Royal Commission') the Investor Group on Climate Change, which represents institutional investors with total funds under management of over \$2 trillion, said:

Climate change and its impacts on bushfires can directly impact the finance system through the consequences of extreme weather on property, infrastructure, agricultural production and other climate dependent industries. It will also have indirect impacts on sovereign credits risks, supply chains, the property market, insurance pricing or wider economic conditions...

...Investment in building resilience is far more cost effective than funding disaster recovery. The longer Australia waits to implement effective adaptation planning and infrastructure solutions to emerging climate change impacts the more expensive it will become to adapt. If governments choose to not address emissions, the viability of adaptation and resilience measures will increasingly become untenable as climate impacts increase and the limits of adaptation are breached (IGCC 2020b).

Australian government agencies have started using the Climate Compass framework (CSIRO and DoEE 2018) in their programs to identify and manage climate risks from the strategic through to operational level. Governments could fully integrate consideration of emissions and climate change risks in decision making about government programs, assets and services (CCA 2020), and apply this approach to economic stimulus measures such as long-lived infrastructure investments.

Information about the impacts of climate change and options for addressing future challenges supports effective decision making and is vital for the preparations Australian businesses and investors need to make (CCA 2020). There is a role for the Australian Government and its science agencies to lead and coordinate the production and communication of Australia-specific climate change information (CCA 2020).

The provision of climate-risk data and the standardisation of climate-risk disclosure will help streamline information, reduce transaction costs and improve efficiencies for the finance sector. It will also help inform lenders, investors and insurers of the material risks associated with climate change and enable them to take strategic steps to diversify away from such risks, protecting businesses, investors and the economy from future systematic shocks (CCA 2020).

Major banks and insurers have recently recruited climate scientists from the CSIRO, the Bureau of Meteorology and universities to help build a comprehensive set of common climate change risk disclosure standards for Australia. The Climate Measurement Standards Initiative will begin by conducting an assessment of the physical risks to residential and commercial property and infrastructure, and could be extended to other sectors in the future (Climate KIC Australia n.d).

Questions to assess the contribution of stimulus decisions to economic resilience

Resilience

Have risks to project delivery and continuance, including **physical and transition-related climate risks**, been assessed and mitigated?

Has the **risk of 'locking-in' assets that could become stranded** in the future been considered?

Would projects have, or contribute, to **supply-chain security** in the longer term?

Would projects **support preparedness** for the changes in climate and associated impacts we know are coming?

Prosperity

Australia can prosper if we plan for the future and take advantage of the opportunities presented by the global transition (CCA 2020). While recognising that much more needs to be done, global action is accelerating and the transition to a low-emissions global economy has commenced. This is a future in which Australia can:

- be a world leader in renewable energy production and exports
- be a manufacturing and export base for energy intensive, sustainable products
- benefit generally from an economy powered primarily by low-cost, clean energy.

Australia's low-emissions industries are already making a contribution to the Australian economy and have the potential to become highly productive export markets and attract strong investment. Australia has:

- abundant renewable resources and expertise in low emissions, clean energy and renewable technology

- potential for and growing expertise in clean hydrogen
- large deposits of lithium, copper, cobalt, vanadium and other minerals critical for batteries and electric motors
- existing and emerging green-tech industries, such as windmill blade and battery production
- expertise in sustainable agriculture and carbon sequestration on the land
- low emissions, climate resilient infrastructure frameworks and knowhow
- water management expertise
- a strong financial services and investment sector with growing climate finance capacity.

An economic stimulus package in response to the devastation of the coronavirus pandemic provides Australia with a unique opportunity to seize the day to grow our economy, increase jobs and reduce our living expenses now and for generations to come.

Questions to assess the contribution of stimulus decisions to economic prosperity

Prosperity

Would projects **support longer term economic activity** in a world facing increasing climate impacts and transitioning to low-emissions?

Would projects contribute to building Australia's **competitive advantages**?

Would projects **prepare workforces and industries** for a future economy?

3. Economic stimulus measures

This chapter highlights how the Authority's previous recommendations can contribute to Australia's post-coronavirus economic recovery and longer-term economic resilience and prosperity (CCA 2020). Additional information is presented in Appendix C.

Boosting jobs and reducing costs with energy productivity

Measures to support energy productivity can boost employment and incomes while offering some of the cheapest ways to reduce emissions and generate financial savings for businesses and households.

Recovery

'Energy productivity' brings together a range of activities that improve the value consumers get from their investment in energy, including energy efficiency, market efficiencies (such as demand-side management) and switching to more efficient fuels. Energy efficiency is a job-intensive industry, employing an estimated 59,000 Australians in 2019. If energy efficiency improvements were pursued across social housing, public buildings and residential and commercial buildings, this could generate more than 120,000 additional jobs (Energy Efficiency Council 2019), deliver savings for struggling households and increase demand for construction and appliances.

Driving energy efficiency through tax incentives would encourage business investment in areas that improve business productivity, reduce costs and provide crucial savings in the medium- and long-term, making business more resilient to future shocks. The Government could look to further enhance existing tax incentive frameworks, for example, by extending the instant asset write-off scheme to all businesses for energy efficiency upgrades, or through introducing an accelerated depreciation schedule for energy efficiency upgrades so businesses can defer their taxable income in exchange for bringing forward investment in

large upgrades that exceed the instant asset write-off threshold. The Government could also consider how it might further support energy-intensive industries and sectors to develop their own 'roadmaps' to low emissions.

Improving household energy efficiency can provide substantial savings for families struggling in the wake of the coronavirus pandemic, freeing up household income for other activities and inoculating them from future price rises (IEA 2020b). There is potential for energy efficiency to deliver up to \$20 billion in financial savings to households, businesses and government entities by 2030 and improve the health and productivity for people who live and work in the built environment (ClimateWorks and ASBEC 2016).

Financial incentives can drive accelerated uptake of energy efficiency in existing buildings by helping to overcome the upfront costs associated with upgrades (CCA 2020). Federal, state and territory governments could work in partnership to deliver targeted programs to improve energy efficiency for priority groups, such as low-income households and small-to-medium businesses, through the provision of additional information, expertise and financial assistance (grants, low-interest loans and tax incentives). Split incentives are a barrier to improving the energy efficiency of private rental properties because benefits accrue to the tenant responsible for paying energy bills, but landlords or building owners make the capital investment decisions. Incentives to upgrade rental properties, potentially tied to tax incentives, could be used to stimulate private sector investment.

Programs could commence rapidly, leveraging existing government measures and regulatory frameworks and providing incentives through the tax system. For example, through the Clean Energy Finance Corporation (CEFC), the Government could continue to work with state and territory governments, and the property and finance sectors, to further incentivise energy efficient, low-emissions homes and retrofits.

The CEFC recently provided \$265 million in debt finance for social housing enterprises to build more than 700 affordable and sustainable homes in Sydney and surrounding regions, retrofit existing homes with energy efficient equipment and appliances and support tenant education programs on how to reduce energy consumption (CEFC 2020).

Australian governments also control a substantial portion of low-income housing stock through public and community housing. Targeted retrofits and steadily rising minimum energy efficiency standards for public housing will benefit low-income householders, who are particularly vulnerable to energy prices, spending up to five times more of their disposable income on electricity than high-income earners.

Pursuing energy efficiency improvements in government owned and leased buildings more generally (for example, hospitals, universities, galleries and government office buildings), can deliver short-term economic stimulus and reduce governments' energy costs over time.

Resilience and prosperity

In 2015, the Australian Government and the Energy Council released the *National Energy Productivity Plan 2015-2030*, setting out a high-level framework and initial steps to attain the target of a 40 per cent improvement in energy productivity by 2030. As COAG noted at the time, *"improving our national energy productivity would be important in delivering greater value from the energy that Australians use. Better energy productivity will boost Australia's competitiveness, help consumers manage their energy costs and reduce Australia's greenhouse gas emissions"* (COAG 2015).

There is scope to reinvigorate the National Energy Productivity Plan. Implementing and accelerating measures to improve Australia's energy efficiency performance offers not only short-term economic benefits but also longer-lasting advantages for both the economy and society. For example, improving the energy efficiency of residential housing will improve the health and wellbeing of Australians (e.g. ACT Government 2019), and measures can be targeted to assist public and low-income housing for the benefit of those more likely to be vulnerable (CCA 2020).

An energy efficient housing stock will ensure we are better prepared for higher average temperatures and weather extremes.

Using energy more efficiently will also help underpin a more productive economy as we transition to lower emissions. The reduction of energy use will lead directly to lower greenhouse gas emissions from energy and lower the cost of transitioning to a low-emissions economy, by reducing the amount of low-emissions energy infrastructure that must be built to replace high-emissions infrastructure (CCA 2020). This takes on even greater importance given the prospect of using ever-increasing amounts of clean energy to support new manufacturing and export opportunities in a lower-emissions global economy.

Transitioning to clean, reliable and affordable electricity

Supporting Australia's post-pandemic recovery through investment in clean, reliable and affordable electricity will lead to jobs and economic activity in the short-term and increase Australia's international competitiveness and income in the medium- to long-term.

Recovery

The supply of affordable and reliable electricity is a critical infrastructure service that underpins economic activity and most aspects of everyday life. Ensuring that electricity prices are as low as they can be will alleviate unnecessary cost pressures on businesses and households, at a time when subdued economic activity is placing significant pressure on business revenues and household incomes, and contribute to a more productive economy on an ongoing basis.

The Australian Energy Market Operator's (AEMO) Integrated System Plan (ISP) sets out the optimal development path for the National Electricity Market (NEM) so Australians can continue to enjoy affordable, secure and reliable energy (AEMO 2020a). Under every scenario modelled by AEMO in the ISP, the NEM's least-cost future features large increases in renewable generation supported by dispatchable generators, large-scale and distributed storage, demand-side participation

and integrating energy consuming sectors like transport and industry with energy production (AEMO 2020b). This outlook is supported by several other analyses (Grattan Institute 2020; IRENA 2020; BloombergNEF 2019).

AEMO's draft 2020 ISP has identified eight priority projects to strengthen the transmission grid requiring investments worth at least \$5 billion (AEMO 2020a). Accelerating these projects would contribute immediate economic stimulus, help maintain electricity grid stability and support the continuing integration and growth of renewable energy generation, in turn generating further jobs and growth.

Investment in the ISP priorities could coincide with accelerated investment in state renewable energy plans and renewable energy zones (NSW Government Department of Planning, Industry and Environment 2020), and in the battery, pumped hydro and other projects required to firm up variable renewable electricity (RBA 2020b). The Commonwealth and New South Wales Governments have already agreed to expedite priority transmission projects in New South Wales through the bilateral NSW Energy Package Memorandum of Understanding (NSW Government Energy 2020).

Federal and state energy ministers could consider options for fast-tracking reforms to facilitate the integration of large amounts of low- and zero-emissions generation and related technologies into the electricity market. They could focus on planning for distributed energy resources, investment in and integration of battery storage and other technologies for firming variable renewable generation, incentivising demand-side response and facilitating timely and efficient transmission and generation investment (CCA 2020). National Cabinet and the National Federation Reform Council (Australian Government 2020c) could provide new opportunities to expedite collaborative decision making on these issues.

Ongoing support for renewable energy projects can deliver several benefits in the context of promoting economic stimulus.

- Renewable energy projects have strong employment benefits and could be rapidly deployed. The ABS estimated the number

of renewable energy jobs at 26,850 in 2018–19 (ABS 2020f). The Clean Energy Council has suggested that if the existing pipeline of wind and solar projects with planning approval were brought forward, it would deliver over \$50 billion in investment, create an estimated 50,000 new direct jobs in construction and generate a further 4,000 ongoing operations and maintenance jobs (Clean Energy Council 2020).

- Projects could target regional areas and generate business for local firms. The RBA recently found that renewable energy investment has generated activity and employment in regional areas, where many large-scale renewable generators are located. In some cases, local content accounts for 25 to 40 per cent of total costs, with local firms delivering engineering, construction and installation services (RBA 2020b).
- Renewable energy projects supported by federal and state government initiatives, such as the CEFC and renewable energy targets, attract considerable private investment, amplifying the stimulus impacts of the public contribution. For example, in 2018–19, on average every CEFC dollar invested across its portfolio was matched by more than \$3 in private finance (CEFC 2019a). In 2018, investment in large-scale renewable energy projects accounted for nearly 5 per cent of non-mining business investment; most from the private sector (RBA 2020b). New investment in large-scale renewable energy projects in 2018 totalled \$10.7 billion (Clean Energy Council 2019).

Natural gas can play a role in the mix of large-scale, dispatchable energy resources required to firm up the increasing share of variable renewable generation in the electricity system. The Government has been encouraging the states and territories to reduce pressure on domestic gas prices by addressing supply constraints, including through the bilateral Memorandum of Understanding with NSW.

Negotiations on such agreements could seek state government funding support for initiatives like the Future Energy Export Cooperative Research Centre, and broaden its scope or

develop new programs to consider improving the efficiency and emissions intensity of not just liquid natural gas export production processes but domestic gas supply chains as well.

Resilience and prosperity

Australia can prosper in a world transitioning to low-emissions if we make the most of our abundant clean energy resources. The electricity sector has already played a role in reducing Australia's emissions, and it continues to be well placed to lead Australia's transition to a low-carbon economy, including through 'electrification' of sectors such as transport and industry.

In its recent Technology Investment Roadmap discussion paper, the Federal Government noted that electricity generation is a crucial sector with linkages across the economy, and demand for lower-emissions sources will grow as global demand for energy increases and countries seek to reduce their emissions (DISER 2020a). In a decarbonising global economy, Australia's clean energy could underpin significant new export opportunities such as hydrogen and low-emissions manufacturing (ANU Energy Change Institute n.d.; CCA 2020). Hydrogen is also an input to the production of ammonia, which has significant potential as a transport fuel, including for shipping.

The Federal and state and territory governments have begun to explore the opportunities that the development of a clean hydrogen industry could present, including through COAG's National Hydrogen Strategy. Hydrogen can be used as an energy carrier and can be made from a variety of energy sources, with the potential for its production to be near-zero emissions (COAG Energy Council 2019c, CCA 2020). The potential for a low-emissions Australian hydrogen export industry relies on Australia's substantial renewable energy resources and potential sites for carbon capture and storage. Several of Australia's trading partners have declared interest in importing low-emissions hydrogen, suggesting that a market could be developed (CCA 2020).

Supporting the growth and competitiveness of our industries

Economic stimulus that incentivises industry to invest in energy saving technologies and incorporate circular economy principles into production processes could generate jobs, increase productivity, provide energy savings, promote localised supply chains and reduce emissions. In the longer-term, Australia's world class renewable energy resources could support the establishment of clean energy-intensive manufacturing industries in Australia.

Recovery

In the industry sector, which incorporates mining, oil and gas, manufacturing and industrial processing, manufacturing is the most significant employer, accounting for almost a million jobs in 2018. Manufacturing contributes significantly to overall employment (8 per cent). Mining accounts for around 2 per cent of Australia's jobs, a significant share of which are located in regional areas (Australian Government 2019).

Electrification and industrial energy efficiency can lead to substantial energy-cost savings, provide energy security and increase productivity. Such projects could quickly deliver jobs in regional areas, including in sectors affected by recent job losses. For example, projects to upgrade commercial appliances, boilers or pumps, fans for refrigeration systems and turbines, and converting equipment to operate on lower emissions fuel, could be quickly deployed and involve jobs to install, upgrade and maintain energy efficient equipment.

The Government's Emissions Reduction Fund (ERF) can support these projects but to date uptake under the relevant ERF methods has been low, in part because they can involve high upfront capital costs that are not immediately offset by carbon revenues.

The Expert Panel examining potential additional sources of low-cost abatement (the 'King review') recently recommended awarding of Australian Carbon Credit Units (ACCUs) under the Emissions Reduction Fund on a compressed timeframe in certain circumstances (DISER 2020b).

The Government intends to consult with stakeholders on the best mechanisms to encourage projects with high upfront costs for various ERF methods (DISER 2020c).

A circular economy approach can support domestic manufacturing with local sources of supplies and employment opportunities in regional areas. Analysts estimate that for every 10,000 tonnes of waste saved, around 9 jobs are created (McCall and Baker 2020, CCA 2020). CSIRO and the Australian Council of Learned Academies have both identified recycling of lithium-ion batteries as a significant opportunity for Australia, estimating that 1 tonne of lithium-ion battery waste has potential recoverable value of between \$4,550 and \$17,252 (CSIRO 2018; CCA 2020). A number of businesses organisations consulted for this report raised the opportunities that circular economy approaches offer in Australia.

Fiscal stimulus could also seek to incentivise private investment in circular economy initiatives in the industrial and manufacturing sectors. The CEFC is already administering a \$100 million Australian Recycling Investment Fund focused on larger-scale commercial and industrial projects in the waste sector (CEFC 2019b). There remains enormous untapped potential for the recycling of metals and high end products like lithium-ion, re-purposing by-product materials generated from mining extraction and production processes (Sustainable Minerals Institute 2017) and creating agriculture and bioenergy feedstock from food manufacturing waste to name just a few examples.

Resilience and prosperity

The coronavirus has thrown a spotlight on Australia's domestic manufacturing capabilities, supply chain strengths and weaknesses and the extent to which we rely upon imports in some sectors. For example, governments' immediate response to the health crisis posed by COVID-

19 needed to address concerns over the availability of personal protective equipment and ventilators.

It is too early, and beyond the scope of this paper, to undertake a detailed examination of the lessons learned from the coronavirus for Australia's industrial sector and the implications for industry policy. However, governments, businesses and workforces positioning our industries to respond to the challenges of the global transition to low emissions will contribute to a more resilient and prosperous industrial sector and economy.

There is the potential for Australia to leverage its clean energy resources to become a hub for low- and zero-emissions manufacturing and processing (CCA 2020). Deployed at a sufficiently large scale, renewable energy infrastructure could allow for low- or zero-emissions energy-intensive manufacturing industries to be established in Australia, or the conversion of existing highly-emitting industrial activities to low emissions.

With low-cost, zero emissions energy, low-emissions steel and aluminium could be produced locally thanks to Australia's substantial iron ore and bauxite resources (CCA 2020). The Grattan Institute recently estimated that if Australia were to generate green steel from clean hydrogen and capture around 6.5 per cent of the global steel market, some \$65 billion in annual export revenue could be generated and 25,000 manufacturing jobs could be created across Queensland and NSW (Grattan Institute 2020).

Such new industries would not only help underpin our future prosperity but also enhance the economy's self-sufficiency across a wider range of industrial products. Combined with greater deployment of new technologies in areas such as flexible manufacturing systems (for example, 3D printing), this raises the prospect of an Australian economy more resilient in the face of external shocks such as those arising from pandemics.

The Authority's consultations identified several opportunities available to governments to facilitate innovation in more energy and emissions efficient manufacturing, building and

construction:

- Reviewing standards to remove unnecessary barriers to the adoption of innovative materials (for example, standards for the use of cement in road construction)
- Developing standards to enable the classification of, and encourage investment in, low- and zero-emissions supply chains
- Deploying government procurement to support growth in these industries where cost effective.

Investing in electric vehicles

Accelerating the uptake of electric vehicles could generate significant economic benefits through increased employment, new investment in infrastructure, savings for consumers and demand for batteries with Australian inputs. Reducing emissions of the passenger motor vehicle fleet and light commercial vehicles will also yield health benefits.

Recovery

The uptake of electric vehicles has gained momentum globally as their performance and cost narrow the gap with internal combustion engine vehicles. Through ARENA, the CEFC and work on an electric vehicle strategy, the Government is already supporting development of the electric vehicle market in Australia.

The Government's Technology Investment Roadmap discussion paper points to the need to ensure electric vehicle refuelling infrastructure keeps pace with the growth in electric vehicle use (DISER 2020). Bringing forward investment in this infrastructure could generate job opportunities, stimulate economic activity in other sectors and act as an important market signal for investment. Both China and the European Commission have indicated that public electric vehicle charging infrastructure will be targeted as part of their post-pandemic economy recovery plans (UNEP 2020). A study by PwC found that accelerated uptake rates for battery electric vehicles similar to Norway could save drivers up to \$1700 per annum in ownership costs (offsetting higher purchase costs with lower running costs), lead to \$3.2 billion net investment in charging

infrastructure and create 13,400 additional jobs by 2030.

These benefits are estimated to lead to a potential real increase in GDP of \$2.9 billion (Electric Vehicle Council 2018).

The Government's forthcoming electric vehicle strategy should aim to minimise barriers to electric vehicle uptake by among other things, ensuring adequate public electric vehicle infrastructure including coverage on highways and in regional areas, setting targets for electric vehicle adoption by government fleets and promoting the development of a used car market for electric vehicles (CCA 2020).

Corporate and government fleet cars make up approximately half of new car sales, meaning they are an important source of demand and eventual supply of used cars (CCA 2020). Targets for electric vehicle procurement in government fleets was raised in consultations for the Authority's *Policy Toolkit* report (CCA 2020) as a straightforward way for governments to encourage the uptake of electric vehicles, with modest (or no) additional cost.

Fleet buyers ... are likely to recognise the lifecycle benefits available through EVs earlier than the broader consumer market. Additionally, the recycling of vehicles into the resale market at the end of fleet leasing arrangements provides a lower cost entry point for the broader consumer market (Origin Energy submission).

Resilience and prosperity

The continuing development of the global electric vehicle industry will require substantial amounts of lithium and other minerals for use in batteries and motors. Australia is well positioned to capitalise on these requirements, thanks to a rich endowment of lithium, nickel, cobalt and rare earth minerals that are used in battery manufacturing.

Australia also has a mature and expert resources industry with a well-developed regulatory regime that can assure an ethical supply chain, which is increasingly being demanded by end-users. Globally, most

analysts expect demand for lithium to more than double by 2025, representing a significant opportunity for Australia, particularly mining industry (CCA 2020). Several industry organisations consulted for this report noted that manufacturing industries could also benefit through domestic processing (for example, flow batteries).

As highlighted in the Technology Investment Roadmap discussion paper, electric vehicles could provide grid-firming benefits and large scale uptake could lead to improved urban air quality and reduced noise pollution, contributing to improved health and wellbeing outcomes.

The aviation sector has been severely impacted by the coronavirus and may be for a time to come. The sector also faces difficult technical challenges to decarbonise. Nevertheless, according to representatives of the sector, Australian airlines remain committed to meeting the International Civil Aviation Organization's strategy for reducing and offsetting emissions. The Australian Government is also participating in these international agreements and supporting Australian airlines to adopt operational and technological improvements (DIRD 2017).

Enhancing agriculture and natural environments

Accelerating Australia's post-pandemic recovery through stimulus spending in initiatives that will increase farm revenue and profitability, reduce emissions and build climate resilience will provide vital economic support to regional farming communities dealing not just with the coronavirus but also with the devastating impacts of drought and bushfire and ongoing risks of floods.

Recovery

The agriculture, forestry and fishing sector provides jobs for more than 325,000 people, with the vast majority being in regional Australia (Australian Government 2019). Although many agricultural producers were not as adversely affected by the immediate impacts of the coronavirus to the extent other economic sectors were, the agriculture and land sector is one of the worst affected by the impacts of

climate change.

A recent report by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) found that since the year 2000 changes in climate have led to a 22 per cent reduction in revenue of Australia's broadacre cropping industry totalling around \$1.1 billion per year (ABARES 2019). Since 2017 the record severe and prolonged drought has caused a decline in farm GDP of up to 30 per cent (RBA 2020a).

Many programs at all levels of government that allow for fast deployment can also be scaled to support substantial short-term job creation and directed towards regions and communities most in need, for example, natural resource management programs and building critical regional infrastructure. Australian farmers and land managers manage around 378 million hectares – nearly 50 per cent of the Australian landmass. There is growing recognition of the desirability of pursuing integrated actions on the land that together address productivity, account for climate change mitigation and adaptation and conserve the natural environment (CCA 2020).

In 2018 the Authority published the *Reaping the Rewards* report, which looked at ways to assist landholders to take action to reduce emissions and conserve natural capital while improving farm profitability, including through financing solutions for multiple benefits (CCA 2018). In that report and more recently (CCA 2020), the Authority recommended the establishment of a Land and Environment Investment Fund (similar to the CEFC) to facilitate greater investment in projects that reduce emissions and have other public benefits in the agriculture and land sector.

The Authority also recommended that the Land and Environment Investment Fund work closely with the rural research and development corporations and other organisations undertaking research on emissions reductions to support commercialisation of new research.

The design and operation of the Fund could draw on experience with other targeted loan programs including the CEFC and the Regional Investment Corporation which administers government loans to support eligible Australian farm businesses.

In time, ERF projects can create revenue streams, jobs and other economic benefits for rural communities and benefits for the natural environment (CCA 2020, CSIRO 2019). In response to the King review, the Government has indicated it is considering all options to support increased uptake of ERF methodologies that increase agricultural productivity. For example, the Clean Energy Regulator (CER) recently issued a consultation paper on a proposal to assist project developers in addressing the upfront costs of initial sampling under the measured soil method (CER 2020). Improved linkages with projects like the Queensland Government's Land Restoration Fund and the Commonwealth's Biodiversity Stewardship Program could improve efficiency and co-benefits of the stimulus deployment beyond the initial economic recovery.

Resilience and prosperity

Investment in research and deployment of new technologies and tools for agriculture can create new industries and jobs and boost the sector's productivity and growth.

For example, leading Australian researchers have found that a common Australian seaweed can almost completely eliminate methane emissions in cattle and sheep. Australia has ideal growing conditions for the seaweed, which could potentially become a major export commodity, creating more regional jobs and economic growth.

However, while there are some small scale projects being undertaken, there are currently no commercial-scale seaweed operations in Australia or a strategic plan for industry development (Scott T 2020). A Land and Environment Investment Fund would be ideally placed to invest in the development and growth of a seaweed feed supplement industry in Australia and other emerging agricultural low-emissions technologies.

Australia has significant carbon sequestration potential through reforestation and afforestation. In a world taking action to limit global warming in line with the Paris Agreement, the land sector could contribute to our prosperity by supplying significant quantities of carbon offsets into international markets (CSIRO 2019).

The actions suggested in the previous section which contribute to short-term economic recovery can also help position the land sector for these opportunities.

Increased Government spending on programs that boost the resilience of our agriculture and land sectors to the changes in our climate expected in coming decades can also contribute to economic recovery in the short-term. The Government recently announced the \$3.9 billion (growing to \$5 billion) Future Drought Fund will be deployed in this way. From July 2020, \$100 million will be invested annually to improve drought resilience, for example by supporting farm business resilience, building the drought resilience of natural resources such as soil and vegetation, and making community facilities drought resilient through investing in small-scale infrastructure projects. The Natural Disaster Resilience Program, a co-funded Commonwealth, state and territory initiative, could also be deployed to support recovery in the near term and resilience for the longer term.

Fostering innovation, technology, research and development

Investment in R&D and commercialisation yields tangible benefits in the long term, but stimulus benefits can be realised now through employment and economic activity. Stimulating jobs through investment in innovation, R&D can flow over to education, banking, finance and more.

Recovery

Researchers and businesses have already identified pathways for the use of renewable energy (heat or electricity) to reduce emissions in processes like production of cement, steel and alumina. Further research and development is expected to create technical pathways for substitution of other currently emissions-intensive manufacturing processes (CCA 2020).

- The Government could consider: in developing and implementing the Technology Investment Roadmap, partnering with industry and researchers to identify areas where research and development support is needed to capitalise

- on areas of comparative advantage for Australia and to support strategic development of clean technology industries
- Targeting support for innovation in emissions reduction towards harder-to-abate and emissions-intensive, trade-exposed industries and towards industries with well-defined low-emissions goals, targets and pathways (CCA 2020).

As mentioned earlier, the CEFC and ARENA could quickly deploy stimulus funding, in the form of loans and concessional loans in the case of the former and grants in the case of the latter, and leverage private investment.

The Government's Technology Investment Roadmap will soon provide a framework for setting economic goals for priority technologies, to help accelerate their competitiveness with higher emissions alternatives (DISER 2020a). While the Technology Investment Roadmap discussion paper considers policy options for prioritising Government investment in low emissions technologies, large-scale private investment will be needed to support the low-emissions transition, particularly as governments are likely to be more fiscally constrained in coming years due to the impacts of and immediate response to the coronavirus pandemic. Investors continue to highlight that unlocking private capital will require a clear long-term signal consistent with Australia's obligations under the Paris Agreement (IGCC 2020a).

The Government has called for stakeholder feedback on the Roadmap discussion paper. It is seeking views on: the technologies that should be shortlisted for policy focus; goals for leveraging private investment; and where Australia is well-placed to take advantage of future demand for low-emissions technologies, as well as to support global emissions reductions by helping to deepen trade, markets and global supply chains (DISER 2020a).

To ensure Australia's long-term prosperity in a world transitioning to low-emissions, it is important that priority technologies for government investment and support are identified in partnership with industry and researchers and aligned with well-defined industry pathways for a low-emissions future.

Resilience and prosperity

Although the development of low-emissions industries may be possible in Australia given the availability of mineral and energy resources and technical viability, these conditions are not sufficient. The highly competitive and trade-exposed nature of Australia's current commodity-based industries can make the necessary sustained investment in research and development and new plant difficult. Further barriers can include the relatively high cost of labour in Australia and a lack of strong policy signals to encourage low-emissions industry. Public support for research, development and innovation for harder-to-abate industries is essential to capitalise on the opportunities that Australia's resources present (CCA 2020).

Liquid biofuels are one of the most promising technologies for aviation abatement, requiring only minimal change to engines, turbines or fuel storage. Although progress has been made in the development of electric aircraft, electrification of aviation appears to remain a difficult proposition for all but the smallest of aircraft due to the low energy density of batteries. Biofuels are well understood, however they face technical and economic challenges to deployment at scale. Australian biofuels production could provide long-term employment, mostly in regional areas (CEFC and ARENA 2019), and aviation industry groups have identified further jobs near airports in the construction phase. They also noted domestic liquid biofuel production could enhance fuel security, and could, over time, develop as an Australian biofuel export industry. ARENA is developing a roadmap to identify opportunities and inform investment and policy decisions in the bioenergy sector.

Appendix A – About the Authority

The Climate Change Authority (the Authority) is an independent statutory agency established to provide expert advice to the Australian Government on climate change policy. The Authority does this by conducting statutory and specifically commissioned reviews and by undertaking independent research and analysis.

The Authority is made up of a Chair, the Chief Scientist and up to seven other members. Further information on the Climate Change Authority can be found at www.climatechangeauthority.gov.au.

The *Climate Change Authority Act 2011* (Cth) requires the Authority to have regard to the following principles when assessing the relative merits of emissions reduction policies:

- economic efficiency
- environmental effectiveness
- equity
- the public interest
- the impact on households, business, workers and communities
- support for the development of an effective global response to climate change
- consistency with Australia's foreign policy and trade objectives.

Appendix B – Public consultation

The Authority received 67 stakeholder submissions to *Prospering in a low-emissions world: an updated climate policy toolkit for Australia*. The Authority also met with 40 organisations in Melbourne, Sydney and Canberra and conducted over 16 teleconferences. The Authority met with and received submissions from industry organisations, research bodies and non-government organisations, Australian, state and territory and local government agencies and businesses and industry associations.

Non-confidential submissions are available on the Authority's website at <http://climatechangeauthority.gov.au/submissions/submissions-received>.

The Authority consulted further in May and June 2020 to seek input from government agencies involved in the stimulus response, and industries and sectors of civil society affected by the coronavirus pandemic.

The Authority thanks all those that provided submissions or engaged with the Authority for this work.

Organisations consulted in May and June this year were:

- Australian Chamber of Commerce and Industry
- Australian Food and Grocery Council
- Green Building Council
- Maritime Industry Australia
- Cement Industry Federation
- Freight and Trade Alliance and Australian Peak Shippers Association
- National Farmers Federation
- Minerals Council of Australia
- Australian Aluminium Council
- Australian Petroleum Production and Exploration Association
- Airlines for Australia and New Zealand
- Australian Council of Social Services
- Clean Energy Finance Corporation
- Department of Agriculture, Water and the Environment
- Department of Industry, Science, Energy and Resources
- Australian Treasury
- Energy Security Board
- Australian Energy Market Commission

Appendix C – Evaluating stimulus attributes of the updated climate policy toolkit

Recommendations were assessed using a multi-criteria analysis framework. The criteria contribute to three pillars:

- **recovery** through rapid employment and economic activity in regions and sectors that need it most
- **resilience** by targeting activities that build and strengthen Australia’s resilience to future economic shocks
- **prosperity** by investing now in activities and pathways that will lead to prosperity for generations to come.

In accordance with the Authority’s role, the Policy Toolkit recommendations targeted strategic policy frameworks and initiatives that incentivise projects (CCA 2020). This assessment takes account of the projects targeted by the recommendations.

High	Medium	Low	Not applicable
------	--------	-----	----------------

	Recommendations	Recovery	Resilience	Prosperity
	Chapter 13. Energy efficiency			
13.27	<p>Working with the COAG Energy Council, reinvigorate the National Energy Productivity Plan, with enhanced ambition and additional resources, including by:</p> <ul style="list-style-type: none"> • implementing a National Energy Savings Scheme that builds on existing state and territory energy efficiency schemes • accelerating implementation of the Independent Review of the Greenhouse and Energy Minimum Standards Act, strengthening existing performance standards and extending coverage to new categories of appliances and commercial equipment, such as hot water products and pumps, boilers and air compressors • accelerating energy efficiency improvements for buildings in the National Construction Code via the Trajectory for Low Energy Buildings initiative • developing a detailed action plan for improving the energy efficiency performance of existing commercial and residential buildings via the Addendum to the Trajectory for Low Energy Buildings initiative; and addressing energy efficiency improvements for vulnerable consumers. 	High	High	High

13.28	In partnership with state and territory governments, design and deliver targeted programs to improve energy efficiency in priority groups, such as low-income households and small to medium businesses, through the provision of information, expertise and financial assistance (grants and tax incentives) where appropriate.	High	High	High
13.29	All governments should pursue energy efficiency improvements in government owned and leased buildings, undertake targeted retrofits and implement steadily rising minimum standards for public housing to improve the energy efficiency performance of the public housing stock.	High	High	High
Chapter 14. Research and development, innovation and technology				
14.30	In developing and implementing the Technology Investment Roadmap: <ul style="list-style-type: none"> partner with industry and researchers to identify areas where research and development (R&D) support is needed to capitalise on areas of comparative advantage for Australia and to support strategic development of clean technology industries continue to fund the Australian Renewable Energy Agency and consider expanding its remit into other sectors requiring R&D for low-emissions technology or practice build on Australia’s Mission Innovation commitment to double investment in clean technology over the five years to 2020 by undertaking to grow the level of investment further to 2030 support the development of negative emissions technologies, including R&D and methodology development for inclusion in the ERF. 	High	High	High
14.32	Expand the remit of the CEFC to allow it to invest in emissions reduction technologies in all sectors to help overcome barriers to finance. Restrictions on the scope of the CEFC’s activities, its portfolio mix and the financial instruments it can use should be lifted. The Government should consider making further capital injections in the CEFC to fund this expansion.	High	High	High
14.31	Target funding support for innovation in emissions reduction towards harder-to-abate and emissions-intensive, trade-exposed industries and towards industries with well-defined low-emissions goals, targets and pathways.	High	Medium	High

Chapter 8. Electricity				
8.11	The COAG Energy Council should fast-track reforms to facilitate the integration of large amounts of low- and zero-emissions generation and related technologies into the electricity market, focusing on distributed energy resources, integration of storage and demand-side response and timely and efficient transmission and generation investment.	High	High	High
8.12	The Government's Underwriting New Generation Investments program and bilateral energy agreements with the states should further align with the priorities for generation and transmission identified in AEMO's Integrated System Plan and be supported by rigorous cost-benefit analysis to ensure efficient outcomes for electricity consumers.	Medium	High	High
8.10	To promote the reliable and secure supply of clean electricity at lowest cost for electricity consumers, National Electricity Market (NEM) jurisdictions should, in the design and implementation of their renewable energy policies: <ul style="list-style-type: none"> emphasise renewable projects that align with the priorities identified by the Australian Energy Market Operator (AEMO) in its Electricity Statement of Opportunities and Integrated System Plan consider supporting projects located outside of their respective jurisdictions where this will maximise benefits for their electricity consumers and the NEM generally include electricity system security as a criterion in project selection processes, consult with AEMO for advice on security implications of proposed projects and consider supporting system strength remediation measures. 	Medium	High	High
8.13	Identify and implement measures for providing greater certainty on the timing of the retirement of ageing coal generators to facilitate timely investment in replacement capacity and storage and to enhance planning for measures to support local workforces and communities affected by closures.	Low	High	Medium
Chapter 12. Waste				
12.26	Recognising the benefits of a circular economy approach for emissions reductions, ensure implementation of the National Waste Policy Action Plan considers industry development, the waste hierarchy, research and development needs, training requirements and barriers to adoption;	High	High	High

	and emphasises the creation of industries in regions undergoing transition.			
12.25	Work with the states and territories to reduce landfill emissions by strengthening and harmonising regulations on methane emissions from landfill waste, diverting organic waste from landfill and fully implementing the National Food Waste Strategy.	Low	Low	Medium
Chapter 9. Industry				
9.14	Enhance the Safeguard Mechanism to deliver emission reductions from large emitters in industry, with: <ul style="list-style-type: none"> • declining baselines with clear trajectories and the ability to trade under- and over-achievement once baselines have commenced declining and are binding • targeted, transitional and transparent competitiveness assistance to emissions-intensive, trade-exposed industries captured by the enhanced Safeguard Mechanism where a demonstrated risk of carbon leakage exists. 	Medium	Medium	High
9.15	Investigate how best to encourage smaller businesses to reduce emissions, including through assistance to participate in the ERF.	Low	Medium	Medium
Chapter 10. Transport				
10.17	The forthcoming electric vehicle strategy should aim to minimise barriers to electric vehicle uptake by: <ul style="list-style-type: none"> • addressing standards for vehicles and charging infrastructure to ensure interoperability • ensuring public electric vehicle infrastructure addresses barriers to uptake for those without access to private charging • ensuring adequate infrastructure coverage on highways and in regional areas • considering implications for electricity network tariff reform and fuel excise revenue • incorporating information about electric vehicle ownership costs in the Green Vehicle Guide • promoting the development of a used car market for electric vehicles, including through consideration of reduced import barriers for quality used electric vehicles • setting targets for electric vehicle adoption in government fleets. 	High	Medium	High

10.16	Reconsider implementing a greenhouse gas emissions standard for light vehicles and undertake a cost-benefit analysis of an emissions standard for heavy vehicles.	Low	Medium	High
10.18	Investigate barriers to shifting freight transport from more emissions-intensive road to less emissions-intensive rail transport and how these can be overcome by government.	Low	Low	High
Chapter 11. Agriculture and land				
11.22	Introduce a Land and Environment Investment Fund (that is, a CEFC for the land) to invest in actions to support low-emissions and climate-smart agriculture and associated environmental services.	High	High	High
11.21	Allocate additional funds for research on low-emissions agriculture and carbon farming, including possible new agricultural industries. This would include basic research, applied research (including on new ERF methods) and the development of tools to report on the emissions profile of agricultural activities.	Medium	High	High
11.24	Together with state and territory governments, continue to coordinate and integrate programs designed to increase mitigation, build resilience to drought and climate impacts, enhance biodiversity and provide benefits for Indigenous communities, including through interjurisdictional partnerships and program linkages.	Medium	High	High
11.20	Undertake a review of green product standards and definitions being developed in export markets and engage with trade partners to ensure they do not unduly restrict market access for Australian agriculture.	Low	High	High
11.19	Land use and agriculture activities should continue to be covered by the ERF crediting mechanism, with credits continuing to be used as offsets for facilities covered by the Safeguard Mechanism and available for use in other (for example, voluntary) markets. The ERF purchasing mechanism should continue until an enhanced Safeguard Mechanism provides a source of demand for credits.	Low	Medium	High
11.23	Investigate and implement the most effective incentives to encourage the use of emissions-reducing inputs in agricultural production systems.	Low	Medium	High
Chapter 15. Finance and investment				

15.33	Review the data that are necessary to enable industry, investors and business to understand and manage climate-related financial risk and develop and implement plans for addressing gaps and deficiencies in the data.	Low	High	High
15.34	<p>A joint taskforce of the Council of Financial Regulators should:</p> <ul style="list-style-type: none"> develop standard reporting criteria to enhance the quality and usefulness of disclosures under the Taskforce on Climate-related Financial Disclosures framework. To support standardised reporting, the Government should develop standardised national climate scenarios aligned to the Paris Agreement temperature goals together with the major accounting bodies, examine the phasing-in and mandatory reporting of climate-related risks and mainstream climate-related disclosures in companies' audited financial statements provide regulatory guidance to clarify the duties of institutional investors to consider climate-related risk. 	Low	High	High
15.35	<p>To facilitate the development of Australia's green finance market and ensure Australian low-emissions industries, products and services are able to benefit from increased international green investment flows, the Australian Government should consider the recommendations of the Australian Sustainable Finance Initiative when the final report is published, and:</p> <ul style="list-style-type: none"> participate in international initiatives developing global green economy rules and standards collaborate with other jurisdictions to ensure alignment and convergence of emerging international classification systems for low-emissions technologies, assets and industries (low-emissions taxonomies) and to ensure Australia's low-emissions exports are defined and included assist the finance and investment sector to develop standards and verification processes for green finance products and services, including through possible funding and endorsement. 	Low	Medium	High
CHAPTER 6. Transitioning Australia to a low-emissions future				

6.2	Include emission reductions and climate resilience as a standing item on the Council of Australian Governments (COAG) meeting agenda.	NA	High	High
6.4	<p>Governments should work together to support industries and communities facing an uncertain future to identify pathways for industries to evolve and remain competitive and to exploit new economic opportunities, including</p> <ul style="list-style-type: none"> • potential infrastructure requirements and supply chain logistics • assessment of vocational training needs for new low-emissions industries • exploration of opportunities for Indigenous communities. 	NA	High	High
6.6	<p>Develop an international climate strategy to:</p> <ul style="list-style-type: none"> • support a strong global response to climate change that minimises physical impacts on Australia and increases international demand for Australia’s emerging low-emissions export industries • maximise the opportunities for Australia from international trade in emissions reductions, including by: <ul style="list-style-type: none"> a. identifying potential carbon trade partners, prioritising developing countries in our region b. supporting potential trade partners to build their capacity to deliver low-cost, high-integrity international units c. defining the criteria for and identifying the international units considered to be ‘high-integrity’ and acceptable to Australia d. establishing quotas on the import of international units to ensure Australia’s domestic transition to a low-emissions economy continues e. establishing a timeline for high-integrity international units to be permitted under the enhanced Safeguard Mechanism. 	NA	High	High
6.1	Develop a long-term climate change strategy that secures Australia’s contribution to the achievement of the temperature goals of the Paris Agreement and ensures we make the most of	NA	Medium	High

	the opportunities arising from the transition to a low-emissions global economy.			
6.3	Develop a trade and investment strategy that identifies and leverages Australia’s competitive advantages in a net-zero emissions world.	NA	Medium	High
6.5	Aim to meet Australia’s 2030 Paris Agreement target using emissions reductions achieved between 2021 and 2030.	NA	Medium	High
Chapter 7. Preparing for a changing climate				
7.8	Fully integrate consideration of emissions and climate change risks in decision making about government programs, assets and services through frameworks such as Climate Compass.	NA	High	High
7.9	Implement the strategic actions in the National Climate Science Advisory Committee’s <i>Climate science for Australia’s future</i> report to get the most out of the Government’s investment in climate science and ensure governments, businesses and communities have the information they need to respond to climate change risks.	NA	High	High
7.7	In consultation with state, territory and local governments, and drawing on the findings of the bushfire National Royal Commission and the forthcoming CSIRO report on climate resilience, review and update the 2015 <i>National Climate Resilience and Adaptation Strategy</i> to ensure a coordinated and integrated approach, with clear roles and accountabilities, to enhance Australia’s climate resilience.	NA	High	Medium

References

- Australian Bureau of Statistics (ABS) 2020a**, *Labour Force, Australia, Jun 2020*, 16 July 2020, viewed 16 July 2020, [https://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/6202.0Media%20Release1Jun%202020?opendocument&tabname=Summary&prodno=6202.0&issue=Jun%202020&num=&view=. .](https://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/6202.0Media%20Release1Jun%202020?opendocument&tabname=Summary&prodno=6202.0&issue=Jun%202020&num=&view=.)
- ABS 2020b**, *Business indicators: Business impacts of COVID-19*, 28 May 2020, viewed 8 June 2020, <https://www.abs.gov.au/ausstats/abs@.nsf/mf/5676.0.55.003>.
- ABS 2020c**, *Retail Trade, Australia, April 2020*, 4 June 2020, viewed 8 June 2020, <https://www.abs.gov.au/AUSSTATS/abs@.nsf/allprimarymainfeatures/A45D2D3C8153B6E0CA2585990021673A?opendocument>.
- ABS 2020d**, *Overseas arrivals and departures, March 2020*, 12 May 2020, viewed 8 June 2020, <https://www.abs.gov.au/ausstats/abs@.nsf/mf/3401.0>.
- ABS 2020e**, *Australian National Accounts: National Income, Expenditure and Product*, 3 June 2020, viewed 8 June 2020, <https://www.abs.gov.au/ausstats/abs@.nsf/mf/5206.0>.
- ABS 2020f**, *Employment in Renewable Energy Activities, Australia, 2018-19*, viewed 22 May 2020, [https://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/4631.0Main%20Features52018-19?opendocument&tabname=Summary&prodno=4631.0&issue=2018-19&num=&view=.](https://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/4631.0Main%20Features52018-19?opendocument&tabname=Summary&prodno=4631.0&issue=2018-19&num=&view=)
- ABS 2020g**, *Preliminary Retail turnover rises 16.3 per cent in May*, 19 June 2020, viewed 23 June 2020, [https://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/8501.0.55.008Media%20Release1May%202020?opendocument&tabname=Summary&prodno=8501.0.55.008&issue=May%202020&num=&view=.](https://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/8501.0.55.008Media%20Release1May%202020?opendocument&tabname=Summary&prodno=8501.0.55.008&issue=May%202020&num=&view=)
- ANU Energy Change Institute n.d.**, *Zero-carbon energy for the Asia Pacific Region*, viewed 24 January 2020, <https://www.anu.edu.au/research/research-initiatives/zero-carbon-energy-for-the-asia-pacific>.
- Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) 2019**, *The effects of drought and climate variability on Australian farms*, December 2019, viewed 28 May 2020, https://www.agriculture.gov.au/sites/default/files/documents/EffectsOfDroughtAndClimateVariabilityOnAustralianFarms_v1.0.0.pdf.
- Australian Capital Territory (ACT) Government 2019**, *Health and wellbeing outcomes from the Energy Efficiency Improvement Scheme*, viewed 4 June 2020, https://www.environment.act.gov.au/_data/assets/pdf_file/0019/1401652/20190809-formatted-mini-report-Health-and-Wellbeing-outcomes-from-EEIS.pdf.
- Australian Energy Market Operator (AEMO) 2020a**, *2020 Integrated System Plan*, viewed 23 May 2020, <https://aemo.com.au/en/energy-systems/major-publications/integrated-system-plan-isp/2020-integrated-system-plan-isp#Current%20Status>.
- AEMO 2020b**, *Renewable integration study: Stage 1 report*, viewed 23 May 2020, <https://aemo.com.au/-/media/files/major-publications/ris/2020/renewable-integration-study-stage-1.pdf?la=en>.
- Australian Government 2020a**, *Economic response to the coronavirus*, 25 May 2020, viewed 8 June 2020, <https://treasury.gov.au/sites/default/files/2020-05/Overview-Economic-Response-to-the-Coronavirus-3.pdf>.
- Australian Government 2020b**, *Homebuilder*, 4 June 2020, viewed 8 June 2020, https://treasury.gov.au/sites/default/files/2020-06/Fact_sheet_HomeBuilder.pdf.
- Australian Government 2020c**, *COAG becomes National Federation Reform Council*, 2 June 2020, viewed 30 June 2020, <https://www.pmc.gov.au/news-centre/government/coag-becomes-national-cabinet>.
- Australian Government 2019**, *Australian Jobs 2019*, viewed 25 May 2020, <https://docs.employment.gov.au/system/files/doc/other/australianjobs2019.pdf>.
- Australia Institute 2020**, *Pandemic response impact on electricity emissions minimal: National Energy Emissions Audit*, viewed 8 June 2020, <https://www.tai.org.au/content/pandemic-response-impact-electricity-emissions-minimal-national-energy-emissions-audit>.

BloombergNEF 2019, *New Energy outlook 2019*, viewed 4 June 2020, <https://about.bnef.com/new-energy-outlook/>.

Business Victoria 2020, *Coronavirus business support*, viewed 8 June 2020, <https://www.business.vic.gov.au/disputes-disasters-and-succession-planning/coronavirus-covid-19/coronavirus-business-support>.

Climate Change Authority (CCA) 2020, *Prospering in a low-emissions world: An updated climate policy toolkit for Australia*, viewed 22 May 2020, <http://www.climatechangeauthority.gov.au/prospering-low-emissions-world-updated-climate-policy-toolkit-australia>.

CCA 2019, *Industry action on climate change mitigation and low-emissions technologies*, viewed 27 May 2020, <https://www.climatechangeauthority.gov.au/publications/three-stocktake-reports-actions-mitigate-emissions-industry-and-governments-australia-and-taking-place-internationally>.

CCA 2018, *Reaping the rewards: Improving farm profitability, reducing emissions and conserving natural capital. Final report*, viewed 28 May 2020, <https://www.climatechangeauthority.gov.au/publications/three-stocktake-reports-actions-mitigate-emissions-industry-and-governments-australia-and-taking-place-internationally>.

CCA 2017, *Review of the Emissions Reduction Fund*, viewed 20 January 2020, <https://www.climatechangeauthority.gov.au/publications/review-emissions-reduction-fund>.

Clean Energy Council 2020, *A clean recovery: Using Australia's enormous renewable energy potential to create jobs and jumpstart the economy*, 5 May 2020, viewed 22 May 2020, <https://assets.cleanenergycouncil.org.au/documents/advocacy-initiatives/A-Clean-Recovery.pdf>.

Clean Energy Council 2019, *Clean Energy Australia report 2019*, viewed 22 May 2020, <https://assets.cleanenergycouncil.org.au/documents/resources/reports/clean-energy-australia/clean-energy-australia-report-2020.pdf>.

Clean Energy Finance Corporation (CEFC) 2020, *Clean energy and community housing*, viewed 24 May 2020, <https://www.cefc.com.au/where-we-invest/built-environment/housing/community-housing/>.

CEFC 2019a, *Investing in Australia's clean energy transition*, Annual Report 2018–19, viewed 7 June 2020, https://annualreport2019.cefc.com.au/media/1428/cefc_annual_report_2018-19.pdf.

CEFC 2019b, *CEFC welcomes new \$100 million Australian Recycling Investment Fund*, viewed 27 May 2020, <https://www.cefc.com.au/media/files/cefc-welcomes-new-100-million-australian-recycling-investment-fund/>.

CEFC and ARENA 2019, *Biofuels and transport: an Australian opportunity*, viewed 26 June 2019, <https://apo.org.au/sites/default/files/resource-files/2019-11/apo-nid268686.pdf>.

Clean Energy Regulator (CER) 2020, *Consultation now open on draft sampling guidance for measurement-based soil carbon methods*, 11 March 2020, viewed 30 June 2020, <http://www.cleanenergyregulator.gov.au/ERF/Pages/News%20and%20updates/News-Item.aspx?ListId=19b4efbb-6f5d-4637-94c4-121c1f96fcfe&ItemId=756>.

Climate KIS Australia n.d., *Climate Measurement Standards Initiative*, viewed 3 July 2020, <https://climate-kic.org.au/our-projects/cmsi/>.

ClimateWorks 2020, *Decarbonisation Futures: Solutions, actions and benchmarks for a net zero emissions Australia*, viewed 23 May 2020, <https://www.climateworksaustralia.org/resource/decarbonisation-futures-solutions-actions-and-benchmarks-for-a-net-zero-emissions-australia/>.

ClimateWorks for the Australian Sustainable Built Environment Council (ASBEC) 2016, *Low carbon, high performance*, viewed 23 May 2020, <https://www.asbec.asn.au/wordpress/wp-content/uploads/2016/05/160509-ASBEC-Low-Carbon-High-Performance-Full-Report.pdf>.

Council of Australian Governments (COAG) 2015, *National Energy Productivity Plan 2015-2030*, viewed 24 June 2020, <http://www.coagenergycouncil.gov.au/publications/national-energy-productivity-plan-2015-2030>.

COAG Energy Council 2019a, *Achieving low energy existing commercial buildings in Australia*, viewed 23 May 2019,

<http://coagenergycouncil.gov.au/sites/prod.energycouncil/files/publications/documents/Trajectory%20Addendum%20-%20EY-Achieving%20Low%20Energy%20Existing%20Commercial%20Buildings%20in%20Australia.pdf>.

COAG Energy Council 2019b, *Report for achieving low energy existing homes*, viewed 23 May 2019,

http://coagenergycouncil.gov.au/sites/prod.energycouncil/files/publications/documents/Trajectory%20Addendum%20-%20Report%20for%20Achieving%20Low%20Energy%20Existing%20Homes_1.pdf.

COAG Energy Council 2019c, *Australia's national hydrogen strategy*, viewed 27 May 2019,

<https://www.industry.gov.au/sites/default/files/2019-11/australias-national-hydrogen-strategy.pdf>.

Commonwealth of Australia 2020, *Senate Select Committee on COVID-19*, Hansard, 9 June 2020,

viewed 3 July 2020, https://parlinfo.aph.gov.au/parlInfo/download/committees/commsen/76537230-2985-4353-9281-8eae043897d2/toc_pdf/Senate%20Select%20Committee%20on%20COVID-19_2020_06_09_7757.pdf;fileType=application%2Fpdf#search=%22committees/commsen/76537230-2985-4353-9281-8eae043897d2/0000%22.

CSIRO 2019, *Australian National Outlook 2019*, viewed 28 May 2019,

<https://www.csiro.au/en/Showcase/ANO>.

CSIRO 2018, *Lithium-ion battery recycling*, viewed 26 May 2020,

<https://www.csiro.au/en/Research/EF/Areas/Energy-storage/Battery-recycling>.

CSIRO and DOE 2018, *Climate Compass: A climate risk management framework for Commonwealth agencies*, viewed 29 May 2020,

<https://www.environment.gov.au/climate-change/adaptation/publications/climate-compass-climate-risk-management-framework>.

Department of Industry, Science, Energy and Resources (DISER) 2020a, *Technology Investment Roadmap Discussion paper: A framework to accelerate low emissions technologies*, viewed 23 May

2020, https://consult.industry.gov.au/climate-change/technology-investment-roadmap/supporting_documents/technologyinvestmentroadmapdiscussionpaper.pdf.

DISER 2020b, *Report of the Expert Panel examining additional sources of low cost abatement*, 14

February 2020, viewed 23 May 2020, <https://www.industry.gov.au/sites/default/files/2020-05/expert-panel-report-examining-additional-sources-of-low-cost-abatement.pdf>.

DISER 2020c, *Australian Government response to the final report of the Expert Panel examining additional sources of low cost abatement (the 'King Review')*, viewed 23 May 2020,

<https://www.industry.gov.au/sites/default/files/2020-05/government-response-to-the-expert-panel-report-examining-additional-sources-of-low-cost-abatement.pdf>.

Electric Vehicle Council 2018, *Recharging the economy*, viewed 25 May 2020,

<http://goevie.com.au/recharging-the-economy-released/>.

Energy Efficiency Council 2019, *Energy efficiency employment in Australia*, February 2019, viewed 23 May 2020,

http://greenmarkets.com.au/images/uploads/Industry_Reports/Energy_Efficiency_Employment_in_Australia_full_report.pdf.

Executive Office of the President of the United States 2016, *A retrospective assessment of clean energy investments in the Recovery Act*, viewed 22 May 2020,

https://obamawhitehouse.archives.gov/sites/default/files/page/files/20160225_cea_final_clean_energy_report.pdf.

Frydenberg J 2020, *Ministerial Statement on the Economy: The economic impact of the crisis*, Parliament House Canberra, 12 May 2020, Viewed 21 May 2020,

<https://ministers.treasury.gov.au/ministers/josh-frydenberg-2018/speeches/ministerial-statement-economy-parliament-house-canberra>.

- Gerber J 2020**, *Australia, New Zealand have world's best COVID health and economic response*, 30 April 2020, Australian Financial Review, viewed 8 June 2020, <https://www.afr.com/policy/economy/australia-nz-have-world-s-best-covid-health-and-economic-response-20200430-p54ofs>.
- Grattan Institute 2020**, *Start with steel: A practical plan to support carbon workers and cut emissions*, 10 May 2020, viewed 27 May 2020, <https://grattan.edu.au/wp-content/uploads/2020/05/2020-06-Start-with-steel.pdf>.
- Hepburn C et al**, *Will COVID-19 fiscal recovery packages accelerate or retard progress on climate change*, Oxford Smith School of Enterprise and the Environment (Working Paper No 20-02), viewed 3 July 2020, <https://www.smithschool.ox.ac.uk/publications/wpapers/workingpaper20-02.pdf>.
- International Energy Agency (IEA) 2020a**, *Global Energy Review 2020*, viewed 23 May, https://www.iea.org/reports/global-energy-review-2020?utm_campaign=IEA%20newsletters&utm_source=SendGrid&utm_medium=Email.
- IEA 2020b**, *Energy efficiency and economic stimulus*, 8 April 2020, viewed 23 May 2020, <https://www.iea.org/articles/energy-efficiency-and-economic-stimulus>.
- International Renewable Energy Agency (IRENA) 2020**, *Renewable power generation costs in 2019*, viewed 4 June 2020, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Jun/IRENA_Power_Generation_Costs_2019.pdf.
- Investor Group on Climate Change (IGCC) 2020a**, *Technology development will require private capital to get to a net-zero emissions destination*, Media release, 21 May 2020, viewed 27 May 2020, https://igcc.org.au/wp-content/uploads/2020/05/21052020_MR_IGCC_Technology-Roadmap.pdf.
- IGCC 2020b**, *Submissions to: Royal Commission into National Natural Disaster Arrangements*, April 2020, viewed 27 May 2020, https://igcc.org.au/wp-content/uploads/2016/04/IGCC-submission-Bushfire-RC_30.04.20-final.pdf.
- Kompas, Tom, Van Ha Pham and Tuong Nhu Che 2018**, *The Effects of Climate Change on GDP by Country and Global Economic Gains from Complying with the Paris Climate Accord (2018) 6 Earth's Future 1153*, viewed 27 May 2020, <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2018EF000922>.
- Lelieveld J, Evans J.S, Fnais M, Giannadaki D, Pozzer A 2015**, *The contribution of outdoor air pollution sources to premature mortality on a global scale*, Nature, 16 September 2015, viewed 3 July 2020, <https://www.nature.com/articles/nature15371>.
- Liebreich M 2020**, *Covid-19 - The low carbon crisis*, BloombergNEF, 26 March 2020, viewed 23 May 2020, <https://about.bnef.com/blog/covid-19-the-low-carbon-crisis/>.
- Martin 2020**, *VFacts: Covid-19 crushes car sales*, GoAuto.com.au, 5 May 2020, viewed 8 June 2020, <https://www.goauto.com.au/news/vfacts/sales-2020/vfacts-covid-19-crushes-car-sales/2020-05-05/82685.html>.
- McCall T, Baker M 2020**, *Circular Economy positive way forward*, Sunday Examiner, 24 May 2020, viewed 26 May 2020.
- Minerals Council of Australia (MCA) 2020**, *Climate Action Plan*, viewed 22 June, https://minerals.org.au/sites/default/files/MCA%20Climate%20Action%20Plan_22_June_20.pdf.
- Monks P 2020**, *Coronavirus: Lockdown's effect on air pollution provides rare glimpse of low carbon future*, The Conversation, 15 April 2020, viewed 08 June 2020, <https://theconversation.com/coronavirus-lockdowns-effect-on-air-pollution-provides-rare-glimpse-of-low-carbon-future-134685>.
- Morrison S 2020**, *CEDA's State of the Nation Conference*, viewed 17 June 2020, <https://www.pm.gov.au/media/address-%E2%80%93ceda%E2%80%99s-state-nation-conference>.
- New South Wales Government Department of Planning, Industry and Environment 2020**, *Net Zero Plan Stage 1: 2020-2030*, viewed 3 June 2020, <https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Climate-change/net-zero-plan-2020-2030-200057.pdf?la=en&hash=D65AA226F83B8113382956470EF649A31C74AAA7>.

New South Wales Government Energy 2020, *Memorandum of understanding – NSW energy package*, viewed 3 July 2020, <https://energy.nsw.gov.au/media/2001/download>.

New South Wales Government Treasury 2020, *Health and stimulus package*, viewed 8 June 2020, <https://www.treasury.nsw.gov.au/Covid-19Stimulus>.

New South Wales Government Health n.d., *Particulate matter (PM10 and PM2.5)*, viewed 22 June 2020, <https://www.health.nsw.gov.au/environment/air/Pages/particulate-matter.aspx#:~:text=PM2.,evidence%20that%20exposure%20to%20PM2.&text=Note%20that%20PM10%20includes%20PM2>.

New Zealand Climate Change Commission (NZ CCC) 2020, *Open letter to the Hon James Shaw, Minister for Climate Change*, 7 April 2020, viewed 21 May 2020, <https://ccc-production-media.s3.ap-southeast-2.amazonaws.com/public/Climate-Commission-advice-re-stimulus.pdf>.

Reserve Bank of Australia (RBA) 2020a, *Statement of Monetary policy: Macro economic effects of the drought and bushfires*, February 2020, viewed 21 May 2020, <https://www.rba.gov.au/publications/smp/2020/feb/box-b-macroeconomic-effects-of-the-drought-and-bushfires.html>.

RBA 2020b, *Renewable Energy Investment in Australia*, Reserve Bank of Australia, viewed 22 May 2020, <https://www.rba.gov.au/publications/bulletin/2020/mar/pdf/renewable-energy-investment-in-australia.pdf>.

RBA 2019, *Financial stability review*, viewed 28 May 2020, <https://www.rba.gov.au/publications/fsr/2019/oct/box-c-financial-stability-risks-from-climate-change.html>.

Scott T 2020, *Cows and seaweed pair up to reduce emissions*, 8 May 2020, viewed 28 May 2020, <https://farmers.org.au/news/cows-and-seaweed-pair-up-to-reduce-emissions/>.

Sustainable Minerals Institute 2019, *Australian opportunities in the circular economy for metals*, viewed 22 June 2020, https://smi.uq.edu.au/files/13348/Wealth_From_Waste_Report_WEB.pdf.

United Nations Environment Programme (UNEP) 2020, *Building back better: the role of green fiscal policies*, Green economy policy brief, viewed 3 July 2020, <https://www.greengrowthknowledge.org/sites/default/files/UNEP-Building-Back-Better-Policy-Brief-The-role-of-green-fiscal-policies.pdf>.

UNEP 2019, *Emissions Gap Report 2019*, viewed 8 June 2020, <https://www.unenvironment.org/resources/emissions-gap-report-2019>.

Worldometer 2020, *COVID-19 Coronavirus Pandemic*, 8 June 2020, viewed 08 June 2020, https://www.worldometers.info/coronavirus/?utm_campaign=homeAdUOA?Si.

Xiao W, Nethery R 2020, *Covid-19 PM2.5: A national study on long-term exposure to air pollution and COVID-19 mortality in the United States*, Harvard University, viewed 8 June 2020, <https://projects.iq.harvard.edu/covid-pm>.

Zachariah B and Murphy L 2020, *Vfacts: May 2020 new car sales, the complete report*, viewed 23 June 2020, <https://www.caradvice.com.au/854859/vfacts-may-2020-new-car-sales-the-complete-report/>.