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Committee Secretary
Economics and Governance Committee
Parliament House
George Street
Brisbane Qld 4000

30 June 2020

To whom it may concern

We welcome the opportunity to provide a submission to the Queensland Economics and Governance Committee's Inquiry into the Queensland Government's economic response to COVID-19.

As part of the bridge to recovery from the profound economic impacts of COVID-19, on 7 June 2020 World Wide Fund for Nature-Australia (WWF-A) launched our Renewable Recovery Campaign. Attached is our proposal for a renewable economic stimulus which would drive new employment growth, provide greater diversity within the broader economy, and accelerate action to address climate change through technological solutions.

We commend the focus of the Queensland Government on renewable energy as part of its stimulus to date. Including support for Copper String, renewable hydrogen, a new training facility and the acceleration of renewable energy projects. However, we believe the Queensland Government can and should do much more to implement a Renewable Recovery package as part of your efforts to stimulate economic growth. We further note, the urgent need for stimulus as part of the economic recovery to the COVID-19 crisis.

We have talked to Australians from all walks of life about this topic, and we know they are enormously excited about the prospect of us becoming a renewable energy powerhouse. Using Aussie innovation and ingenuity, we could future-proof our own country, and lead the world too. Recent polling by WWF-Australia shows that in Queensland, when asked to choose between two positions, 72% of respondents said Australia's potential to be an economic superpower of the post carbon world was more aligned with their thinking, than a critique of renewables which argued they were not a good solution for the future. This was the highest positive response of any state. Most Australians want us to go for renewable-powered growth.

In a report commissioned by WWF-Australia, EY found an economic recovery based on renewables would boost local manufacturing, grow existing sectors and unlock new industries, increase exports, reskill our workforce, and reduce carbon pollution. This is the first step to take to become a "renewable energy powerhouse" - winning the race to the top that COVID-19 has presented us with. By combining what Queensland is famous for – endless sunshine, huge land area, powerful winds, world-class expertise, and strong trade relationships – with the global shift to a low carbon future, we could lead the world in the export of renewable energy, technology and all the expertise that goes with it.

Business and industry agree that investment in the renewable industry will create thousands of jobs and future-proof us in the new world that is rebuilding out of the pandemic¹. As a first step to achieving this vision WWF-Australia has consulted widely to develop five stimulus measures that could play a significant part in Queensland's economic recovery and beyond, while positioning Queensland as a leader in the global renewable economy. These measures involve:

1. Unlocking Queensland and Australia's potential to become a leader in global battery manufacture. This would build on the now closed Queensland home battery loan scheme, to provide support for more home and communities batteries and in the process create local demand for batteries made in Australia, ideally in Queensland.
2. Delivering at least one new solar project in every community in the state, cutting energy costs for thousands of community organisations, and freeing up funds to spend on core services. This should specifically, look at supporting Aboriginal and Torres Strait Islander communities and helping to reduce remote communities' reliance on diesel.
3. Converting even more of Queensland's bus fleet to electric, building on the recent all-electric metro announcement; let's make the world's best buses here, and sell them to the world too.
4. Upgrading our critical manufacturing industries to be more efficient and access renewable power sources, providing cheaper power bills and invest the savings in new jobs.
5. Putting Australia at the forefront of the emerging global renewable hydrogen market, capitalising on our world-leading renewable resources and increasing our own fuel security and energy reliability. Specifically, we recommend the creation of renewable hydrogen industry and manufacturing hubs in locations like Gladstone linked to accelerated Renewable Energy Zones.

It is not just jobs, and helping to meet emissions commitments, that flow from a renewable stimulus. There are major health benefits in a low carbon future. Covid-19 shutdowns have seen a reduction in pollution and significant improvements in air and water quality. Air pollution is one of the world's leading risk factors for death, and evidence suggests long-term exposure can impact other aspects of health and wellbeing, including early childhood cognitive function. We recommend that the Queensland Government look at the co-benefits associated with economic stimulus measures including, but not limited to lowering emissions and health benefits.

Please find attached the following:

- **EY Renewable Recovery Report.** This is an agenda setting report, that makes the case for renewables and clean energy to be a priority focus for stimulus programs aimed at kick-starting the economy as we emerge from the COVID-19 crisis. This report identifies six focus areas for government action and recommends 12 opportunities that we recommend to the Queensland Government for implementation.
- **WWF-Australia Renewable Recovery Package Policy Paper.** This document sets out \$2 billion Renewable Recovery Package. The Package consists of five proposed stimulus measures: Battery Nation, Electric Bus Revolution, Local Solar, Modernising Manufacturing and Accelerating Renewable Hydrogen. This paper includes a summary of the package, as well as costings, job numbers, case studies and policy design for each of the five measures. These stimulus measures could be adapted to Queensland or the Queensland Government could advocate to the Federal Government to adopt these measures to ensure Queensland benefits from a renewable recovery.
- **WWF's Hydrogen Position Paper.** This document sets out WWF's position on hydrogen and provides guidance for governments on the needs and opportunities associated with creating a large-scale renewable hydrogen industry for domestic needs and export.

For more information please contact Nicky Ison, Energy Transition Manager on [REDACTED] or by email [REDACTED].

¹ Industry backs calls for renewables to lead Australia back to prosperity | ABC News
<https://www.youtube.com/watch?v=gIChZPHUNDE>

Sincerely,

A handwritten signature in black ink, appearing to read 'Dermot O'Gorman', is written over a horizontal line. The signature is stylized with a large loop at the end.

Dermot O'Gorman
Chief Executive Officer
WWF-Australia



WWF

REPORT

2020

A low-angle photograph looking up at three workers installing solar panels on a metal frame. One worker in blue overalls and a white hard hat is at the top, another in a striped shirt and blue pants is in the middle, and a third in a bright green shirt and blue overalls is at the bottom. The solar panels are large and rectangular, with a grid pattern. The sky is bright and clear.

**Australian renewable
export COVID-19
recovery package**

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Acknowledgements

WWF-Australia acknowledges the Traditional Custodians of Country throughout Australia and their continuing connection to land, water and culture. We pay our respects to their Elders - past, present and emerging.

Key corporate stakeholders across a range of industries were engaged to ensure the report captured the insights from multiple sectors of the Australia economy. Their input was a critical component of developing this report and provided key insights into the practicality and tangibility of opportunities relating to Australia's economic rebuild following the COVID-19 crisis. We wish to thank those we engaged with for their input.

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Image featured on the cover © Adobe / Anatoliy Gleb / WWF-Australia

WWF is one of the world's largest and most experienced independent conservation organisations, with over five million supporters and a global network active in more than 100 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

The following pages within are analysis prepared by EY at the request of WWF-Australia to explore the renewable energy opportunities in a COVID-19 recovery package that would put Australia on the pathway to becoming a renewable exporter.



Foreword

The world is currently facing a once-in-a-lifetime challenge, with COVID-19 causing both social and economic harm across communities, countries, and continents. This pandemic has sown personal tragedies and undone years of gains in employment, and questions are being increasingly asked about what a “new normal” will look like for the global economy. Francesco La Camera, Director General of the International Renewable Energy Agency, has said that COVID-19 has exposed “deep vulnerabilities in the current system.”

A successful COVID-19 recovery plan for Australia could well mean a broader economic base, and unlocking genuine, long-term value creation. Specifically, we see the opportunity for Australia to emerge as a renewable export superpower, playing a fundamental role in Australia’s recovery and global action to address climate change.

Australia is already a global energy and resources superpower, but in the months and years ahead we will face a choice: return to past priorities or invest in emerging industries that generate jobs and growth. Choosing to prioritise the second path will deliver a range of economic, employment, health, and environmental benefits, which will flow from these new and emerging industries. With support from public and private sector leaders, the Government has an opportunity to support a renewable energy stimulus package to make this a reality and begin rebuilding the economy now.

This report sets out opportunities to grow the Australian economy post COVID-19. Where it makes economic sense, Australia should embrace new technologies, deploy renewables and utilise our domestic strengths to grow export opportunities. This report builds on WWF’s ambition of accelerating Australia’s transition towards becoming the leading global exporter of renewable energy by 2030 and put us on the pathway to 700% renewables.

1. Executive Summary

Climate change and COVID-19 have much in common: both are planetary-scale challenges that threaten our health and economic prosperity, and both are oblivious to national borders or the size of national economies. But these two challenges also highlight differences in our ability to recognise and respond to the threat within political timeframes: COVID-19 is an acute challenge that is being faced inside one political cycle, whereas the long-term challenges of climate change have to-date lessened the political drive for action.

COVID-19 and Australia

The impacts from COVID-19 are being felt today, and will continue to be felt as our economy, and economies around the world, adapt and return to growth. But this provides a short period to pause and reflect on what our economies should prioritise post COVID-19. As we begin to emerge from our initial economic response, we have the opportunity to plan and build a more resilient future economy. For Australia, this means supporting economic growth, broadening our industrial and resources base, reducing the rate of unemployment and reskilling the nation's workforce. This future presents Australia with a unique opportunity to position itself as a renewable energy superpower.

Along with many other countries, Australia is experiencing a supply shock, aggregate demand shock and a liquidity squeeze in a less robust, fragmented global economy. Closed borders and enforced stringent social distancing have resulted in reductions in GDP and job losses globally, and the four key trends (below) will be important factors in shaping our economic future.



Supply chain disruption

COVID-19 has resulted in significant disruptions to supply chains. With forced government lockdowns, increased hygiene controls and border closures, our globalised world has been crippled, with limited capacity to trade across regions – therefore re-prioritising an onshore supply chain.



Business resilience and agility

Through necessity, COVID-19 has forced businesses to reconsider their strategic priorities and adapt to a new way of working. As business navigates the short-term crisis, there is a concurrent requirement to reshape and reimagine a new business-as-usual environment in a post-crisis world.



Changing consumer behaviour

Consumer spending patterns have distinctly changed in response to the crisis weighted towards essential items and limiting discretionary spend. In a post-crisis world, a significant portion of consumers will exhibit behavioural change. Post COVID-19, some global consumers have recently suggested they will be willing to pay a premium for locally made, and more sustainable, goods and services. It is anticipated that Australian consumers will follow this trend.



Reduced pollution and GHG emissions

The reduction in economic activity, mainly manufacturing and production, caused by COVID-19 shutdowns has seen a corresponding reduction in pollution with significant improvements in air and water quality forming some of the more conspicuous examples. This has highlighted the resilience of the natural environment, its well-being value to humans and tangibly shown that it is possible to enact change.

The opportunity to rebuild the Australian economy

A forward-looking stimulus package that aligns with our national climate change greenhouse gas (GHG) emissions goals would deliver long-term economic, employment, and environmental benefits for Australia. Near-term opportunities for continued investment in renewable energy technology and infrastructure, such as solar, batteries, wind, hydrogen and fuel cells, could be the cornerstone of this package, creating and reshaping thousands of jobs in the electricity, transport, manufacturing and industrial sectors, while reducing Australia's domestic emissions and positioning Australia to benefit from low carbon trade opportunities. These solutions could also help to create new jobs and economic opportunities in Aboriginal and Torres Strait Islander (ATSI) communities. Longer-term, emerging low carbon technologies offer further growth and employment opportunities, helping to secure future prosperity for Australia in a globally decarbonised world.

Rebuilding the Australian economy, supported by a forward-looking stimulus package, could unlock new industries alongside growth in existing industries, while creating additional employment opportunities.

Near term

- ▶ **Over 100,000 direct jobs could be unlocked** by accelerating Australia's wind and solar project pipeline, fast-tracking new transmission projects to revitalise Australia's congested transmission network and through a combination of modernised manufacturing, battery projects, electrified buses, local solar and hydrogen.¹
- ▶ **Every dollar of stimulus** spent on **clean projects** generates nearly **three times as many jobs per dollar** than investment in fossil fuel projects.²

Longer term

- ▶ Capturing about **6.5%** of the global steel market through the manufacture of green steel would generate about **\$65 billion in annual export revenue** and could **create 25,000 manufacturing jobs** in Queensland and NSW.³
- ▶ Sun Cable's high voltage direct current (HVDC) cable to Singapore would require **15,000ha of solar PV** arrays and **3,800km of HVDC cable, driving \$20 billion in capital expenditure**.⁴
- ▶ Using renewable energy, Australia could become a major manufacturer and exporter of hydrogen. Hydrogen (which produces no GHGs when burned) could meet up to **24% of world energy demand** by 2050 with annual hydrogen sales of **\$700 billion USD**.⁵
- ▶ An additional **60,000 regional employment opportunities** could be created by 2030 if Australia transitions electricity generation (for energy demand) to a 50% renewable energy powered grid, which would be multiplied if electrification and export opportunities were incorporated into this transition.⁶ A more rapid transition would generate proportionally more employment to 2030, and beyond.

¹ 50,000 new direct jobs by accelerating wind and solar projects with development approval (Clean Energy Council, A Clean Recovery, 2020), 8,000 jobs through fast-tracking new transmission projects to revitalize Australia's congested transmission network (Beyond Zero Emissions, The Million Jobs Plan, 2020) and 45,000 jobs through a combination of modernizing manufacturing, battery projects, electrified buses, local solar and hydrogen (WWF, Delivering Economic Stimulus Through Renewables, 2020)

² Adapted from Garrett-Peltier 2017, Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model. Economic Modelling, Volume 61.

³ Grattan Institute, Start with steel: A practical plan to support carbon workers and cut emissions, 2020.

⁴ Sun Cable, Renewable Energy for Singapore & Australia, 2020.

⁵ Bloomberg New Energy Finance, Hydrogen Economy Outlook, 2020.

⁶ Climate Council, Renewable Energy Jobs: Future Growth in Australia, 2016.

Government will need to play a leadership role to ensure that the opportunities and benefits of renewables turn into reality, and building on past successes will be the foundation for achieving a renewables-oriented domestic economy. For example, Australia already has the highest rate of residential rooftop solar penetration in the world, but there is significant room for growth. Continued growth in rooftop solar installations is a platform from which we can expand into new opportunities such as distributed energy solutions, both domestically and for export. Current measures to support opportunities in hydrogen, such as the recently announced Advancing Hydrogen Fund and the expansion of the Clean Energy Finance Corporation (CEFC) to fund hydrogen, move in the right direction, but there are alternative opportunities to develop a broad-based renewables sector.

To unlock these growth opportunities in a world emerging from COVID-19, a renewable stimulus package would support investment and employment for Australia to become a leading renewable energy exporter. Engagement with experts and industry has been synthesised into a set of focus areas for Australia to use renewable energy to support the regrowth of Australia's economy in a post COVID-19 world. The following six focus areas form the foundation of this economic rebuild (Figure 1).

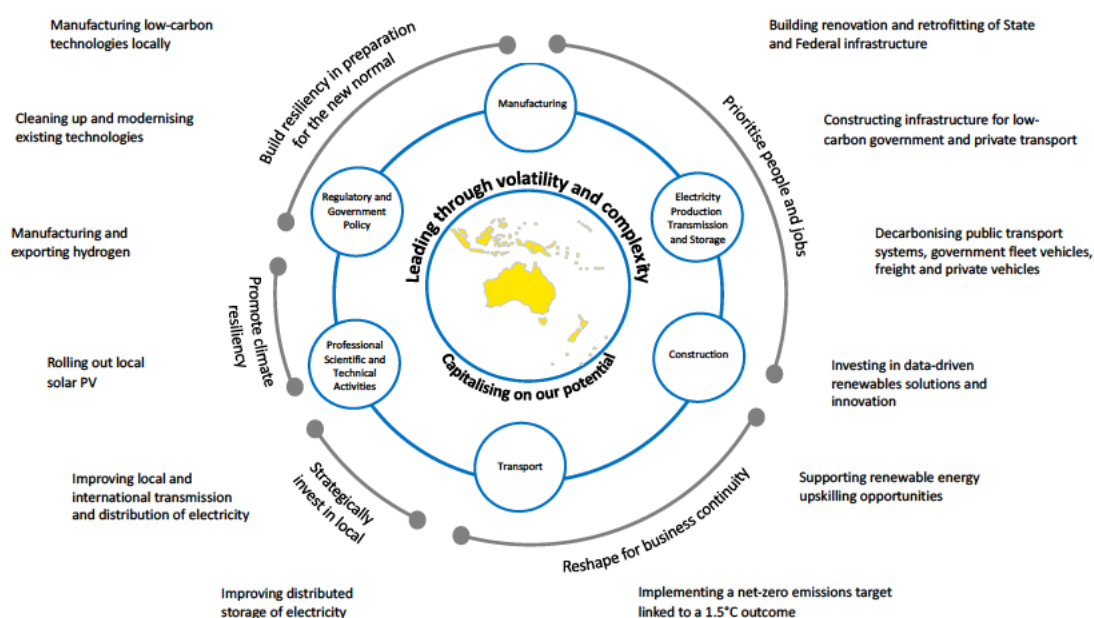


Figure 1: Focus areas matrix indicating the interrelationships of the 12 opportunities (text external to the diagram) with the 6 focus areas (yellow circles), with 5 broader policy trends necessary for the transition (outer-most grey ring)

- **Reimagining our manufacturing and export industries to increase competitiveness**, including manufacturing low-carbon technologies locally, electrifying and reducing GHG emissions from existing manufacturing and manufacturing, using and exporting green hydrogen
- **Incentivising renewable electricity generation, transmission and storage, and energy exports**, including increasing community rooftop solar photovoltaics (PV), improving local and international transmission and distribution of electricity and improving distributed storage of electricity
- **Directing infrastructure investment towards zero carbon activities** including building renovation and retrofitting of State and Federal infrastructure

- ▶ **Rethinking and decarbonising transport**, including constructing infrastructure to enable public transport, government fleet vehicles, and private vehicles to run on renewable electricity
- ▶ **Investing in Australian research, training, innovation and technology**, including investing in data-driven renewables solutions and innovation and supporting renewable energy upskilling and education opportunities
- ▶ **Regulatory and government driven climate action**, including implementing a 2050 net-zero emissions trajectory and target.

2. COVID-19: Impact and response

2.1 Impact

Economically, the COVID-19 crisis has caused a supply shock, aggregate demand shock and liquidity squeeze in a less robust, fragmented global economy with higher levels of debt and lower interest rates than previous Black Swan events.

In many countries, the response has been to require specific industries to close, and to limit the operation of others through physical distancing requirements: this has precipitated job losses and GDP impacts to manage public health. Similarly, the need to limit physical interaction, such as governments prohibiting non-essential travel, has significantly reduced demand, forcing some businesses to close, decreasing the turnover of others and resulting in widespread job losses.

The impacts from COVID-19 are varied between industries, locations, and demographics. Four significant economic trends are resulting from the COVID-19 crisis. These trends transcend industries, and demonstrate the impetus for Australia, and the world, to re-evaluate the current economy, and prioritise an economic rebuild.

- ▶ **Supply chain disruption:** COVID-19 has resulted in significant disruptions to global and domestic supply chains. With forced government lockdowns, increased hygiene control and border closures. Our globalised world has been crippled, with limited capacity to trade across regions, therefore re-prioritising an onshore supply chain.
- ▶ **Business resilience and agility:** Through necessity, COVID-19 has forced businesses to reconsider their strategic priorities and adapt to a new way of working. As businesses navigate the short-term crisis, there is a concurrent requirement to reshape and reimagine a new business-as-usual environment in a post-crisis world.
- ▶ **Changing consumer behaviour:** Consumer spending patterns have changed in response to the crisis, weighted towards essential items and decreased discretionary spending. In a post-crisis world, a significant portion of consumers will exhibit behavioural change, which will be guided by income levels and demographics.
- ▶ **Reduced pollution and GHG emissions:** The reduction in economic activity, mainly manufacturing and transport (including aviation, road and sea transport), caused by COVID-19 shutdowns has seen a corresponding reduction in pollution, highlighting the resilience of the natural world.

2.1.1 Supply chain disruption

Production shutdowns, national border closures and increased hygiene controls due to COVID-19 have significantly disrupted global and domestic supply chains. A halt in manufacturing due to forced government lockdowns abroad, firstly and particularly in China, has translated to an unavailability of many inputs to Australian businesses and final consumer goods. Additionally, border closures and increased health compliance across the logistics chain have slowed the overall speed of the supply chain. In the first quarter of the 2020 calendar year, imports decreased 3% in January and 14% in February, with further reductions expected throughout 2020 (Figure 2).

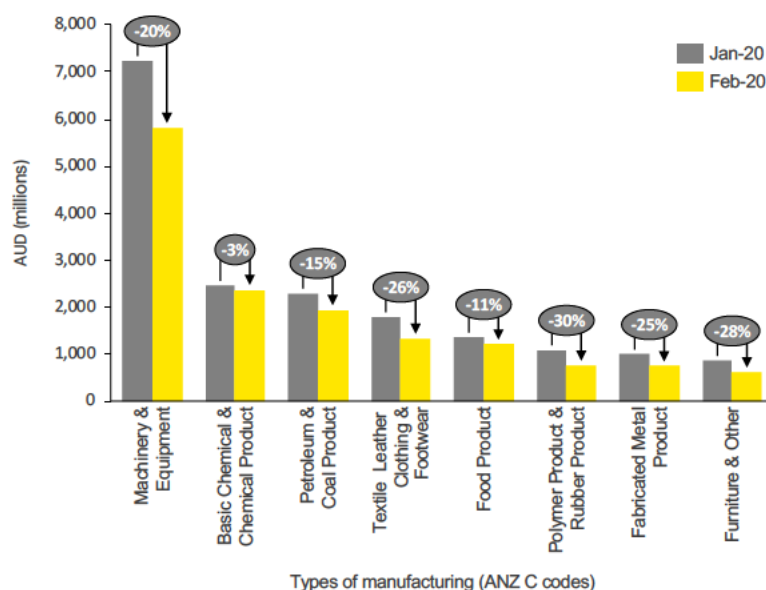


Figure 2: Australian imports in January and February 2020 for key sectors (EY analysis, ABS data)

Manufactured goods have seen some of the largest drops in absolute and percentage terms from January to February (Figure 2), likely the result of supply chain disruption alongside reduced local demand. A consequence of this supply chain interruption has been an enhanced focus on local manufacturing security with the potential for the expansion of Australian manufacturing in strategic areas where we possess a competitive advantage. Specific manufacturing examples and trends resulting from this crisis include:

- ▶ Re-building manufacturing capabilities onshore to secure supply chains and reduce reliance on international producers and suppliers.
- ▶ Domestic demand responses, such as Tindo Solar – Australia’s only solar panel manufacturer – experiencing record sales since the start of March.
- ▶ Food security and supply availability concerns have driven the consideration of transforming Australia from a net importer of chemical and fertiliser manufacturing, to a net exporter. Additionally, this will contribute to strengthen the historically strong Australian agriculture sector.

2.1.2 Business resilience and agility

As sections of the Australian economy have gone into hibernation, COVID-19 has tested business resilience and agility through greater workforce flexibility, realignment of strategic priorities, development of IT and communications infrastructure and the cultural shift towards new ways of working.

- ▶ **Workforce flexibility:** Businesses have seen increased remote working, changed hours and adaption to new physical distancing and public health measures. Many businesses have observed the possibilities and productivity of remote work, which will likely increase after COVID-19. However, the need for physical social interaction and the inability of the majority of labour-intensive (manual) jobs to be undertaken remotely suggests this trend is likely to have less of an aggregate impact throughout the entire economy than many “work futurists” are hypothesising.

- ▶ **Realignment of strategic priorities:** The sudden shock of the COVID-19 crisis has forced businesses to re-evaluate their business models and cashflow in the short-term, and realign their strategic priorities and plans for the longer-term. Particular trends include a focus on increased supply chain security, sustainable growth and crisis planning and management.
- ▶ **Development of IT and communications infrastructure:** A rapid digitisation and upscaling of IT infrastructure and communications systems and protocols has occurred due to the physical distancing requirements imposed during COVID-19. While some of this may be scaled back after the immediate crisis, much of the infrastructure and acquired knowledge will remain, resulting in enhanced productivity.
- ▶ **Cultural shift towards a new way of working:** Arguably the most significant medium to long-term change for the private sector will be a more creative, empathetic and dynamic approach to working and communicating. This provides an opportunity for enhanced diversity and inclusion, including for parents of young children, geographically remote individuals and those with physical disabilities, lifting output and well-being overall.

These trends constitute large elements of the current state of flux in business which make this moment in time the right time for strong decisive leadership in policy and stimulus.

2.1.3 Changing consumer behaviour

COVID-19 has resulted in large job losses, significant health and well-being concerns and reduced consumer confidence which has seen distinct changes in consumer spending patterns. Consumer confidence has fallen by over 30% in the past five months according to the ANZ-Roy Morgan consumer confidence index, with other consumer confidence indexes such as the Westpac-Melbourne Institute index displaying similar trends. This decline in consumer confidence is a result of the inherent uncertainty of the COVID-19 crisis and job losses with real world implications for spending behaviours. Recent data from the big four banks has evidenced this trend, particularly relating to an increase in spending on essential goods, decrease in discretionary spending, and higher expenditure on physical goods relative to services, and lower expenditure on services overall.

Looking forward, EY's FutureConsumer.Now research suggests a significant percentage of consumers will exhibit behavioural change and increased spending in certain areas in the COVID-19 recovery phase and beyond. Post COVID-19, some global consumers have recently suggested they will be willing to pay a premium for certain products and services (Figure 3): onshore manufacturing of products and more sustainable of products and services were the second and third most compelling justifications for consumers paying a premium. It is anticipated that Australian consumers will follow this global trend and be willing to pay a premium for more sustainable options, representing an opportunity in the form of local and sustainable manufacturing.

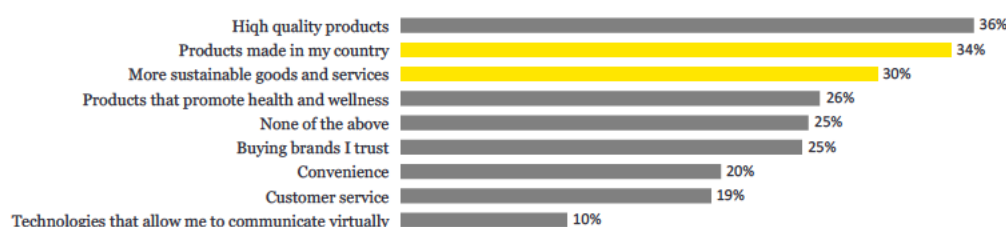


Figure 3: Reasons for consumers to pay a premium for products and services post COVID-19 (EY FutureConsumer.Now, April 2020)

2.1.4 Reduced pollution and GHG emissions

The sudden reduction in production stemming from COVID-19 has seen a corresponding reduction in pollution, with air and water pollution being more obvious examples. Similarly, GHG emissions are likely to show reductions from business as usual.

Air pollution is one of the world's leading risk factors for death, with the Global Burden of Disease study estimating that it contributes to over 3.4 million premature deaths.⁷ Further, 91% of the world's population lives in places where air quality exceeds the World Health Organisation's (WHO's) guideline limits.⁸ There is a growing body of evidence that suggests long-term exposure to air pollution can impact other aspects of health and wellbeing, including early childhood cognitive function. Acute events such as the recent 2019/20 Australian bushfire season brought poor air quality to much of Australia's population: the carbon dioxide (CO₂), carbon monoxide (CO), sulfur dioxide (SO₂) and nitrogen dioxide (NO₂) found in bushfire smoke can be toxic to the environment and human health.

COVID-19 and the Australian bushfires have had major economic and environmental consequences. COVID-19 represents the most challenging hurdle for Australia's economy since World War II. For bushfire-affected areas experiencing already depressed economic activity the COVID19 economic impacts have been severe..

Past recessions have shown that quick recoveries – quick being within three years – are possible, but their speed and coverage is uncertain. For example, after the Great Depression, WWII and the Spanish Flu, the Australian economy had an average of 8% growth in the three years following each recession.⁹ Australia's rebound will depend in part on strategic investment across all regions, especially those local government areas affected by the bushfires and reduced tourism.

But while the acute impacts of COVID-19 have drawn an almost immediate policy response, addressing the longer term chronic impacts of climate change similarly requires economic and industrial innovation. Longer term, air pollution and GHG emissions will be strongly influenced by the approach to economic recovery and stimulus priorities following the COVID-19 crisis

2.2 Response: stimulus opportunities

2.2.1 Stimulus options

The Australian Government has implemented large fiscal stimulus packages while the RBA has utilised many of its monetary policy levers in an attempt to lessen the impacts of COVID-19. The already fragile Australian economy appears to be most heavily impacted by reduced local demand. COVID-19 will continue to transform global economies, with Australia not immune to its impacts. However, in part due to the early measures Australia took to limit the spread, Australia is now in a stronger position to many of our country peers in addressing the challenges of COVID-19.

But while other challenges facing Australia and the world have been pushed from the front pages, they have not gone away. Climate change remains a pressing global challenge – the world is already on

⁷ GBD 2017 Risk Factor Collaborators – “Global, regional, and national comparative risk assessment of 84 behavioral, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017.

⁸ World Health Organisation, Ambient air pollution: A global assessment of exposure and burden of disease 2016.

⁹ COVID-19 and summer bushfires: The economic impact on your suburb and pathways to recovery, SGS Economics and Planning, 2020.

track to record its hottest year ever¹⁰ – while lethargic growth amongst many OECD countries and increasing inequality in our societies, already presents long-term structural challenges.

The acute economic effects of COVID-19 need to be managed (Figure 4): wage support and tax incentives can meet those short-term needs¹¹. But long-term growth is best served by approaches which position the Australian economy for inevitable future changes, rather than uncritically following historic patterns. This includes prioritising green construction projects such as clean energy infrastructure (e.g. renewable energy assets, and new energy storage opportunities such as hydrogen and grid mobilisation) where they demonstrate a high economic impact.

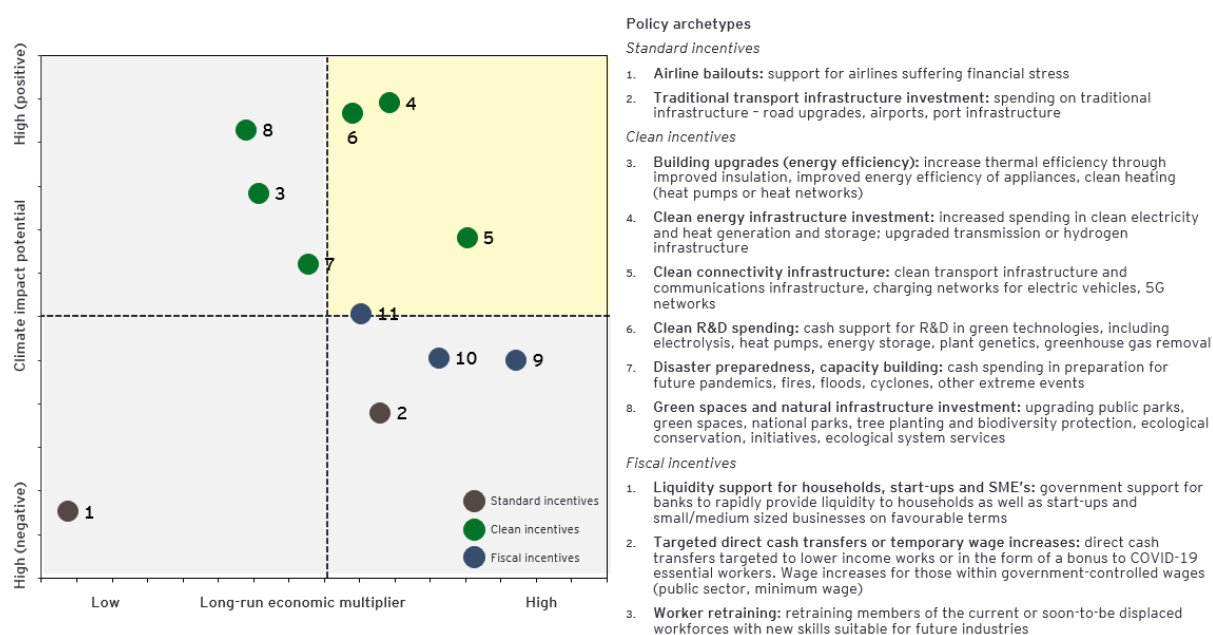


Figure 4: COVID-19 policy archetypes mapped to climate impact potential and long-run economic multiplier¹²

COVID-19 is a global disaster that will take time to address: its short-term impacts have been severe, with every indication that the future may look very different to the past. However, there will be a future recovery, and we have a window of opportunity to achieve long-term benefits (economic and climate). Communities need employment, the country needs growth, and our challenge is to ensure that policy and economic stimulus decisions taken now meet both immediate needs, and also create the foundation for long-term sustainable growth. Focus areas in renewable energy use domestically and for exports would align with our climate goals, deliver jobs and growth, and position us as a new world superpower for a growing energy market.

¹⁰ National Centers for Environmental Information. Global Climate Report. March 2020.

¹¹ Adapted from Hepburn et al 2020, *Will COVID-19 fiscal recovery packages accelerate or retard progress on climate change?* Oxford Review of Economic Policy 36(S1): forthcoming.

¹² Adapted from Hepburn et al 2020, *Will COVID-19 fiscal recovery packages accelerate or retard progress on climate change?* Oxford Review of Economic Policy 36(S1): forthcoming.

3. A renewable exports stimulus plan

A stimulus package focused on decarbonising the economy post COVID-19 would open up major economic, social and environmental opportunities for Australia. Continued investment in energy efficiency, electrification and renewable energy such as solar, batteries, wind, hydrogen and fuel cells are important to create and reshape thousands of jobs in the electricity, transport, manufacturing and industrial sectors while reducing Australia's emissions.

But an economic rebuild will not occur without collaboration. Government (federal and state), private sector, non-profit organisations and communities are all necessary contributors. Government policy, coherent regulatory frameworks, and private investment are fundamental for Australia to develop innovative, low-carbon technologies and economic activities.

With the support from public and private sector leaders, if executed consistently and coherently, the opportunities identified in this report for economic stimulus could rebuild the Australian economy and provide extensive employment opportunities, while simultaneously positioning Australia as a new order energy superpower. An objective within Australia's economic rebuild is to accelerate transition towards becoming the leading global exporter of renewable energy by 2030 and put Australia on the pathway to 700% renewables. Transition, in this context, refers to the macroeconomic, macrosocial and macro-environmental change from the status quo to the target condition – cementing Australia's position as the leading exporter by 2030.

The following criteria were used as the guiding principles to ensure that the focus areas and opportunities included in this report are economically impactful, politically engaging and align to an innovation agenda.

- ▶ **Prioritise people and jobs:** Stimulate job creation and redeployment across existing and new industries
- ▶ **Reshape for business continuity:** Be cost effective, politically feasible and manage the impacts of this health crisis in the short-term
- ▶ **Strategically invest in local:** Promote capital investment and commercialisation of onshore supply chains and technology
- ▶ **Promote climate resiliency:** Prioritise climate adaptation and mitigation and align opportunities to achieving Australia's Paris Agreement target
- ▶ **Build resilience in preparation for the new normal:** Develop a local knowledge economy and focus on rebuilding in a post COVID-19 world where economic priorities have strategically shifted

3.1 Stimulus focus areas

Within the six focus areas, 12 detailed opportunities which support Australia to realise its economic, jobs and renewable energy potential in a post COVID-19 world were identified. These strategic opportunities are outlined in Table 1 below with a more detailed analysis provided in Annexure 1.







	Focus Area	Opportunity	
	Restarting our manufacturing industries	Manufacturing low-carbon technologies locally	<i>Support the Australian manufacturing industry to build components for clean energy projects and energy efficient equipment for buildings locally while increasing export subsidies</i>
		Cleaning up and modernising existing manufacturing	<i>Support the Australian manufacturing industry to improve the energy and emissions efficiency of their plant, equipment and operations, which will in turn increase their competitiveness domestically and internationally</i>
		Manufacturing, using and exporting renewable hydrogen	<i>Commercialise production, develop infrastructure, build capabilities, drive demand and promote green steel and ammonia industries with an end-goal of exporting embodied renewable energy in the form of high-value products</i>
	Incentivising electricity generation, transmission and storage, and energy exports	Rolling out community solar PV	<i>Install rooftop solar PV on all public housing, low-income rental housing, community organisations, and all state infrastructure (where feasible), and expand financing options</i>
		Improving local and international transmission and distribution of electricity	<i>Create high quality, integrated transmission networks domestically and internationally, accelerate the development of Renewable Energy Zones, and develop regional and remote microgrids</i>
		Improving distributed storage of electricity	<i>Increase distributed energy storage in communities and homes, and increase coordination of and demand for distributed energy resources</i>
	Directing infrastructure investment towards zero carbon activities	Building renovation and retrofitting of state and federal infrastructure	<i>Strategically invest in government building renovations and retrofits, while maintaining the historical significance of such buildings</i>
	Rethinking and decarbonising transport	Constructing infrastructure for low-carbon government and private transport	<i>Incentivise the uptake of private vehicle owners purchasing electric vehicles, whilst simultaneously supporting current electric vehicle owners through increased charging infrastructure</i>
		Decarbonising public transport services, government fleet vehicles, freight and private vehicles	<i>Accelerate the electrification of all public transport, and develop and construct electric public transport infrastructure which will in turn have supply- and demand-side benefits</i>
	Investing in Australian research, training, innovation and technology	Investing in data-driven renewables solutions and innovation	<i>Increase funding for renewable energy innovation hubs, incentivise data collaboration, and create a streamlined system to support R&D tax incentives</i>
		Supporting renewable energy upskilling opportunities	<i>Future-proof Australia's professional, scientific and technical knowledge-base, and provide increased subsidies for renewable energy education and training opportunities</i>
	Regulatory and government driven climate action	Implementing a net-zero emissions target linked to a 1.5°C outcome	<i>Establish an economy-wide net-zero emissions target by 2050</i>

Table 1: Outlining the detailed opportunities for economic stimulus in Australia's economic rebuild through six key focus areas

3.2 A comprehensive and strategic approach

The focus areas identified in this report are focused on gently nudging the economic order towards clean, financially viable solutions. The focus areas are supported by a comprehensive and coordinated renewable energy and sustainable finance approach to drive economic growth, employment, export capabilities and financial sector investment (Table 2). The focus areas outline Australia's blueprint for renewable energy success, support growth across value chains and deliver long-term economic and employment value, even during turbulent times, with volatile markets and growing unemployment.







Focus Area	Horizon	Type of Measure				Financial Mechanism	Gravity
		Govt. spending	Tax	Subsidy	Regulatory Reform		
Restarting our manufacturing industries	Medium	✓		✓	✓	<ul style="list-style-type: none"> ▶ State and Federal Government Loan Guarantee ▶ Tax subsidies for process electrification ▶ Export subsidy ▶ Export Development Grant 	
Incentivising electricity production, transmission and storage, and energy exports	Medium	✓		✓	✓	<ul style="list-style-type: none"> ▶ Government funded interest-free loan ▶ Subsidy ▶ Export subsidy ▶ Peer-to-peer energy trading 	
Directing infrastructure investment towards zero carbon activities	Medium	✓		✓	✓	<ul style="list-style-type: none"> ▶ Co-investment ▶ State and Federal Government Loan Guarantee 	
Rethinking and decarbonising transport	Medium	✓	✓	✓	✓	<ul style="list-style-type: none"> ▶ Federal Government Loan Guarantee ▶ Tax offset/exemption 	
Investing in Australian research, training, innovation and technology	Short	✓	✓	✓	✓	<ul style="list-style-type: none"> ▶ Tax offset ▶ Delegated Government Organisation Funding ▶ Education subsidy 	
Regulatory and government driven climate action	Long	✓	✓		✓	<ul style="list-style-type: none"> ▶ Net-zero GHG emissions 2050 target ▶ Offsets market 	

Table 2: Focus Areas Matrix – assessing each Focus Area's time horizon, type of measure, financial mechanism required, gravity and risk

3.3 The employment and investment case for stimulus

3.3.1 Immediate employment impacts of COVID-19

As a direct result of the acute COVID-19 crisis, unemployment and underemployment within Australia has risen and is expected to continue to do so despite the Federal Government wage subsidy programme. These trends are economy wide with all industries being disrupted to some degree. This is demonstrated by the change in employment across sectors (Figure 5), with wages also appearing to fall. The education and training sector was the only exception: however, this increase in employment is not expected to continue due to employment reductions in tertiary education resulting from decreased international students and online learning.

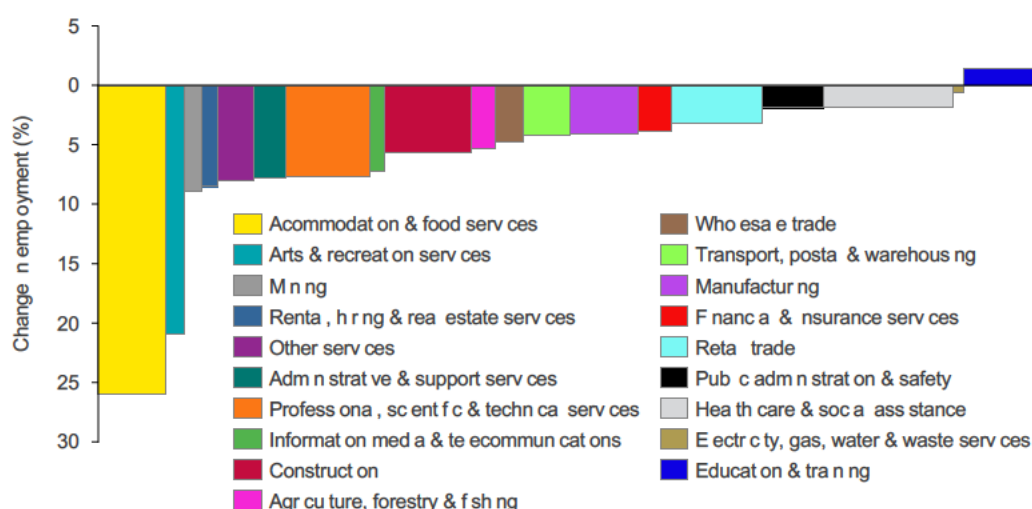


Figure 5: Changes in employment across Australia's sectors from March to April 2020, weighted by total employment

3.3.2 Future investment, future jobs

An Australian renewable stimulus could support the Australian economy, in particular employment for the workforce which has been impacted by the COVID-19 crisis. The impact of a renewable stimulus would be to both drive new employment growth and provide greater diversity within the broader economy. There is an option to transition employment through fiscal stimulus, and through strategic redeployment and reskilling, to accelerate and diversify employment gains.

And there is good reason to invest for growth in the renewables and renewable export sector: every \$1 million of spending generates 4.8 full-time jobs in renewable infrastructure and 4.95 full-time jobs in energy efficiency¹³. Given these employment effects, a modest expansion of Australia's current COVID-19 economic stimulus package (\$153.6 billion from the Commonwealth, \$11.8 billion from the states and \$105 billion in Reserve Bank of Australia lending¹⁴), would see significant employment growth across all sectors, including those impacted by COVID-19.

For example, were 10% of total stimulus directed towards clean projects, 160,000 additional employment opportunities would be unlocked, an employment return on investment around three times

¹³ Adapted from Hepburn et al 2020, *Will COVID-19 fiscal recovery packages accelerate or retard progress on climate change?* Oxford Review of Economic Policy 36(S1): forthcoming.

¹⁴ Australian Government, EY Analysis.
Australian renewable export COVID-19 recovery package report – WWF-Australia

greater than would be generated by similar spending in fossil fuel sectors. By comparison, every AUD\$1 million of spending generates 1.7 FTE in fossil fuel industries.¹⁵

From an export perspective, 16,000 jobs and over \$10 billion in export revenue are expected from production of hydrogen for export by 2040 under a high hydrogen demand scenario (global demand of 80 million tonnes)¹⁶ with broader employment benefits such as up to 25,000 additional manufacturing jobs by capturing 6.5% of the global steel market.¹⁷

To place the costs of this green stimulus package in context, it represents a fraction of the immediate government stimulus package while generating significant job numbers and reorienting the economy towards a more strategic, low-carbon trajectory.

3.3.3 Skills and re-skilling

Inherent in this job creation is the need to consider the skills of those made unemployed and the skills required for these new jobs in low carbon projects.

EY has identified key skills which we believe will be central to rebuilding the Australian economy, post COVID-19. Coupled with this skills analysis, we have utilised the ABS's estimated job losses from March-April 2020 and analysed the key industries which have been, and are likely to continue to be, impacted by the COVID-19 crisis.

Economy wide, there are opportunities for upskilling and redeployment of employees impacted by the COVID-19 crisis to support an economic rebuild. The sectorial job losses capability matrix below (Table 3) indicates the skills vital in a renewable energy transition, and maps these skills to each sector, to demonstrate the wide-ranging opportunities for upskilling and redeployment. The severity of job loss is represented horizontally across sectors via a colour scale, while key skills for a renewable energy economic rebuild are represented vertically. Approximate estimates for absolute job losses are displayed for each sector on the far right for additional perspective to the percentage changes already presented.

With the exception of Arts and Recreation Services, there is a significant overlap in the skills between highly impacted sectors and the new economy employment needs. As discussed further below, job losses in Construction, Manufacturing and Professional, Scientific and Technical Services have potential to be redeployed in a renewable energy transition with adequate supporting policy and stimulus.

¹⁵ Adapted from Garrett-Peltier 2017, Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model. Economic Modelling, Volume 61.

¹⁶ ARENA, Opportunities for Australia from Hydrogen Exports, 2018.

¹⁷ Grattan Institute, Start with steel: A practical plan to support carbon workers and cut emissions, 2020. Australian renewable export COVID-19 recovery package report – WWF-Australia

Sectorial job losses capability matrix		Vital skills									Job losses from the start of March to April ¹⁸
		Legal	Financial	Business	Engineering	Project Management	Skilled Manual Labour	Unskilled Manual Labour	Logistics	Technology	
ANZIC sectors	Agriculture, Forestry and Fishing			✓		✓	✓	✓	✓	✓	17,000
	Mining			✓		✓	✓	✓	✓		21,000
	Manufacturing		✓	✓		✓	✓	✓	✓	✓	38,000
	Electricity, Gas, Water and Waste Services					✓	✓	✓		✓	1,000
	Construction			✓		✓	✓	✓	✓		68,000
	Wholesale Trade		✓	✓		✓	✓	✓	✓		19,000
	Retail Trade		✓	✓			✓	✓	✓		41,000
	Accommodation and Food Services			✓			✓	✓			243,000
	Transport, Postal and Warehousing					✓	✓	✓	✓		28,000
	Information Media and Telecommunications	✓		✓		✓				✓	15,000
	Financial and Insurance Services	✓	✓	✓		✓				✓	18,000
	Rental, Hiring and Real Estate Services	✓	✓			✓					19,000
	Professional, Scientific and Technical Services	✓	✓	✓		✓	✓			✓	90,000
	Administrative and Support Services					✓	✓	✓			34,000
	Public Administration and Safety	✓	✓	✓		✓					16,000
	Education and Training					✓	✓				(16,000) ¹⁹
	Health Care and Social Assistance					✓	✓				33,000
	Arts and Recreation Services						✓				52,000
	Other Services							✓			40,000

Table 3: Job loss capability matrix for all sectors against the key skills needed in a renewable transition

¹⁸ EY analysis of ABS data from the start of March to the start of April.¹⁹ Denotes estimated employment gains from the start of March to the start of April. Australian renewable export COVID-19 recovery package report – WWF-Australia

The three industries we have identified with the potential to support the rebuild of the Australian economy are as follows:

- ▶ **Construction:** The third largest employer in the Australian economy also experienced the third largest job losses from March to April and possesses the expertise and appetite to develop much of the physical infrastructure for Australia to become a renewable energy economy. An additional 58,000 construction jobs could be unlocked through the fast tracking of new renewable projects,²⁰ accounting for nearly all construction jobs lost to date due to COVID-19.
- ▶ **Professional, Scientific and Technical Services:** Australia's fourth largest employing sector suffered the second largest job losses from March to April and possesses the relevant business acumen and project delivery experience to power much of the planning, operation and management required in Australia becoming a major renewable energy exporter.
- ▶ **Manufacturing:** The seventh largest employer in the economy experienced the seventh largest number of jobs lost from March to April and possesses skills essential to Australia becoming a large manufacturer of renewable hydrogen and renewable energy embodied exports. Skills and expertise within the manufacturing industry could also support Australia develop the onshore security of supply chains.

These three sectors are predominantly comprised of employment in state capitals, although the Construction and Manufacturing sectors both employ approximately 40% of their workforces in non-capital cities (Figure 6). This implies scope for rural, regional and metropolitan redeployment where job losses have occurred, with less disruption to the livelihoods of these workers.

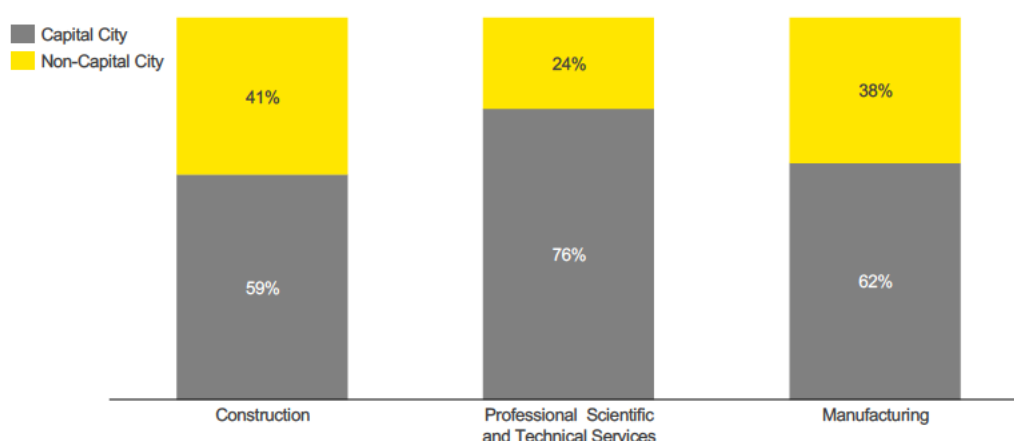


Figure 6: Employment split between capital and non-capital cities for the construction, professional, scientific and technical services and manufacturing sectors (EY analysis, ABS data)

Additionally, the Accommodation and Food Services sector, whilst not having the same skills alignment in the longer-term, has the opportunity to bounce back into employment through untraditional forms. An energy focused example includes undertaking a large-scale energy efficiency retrofit program targeted at the hospitality sector, providing short-term employment of lost jobs before transitioning back to previous forms of employment while simultaneously improving the profitability and sustainability of the hospitality sector in the longer-term.

²⁰ Clean Energy Council, 2020 and Beyond Zero Emissions, 2020.
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3.3.4 Closing the Gap

Since 2008, there has been a conscientious effort by Australian governments to deliver better health, education and employment outcomes for Aboriginal and Torres Strait Islander (ATSI) people, to eliminate the gap between Indigenous and non-Indigenous Australians.²¹ After a decade of efforts, the ATSI employment rate was 49% compared to 75% for non-Indigenous Australians in 2018.²² Further, it was identified that the ATSI employment rate varied by remoteness, with major cities having the highest ATSI employment rate of 59% compared to 35% in very remote areas. There is a growing impetus on state and federal governments to create opportunities for ATSI involvement and employment.²³

A post COVID-19 stimulus package, focused on widespread development and the use of Australia's vast land and resources for renewable development, could help close the gap. Large scale stimulus could benefit ATSI organisations and communities by sharing the ownership and benefit of the outcomes of renewable energy projects. To date, ATSI participation has not been a major consideration for most renewable development. However, a stimulus package could change this by directly supporting renewables for ATSI communities and encouraging renewable developers to work alongside traditional owners and providing ATSI communities access to additional resources and support to participate in the development of renewable projects.

All governments and private entities involved in cementing Australia's place as a renewable energy export superpower should work with ATSI organisations and communities. This creates the opportunity to drive Australia's renewable energy progress for current and future generations, through direct collaboration with ATSI organisations and communities, bringing traditional and technical knowledge to the forefront.

²¹ Closing the Gap, Closing the Gap Report 2020.

²² Closing the Gap, Closing the Gap Report 2020.

²³ Closing the Gap, Closing the Gap Report 2020.

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4. Next steps

There is the opportunity to support economic growth, and the employment that will accompany it, as our economy emerges from COVID-19. But the choices we make about where investments occur in the economy, and the shape of broader economic stimulus measures, will impact the success of this recovery.

Australia *will* rebuild its economy, but it can also choose to incentivise those sectors that maximise employment growth, diversify the economy, and open up new export markets as the world transitions to a lower carbon future. Success would position Australia as a renewable energy export superpower and deliver Australia a competitive advantage on the global stage as nations around the World look to renewable energy options.

This report has set out the opportunity, but this opportunity won't be realised without action. Key to successfully building on our existing renewable energy industries, and building new renewable energy export industries, includes:

- ▶ Government successfully leveraging private sector capital and buy-in
- ▶ Government and the private sector acknowledging and championing the economic and employment value of an expanded renewable energy sector to Australia, and
- ▶ A supportive policy framework, at both Federal and State level, that signals to investors, employers and employees the long-term direction of renewable-energy related growth in Australia.

To be a renewable export superpower, support Indigenous communities and protect Indigenous lands, while creating an economic future compatible with our national and global climate goals, will require strong commitment in the form of government spending, tax, subsidies and regulatory reform. Realising this vision also requires the collaboration of State and Federal government, private actors, non-profit organisations, and communities.

An economic rebuild is possible, but it requires strong commitment and engagement from all. Government-based economic stimulus will in part shape this new normal, this means we have a choice: rebuild the past or invest and position our economies and societies for the future.

ANNEXURE 1:

The opportunities in detail

5. The opportunities in detail

Each of the 12 opportunities have been identified and analysed to ensure maximum impact across the economy, and there are tangible strategies which can be implemented to achieve the objectives and outcomes. The opportunities have been curated based on desktop research and analysis, as well as through engagement with business leaders, to understand their position in relation to the value of each opportunity. The opportunities sit under the six focus areas introduced in the Executive Summary.

Objectives	► Strategic objective/s of each opportunity to support the overall vision and purpose of the stimulus package split into immediate and long-term objectives
Outcomes	► Outcome/s resulting from implementing the measures associated with each of the opportunities
Gravity	<p>Economic impact (GDP and employment)</p> <p>VERY LOW LOW MODERATE HIGH VERY HIGH</p> <p>Scale of impact (Portion of the economy impacted)</p> <p>SMALL MEDIUM HIGH</p> <p>Timeframe (Timeframe for implementation)</p> <p>0 – 6 MONTHS 6 MONTHS – 3 YEARS 3 YEARS – 10 YEARS 10+ YEARS</p>
Measures	► Measures to be supported and implemented by state and federal governments to achieve objectives and outcomes split into immediate and long-term measures

5.1 Restarting our manufacturing industries

Opportunity 1: Manufacturing low-carbon technologies locally

Supporting the Australian manufacturing industry to build components for clean energy projects and energy efficient equipment for buildings locally while increasing export subsidies.

Objectives	<ul style="list-style-type: none"> ► Redeploy displaced manufacturing workers to build energy efficient products and equipment ► Promote the local manufacturing of energy efficient equipment for buildings and their key components, including the manufacturing of high efficiency windows, high efficiency doors, insulation products, hot water fittings, efficient household appliances, high efficiency lighting, and high efficiency heating/cooling and ventilation systems ► Promote the local manufacturing of products, key components and machinery that are essential for renewable energy technologies such as solar, wind, hydro wave, and battery storage ► Promote the local manufacturing of the components for low-carbon transport vehicles (land, rail, air and water).
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Outcomes	<ul style="list-style-type: none"> ▶ Increased short to long-term re-deployment and re-employment of a portion of the Australian workforce impacted by COVID-19 ▶ Increased sales of local clean energy technologies to domestic and international buyers, improving Australian manufacturers' profitability and global exposure ▶ Reduced emissions within the Australian and global economy as individuals and businesses begin purchasing Australian-produced/supported clean energy technologies ▶ Fostering financial sector willingness to invest in viable renewable energy projects and technologies (via the CEFC)
Gravity	<p>Economic impact ● H GH</p> <p>Scale of impact ● MED UM</p> <p>Timeframe ● 6 MON HS – 3 YEARS</p> <p>The development of clean energy technologies in Australia will likely have two main impacts:</p> <ul style="list-style-type: none"> ▶ It will re-employ semi-skilled workers who were displaced due to COVID-19 as identified in the employment analysis in Section 3.3 above ▶ The export subsidies allow medium to large businesses to increase their sales potential. This may also provide these businesses the opportunity to scan overseas markets for franchising or even production opportunities
Measures	<p>Short-term</p> <ul style="list-style-type: none"> ▶ Asset write-off threshold: further increase the instant asset write-off threshold for manufacturers that are developing clean energy technologies <p>Long-term</p> <ul style="list-style-type: none"> ▶ Increase export subsidies²⁴: increase subsidies for the sale of clean energy technologies and products overseas through the introduction of lower-cost government loans (via the CEFC) or tax relief for exports, or government-financed international advertising or R&D. This could be realised through the existing Export Development Grants Scheme or by a specific renewable energy export mandate for Export Finance Australia (EFA). Risk hedging: ensure that risk hedging by the federal and state government and its subsidiary organisations (ARENA, CSIRO, EFA etc.) is compatible with renewable energy and sustainability requirements. Projects that undermine a clean-energy, technologically-driven future, cannot be guaranteed. This can reduce institutional and private investor risk when investing in renewable energy projects as renewable energy projects become more financially secure in comparison to non-renewable energy projects.

²⁴ Export subsidies are government policies used to encourage the export of goods through direct payment, low-cost loans, tax relief for exporters, or government-financed international advertising. For example, in 2019, the Federal Government announced a Defence Export Strategy worth \$3.8 billion, enabling EFA to provide financial assistance to more defence export contractors. Australian renewable export COVID-19 recovery package report – WWF-Australia



Case study: Tindo Solar

Tindo Solar, Australia's only solar PV panel manufacturer, is expanding its Adelaide factory after an increase in demand as global supply chains are disrupted, forcing customers to consider locally-sourced options. Its current assembly plant can produce up to 60MW of panels each year.

Currently, the manufacturer is awaiting the federal government's response to a grant application, which would further increase capacity in the plant and increase production. CEO Glen Morelli indicated that the company has increased production since March 2020, despite COVID-19 hampering some other conventional energy manufacturers – driven largely by an upswell in the Australian community to be self-sufficient producers of renewable energy components and renewable energy itself.

Tindo Solar is an example of a successful and thriving Australian business that is delivering low-carbon technologies to the Australian market, even during COVID-19. Further rounds of funding will allow it to grow, innovate and automate its processes.

Opportunity 2: Cleaning up and modernising existing manufacturing

Supporting the Australian manufacturing industry to improve the energy and emissions efficiency of their machinery and operations. This increases the competitiveness of manufacturing, with studies showing that certain companies could achieve growth in annual profits of 2-13% by increasing their energy productivity to that of their best performing peer within their sector²⁵.

Objectives	<p>Short-term</p> <ul style="list-style-type: none"> ▶ Redeploy displaced manufacturing workers to install and upgrade energy efficient systems and products ▶ Promote the installation of energy efficient systems and products powered by renewable energy within Australian manufacturers' operations <p>Long-term</p> <ul style="list-style-type: none"> ▶ Reduce energy consumption for Australian manufacturers ▶ Reduce embedded carbon of Australian manufacturing products ▶ Increase the uptake of renewable energy by Australian manufacturers
Outcomes	<ul style="list-style-type: none"> ▶ Increased short to long-term re-deployment and re-employment of a portion of the Australian workforce impacted by COVID-19 to install and upgrade lighting, HVAC systems, motors, fans and pumps, compressed air systems etc ▶ Reduced emissions from the Australian manufacturing sector ▶ Reduced emissions within the Australian and global economy as individuals and businesses begin purchasing embedded-carbon manufacturing products.
Gravity	<p>Economic impact ● H GH</p> <p>Scale of impact ● MED UM</p> <p>Timeframe ● 6 MON HS – 3 YEARS</p> <p>Investing in capital and operational improvements could increase employment opportunities for machinery designers, installers and operators while reducing long-term operational costs of manufacturing equipment, and reducing emissions from Australia's manufacturing sector.</p>
Measures	<p>Short-term</p> <ul style="list-style-type: none"> ▶ Asset write-off threshold: further increase the instant asset write-off threshold for manufacturers that are investing in capital and operational improvements aimed at reducing their emissions profile ▶ Enhancement and harmonisation of white certificate energy saving schemes: Harmonise the individual State-based energy efficiency targets into a Federal scheme with increased target ambition and a broader set of methodologies. This should increase the financial incentive for energy efficiency by increasing demand and broaden the opportunities available for businesses

²⁵ ClimateWorks Australia, 2016.

Long-term

- ▶ **Clean Technology Investment Program (CTIP):** reinstate the CTIP to increase investment and commitment to clean technology development onshore
- ▶ **Energy Efficiency Opportunities (EEO) Act:** reintroduce an expanded EEO Act. The original EEO program delivered an additional \$291 million in annual net financial savings for participating businesses.²⁶ The revamped Act should require a lower participation threshold of 0.1PJ, resulting in 399 companies being eligible. Further, the scope of the Act should be extended beyond energy efficiency to include other clean energy options, including renewable energy.



Case study: Unilever Australia switches to 100% renewable energy

In January 2020, Unilever Australia joined Unilever globally in switching to 100% renewable electricity to power all of its operations, well ahead of its end-2020 target. The majority of Unilever's Australian renewable electricity supply is met through a five-year Power Purchase Agreement (PPA) with energy retailer Red Energy, which directly supports a number of wind and solar farms across NSW, Victoria & South Australia. The remainder of Unilever's power supply is covered by purchasing Renewable Energy Certificates.

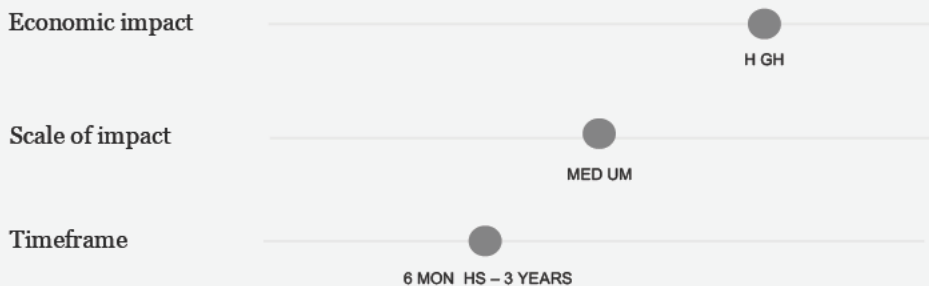
As a result of making this switch, Unilever is reducing its greenhouse emissions by about 30,840 tonnes of CO₂, each year. This is equivalent to the emissions generated by powering more than 3,600 Australian homes or 6,600 cars annually. The switch is not only good for the environment, but it also makes good business sense for Unilever by delivering a combination of flexibility, cost savings and certainty on energy costs. It also gives Unilever's consumers reassurance that they are purchasing sustainably produced products, for which demand is increasingly growing.

This local milestone demonstrates how Unilever is decoupling its growth from its environmental impact. But there is still more to be done and Unilever recognises the ongoing urgency of addressing climate change, which is why it also set itself the ambition of becoming carbon positive by 2030. The next step will be looking at electrifying more of its manufacturing processes. Unilever will also directly support the generation of more renewable energy than it needs for its own operations, making the surplus available to the markets and communities in which it operates.

Opportunity 3: Manufacturing, using and exporting hydrogen

Hydrogen is a versatile, safe, readily storable and transportable fuel with early opportunities in the fertiliser industry, heavy road transport and through direct gas injection into the existing gas network. While longer-term opportunities exist in the manufacture of zero carbon embodied building materials (e.g. green steel), shipping and as an export commodity. Renewable energy can be used to electrolyse water to generate renewable hydrogen. Research from the Grattan Institute suggests Australia could generate approximately \$65 billion in annual export revenue and 25,000 manufacturing jobs by supplying 6.5% of the global steel market. Whilst a significant amount of work is already being done by the public and private sectors in this space, and this should continue, new policies could further support and develop the hydrogen industry in Australia.

²⁶ ClimateWorks Australia Submission to the Senate Economics Legislation Committee into Energy Efficiency Opportunities (Repeal) Bill 2014. Australian renewable export COVID-19 recovery package report – WWF-Australia

Objectives	<p>Short-term</p> <ul style="list-style-type: none"> ▶ Redeployment and reskilling of the manufacturing workforce ▶ Commercialise hydrogen production in Australia and support the development of infrastructure and capabilities within the sector ▶ Update the regulatory environment to support safety and industry standards <p>Long-term</p> <ul style="list-style-type: none"> ▶ Promote the production of green steel and green ammonia (for agricultural fertilisers) locally and supporting the export of embodied renewable energy in the form of these high-value products ▶ Promote the use of hydrogen in heavy transport and injection in the existing gas infrastructure
Outcomes	<ul style="list-style-type: none"> ▶ Increased short to long-term employment, especially in regional and remote Australia ▶ Enhanced economic growth in the medium to long-term ▶ Reduced dependence on imported fuels ▶ Increased export of fuels and embodied products (made with hydrogen) ▶ Reduced GHG emissions nationally and globally.
Gravity	 <p>The APEC region includes markets which have identified hydrogen as a strategic opportunity (consuming over 50% of current global hydrogen production),²⁷ and energy-rich countries with access to ample low-cost renewables. Large energy users in the APEC region (South Korea, Japan, China and the USA specifically) have national level hydrogen strategies. In the short-term, these strategies mainly focus on building demand for hydrogen, investing in fuel-cell technology and developing the supply chain. Further, energy-rich countries with access to cheap renewable resources (Australia, New Zealand, Chile, Canada and the USA) also have national strategies that focus on strategic partnerships with larger energy consuming countries, R&D and piloting green hydrogen projects. As such, in line with the National Hydrogen Strategy, investing in manufacturing and storing hydrogen could have positive long-term benefits for all Australian hydrogen exporters by creating international growth opportunities with large APEC energy users and allowing exporters to employ more workers.</p>
Measures	<p>Short-term</p> <ul style="list-style-type: none"> ▶ Investment in R&D: reduce production costs, resulting in increased demand. Increased demand will incentivise private investment, which would further advance technological development, this would be best delivered through ARENA ▶ Commercialisation: Continue co-funding through the CEFC commercialisation projects growing in size over the next decade ▶ Regulation: Harmonise regulation across the states with a common criterion, ensuring correct safety standards

²⁷ IHS Markit, Chemicals Economic Handbook.
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Long-term

- ▶ **Legislation:** Legislate and net zero emissions target as discussed further below
- ▶ **Increase export subsidies:** similar to the manufacturing of low-carbon technologies
- ▶ **Regulatory consistency:** embed regulatory consistency with a nationally coordinated approach, with buy-in from all states and territories. For example, R&D can be driven in NSW, QLD and Victoria that already have established innovation hubs while the physical processes can be conducted by WA and NT that have advanced manufacturing infrastructure
- ▶ **Hydrogen hubs:** creation of hydrogen hubs in urban, regional and remote regions to support infrastructure and economic growth, foster innovation and facilitate the sharing of expertise and services. This could be financed through ARENA and CEFC in the form of grants and government-backed loans.

5.2 Incentivising renewable electricity generation, transmission and storage, and energy exports

Opportunity 4: Rolling out local solar PV

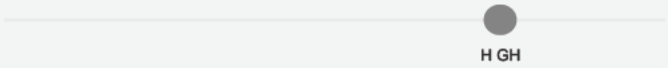

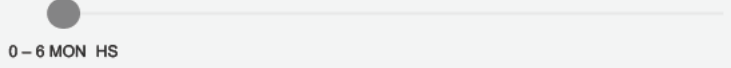
Local solar PV can provide low-cost, distributed energy in the community while delivering large employment benefits as part of a Covid-19 recovery. This would complement the already high uptake rates of residential rooftop and utility scale solar PV.

Objectives
Short-term

- ▶ Widespread creation of jobs and redeployment of displaced workers, especially for tradespeople
- ▶ Installation of rooftop solar PV and batteries on public housing, low-income rental housing and state infrastructure, including schools and hospitals
- ▶ Installation of rooftop solar PV and batteries on council and community-owned buildings like kindergartens, rural fire stations, libraries, ATSI organisations and sports clubs
- ▶ Respecting and protecting land while deploying community solar

Long-term

- ▶ Creation of long-term employment as installed solar and community batteries require ongoing maintenance and support
- ▶ Greater community resilience

Outcomes	<ul style="list-style-type: none"> ▶ Increased employment within communities, including ATSI communities as labourers and contractors are employed to install and maintain solar PV ▶ Increased domestic manufacturing of rooftop solar PV (e.g. Tindo Solar) as demand increases and global supply chains are disrupted ▶ Decreased electricity costs for those living in public housing, low-income rental housing, private homeowners and businesses ▶ Decreased electricity costs for states ▶ Reduced dependency on non-renewable forms of energy generation ▶ Reduction in Australia's energy sector GHG emissions ▶ Increased private and public resilience to extreme climactic events (as transmission lines may be damaged during floods, bushfires, extreme heat etc.) ▶ Increased support and benefits for ATSI communities relating to lower electricity prices.
Gravity	<p>Economic impact </p> <p>Scale of impact </p> <p>Timeframe </p> <p>COVID-19 has provided an opportunity for state and federal governments to mobilise the labour workforce, who may have been displaced during the crisis. Governments can quickly dispatch workers across the nation to install rooftop solar PV for all public housing, low-income housing and state infrastructure. This would create jobs and boost the economy in the short term, while providing individuals living in these homes with more disposable income due to decreased electricity bills. Although wholesale electricity prices have fallen recently, this is unlikely to be sustained in a post-COVID-19 world, especially as the economy starts ramping up production.</p>
Measures	<p>Short-term</p> <ul style="list-style-type: none"> ▶ Community Energy Efficiency and Solar Grants Program: expand the program to include a \$500 million solar grant program to install rooftop solar on community facilities and in remote communities, covering the full cost of development and installation ▶ CEFC Local Government Finance Program: expand this funding to \$400 million, releasing low-interest loans for state and local council governments, land-councils and other ATSI organisations to develop solar farms, rooftop PV on assets such as schools and hospitals, and community batteries. ▶ Electric Heat Pumps: Increase funding for and awareness of electric heat pumps across application (including space, water and industrial heating) <p>Long-term</p> <ul style="list-style-type: none"> ▶ Procurement Guidelines: develop joint procurement guidelines to allow councils to enter into a buying consortium in utility solar through mechanisms such as corporate PPAs

Opportunity 5: Improving local and international transmission and distribution of electricity

Creating high quality, integrated transmission networks that unlock strategic REZ, increase interconnection capacity between NEM regions and reduce electricity prices in the long term.

Objectives	Short-term <ul style="list-style-type: none"> ▶ Design high quality electricity transmission networks and upgrading current networks ▶ Fast-track the development of new transmission network projects such as interconnectors: VIC-NSW, SA-VIC, TAS-VIC, SA-NSW, NSW-QLD, Darwin-Alice Springs ▶ Identify and accelerate the development of renewable energy zones (REZs) and connecting the zones to the grid.
	Long-term <ul style="list-style-type: none"> ▶ Investigate the opportunity for more international electricity transmission networks (undersea cables between Australia and the Asia-Pacific region) ▶ Promote the export of Australia's renewable energy
Outcomes	<ul style="list-style-type: none"> ▶ Increased employment of scientific and technical workers to design and innovate high quality electricity transmission networks, new transmission networks, international networks, REZs and microgrids ▶ Increased employment of labourers and industrial electricians ▶ Increased economic growth as demand for the materials used in transmission networks increases ▶ Increased accessibility to renewable energy for businesses and consumers through larger renewable energy penetrations in the grid ▶ Better and more technologically and geographically innovative transmission networks will effectively lower the cost of electricity for customers ▶ Export support will help manufacturers and electricity retailers to invest in capital and maintain operational efficiency ▶ Unlock more than 50,000 jobs that would flow from currently approved renewable energy projects²⁸
Gravity	<div> <div>Economic impact</div> <div> <div>VERY HIGH</div> </div> </div> <div> <div>Scale of impact</div> <div> <div>HIGH</div> </div> </div> <div> <div>Timeframe</div> <div> <div>3 YEARS – 10 YEARS</div> </div> </div> <p>Efficient and effective transmission networks, both domestically and internationally, are vital to ensuring a clean energy future and promoting economic and jobs growth. Although Australia's networks have evolved over time and there is a shift towards integrating renewables, there are still inadequate infrastructure to unlock much of Australia's renewable energy potential. The NSW Government's REZ Plan, outlined below, will likely create a redistribution of financial sector investment and create technical and construction jobs.</p>

²⁸ Clean Energy Council, A Clean Recovery, 2020.
 Australian renewable export COVID-19 recovery package report – WWF-Australia

Measures	Short-term <ul style="list-style-type: none"> ► Funding: Government leadership on a co-funding model between government, transmission companies and generation firms to efficiently and equitably allocate capital and operational costs, including funding the next phase of early planning works for the priority transmission lines ► Regulation: Fast-track approval for key projects through the Regulatory Investment Test for Transmission (RIT-T) ► Renewable Energy Zones (REZ): Each state and territory to identify at least 3 strategic REZs for development and establish the business case for each ► Infrastructure fund: Develop a national transmission infrastructure fund that expedites the approval of new network projects and allows for planning by transmission companies paid for by consumers due to the very low cost when distributed
	Long-term <ul style="list-style-type: none"> ► Training and qualifications: provide subsidised training and qualifications for front-line constructions workers and technical support staff ► National Electricity Objective (NEO): Introduce a climate imperative in the National Electricity Objective (NEO) to AEMO's ISP so that it can consider far north Queensland transmission, emissions consistent with the IPCC and the option of RE export ► Far North Queensland: Greater prioritisation of transmission to far north Queensland to unlock its valuable wind resource required for a high penetration renewables grid ► HVDC: Develop HVDC transmission expertise for the development of the Marinus Link or a HVDC link to far north Queensland or the proposed SunCable project in the NT.



CASE STUDY: NSW Government Renewable Energy Zones (REZ)

The NSW Government's Electricity Strategy outlines the development of three Renewable Energy Zones in the states Central-West, South-West and New England areas by unlocking them with transmission infrastructure. Construction of the initial central west region is expected to start in 2022. The key objectives of the program are:

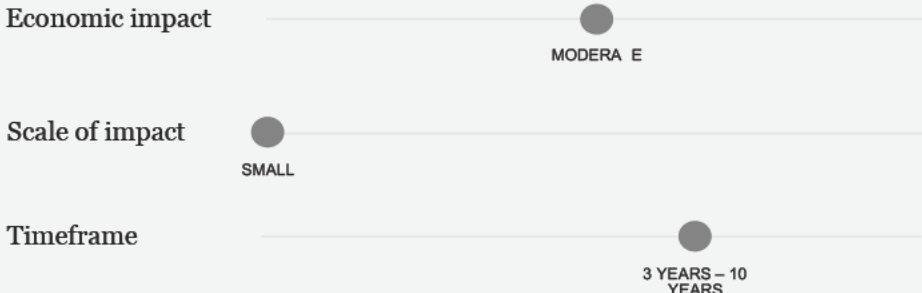
- Improving electricity reliability
- Increasing affordability
- Supporting emissions reduction
- Engaging communities

The plan will unlock approximately 3GWs of renewable energy generation while supporting up to an expected \$23 billion of private sector investment and 2,000 annual construction jobs.

Opportunity 6: Improving distributed storage of electricity

Incorporating distributed energy storage increases reliability and flexibility and provides an opportunity for increased renewable energy in the electricity market. Distributed storage can play a vital role in improving stability and energy security.

Objectiv	Short-term <ul style="list-style-type: none"> ► Increase distributed energy storage in communities and homes
	Long-term <ul style="list-style-type: none"> ► Increase coordination and utilisation of distributed energy resources

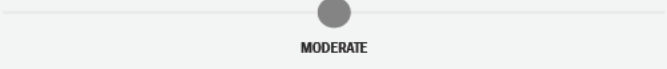
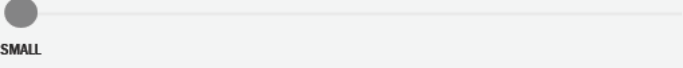
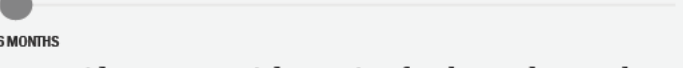
Outcomes	<ul style="list-style-type: none"> ▶ Greater network stability and reduced network augmentation costs ▶ Greater distributed storage capacity and utilisation in the grid ▶ Greater opportunity for variable renewable energy in the electricity market ▶ Large employment opportunity increases due to the labour-intensive nature of installation (similar to rooftop PV) ▶ Increased technical knowledge regarding installation, operation and system design of batteries ▶ Growth of an Australian battery supply chain
Gravity	 <p>Economic impact: MODERATE</p> <p>Scale of impact: SMALL</p> <p>Timeframe: 3 YEARS – 10 YEARS</p> <p>As technologies improve, distributed storage would support Australia's energy stability, affordability, security and environmental impact. It will also create jobs in the short-term as a workforce is required to install the batteries.</p>
Measures	<p>Short-term</p> <ul style="list-style-type: none"> ▶ National Storage Target: introduce a National Storage Target operating parallel to the RET and in a similar fashion with regards to the mechanism, regulatory bodies, participants and other elements ▶ Battery subsidies: introduce subsidies for home batteries as a direct per-unit-energy-stored rebate upon installation ▶ Regulatory requirements: create a regulatory structure for VPPs with adequate incentives for and requirements of participants <p>Long-term</p> <ul style="list-style-type: none"> ▶ Peer-to-peer energy trading: facilitate peer-to-peer energy trading to increase the economic attractiveness to households and communities ▶ Battery discharge: encourage or mandate all electricity retailers to provide households the option to discharge their batteries at times of network peak demand in return for credit commensurate with the value provided to the network (similar to how Mojo Power engaged with a sample of volunteer customers to trial demand response in 2017)

5.3 Directing infrastructure investment towards zero carbon activities

Opportunity 7: Building renovation and retrofitting of State and Federal infrastructure

Energy efficient renovations and retrofitting of government buildings positively contributes to economic growth, job creation, cost savings and environmental protection.

Objectives	<p>Short-term</p> <ul style="list-style-type: none"> ▶ Identify government buildings that are energy-intensive, and use this data to invest in strategic renovations and retrofitting ▶ Maintain the historical significance of state and federal buildings
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

Outcomes	<ul style="list-style-type: none"> ▶ Increased employment as planners, architects and labourers are tasked with designing innovative renovation and retrofits ▶ Renovating and retrofitting allows technical workers to innovate and experiment with novel building concepts, expanding Australia's technical knowledge base ▶ Retrofitting can increase the commercial value of buildings, which can help governments lease office space ▶ Improving government buildings' energy efficiency may incentivise private commercial building owners to improve their buildings' energy efficiency
Gravity	<p>Economic impact </p> <p>Scale of impact </p> <p>Timeframe </p> <p>Renovation and retrofitting provide near-term job creation for those who may have been stood down during COVID-19. In addition, a reduction in the energy-related costs of state and federal buildings and a reduction in emissions from state and federal infrastructure could result from these activities. The expected increasing in remote working may also heighten the benefits of this opportunity.</p>
Measures	<p>Short-term</p> <ul style="list-style-type: none"> ▶ Investment: investment in renovating and retrofitting all state and federal buildings with energy efficient upgrades ▶ Local manufacturing: strategically supporting local, onshore manufacturers for the required construction products.

5.4 Rethinking transport

Opportunity 8: Constructing infrastructure for low-carbon government and private transport

Electric vehicles (EVs) are becoming increasingly common, for both government fleet vehicles and privately-owned vehicles. Investing in EV charging infrastructure would help incentivise private vehicle owners to switch to EVs as it would provide more options for them to charge their vehicles.

Objectives	<p>Short-term</p> <ul style="list-style-type: none"> ▶ Incentivising the uptake of private vehicle owners purchasing EVs
	<p>Long-term</p> <ul style="list-style-type: none"> ▶ Supporting current EV owners (including government EV fleet) through greater access to charging infrastructure
Outcomes	<ul style="list-style-type: none"> ▶ Increased employment to design and construct charging infrastructure, especially in regional towns and along major highways ▶ Reducing costs for government EV fleets (greater access to charging stations) ▶ Long-term reduction in costs for private vehicle owners and government fleet as the maintenance costs of EVs are significantly lower than conventional petrol or diesel engines ▶ Reducing Australia's emissions from the transport sector.

Gravity	Economic impact	
	Scale of impact	
	Timeframe	
	<p>Promoting EVs and their associated industries offer new opportunities for expanding local businesses and employment: businesses could supply and install charging stations, manufacture EV components and systems, conduct R&D and innovation and maintenance of batteries and recycling of parts. This creates substantial economic growth and employment opportunities across many industries and sectors. EVs are also more environmentally conscious (with no exhaust emissions) and if charging infrastructure utilises renewable energy, then emissions are reduced even further. Additionally, due to the reduction in emissions, there are other co-benefits, such as health benefits, especially for communities located close to busy roads. Finally, Australia is heavily dependent on other nations for petroleum imports, and EVs can support with Australia's energy security as they can be powered from domestic renewable energy sources.</p>	
Measures	Short-term <ul style="list-style-type: none"> ▶ Approvals: accelerate approvals of charging infrastructure proposals. For example, in 2018, the NSW Government's Department of Planning removed the requirement for planning approvals for the installation of EV chargers in carparks and depots ▶ Building codes: require all new buildings, including apartment blocks, shopping centres and office buildings to incorporate EV charging stations (via the National Construction Code and Wiring Rules) ▶ Regulatory guidelines: develop regulatory guidelines for the installation of charging points within existing service stations 	
	Long-term <ul style="list-style-type: none"> ▶ Charging infrastructure investment: co-investment in EV charging infrastructure, including fast charging stations (especially on major highways to ensure comfortable long-distance driving) 	

Opportunity 9: Decarbonising public transport services, government fleet vehicles, freight and private vehicles

Transport is often the greatest contributor to air pollution in urban areas and contributes to around 25% of global greenhouse gas emissions. Globally, cities and states are deploying electric public transport options which would result in zero exhaust emissions.

Objectives	Short-term <ul style="list-style-type: none"> ▶ Financing higher rebates, tax incentives or subsidies for public transport organisations and private freight and fleet owners
	Long-term <ul style="list-style-type: none"> ▶ Accelerating the electrification of all public transport (buses, trains, ferries and trams) ▶ Research and development and construction of electric public transport infrastructure (including manufacturing vehicles or components, and the charging infrastructure)

Outcomes	<ul style="list-style-type: none"> ▶ Increased demand for local manufacturers to construct the key components of EVs, as global supply chains are disrupted ▶ Increased employment as charging infrastructure is constructed in Australia ▶ Boosting Australia's understanding and innovation capabilities in relation to electric public transport vehicles ▶ Lowering operating and maintenance costs of electric public transport ▶ Longer ranges and short refuelling times ▶ Lowering reliance on imported fuels ▶ Increased corporate and private EV ownership
Gravity	<p>Economic impact MODERATE</p> <p>Scale of impact MEDIUM</p> <p>Timeframe 6 MONTHS – 3 YEARS</p> <p>Electric public transport and its associated industries offer exciting opportunities for expanding local businesses and employment. State governments could contract companies to supply and install charging stations, develop EV components and systems, conduct R&D and innovation and maintenance of batteries and recycling of parts. This creates substantial economic growth and employment opportunities across many industries and sectors. Strategic federal government spend could further unlock these opportunities. New technologies are also showing that electric public transport batteries can also be used as part of a distributed electricity storage network, essentially feeding surplus energy back into household supplies or the grid. As discussed earlier in this Report, Australia has a large dependence on foreign fuels and therefore, a transition to electric public transport will increase domestic fuel security.</p>
Measures	<p>Short-term</p> <ul style="list-style-type: none"> ▶ Green loans and financial incentives: federal government green loans and grants to support state governments with capital injection into the decarbonisation strategy, as well as financing higher rebates, tax incentives or subsidies for corporate and private vehicle owners looking to purchase EVs, either through a one-off payment or reducing buyers' stamp duty or Luxury Car Tax. For example, in the ACT, brand new EV purchasers pay \$0 stamp duty and receive a 20% discount on annual registration. ▶ Electric bus fund: establish an electric bus innovation fund to support operators and manufacturers commercialise projects at increasing scale similar to New Zealand's Low Emission Vehicle Contestable Vehicles Fund. ▶ Electric public transport: trialling the use of electric public transport.

Case study: Sydney Airport – Electric blue emu buses

Sydney Airport is at the forefront of utilising electric buses for moving passengers from its long stay car park to its various terminals. The buses, provided by Carbridge, have been popular with customers due to their smooth and quiet operation while improving the Airport's environmental performance. The Airport indicated that the low costs of charging and maintenance have allowed it to lower costs – resulting in a good business decision that positively benefits the environment. The Airport indicated that the low maintenance costs make up for the higher upfront capital costs of purchasing an electric bus.



5.5 Investing in Australian research, training, innovation and technology

Opportunity 10: Investing in data-driven renewables solutions and innovation

Promotion of the development of onshore technological advancements and investment in Australian renewable energy innovation. Currently, there is no systematic, holistic approach to ensure a comprehensive and consistent information base across the technology, innovation and R&D sectors.

Objectives	Short-term <ul style="list-style-type: none"> ▶ Increase funding for renewable energy innovation hubs, including ARENA, CEFC and CSIRO's Energy Business Unit ▶ Increase R&D tax incentives ▶ Allow entities that have carried out R&D for another entity to claim the R&D tax offset, rather than the entity for which the R&D has been carried out for
	Long-term <ul style="list-style-type: none"> ▶ Incentivise data collaboration between government and non-government actors.
Outcomes	<ul style="list-style-type: none"> ▶ Direct technical and scientific employment within Australia (for ARENA, CEFC, CSIRO and other smaller technical organisations and universities), and indirect employment via funding and grants to develop solutions and technology (e.g. manufacturing) ▶ Stronger base of renewable energy information within the Australian technology sector ▶ Better financial sector understanding of climate-induced risks, which would allow insurers to effectively cover real economy transition risks ▶ Greater and more streamlined access to information as all grants/funding/incentives are housed in the one website, reducing the need to monitor different grants/funding/incentive channels ▶ Enhance professional, scientific and technical skills which can be exported overseas ▶ Improve collaboration between local technical bodies, government entities and commercial organisations ▶ Improve and more efficient technologies in the long-term.
Gravity	<p>Economic impact ● H GH</p> <p>Scale of impact ● H GH</p> <p>Timeframe ● 0 – 6 MON HS</p>
	<p>Investing in technical energy workers aligns with Australia's roadmap to reduce emissions. ARENA, CEFC and the CSIRO Energy Business unit partner with local and global companies to deliver energy solutions for a sustainable future, as well as working with state and federal governments, universities, research agencies and industry groups. These important partnerships range from the provision of testing services and short-term contracts, to in-business scientists for SMEs, or longer-term research and strategic alliances.</p> <p>Increased tax incentives boost the Australian economy by encouraging Australian companies to conduct R&D that may otherwise not have been financially viable. Further, it creates an incentive for smaller organisations, such as start-ups to undertake renewable energy R&D while turning a profit. Lifting the aggregated turnover amount allows larger entities within the industry to begin or continue their existing R&D in renewable energies.</p>

Measures	<p>Short-term</p> <ul style="list-style-type: none"> ▶ ARENA funding: since its establishment in 2012, ARENA has invested approximately \$1.46 billion to over 490 projects, ranging from battery storage, to hydrogen fuel, PV power stations and wave energy. To grow this impact and generate an urgent two-year extension for ARENA, consider the Australia Institute's pre-budget proposal of a \$460 million top-up of ARENA before funding finishes in mid-2020 ▶ Tax offset: increase the refundable R&D tax offset, which currently sits at 43.5% and non-refundable R&D tax offset, which currently sits at 38.5%, for all eligible entities ▶ Regulatory reform: undertake regulatory reform to allow companies that are conducting R&D activities for another entity to still claim the R&D tax offset
	<p>Long-term</p> <ul style="list-style-type: none"> ▶ Climate risk research: expand the fundamental research being conducted on the ramifications of climate change to allow the financial sector to better forecast climate-induced risk ▶ Incentivise R&D: develop a consolidated website for all grants, funding and incentives (tax offsets or otherwise). Similar to a Google Search, allow organisations to enter in key words, e.g. 'renewable energy', 'hydrogen' to see all the grants/funding/incentives that are available to them. The website should include information on what the type of funding is, when it will be released, how many weeks organisations have to respond/apply, what documents may be required to respond and any other relevant information.



Case study: ARENA \$70 million funding for large scale renewable hydrogen

ARENA recently announced a \$70 million round of funding to expedite the development of renewable hydrogen in Australia. This funding, during COVID-19, is a strategic move to boost the economy and create jobs. The funding aims to support two or more large scale renewable hydrogen projects, with electrolyzers of a minimum of 5 MW capacity. It will help fund some of the largest electrolyzers in the world and the funding is contingent on projects being powered by renewable energy (either directly or through power purchase agreements (PPAs) or large-scale generation certificates (LGCs).

ARENA has already committed to \$55 million in funding to accelerate pre-commercial activities including power to gas and renewable ammonia and has conducted in-depth feasibility assessments for commercial-scale deployments of hydrogen including Dyno Nobel, Queensland Nitrates, Yara and Stanwell. The results of these assessments indicated significant commercial gaps, warranting further funding for hydrogen production facilities in the short-medium term.

This financial support indicates ARENA's goal to take advantage of Australia's vast resources and harness the potential of hydrogen. It also signals its intention to share knowledge and work collaboratively with technical and commercial partners for the construction, production and exportation of renewable hydrogen domestically and internationally.

Opportunity 11: Supporting renewable energy upskilling opportunities


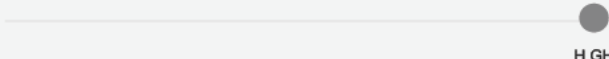
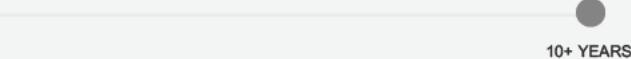
Australia faces a renewable energy and sustainable finance capacity and skills shortage. Strategic investment in software, services and skills is required for a clean energy future.

Objectives	Short-term <ul style="list-style-type: none"> ▶ Providing subsidised renewable energy education and training opportunities for the current workforce through upskilling and recognised certification programs.
	Long-term <ul style="list-style-type: none"> ▶ Future-proofing Australia's professional, scientific and technical workforce in relation to renewable energy, economics and climate change ▶ Providing greater and more highly paid opportunities for future workers.
Outcomes	<ul style="list-style-type: none"> ▶ Current and future workforce that is well-versed in renewable energy technologies and identifying climate-related financial risks ▶ Better understanding of climate-related financial risk across government and non-government entities (where relevant)
Gravity	<p>Economic impact: MODERATE</p> <p>Scale of impact: MEDIUM</p> <p>Timeframe: 0 – 6 MONTHS</p>
	<p>Teaching and upskilling will prepare Australia's workforce for major economic shifts and employment opportunities due to COVID-19. Future-proofing Australia's workforce ensures that all members of society are supported in the transition to net zero emissions. This includes alignment of clean economic priorities and employment opportunities.</p>
Measures	Short-term <ul style="list-style-type: none"> ▶ Tertiary education: require all economic, commerce, business university and vocational courses to incorporate compulsory sustainability units (e.g. sustainable finance, climate change related financial risks etc.) ▶ Education subsidies: provide subsidised university and vocational renewable energy training for existing students and workers (e.g. via scholarships or university grants) ▶ Upskilling trades: upskill tradespeople to undertake energy efficiency renovating, retrofitting and upgrades, as well as the installation of rooftop solar PV and household and community batteries ▶ Regulatory reform: regulate mandatory requirements for companies to report on their climate-related financial risks (e.g. TCFD)
	Long-term <ul style="list-style-type: none"> ▶ School education: require all primary and secondary education facilities to teach sustainability and climate change-related subjects to students until year 10 ▶ Risk management: incorporate the inclusion of environmental risks in risk management systems and calibrate this to capital adequacy requirements (via APRA) ▶ Executive training: promote ongoing sustainability and climate-related training at the senior executive level across private and public-sector organisations.

5.6 Regulatory and government driven climate action

Implementing a net-zero emissions target linked to a 1.5°C outcome

Establish an economy-wide net-zero emissions target by 2050. This will allow flexibility in approach and certainty in outcome for business and industry, allowing Australia to develop a carbon competitive advantage.

Objectives	<p>Short-term</p> <ul style="list-style-type: none"> ▶ Establish an economy-wide emissions cap and trajectory consistent with the requirements of keeping global warming below 1.5°C <p>Long-term</p> <ul style="list-style-type: none"> ▶ Transition our economy to a productive, low-carbon one
Outcomes	<ul style="list-style-type: none"> ▶ Provide business certainty on climate outcomes ▶ Create a regional comparative advantage for business and the broader economy ▶ Reduce national emissions to avoid reaching a tipping point of global warming ▶ Incentivise innovation and greenhouse gas abatement
Gravity	<p>Economic impact </p> <p>Scale of impact </p> <p>Timeframe </p> <p>Implementing a target of zero emissions, in line with the Paris Agreement, will reshape Australia's economy, promoting new jobs in existing and new sectors and creating new export opportunities.</p>
Measures	<p>Short-term</p> <ul style="list-style-type: none"> ▶ Budget: Establish Australia's carbon budget in-line keeping global warming below 1.5°C and continue tracking these emissions ▶ Legislation: Legislate a net zero emissions target by 2050 to allow for flexibility in achieving the outcome ▶ Communication: communicate economic benefits and costs of the policy clearly to the public with a particular focus on obtaining business support <p>Long-term</p> <ul style="list-style-type: none"> ▶ Expansion: Conduct economic modelling to determine the least cost approach to achieving net zero emissions ▶ Offsets: Expand the Carbon Farming Initiative to include additional methodologies and funding to allow offsets programs to advance from a simple carbon accounting tool to a method of shared value creating between agriculture and other sectors.



Case study: Lion

Lion is a leading beverage company headquartered in Sydney, Australia. In April 2020, Lion announced its certification to Climate Active's Carbon Neutral Organisation standard. This announcement follows an impressive history of drawing on carbon reduction innovation and technology to reduce greenhouse gas emissions by 28 per cent from a 2015 baseline. Examples of low-carbon expertise drawn from the Australian economy include energy auditing, bio-gas plants, industrial rooftop solar PV installations, and renewable power purchase agreements linked to large scale solar farms in NSW.

The carbon neutral commitment also comprises Australian Carbon Credit Units from shared value projects to support the financial viability of rural communities. Longer term, Lion plans to direct this investment towards regenerative agriculture and building climate resilience within its supply chain.

This multi-dimension success shows the strength and diversity of Australia's emerging low-carbon industry and the potential for further growth with targeted stimulus.

A RENEWABLE FUTURE

CLIMATE CHANGE

As the world moves to act on climate change and fulfil the promise of the Paris Climate Agreement, places that have the best renewable resources in the world have a significant opportunity.

CLEAN ENERGY

Renewable energy such as solar and wind is critical to decarbonising more than two thirds of global emissions, in the electricity, transport, building and industrial sectors.

POPULAR CHOICE

With over 2.1million rooftop solar systems, you just have to walk down the street to see how Australians have embraced renewable energy.

A JUST TRANSITION

WWF-Australia supports a climate action plan that ensures nobody is left behind.

RENEWABLE LEADER

Our goal is for Australia to be a leading exporter and investor in renewable energy with a zero-carbon economy achieved well before 2050.



Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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WWF

REPORT

2020

Delivering economic stimulus through renewables



DELIVERING ECONOMIC STIMULUS THROUGH RENEWABLES

Introduction

Australia has to date successfully managed the health impacts of the COVID-19 crisis. But the COVID-19 related employment loss is predicted to impact 8-10% of the current Australian workforce over the next 18 months (despite the Jobkeeper program). This is the next stage of the COVID-19 crisis that Australia will confront. Australian governments at all levels now need to frame strategies to deal with the complex problems of economic and social recovery and create the cooperation necessary to avoid prolonged stagnation and international disruption.

In response to the profound economic impacts of COVID-19, WWF-Australia proposes a renewable stimulus which would drive new employment growth, provide greater diversity within the broader economy, accelerate climate action and put Australia on the pathway to becoming a renewable export powerhouse.

Recent polling by WWF shows that nationally, when asked to choose between two positions, 69% of respondents said Australia's potential to be an economic superpower of the post-carbon world was more aligned with their thinking, than a critique of renewables which argued they were not a good solution for the future. This holds up across all states and even across party lines. For example, in Queensland this rises to 72%. Among coalition voters this figure is 61%. Most people want us to go for renewable-powered growth.

WWF's Renewable Recovery Package - Summary

WWF-Australia's renewable recovery package has two components.

1. ***"Australia renewable export COVID-19 recovery package"***, a report authored by EY (formerly known as Ernst and Young).

This report outlines how an economic recovery based on renewables can boost local manufacturing, grow existing sectors and unlock new industries, increase exports, reskill our workforce, and reduce carbon pollution.

More specifically it shows how we can re-employ people across industries which suffered some of the largest job losses – construction, professional, scientific and technical services, and manufacturing – and provide work in Indigenous communities. It identifies 12 stimulus opportunities that fall into six focus areas for action:

- **Reimagining our manufacturing and export industries to increase competitiveness**, including manufacturing low-carbon technologies locally, electrifying and reducing GHG emissions from existing manufacturing and manufacturing and exporting green hydrogen
- **Incentivising renewable electricity generation, transmission and storage, and energy exports**, including increasing community rooftop solar photovoltaics (PV), improving local and international transmission and distribution of electricity and improving distributed storage of electricity
- **Directing infrastructure investment towards zero carbon activities** including building renovation and retrofitting of State and Federal infrastructure

- **Rethinking and decarbonising transport**, including constructing infrastructure to enable public transport, government fleet vehicles, and private vehicles to run on electricity.
- **Investing in Australian research, training, innovation and technology**, including investing in data-driven renewables solutions and innovation and supporting renewable energy upskilling and education opportunities.
- **Regulatory and government driven climate action**, including implementing a 2050 net-zero missions trajectory and target.

2. Detailed renewable stimulus proposals

Based on the focus areas identified by EY, WWF has designed five targeted economic stimulus measures (see Table 1) that will create jobs and support redeployment across existing and new industries, are cost effective, promote capital investment and commercialisation of onshore supply chains and technology, prioritise climate adaptation and mitigation, develop a local knowledge economy and focus on rebuilding in a post-COVID-19 world.

WWF-Australia proposes \$2 billion in Commonwealth renewable stimulus spending over the forward estimates to deliver these five measures, beginning in 2020-21, with 90% spent in the first two years. This would provide employment for just over 45,000 people.

If these five measures were combined with support for transmission and large-scale renewable deployment the employment potential grows to over 100,000 jobs.

Program	Description	Commonwealth investment	Estimated jobs created	Economic benefits
Modernising critical manufacturing	Boosts the competitiveness and resilience of our critical manufacturing sector by slashing costs, creating new jobs and positions Australian manufacturers as global leaders in the renewable, advanced manufacturing revolution.	\$520 million	22,000	\$1.4 billion industry contribution
Battery nation	Positions Australia as a leading global battery manufacturer, leveraging our minerals and industrial capabilities to increase value and jobs across the supply chain.	\$500 million (plus \$240 million on low-cost finance)	4,500 manufacturing jobs 2,300 installer and construction jobs	\$1 billion household investment in home batteries \$5 billion industry investment by 2030
Electric bus revolution	Fast-track electric buses in our cities and build a national manufacturing sector that supplies electric buses to the world.	\$240 million	10,000	\$233 million industry & public transport investment
Local solar	Cuts the cost of energy for thousands of community organisations – childcare centres, schools, country fire stations, Aboriginal communities, public houses, sports clubs, hospitals, and Councils - freeing up funds to spend on core services.	\$500 million (plus 400 million on low-cost finance)	5,000	Up to \$1 billion in community and private investment
Accelerate renewable hydrogen	Accelerating Renewable Hydrogen will increase Australian fuel security, increase energy reliability, and position Australia at the forefront of an expanding global hydrogen market, capitalising on our world-leading renewable resources.	\$225 million	1200	Up to \$765 million in private sector investment
Total		\$1985 million	45,000 direct jobs	\$9398 million

Given the existing work on renewables of many State and Territory governments, we recommend that these measures be delivered cooperatively by the Commonwealth, State and Territory governments, working in close collaboration with the private sector and building on existing and proven coordination and delivery mechanisms. We recommend that, where possible, regions hardest hit by the COVID-19 economic impacts be prioritised for the delivery of these measures.

While the five detailed proposals are Federally focused, WWF-Australia calls on all levels of government to support this stimulus package. By supporting WWF's renewable recovery package - opportunities identified in the EY report and the five priority stimulus measures - governments can unlock more than 100,000 jobs.¹

The push for a clean stimulus package is the first step towards WWF's priority of [making Australia a renewable export powerhouse](#). If you would like to support WWF's efforts or for more information please contact WWF-Australia's Energy Transition Manager Nicky Ison on [REDACTED].

¹ This figure combines the 50,000 new direct jobs by accelerating wind and solar projects with development approval (Clean Energy Council, A Clean Recovery, 2020), the 8,000 jobs through fast-tracking new transmission projects to revitalize Australia's congested transmission network (Beyond Zero Emissions, The Million Jobs Plan, 2020), the 45,000 jobs in WWF's five priority stimulus measures and many more that are unquantified in the remaining stimulus opportunities set out by EY.

1. MODERNISING CRITICAL MANUFACTURING

Modernising critical manufacturing will boost the competitiveness and resilience of our critical manufacturing sector by slashing costs and creating new jobs. The program will position Australian manufacturers as global leaders in the renewable, advanced manufacturing revolution.

At-a-glance

- \$520 million Commonwealth investment over two years
- \$1 billion of industry investment in energy modernisation
- More than 22,000 jobs created
- Energy costs of manufacturers slashed through tax investment incentives, grant funding for critical industries, and increasing the energy knowledge and capabilities of manufacturers.

1.1. The case for energy transformation in our industries

Covid19 has highlighted how critical manufacturing is for ensuring Australia has the products and services we need to survive and thrive. Manufacturing has been in long-term decline in Australia. Today only 7% of our workforce (about 729,000 people) is in manufacturing. This decline is not inevitable. Manufacturing makes up 16% of the workforce in Germany, Switzerland and Japan, and advanced manufacturing is thriving in Sweden and Israel who both have small populations.²

Energy is a major factor in how competitive a manufacturer is. Australian industry is the most energy inefficient in the developed world, and this means our businesses are paying much more than they should for their energy needs.³ The Australian Alliance to Save Energy (A2SE) estimates that if Australia doubles energy productivity by 2030 there will be a 2.8% increase in real GDP (\$2000 per capita), a \$30 billion savings in energy spend and a 20% reduction in greenhouse gas emissions.⁴

While ClimateWorks found that certain Australian companies could be much more competitive and achieve growth in annual profits of 2-13% by increasing their energy productivity to that of their best performing peers within their sector globally.⁵

Manufacturers' reliance on gas has put enormous pressure on companies. After Australia became an exporter of gas in 2014 the price of gas doubled.⁶ While gas prices have recently come down, they are anticipated to rise again. Long-term gas contracts set long-term gas

² *Manufacturing further economic decline*, The Australian, 2 December 2019, <http://www.theaustralian.com.au/commentary/manufacturing-further-economic-decline/news-story/5357ac5f103f8abeac50010ccd8d3ed2>, accessed 8 May 2020

³ *Australia deemed a world laggard in energy efficiency*, ARF, <https://www.afr.com/companies/energy/australia-deemed-a-world-laggard-in-energy-efficiency-20180626-h11vpo>, Accessed on 5 May 2020

⁴ www.a2se.org.au/component/content/article/53-media/media-releases/406-doubling-energy-productivity-by-2030-saving-30-billion-each-year

⁵ ClimateWorks Australia, 2016, <https://www.climateworksaustralia.org/wp-content/uploads/2019/11/climate-works-australia-energy-productivity-index-companies-guide-for-investors-fn-a-may2016.pdf>

⁶ *Electrifying Industry*, Beyond Zero Emissions, 2018

prices, and these are currently at \$8 – \$12 per Gigajoule, which is around two to three times the price of international pricing.⁷

Investor action on climate change is also driving industry to reduce emissions. A recent survey of Australian and New Zealand investors (representing AU \$1.3 trillion) finding investors have an increasing appetite for climate aligned investment.⁸ Businesses are also leading with 873 global companies committed to science-based targets stretching right across their supply chains to future proof their business.⁹

Electrical heat technologies provide opportunities to cut the cost of energy and emissions by using Australia's abundant renewable energy. Think Tank *Beyond Zero Emissions* has demonstrated that existing, proven electrical technologies can be used to generate any industrial heat process, and comes with a whole host of benefits including efficiency, speed, precision, and flexibility.¹⁰

Boosting energy efficiency fuel-switching to renewable electricity will transform our industries by lowering the risk of energy price shocks. But much more than this, it will competitively position Australia as the natural home for manufacturing, with our abundant renewable energy attracting investors and businesses looking for a major cost advantage in the renewable economy.

1.2. Program Aims

The Modernising Critical Manufacturing program aims are to:

- Significantly improve the energy productivity of Australian manufacturers, reducing their costs, boosting profits, and creating jobs
- Build domestic manufacturing capacity and resilience across supply chains
- Accelerate the uptake of clean technology and renewable energy across the manufacturing sector
- Strategically position Australia as a global clean energy manufacturing hub that leverages climate aligned investment.

1.3. Program investment and job creation

This program will invest \$520 million to protect our existing 914,000 jobs¹¹ in manufacturing and create 22,000¹² more.

⁷ What's the 'new normal' post coronavirus? Australia says gas. This is a mistake, IEEFA Gas Chat, 23 April 2020, Accessed at <http://www.breaker.audio/ieefa-gas-chat/e/61896762>

⁸ *Accelerating Change: Capital Growth in Climate Solutions*, IGCC, August 2019

⁹ *Science Based Targets Initiative*, SBTi, <https://sciencebasedtargets.org>, Accessed 5 May 2020

¹⁰ *Electrifying Industry*, Beyond Zero Emissions, 2018

¹¹ *Australian Manufacturing in 2019; Local and Global Opportunities*, The Australian Industry Group, May 2019

¹² We have assumed similar manufacturing job creation to that realised under the *Manufacturing Modernisation Fund*, where an investment of \$215 million in capital equipment and new technologies will deliver more than 2,600 new jobs. See <http://www.minister.industry.gov.au/ministers/karenandrews/media-releases/backing-aussie-manufacturers-modernise>

1.4. Part one: Asset write-offs to support energy upgrade investment

Investing in energy upgrades will reduce energy costs and build resilience by:

- reducing exposure to high gas and electricity prices
- leveraging the falling cost of renewable energy power purchasing agreements, and
- aligning energy use with advanced manufacturing processes.

1.4.1. The opportunity

There are proven and commercialised energy efficiency and fuel switching technologies, but the capital investment cost can be a disincentive to investment. Extending the instant asset write-off program for energy upgrades will support businesses to invest in new equipment that will deliver immediate cost savings. Instant asset write-offs provide quick and uncomplicated investment support for businesses, and the current program has been warmly welcomed by peak groups including the Australian Industry Group and the Australian Chamber of Commerce and Industry. This package also complements the Federal Government's generous *Backing Business Investment* initiative.

1.4.2. Investment

This package will allocate \$280 million over one year.

1.4.3. What does the package do?

WWF-Australia recommends extending the COVID-19 instant asset write-off threshold of \$150,000 (for an annual turnover of less than \$500 million) for one year, made available for the purchase energy modernisation equipment, for example, energy productivity measures, electrical heating technologies like industrial heat pumps, solar panels and battery storage. Instant cash write-offs deliver immediate investment support for businesses. Write-offs are streamlined, easy to access and significantly reduce the time and administrative burden of grant funding support. We assume this package would realise \$1 billion in industry investment, saving businesses \$280 million.¹³

1.4.4. Industry participation requirements

To be eligible for instant tax write-offs, businesses need to provide evidence of purchasing energy modernisation equipment. To ensure clarity, an approved list of equipment should be prepared and published by the ATO.

¹³ Extending the \$700 million net cost (for approximately one quarter) to an entire year would be a net cost of \$2.8 Billion. We assume that 10% of the uptake of the Covid19 \$150,000 instant write off will be for energy equipment. Therefore, the budget impact of offering \$150,000 instant asset write-offs for energy equipment is assumed to be 10% of \$.8 Billion. See http://treasury.gov.au/sites/default/files/2020-03/Fact_sheet-Support_for_business_investment.pdf

1.4.5. How will the package be delivered?

Instant assets write-offs will be delivered through the 2020-21 budget process.

1.5. Part two: Energy fit program for critical supply chains

COVID-19 has highlighted the risks of international interdependence across supply chains. Government has signalled plans for increasing Australia's economic sovereignty, and Australian businesses are forecast to increasingly place greater value on domestically manufactured production inputs across all supply chains.¹⁴ Ensuring production output in these critical industries are matched with energy upgrades and fuel switching will maximise the productivity and resilience across supply chains.

1.5.1. The opportunity

Building energy productivity and renewable energy into expanded manufacturing for critical supplies - like food and pharmaceuticals - will build an energy fit supply chain that cuts energy costs, freeing up funds for innovation and job creation. Supporting targeted, strategic sectors over the long-term will deliver productivity gains across an entire national supply chain as the lessons learnt, user experience with energy fit processes and supply of equipment is mainstreamed across an entire sector (and not limited to sporadic case studies). The Federal Government's recent support for the newly established Race for 2030 CRC provides the perfect catalyst for this national building initiative.

"...it is so important that we work together with industry and researchers to deploy the right technology when and where it is needed for cheaper bills and lower emissions." - Minister Taylor, at the launch of Race for 2030.¹⁵

1.5.2. Investment

This package will allocate \$220 million over two years.

1.5.3. What does the package do?

This investment will provide grants for up to 1,000 manufacturers in industries identified by the Government as critical for sovereign industrial capability. The grants will support manufacturers to modernise energy processes. Grant recipients can access grant funding for capital upgrades that increases energy productivity and fuel switches to renewable electricity (for example, industrial heat pumps, refrigeration upgrades, solar and battery storage, waste avoidance and recovery to reduce energy costs associated with waste). Grant recipients can use grant funds for developmental costs, installation of equipment and associated staff training. The program will also fund program leaders and outreach officers to ensure this national building investment is strategically deployed to achieve long-term

¹⁴ *Short Supply: COVID-19 Implications for Australian Supply Chains*, IBISWorld, 21 April 2020, <http://www.ibisworld.com/industry-insider/analyst-insights/short-supply-covid-19-will-have-long-term-implications-for-australian-supply-chains>

¹⁵ *Race for 2030 Funding Announced: Supporting affordable clean energy*, 22 April 2020, racefor2030.net.au, Accessed 6 May 2020

growth and resilience of these industries. The grant program can be matched by innovative finance options, such as the Sustainable Finance Fund (underwritten by Bank Australia) that provides low cost, long-term finance for environmental and building upgrade projects.¹⁶

1.5.4. Industry participation requirements

To be considered for a grant, businesses will need to demonstrate that the investment will increase energy productivity and lead to job creation. Businesses must also demonstrate that they will prioritise local procurement of equipment, where available.

1.5.5. How will the package be delivered?

The Department of Industry, Science, Energy and Resources' successful *Modernising Manufacturing Fund* can be extended to deliver the Energy Fit program. Levering existing program grant infrastructure will save administrative costs and time. Following the recent Modernising Manufacturing Fund grant round structure, small projects could receive 50% of project costs up to \$100,000, and large projects between \$100,000 and \$1 million could access funding for 25% of project costs. Energy transformation outcomes and outputs of the grant should be co-designed with leaders of the nominated critical industries, energy productivity experts and peak groups, and the Race for 2030 CRC. Slight adjustments to co-funding requirements and milestone payments may be needed to ensure grant funding can unlock private investment. This adjustment should be developed in close consultation with industry peak groups. An Energy Modernisation program unit, steered by an expert advisory committee, will design and deliver the grant program. This Unit will also deliver a supply chain capacity program to ensure the grants achieve long-term gains in energy productivity.

1.6. Part three: Industry energy knowledge and capacity building

This package provides practical mentoring and support to significantly improve manufacturers' energy knowledge and support the sector to make strategic energy investment decisions.

1.6.1. The opportunity

The doubling of energy prices since 2014 has made energy use and procurement a complex and strategic business decision. Manufacturers (from executives, workers, engineering consultants to electricians and plumbers) don't always have all the knowledge they need to transform energy use. They are also time poor, making it a challenge to invest in new energy skills and capacity building.

Successful state government programs show that energy mentoring and capacity building can make a positive difference for businesses. The NSW Sustainable Advantage program has engaged 500 businesses, and their combined actions are saving \$95 million every year.¹⁷ Circular Economy programs can also save money by reducing the embodied energy of a material through replacing raw materials with reuse and recycling. Supporting state and territory governments and peak groups to expand their capacity building programs will

¹⁶ See sustainableaustraliafund.com.au

¹⁷ *Sustainable Advantage*, NSW Department of Planning, Industry and Environment, <https://www.environment.nsw.gov.au/sustainabilityadvantage/>, Accessed 5 May 2020

quickly add value for manufacturers by leveraging existing relationships, program infrastructure and aligned grants. There is also the opportunity to deliver sector-wide, long-term energy capacity by partnering with peak groups to develop and deliver a strategic reform project that lifts the energy productivity of Australian manufacturers.

1.6.2. Investment

This package will allocate \$20 million over two years.

1.6.3. What does the package do?

This package will scale the leadership and capacity of state and territory governments, industry groups and other training providers to deliver knowledge and capacity building programs for industry. Entities seeking funding will be encouraged to put forward program proposals that can quickly leverage existing program infrastructure and industry relationships to ensure programs can add value to businesses in the short-term. Existing initiatives that could be scaled include:

- Capacity building projects like NSW's *Sustainable Advantage*¹⁸ program and the Australian Industry Group's *Energy efficiency mentoring program*¹⁹
- Circular economy programs that reduce energy via recycling, like the ASPIRE program that uses an online marketplace to match businesses with potential remanufacturer, purchases or recyclers of waste materials²⁰
- Learning and networking events, such as those convened by the Australian Alliance for Energy Productivity, industry groups like Dairy Australia and the Energy Efficiency Council
- developing and delivering TAFE programs for energy efficiency and electrical heating technology, like the Victorian *Advanced Diploma of Engineering Technology*²¹ and the Certificate IV in *Energy Management and Control*.

The package also provides funding to develop a national strategy for increasing the energy literacy of manufacturers. This is an essential precondition for Australia to move from being the most energy inefficient, to one of the most competitive and productive sectors in the world.

1.6.4. Participation requirements

Program providers must be able to demonstrate that their proposals:

- leverages existing program infrastructure, capabilities, and relationships, and can be scaled and delivered quickly
- will involve business and industry groups to ensure content and delivery will add value for businesses
- will use energy experts that are suitably experienced and qualified (for example, are certified to deliver energy audits).

¹⁸ *Sustainable Advantage*, NSW Department of Planning, Industry and Environment, <http://www.environment.nsw.gov.au/sustainabilityadvantage/>, accessed on 8 May 2020

¹⁹ *Energy Efficiency Capability Program*, The Australian Industry Group, <http://www.aigroup.com.au/policy-and-research/businesspolicy/energy/energy-efficiency-capability-program/> Accessed on 8 May 2020

²⁰ ASPIRE, <http://www.aspiresme.com>, Accessed 6 May 2020

²¹ *22478VIC Diploma of Engineering Technology and 22479VIC Advanced Diploma of Engineering Technology*, Victorian Department of Education and Training, 2018

1.6.5. How will the package be delivered?

The funding opportunity for capacity building programs will be administered by the Federal Department of Industry, Science, Energy and Resources, who will call for proposals and allocate program funding to providers. The energy productivity strategy will be led by the Department of Industry, Science, Energy and Resources in partnership with the Energy Efficiency Council, Australian Industry Group, Race for 2030 CRC, State and Territories, and other industry peak groups.

2. BATTERY NATION

Battery Nation will position Australia as a leading global battery manufacturer, leveraging our minerals and industrial capabilities to increase value and jobs rights across the supply chain.

At-a-glance

- \$500 million Government investment over three years plus \$240 million in low cost finance
- Delivers:
 - 100,000 home battery installs
 - 5 small battery manufacturing plants
 - new infrastructure to recycle 6,000 tonnes of waste every year
 - 2 large-scale battery manufacturing plants
 - 1 lithium refinery plant
- Creates 4,500 ongoing manufacturing jobs and 2,300 installer and construction jobs
- Leverages:
 - \$1 billion private investment in home batteries by 2024
 - \$5 billion industry capital investment in heavy industry by 2030
- Positions Australia as a leading global battery manufacturer by 2030 by scaling up the South Australian Home Battery Program nationally, ensuring procurement leads to local battery manufacturing and incentives for lithium refining, battery recycling and reprocessing and battery innovation.

2.1. The case for ramping up battery manufacturing

Global energy storage is set to boom by 2040 and this represents a \$662 billion investment opportunity.²² Experts anticipate that Australia is one of only ten countries able to secure three-quarters of this global market.²³ The global electric vehicle market alone is predicted to consume 2.7 million tonnes of lithium by 2025. For context, the world currently makes around half a million tonnes, and new lithium refining capacity currently planned for Australia will only double world supply to 1 million tonnes.²⁴

Now is the time to assertively position Australia as the world's leading battery nation. Australia has all the pre-conditions to capture the full value of the battery supply chain: minerals, an excellent investment destination, outstanding industrial capacity, an attractive market for small and big scale batteries, world-class infrastructure, and proximity to Asia. But we are not doing enough to make sure that the full economic value of our resources benefits Australia. While we have outstanding reserves of lithium most of our activity is limited to mining and exporting. This is a problem because most of lithium's economic value is in refining, processing, and battery manufacturing. In 2017 Australian lithium realised \$213 billion in the global market, but only 0.53% (\$1.13 billion) of this wealth stayed in Australia.²⁵ Most of Australia's lithium (spodumene) is exported to China for processing. After that it is

²² *Energy Storage Investments Boom As Battery Costs Halve in the Next Decade*, Bloomberg New Energy Finance, 31 July 2019, <https://about.bnef.com/blog/energy-storage-investments-boom-battery-costs-halve-next-decade/>, Accessed 3 May 2020

²³ Ibid

²⁴ *A bubble or the next big thing*, resourceful, Issue 15, 15 October 2018

²⁵ *The Lithium-Ion Battery Value Chain – New Economic Opportunities for Australia*, Australian Trade and Investment Commission, 2018

sent to Japan and Korea where it is transformed into battery packs, which are then imported to Australia and other countries.²⁶

The critical parts of advanced battery manufacturing can all be made in Australia. The Australian Trade and Investment Commission has identified that the current lack of advanced battery manufacturing is a critical gap in the Australian lithium supply chain.²⁷ Accelerating the uptake of home batteries is the key to establishing Australian battery manufacturing plants that can quickly scale up and generate high quality manufacturing jobs.

In turn, this growing market will generate demand for downstream lithium processing, boosting the business case for investing in new refinery plants. In line with the Commonwealth Government's Critical Minerals Strategy and a commitment to "*promoting investment in Australia's critical minerals sector and downstream processing*",²⁸ Australia should aim to capture between 15 to 25% of the anticipated \$662 billion global lithium market growth by 2040. Targeted Government support now will unleash a global battery powerhouse that drives investment and jobs right across the value chain from mining, refining, making, and recycling.

Case studies highlighting Australia's battery opportunity are included at Section 3.7

2.2. Program Aims

- Create nearly 7,000 jobs by 2030
- Increase the value capture of Australia's lithium resources to 25% by 2030 (up from 0.53% in 2017)
- Increase lithium-ion battery recycling to 25% by 2025
- Lower power bills by accelerating battery uptake across Australia.

2.3. Program investment and job creation

Battery Nation invests \$500 million and provides \$240 million for low-cost finance. This investment will secure 2,000 new jobs within three years, with an additional 4,800 jobs created by 2030.

2.4. Part one: Home and small business battery scheme

Ramping up home batteries is Australia's most immediate opportunity to expand our lithium supply chain. This package will scale up the successful South Australian Government's *Home Battery Scheme*, making the benefits of small batteries available Australia-wide, while incentivising investors to set up battery manufacturing and assembling plants in all states and territories.

2.4.1. The opportunity

²⁶ *The Lithium-Ion Battery Value Chain – New Economic Opportunities for Australia*, Australian Trade and Investment Commission, 2018

²⁷ Ibid

²⁸ <https://www.industry.gov.au/data-and-publications/australias-critical-minerals-strategy>

Smart Government support that encourages home battery uptake will incentivise battery manufacturers to invest in Australia by creating market demand. This in turn will grow jobs on the factory floor and across the supply chain. The South Australian Government has shown what smart investment and a simple, streamlined program can do. After just 18 months SA has attracted 2 new battery manufacturers to Adelaide, creating 350 jobs. Sonnen has set up in the former Holden Factory and has recruited former Holden workers into their business.

Home batteries will lower power bills, and by using smart technology, can be linked to create virtual power plants that secure energy supply across the grid. The 2020 Australian Battery Market report found that “Home energy storage systems are still the main game for most battery manufacturers, wholesalers and retailers.”²⁹ In 2019 more than 22,000 small-scale batteries were installed across Australia, providing more than 1 GWh in capacity,³⁰ and this is projected to grow to 28,000 batteries in 2020.³¹

2.4.2. Investment and jobs

This package will allocate \$480 million over three years:

- \$240 million will provide battery subsidies for households and small businesses
- \$240 million in low cost finance will be made available through the Clean Energy Finance Corporation.

The program aims to create:

- 500 new installer jobs
- 1200 new manufacturing, technical support, and sales jobs
- 300 construction jobs.

2.4.3. What does the package do?

This package will:

- subsidise 100,000 small battery installations for households and small businesses (under \$1 million turnover) over three years
- make available low interest loans.

To incentivise rapid uptake in the first year of the program and generate the scale needed to attract new manufacturing plants, the first participating 20,000 households and / or small businesses will receive a \$4,000 subsidy.³² All remaining 80,000 participants will receive a \$2,000 subsidy. The increased market demand generated by the subsidies and low interest loans will attract new battery manufacturers to Australia. The program will have a target of attracting at least five new small battery manufacturers, generating 1,200 direct new jobs in total. We also assume building these new plants will generate at least 300 construction jobs. This package will unlock \$1 billion in private investment from households.

2.4.4. Industry participation requirements

²⁹ *Australian Battery Market Report 2020 (media summary)*, Sunwiz, April 2020.

³⁰ *Clean Energy Australia Report 2020*, Clean Energy Council, April 2020.

³¹ *Australian Battery Market Report 2020 (media summary)*, Sunwiz, April 2020

³² This builds on the SA experience, who realised a rapid increase in subsidy applications when it recently signalled it would reduce the subsidy from \$6,000 to \$4,000.

The program will recruit a panel of approved battery providers, and by using these providers households and small businesses will be able to receive subsidies and access low interest loans.

To become a battery provider for the program, four threshold conditions must be met:

- demonstration of financial and technical competency
- battery must be able to participate in a Virtual Power Plant
- a Clean Energy Council accredited supplier
- a demonstrated commitment to install batteries assembled or made in Australia.

2.4.5. How will the package be delivered?

The package will be administered through the Federal Department of Industry, Science, Energy and Resources. This will ensure a rapid start-up, while also strategically linking the program to aligned industry development programs across the Federal Government. WWF-Australia notes that only the South Australian Government has an extensive home battery program. Consulting with the South Australian Government will ensure the two programs align to offer maximum value for SA residents and battery providers. Other state and territory programs are smaller in scale. Households and small businesses will only be able to access one subsidy program and will not be able to 'double up' by accessing both a federal and state government subsidy.

2.5. Part two: processing and manufacturing package

This package provides support for establishing new high value-add lithium industries across Australia. Funding and market incentives will focus on three priorities: mineral refining, battery manufacturing and battery recycling.

2.5.1. The opportunity

Scaling up lithium refining, processing and battery manufacturing will keep the high value parts of the battery supply chain in Australia. Increasing our lithium value capture from 0.53% to 25% would boost the annual economic value from \$1 billion, to \$54 billion. Ramping up battery recycling will maximise the value of our lithium. CSIRO estimates that today's lack of battery recycling represents a lost economic opportunity of \$813 million to \$3 billion.³³ The Battery Stewardship Council of Australia has developed an industry-led battery stewardship scheme, which will drive responsible management across the entire battery supply chain, importantly increasing recycling rates³⁴. The scheme is currently awaiting approval from the ACCC. There are positive developments in lithium refining and battery manufacturing, but they need to be scaled up and coordinated to ensure we build a competitive and world leading industry.

2.5.2. Investment and jobs

This package will allocate \$240 million over five years to provide smart investment support to establish new refineries, manufacturing, and recycling plants. The program aims to create:

³³ *Lithium battery recycling in Australia; Current status and opportunities for developing a new industry*, CSIRO, April 2018

³⁴ *Proposed Stewardship Scheme for Batteries*, Battery Stewardship Council, November 2020

- 500 new refinery jobs
- 2,300 large scale battery manufacturing jobs
- 500 recycling jobs
- 1,500 construction jobs.

2.5.3. What does the package do?

This package will provide targeted investment to support the commercialisation and scaling up of large processing and manufacturing facilities. The package aims to create:

- at least one new refinery and two new large-scale battery plants, and
- new battery recycling infrastructure that recycles 5,000 tonnes (25% of annual battery waste) within 5 years.

An expert panel of industry leaders will be formed to advise Government on high-value industry ventures to support, and to provide on-going advice and facilitation for funded projects to ensure long-term success. This package also includes a three-year infrastructure grant program to increase domestic battery recycling infrastructure and processing. This is a key support package to ensure the success of the Battery Product Stewardship Scheme. For the battery recycling grant, we suggest a design of 25% federal funding, 25% state funding and 50% commercial funding.

2.5.4. Industry participation requirements

All investors, new market entrants and manufacturers set to benefit from federal government investment support and grant funding must demonstrate that their proposal:

- supports local content procurement, to maximise the value of investment into regional economies
- complies with the National Battery Stewardship Scheme
- creates new job opportunities for Australians
- excellence in environmental management
- supports strong economic empowerment for Traditional Owners, including trade opportunities with Aboriginal owned enterprises and job opportunities.

2.5.5. Delivery

ARENA will deliver investment in battery commercialisation and scaling and will convene the expert panel of industry leaders to advise on funding allocation. The Federal Department of Industry, Science, Energy and Resources will administer the battery recycling grants. This package should be designed and delivered in partnership with the CRC for Future Battery Industries, The Chief Scientist, The Battery Stewardship Council, industry leaders and state and territory governments.

2.6. Part Three: Battery Innovation

This package will ensure Australia is a global leader in advanced manufacturing and battery innovation through developing a national battery strategy and supporting innovation across the battery supply chain.

2.6.1. The opportunity

The Federal Government's recently announced *National Hydrogen Strategy* and aligned funding packages have excited industry and generated investor interest. Australia can also be at the forefront of battery storage, exporting its batteries and expertise to the world. Exciting innovations include light-weighting batteries to power electric buses that hold more passengers, electric planes, and electric road trains, and, graphene batteries in a car which could be refuelled while stopped at traffic lights.³⁵ Developing a national battery strategy and supporting Australian innovation will position us at the forefront of global battery economy.

2.6.2. Investment

This package invests \$20 million over five years.

2.6.3. What the package does

The package funds the Chief Scientist to develop a national battery strategy and boosts CSIRO's capacity to deliver research and commercialisation of new battery technologies. The national battery strategy should consider:

- how to maximise Australian lithium value capture across the full supply chain
- the target scale and size of the industry, including full investment, jobs, and export potential
- a series of incentives to attract new metal refineries, small- and large-scale battery manufacturers and recyclers to Australia.

2.6.4. Delivery

The COAG Energy Council will commission the strategy, which will be delivered by the Chief Scientist, and CSIRO will deliver new battery research projects. Both programs should be delivered in partnership with the CEC for Future Battery Industries.

2.6.5. New Jobs Created

This package will support long term job creation highlighted in Part 2 by ensuring the right market incentives are in place to grow Australia's manufacturing and battery export potential.

³⁵ A *graphene breakthrough hints at the future of battery power*, Wired UK, 16 August 2018, Accessed at <https://www.wired.co.uk/article/graphene-batteries-supercapacitors> on 2 May 2020

2.7. BATTERY CASE STUDIES

South Australia Home Battery Scheme

The South Australian Government's leading Home Battery Scheme shows how Government can kick-start a local manufacturing sector. Launched on 29 October 2018, the scheme is cutting energy costs for residents and attracting battery manufacturers to the state.

Fast facts

- Government is investing \$200 million over three years to install 40,000 home batteries that can be linked to create a Virtual Power Plant. The South Australian Government is providing \$100 million in subsidies, and the Clean Energy Finance Corporation is providing \$100 million in low interest loans.³⁶
- 6,700 new homes applied for funds in late April. Installing these will generate the equivalent of **150 full-time installer jobs** in six months.³⁷
- The program has attracted three new battery providers to the state. Two of these will manufacture batteries in Adelaide.
- Sonnen started manufacturing batteries in the former Holden factory in October 2018. After one year **47 people were employed and 2,000 batteries** were made.³⁸ Sixty-six additional people are employed in technical support and sales.³⁹
- AlphaESS manufacturing plant opened in September 2019. This year they aim to make **1,000 batteries per month**, and they intend to **employ between 80 to 100 people**.⁴⁰

"Australia is on the map for cleantech manufacturing...We've leveraged Australia's heritage in automotive manufacturing and applied this to cleantech..." – Nathan Dunn, Managing Director Sonnen Australia.

Other state and territory schemes include:

- NSW – interest free loans to homeowners in the Hunter Valley
- VIC – rebates offered for 10,000 batteries over ten years⁴¹
- QLD - interest-free loans or grants (program now closed)
- ACT – rebates available for up to 5,000 homes
- NT - \$6,000 grant available for 130 batteries (recently launched)
- WA – no scheme, recently announced that government will install ten community batteries.

³⁶ *Switch flicked on world leading home battery scheme*, South Australian Government, 29 October 2018, accessed at <https://www.premier.sa.gov.au/news/media-releases/news/switch-flicked-on-world-leading-home-battery-scheme> on 27 April 2020

³⁷ *Thousands pile into S.A. home battery scheme before subsidy winds back*, One Step of the Grid, 17 April 2020, <https://onestepofthegrid.com.au/thousands-pile-in-to-s-a-home-battery-scheme-before-subsidy-winds-back/>, Accessed 3 May 2020

³⁸ *Sonnen Li Ion Batteries gain Australian made status*, @AuManufacturing, 21 October 2019, <https://www.aumanufacturing.com.au/sonnen-li-ion-batteries-gain-australian-made-status>, Accessed 3 May 2020

³⁹ *A lot can change in 12 month at sonnen*, 25 November 2019, <https://sonnen.com.au/blog/lot-can-change-12-months-sonnen/>, Accessed 3 May 2020

⁴⁰ *Ramp-up of a new SA battery plant*, 26 September 2019, <https://alpha-ess.com/Web/News-Detail.aspx?newsId=abd73d3f-7cc0-40b8-bf6f-abdf9d2b427d>, Accessed 3 May 2020

⁴¹ *Notice to Market Solar Homes Program*, Solar Victoria, 17 April 2020

Western Australia's lithium valley

A coalition of Western Australian industries has come together to create the *Lithium Valley* concept, showing the way with an exciting vision that could be extended right across Australia. The coalition's aim is for WA industries, clustered around the Kwinana industrial area, to be a "World leader in power storage design, production, research, operations, technology and applications... also encapsulat(ing) other industries and products, such as transport or hydrogen, that are part of the global transformation of energy."⁴²

Western Australia holds the world's largest lithium reserves and is leading the charge to keep the lithium value chain in Australia. Three refineries are currently in different stages of development, and together are expected to generate 2,100 construction jobs and 1,000 ongoing jobs.

Project	Investors	Annual output	Job creation
Covalent: ⁴³ <ul style="list-style-type: none"> Mt Holland mine and concentrator Kwinana refinery 40-year project 	SQM & Wesfarmers 50:50 joint venture	<ul style="list-style-type: none"> 340,000 tonnes spodumene concentrate 45,000 tonnes battery quality lithium hydroxide 	<ul style="list-style-type: none"> 700 construction jobs 150 mining jobs 150 refinery jobs
Tianjin Kwinana refinery: <ul style="list-style-type: none"> Spodumene sourced from Greenbushes WA mine 	Tianqi Lithium (Cheney, China)	<ul style="list-style-type: none"> 48,000 tonnes battery quality lithium hydroxide 	<ul style="list-style-type: none"> 900 construction jobs 200 refinery jobs⁴⁴
Albemarle Kemerton refinery: <ul style="list-style-type: none"> Spodumene sourced from Greenbushes, WA \$1 Billion investment Works began January 2020 	Albemarle (Albemarle also holds 49% shares in its Talison Lithium, owner of Greenbushes mine)	<ul style="list-style-type: none"> 100,000 tonnes battery quality lithium hydroxide by 2025⁴⁵ 	<ul style="list-style-type: none"> 500 construction jobs 500 operational jobs⁴⁶

⁴² *Lithium Valley Strategic Plan Summary*, Infranomics, April 2020

⁴³ Covalent Lithium, <https://www.covalentlithium.com/news-1> Accessed 1 May 2020

⁴⁴ Tianqi Lithium Australia, <https://www.tianqilithium.com.au/site/About-Us/tianqi-lithium-global>, Accessed 1 May 2020

⁴⁵ Albemarle, <https://www.albemarle.com/businesses/lithium/locations/western-australia>, Accessed 1 May 2020

⁴⁶ *WA cashed in on lithium boom as work begins on world's largest lithium refinery*, ABC News, 28 March 2019, <https://www.abc.net.au/news/2019-03-28/wa-cashes-in-as-work-begins-on-worlds-largest-lithium-refinery/10950970>, Accessed 3 May 2020

Making big batteries

The Hornsdale battery (which at 100MW is the biggest in the world) demonstrates the benefits of utility scale batteries. In 2019 the battery saved customers \$116 million, up from \$40 million in savings delivered in 2018.⁴⁷

Demand for community scale grid batteries are also set to grow. The Federal Regional and Remote Communities Fund is investing \$50.4 million over five years to fund microgrid feasibility studies.⁴⁸ The WA Government's *Distributed Energy Resources Roadmap* proposes that ten new community batteries be installed by the end of this year.⁴⁹

“Supplying remote, grid supplied customers to a self-supporting microgrid could save hundreds of millions of dollars in costly network infrastructure and maintenance while improving reliability.” Minister for Energy Angus Taylor⁵⁰

Paving the way for utility scale battery manufacturing today will ensure Australia is leading hub for global supply by 2040.

Spotlight on Magnis' Townsville Giga-battery Factory

Magnis is moving forward with its plans to build Australia's first large scale battery cell production in Townsville. Magnis' feasibility study found that the 18 GWh lithium-ion battery manufacturing plant would achieve a net present value of \$2.55 billion. The plant will cost \$3 billion and provide 1,150 direct jobs.⁵¹

⁴⁷ *Hornsdale big battery doubles savings to consumers, and keeps lights on*, RenewEconomy, 28 February 2020, <https://reneweconomy.com.au/hornsdale-big-battery-doubles-savings-to-consumers-and-keeps-lights-on-85139/>, Accessed on 27 April 2020

⁴⁸ *Regional and remote communities reliability fund*, <https://www.energy.gov.au/government-priorities/energy-programs/regional-and-remote-communities-reliability-fund>, Accessed 1 May 2020

⁴⁹ *West Australia puts community batteries at top of new energy roadmap*, RenewEconomy, 5 April 2020, <https://reneweconomy.com.au/west-australia-puts-community-batteries-at-top-of-new-energy-roadmap-38533/>, Accessed 1 May 2020

⁵⁰ *Federal Government launches \$50 million microgrid funding program*, PV Magazine, 11 October 2019, <https://www.pv-magazine-australia.com/2019/10/11/federal-government-launches-50-million-microgrid-funding-program/>, Accessed 1 May 2020

⁵¹ *Magnis moves closer to \$1BN battery plant go ahead*, Australian Manufacturing Forum, 2 October 2019, <https://www.aumanufacturing.com.au/magnis-moves-closer-to-1bn-battery-plant-go-ahead>, Accessed on 27 April 2020

Battery recycling gets full value from lithium

Setting up a battery recycling industry will ensure Australia gets maximum value from lithium and other critical battery elements. Australia generates about 20,000 tonnes of battery waste every year, but only 10% is recovered.⁵² By 2036 waste is expected to grow to between 100,000 to 188,000 tonnes.

Spotlight on Envirostream

Starting in 2017, Victorian company Envirostream became Australia's first lithium battery recycler. Located in New Gisborne, the \$2 million facility has provided 5 new jobs.⁵³ In 2018 Envirostream recycled 240 tonnes of batteries. Last year Lithium Ion Australia increased its investment in Envirostream from 23.9% to 74%, signifying the opportunity to market participants who vertically integrate across the supply chain.

"Lithium Australia and Envirostream are developing environmentally responsible solutions to the mounting problems of spent batteries...Keeping spent batteries from landfill and exporting the energy metals they contain is an Australian imperative." Adrian Griffin, Lithium Australia Managing Director.⁵⁴

Battery innovation

ARENA has invested \$95 million in battery innovation which is now accelerating the benefits of distributed energy resources across our energy system.⁵⁵ Projects include the:

- Hornsdale Power Reserve Upgrade, adding an extra 50 MW to provide an Australian-first large-scale demonstration of battery potential to provide inertia to our network
- Agnew hybrid microgrid which will deliver up to 60% renewable energy to the Agnew gold mine
- Ballarat Energy Storage System, which will store energy at times of relatively low value. The battery will use stored energy and use it at times of relatively high value.⁵⁶

Continued ARENA funding will accelerate national uptake of battery storage, drive down energy costs and build demand along the lithium battery supply chain.

CSIRO has over 35 years of experience with batteries and has been working in the lithium battery field for over 15 years.⁵⁷ Investing in CSIRO will continue to drive battery innovation in partnership with industry.

⁵² Advice provided by industry expert to WWF Australia's consultant, 1 May 2020

⁵³ *Australia's first lithium battery recycling plant opens*, Sustainability Victoria, 28 April 2018, <https://www.sustainability.vic.gov.au/About-us/Latest-news/2018/04/26/04/57/Australias-first-lithium-battery-recycling-plant-opens> Accessed on 27 April 2020

⁵⁴ Ibid

⁵⁵ *ARENA Annual Report 2018*, ARENA, 2019

⁵⁶ *Projects*, ARENA, <https://arena.gov.au/projects/?project-value-start=0&project-value-end=200000000&technology=battery-storage>, Accessed 2 May 2020

⁵⁷ *Advanced lithium batteries*, CSIRO, <https://research.csiro.au/lithium/>, Accessed 2 May 2020

Spotlight on Ultra Battery

The Ultra Battery combines the lead-acid battery and a super capacitor to create an economical, super-fast charging battery with long life power.⁵⁸ The battery was developed by CSIRO and built by the Furukawa Battery Company. Following commercialisation, it is now being used in the Honda Odyssey hybrid.⁵⁹

⁵⁸ *UltraBattery*, CSIRO, 18 October 2019, <https://www.csiro.au/en/Research/EF/Areas/Grids-and-storage/Energy-storage/UltraBattery> Accessed on 2 May 2020

⁵⁹ *Ibid*

3. ELECTRIC BUS REVOLUTION

Electric Bus Revolution will fast-track electric buses in our cities and build a national manufacturing sector that supplies electric buses to the world.

At-a-glance

- \$240 million Government investment over two years that puts 500 new, Australian made buses on the road
- Leverages \$233 million of industry investment in electric buses and depots
- Grant funding puts 500 new electric buses on the road and builds associated charging depots
- Doubles Australia's existing manufacturing workforce of 10,000 people by 2030 with a two-pronged approach – a grant program and innovation fund - to create:
 - 3,000 new jobs by 2023 through public transport bus procurement and depot upgrades
 - 8,000 new jobs by 2030 through kickstarting an e-bus export industry.

3.1. The case for building an e-bus industry

Global demand for electric buses is set to grow. Today, there are around 425,000 electric buses worldwide. Bloomberg New Energy Finance projects that by 2040, 81% of all municipal (public transport) bus sales will be electric.⁶⁰ Twenty-six global cities have committed to only buy electric buses by 2025 –a procurement potential of 80,000 buses.⁶¹

In Australia, NSW has committed to a fully electric bus fleet, is currently trialling e-buses on four busy routes and is set to expand this with a recent call for expressions of interest to run more trials as part of their plan for a wider switch. Brisbane City Council recently entered into contract for 60 electric buses, and the Victorian and ACT Governments each are trialling an e-bus with success.

The drivers for making the switch to e-buses include:

- Healthier cities – diesel buses release harmful pollutants. New York City is transitioning its fleet of 5,700 buses to electric, and it is estimated that each electric bus will save \$150,000 per year in reduced health care costs.⁶²
- Cheaper to run – electric buses have much lower operating costs (based on total cost ownership) than conventional buses.⁶³ Even the most expensive 350 kWh electric bus can realise around \$130,000 in savings over a 15-year lifetime.⁶⁴

⁶⁰ *Electric Transport Revolution Set to Spread Rapidly Into Light and Medium Commercial Vehicle Market*, Bloomberg New Energy Finance, 15 May 2019, <https://www.about.bnef.com/blog/electric-transport-revolution-set-spread-rapidly-light-medium-commercial-vehicle-market/> Accessed 28 April 2020

⁶¹ *Zero Emission Vehicles*, C40 CITIES, c40.org, Accessed on 28 April 2020

⁶² ClimateWorks Australia submission to inquiry into Electric buses in regional and metropolitan public transport networks in NSW, ClimateWorks Australia, 19 December 2019, <https://www.climateworksaustralia.org/wp-content/uploads/2020/01/ClimateWorks-sabmission-NSW-electric-bus-inquiry.pdf>, Accessed on 28 April 2020.

⁶³ *Electric Buses in Cities: Driving Towards Cleaner Air and Lower CO₂*, Bloomberg New Energy Finance, 10 April 2018, <https://about.bnef.com/blog/electric-buses-cities-driving-towards-cleaner-air-lower-co2/> Accessed on 29 April 2020

⁶⁴ Ibid

- Cost parity - By 2030 it is projected that electric buses will reach upfront cost parity with diesel buses. Accelerated demand could bring this forward to 2025.⁶⁵

Bus manufacturing is an important Australian industry with a workforce of around 10,000 people.⁶⁶ There is a need to support industry to ensure the switch to electric buses maintains and grows these jobs. Bus industry experts are telling us that strong policy support for electric buses combined with procurement will incentivise local manufacturing and assembly of electric buses in Australia.

Nexport currently imports electric bus chassis. They are working to set up an electric chassis manufacturing plant in Australia that would create 100 jobs but need a minimum order of 150 buses (delivered over three years) to make it viable.⁶⁷ Transit Systems operates 830 diesel and CNG buses in Sydney. They state that switching just 10% of Sydney's fleet would be enough to attract commercial opportunities for bus manufacturers and equipment suppliers.⁶⁸ Making electric buses for Australian cities is just the first step to growing manufacturing jobs.

Australia can leverage its existing industry to scale-up and provide electric buses for the global market. If Australia aimed to supply just 5% of the anticipated global market by 2025, more than 8,000 new jobs could be created.

Electric bus case studies are provided at Section 4.6

3.2. Program Aims

The Electric Bus program aims are:

- Double's Australia's existing bus manufacturing workforce, reaching 20,000 by 2030
- Deploy at least 500 Australian made electric buses across our major cities within three years
- Develop an electric bus manufacturing strategy that aims to supply 5% of anticipated global electric bus sales by 2030.

3.3. Program investment and job creation

This program will invest \$240 million to double the existing bus manufacturing workforce, reaching 20,000 by 2030.

⁶⁵ Ibid

⁶⁶ *The Economy and the Bus Industry*, OzeBus, <https://www.bic.asn.au/information-for-moving-people/economy-and-the-bus-industry/> Accessed on 29 April 2020.

⁶⁷ *Nexport submission to inquiry into Electric buses in regional and metropolitan public transport networks in NSW (submission 26)*, Nextport, 20 December 2019, <https://www.parliament.nsw.gov.au/ladocs/submissions/66990/Submission%20-%202026.pdf> Accessed on 29 April 2020

⁶⁸ *Transit Systems submission to inquiry into Electric buses in regional and metropolitan public transport networks in NSW (submission 11)*, Transit Systems, 19 December 2019, <https://www.parliament.nsw.gov.au/ladocs/submissions/66975/Submission%20-%202026.pdf> Accessed on 29 April 2020

3.4. Package one: Electric bus grant program

3.4.1. The opportunity

While global demand for electric buses is growing, markets outside of China are still small. Setting up an electric bus manufacturing sector today will help ensure Australia is shovel ready to sell high quality buses to the world when the expected price tipping point is achieved in 2025.

3.4.2. Investment and jobs target

This package allocates \$200 million in grant funding over three years. This has the potential to create nearly 3,000 jobs:

- 300 new manufacturing jobs, by establishing three new electric chassis manufacturing plants
- 1,700 manufacturing jobs in bus body manufacturing
- 900 construction jobs to build electric charging depots.

We also assume at least 50 construction jobs created to construct 40MW solar or wind farms to power the 500 buses.

3.4.3. What does the package do?

Grants will be provided to public transport authorities to incentivise them to go to market for service contracts that use Australian made electric buses. Funding will support early uptake of up to 500 electric buses, contributing to the current cost difference between diesel and electric buses. Funding can be used to support bus procurement, depot upgrades and charging equipment. This investment will leverage \$233 million investment in buses and charging depots by public transit authorities and commercial operators. This investment will also reduce operating costs for public transport operators and contribute to better air quality and amenity for our cities.

3.4.4. Industry participation requirements

To win grant funding, state and local government public transport authorities must:

- go to market for at least 50 new electric buses per contract
- include local content and manufacturing requirements in their tenders
- demonstrate that mechanisms will be put in place to run the buses with renewable electricity
- demonstrate that state bus service contracts have been updated to reflect new technologies
- demonstrate they have been partnering with the bus operators to design a bus network with the capability of accommodating new technologies and service practices
- demonstrate how they will provide practical support for investors and commercial operators looking to establish local manufacturing operations

- accelerate bus replacement program, bringing the contract life of service buses down to 15 years (from current 25 years) and prioritising the replacement of high floor buses (elderly and mobility impaired people cannot use these services)

3.4.5. How will the package be delivered?

The grant program will be administered by the Department of Infrastructure, Transport, Regional Development and Communications. Two funding rounds will be offered over 2 years, which will provide flexibility for different bus service contracts and end dates. Funding rounds will also be allocated proportionality across states and territories.

3.5. Package Two: Electric Bus Innovation Fund

3.5.1. The opportunity

Electric buses are proven technologies, but to ensure Australia gets the maximum value from electrifying buses and building new manufacturing industries a strategy and coordinated approach is needed.

3.5.2. Investment and job creation

This package will invest \$40 million over two years in zero emission innovation and investment. This will build industry capacity to make and export electric buses, targeting 4,000 buses and 8,000 new jobs by 2030.

3.5.3. What does the package do?

This innovation fund will support bus operators and manufacturers to commercialise Australian e-bus innovation and to strategically scale up manufacturing to target the international market. The fund is modelled on the New Zealand *Low Emission Vehicle Contestable Fund*, where key objectives are to:

- increase the supply and variety of electric and other zero emission buses
- improve the availability of charging and servicing infrastructure
- increase demand for low emission vehicles
- develop innovative products and systems for vehicles.

To complement industry innovation, \$5 million will be allocated to develop a national e-bus manufacturing strategy and implementation plan, with a focus on:

- designing the retrofit of urban bus networks to fully electric services, exploring how proven, advanced technologies can be best adopted and adapted to existing bus networks;
- bus and battery innovation, manufacturing, and deployment, to put Australia at the forefront of technology and advanced manufacturing across the entire bus supply chain;
- vehicle to grid optimisation, to ensure electric bus roll-out provides strategic grid benefits such as demand management and storage.

3.5.4. Industry participation requirements

Industry funding recipients must demonstrate how their project will create jobs and significantly upscale bus manufacturing.

3.5.5. How will the package be delivered?

The Electric Bus Innovation Fund will be administered by ARENA. The Transport and Infrastructure Council will deliver the e-bus strategy and will nominate a state to lead the strategy on behalf of the Council.

ELECTRIC BUS CASE STUDIES

3.5.6. Electric buses in Australia

The NSW Government, in partnership with Transit Systems, started a two-year trial of four electric buses on 1 July 2019. The buses are running in the inner west of Sydney, and the learnings will be shared with industry as NSW moves towards a 100% electric bus fleet.⁶⁹ Four months into the trial, NSW Transport Minister announced that the NSW Government would move to electrify Sydney's 8,000 buses.⁷⁰

The Victorian Government is currently trialling an electric bus in inner Melbourne. The bus is the first one to be made locally in Victoria. Early reports are positive, with the bus successfully running 172 kms a day, showing encouraging cost savings signs, and benefits for driver health with reduced cab noise.⁷¹

The ACT Government is currently trialling a Yutong Electric E12 bus, operating all over Canberra.⁷² An earlier 2017 trial that compared diesel, hybrid and electric buses concluded that electric buses were better in terms of total cost ownership and an economic perspective.⁷³ The ACT Government has committed to a 100% electric bus network.

State	What's happening?
NSW	<ul style="list-style-type: none"> • Trialling of 4 electric buses on Sydney's inner west • Government commitment to electrify all 8,000 Sydney Buses
VIC	<ul style="list-style-type: none"> • Trialling 1 electric bus • Developing a Zero Emissions roadmap
ACT	<ul style="list-style-type: none"> • Trialling 1 electric bus • Commitment to electrify entire fleet
QLD	<ul style="list-style-type: none"> • 1 electric bus in service • Brisbane City Council has entered into contract for 60 electric buses
SA	<ul style="list-style-type: none"> • Tindo electric bus operates in Adelaide • Planning to add electric buses to its trial of hybrid buses
NT	<ul style="list-style-type: none"> • 2019 Electric Vehicle discussion paper includes buses
WA	<ul style="list-style-type: none"> • Recently purchased 900 diesel buses to be delivered over 10 years, contractor could supply alternative electric technologies if requested by Transport Authority

3.5.7. Electromotive - Australia's first turnkey charging provider

Electromotive is offering a unique turnkey charging service to bus operators that provides cost effective charging infrastructure that fits the unique needs of every operator, but without

⁶⁹ *Transit System West case study*, Transport for NSW, transport.new.gov.au, Accessed on 29 April 2020

⁷⁰ *There is a real health impact: Minister plans to electrify Sydney's 8000-strong bus fleet*, SMH, 28 October 2019, <https://www.smh.com.au/national/nsw/there-is-a-real-health-impact-minister-in-push-to-electrify-sydney-s-8000-strong-bus-fleet-20191028-p534ts.html>, Accessed on 29 April 2020

⁷¹ *Video Review: Volgren-BYD Electric*, Bus News, 11 April 2020, <web> Accessed 29 April 2020.

⁷² *Electric bus to join Transport Canberra fleet*, Andrew Barr, MLA and Chris Steel, MLA, 11 November 2019, https://www.cmtedd.act.gov.au/open_government/inform/act_government_media_releases/barr/2019/electric-bus-to-join-transport-canberra-fleet, accessed on 29 April 2020

⁷³ *ACT sees electric buses as viable investment, despite flawed trial*, The Driven, 1 October 2019, <https://thedriven.io/2019/10/01/electric-bus-trial-viable-despite-flaws/>, Accessed on 29 November 2020

the complexity. Electromotive partners with bus operators to plan for the transition to zero-emission technology, establish and then maintain an electric bus network.⁷⁴ Electromotive has partnered with HESS, Volgren and AAB to deliver the Brisbane Metro project, which will put 60 electric buses on the road. ABB's super-fast charging technology will charge buses in under six minutes.⁷⁵

3.5.8. Volgren's First Electric Bus and Bus Optimisation Project

Leading bus manufacturer Volgren recently made their first electric bus at their Dandenong plant. The bus – which has entered service after being purchased by Transdev - has 324 kWh of capacity and a 300 km range.⁷⁶ The bus was a partnership between Volgren and BYD. The body construction and fit out were completed at Volgren's Dandenong plant.⁷⁷ The chassis was provided by BYD - the world's leading manufacturer of electric buses.⁷⁸ This partnership between two leading bus manufacturers highlights how innovative and quality electric buses can be successfully made in Australia.

"In the case of this first electric bus, we wanted to ensure that we built on a known quantity. We didn't want to conduct a science experiment of work with a conglomerate of part suppliers...We wanted something that will work from the start."
Jon Tozer, Volgren Business Development Manager⁷⁹

Volgren is looking to the future. Their Bus Optimisation Project aspires to take one tonne out of their Optimus model to accommodate lithium batteries. Volgren is using a scandium alloyed to aluminium, to reduce weight and maintain strength. To overcome the supply and cost issues of using scandium, Volgren is collaborating with Clean TeQ, who are developing a Scandium/Nickel/Cobalt mine in NSW⁸⁰ Funding support from the Advanced Manufacturing Growth Centre is allowing the Deakin University Institute for Frontier Materials to develop the new metal alloy.⁸¹ This lightweight bus opens exciting domestic and export opportunities for Volgren as the electric bus market grows.

3.5.9. Los Angeles electric buses

In November last year, the Los Angeles Department of Transportation ordered 130 electric buses. The order is part of a wider commitment to electricity all LA buses by 2030.⁸² The

⁷⁴ *Electromotive submission to Electric Buses in Regional and Metropolitan Public Transport Network in NSW*, Electromotive, 20 December 2019, <https://www.parliament.nsw.gov.au/ladocs/submissions/66991/Submission%20-%202027.pdf>, Accessed on 29 April 2020

⁷⁵ *Brisbane to get 60 bi-articulated EV buses with flash-charging*, InsideEVs, 28 November 2020, <https://insideevs.com/news/384541/brisbane-60-ev-buses-flash-charging/>

⁷⁶ *First Victoria-built electric bus gets thumbs up from bus expert*, The Driven, 27 April 2020, <https://thedriven.io/2020/04/27/first-victoria-built-electric-bus-gets-thumbs-up-from-bus-expert/>, Accessed on 29 April 2020.

⁷⁷ Ibid

⁷⁸ *Volgren to show off new electric bus*, @AuManufacturing, 2 October 2019, <https://www.aumanufacturing.com.au/volgren-to-show-off-new-electric-bus>, Accessed on 29 April 2020

⁷⁹ Ibid

⁸⁰ *Why some don't miss the bus*, @AuManufacturing, 14 March 2019, <https://www.amgc.org.au/jens-blog/why-some-dont-miss-the-bus/>, Accessed on 29 April 2020

⁸¹ Ibid

⁸² *Los Angeles orders 130 BYD buses*, electrive.com, 14 November 2019, <https://www.electrive.com/2019/11/14/los-angeles-orders-130-byd-electric-buses/>, Accessed on 29 April

order was supported by funding from the US Government. The buses will be provided by BYD, manufactured in their California factory. The buses will exceed the Federal 'Buy America' requirement and incorporate 70% US content.⁸³ Since 2015, the BYD California manufacturing plant has brought in around \$300 million in regional investment, created over 800 permanent jobs and sold 722 buses.⁸⁴ With federal support, Australia could see similar outcomes.

⁸³ *Los Angeles orders 130 BYD buses*, electrive.com, 14 November 2019, <https://www.electrive.com/2019/11/14/los-angeles-orders-130-byd-electric-buses/>, Accessed on 29 April

⁸⁴ *BYD receives inaugural select LA foreign direct investment award*, en.byd.com, 1 June 2018, <https://en.byd.com/news-posts/press-release-byd-receives-inaugural-select-la-foreign-direct-investment-award/>, Accessed on 29 April 2020.

4. LOCAL SOLAR

Local solar will cut the cost of energy for thousands of community organisations, freeing up funds to spend on core services. Kindergartens, country fire stations, Aboriginal communities, public halls, sports clubs, schools, hospitals, and Councils will all benefit from the biggest local solar roll-out Australia has ever seen.

At-a-glance

- \$500 million in Government investment, with \$400 million offered for low cost finance.
- Up to 22,000 community and public buildings fitted with solar, cutting energy costs right around Australia
- Up to 5,000 jobs created.
- Potential to leverage up to \$1 billion in community and private investment.

4.1. The case for local solar

Solar cuts the cost of energy. For community facilities that operate during the day, like kindergartens, health care centres, country fire authorities and clubs, solar can make a big difference to the bottom line, freeing up funds for core activities. A total of 160kW of solar photovoltaic systems installed across six Aboriginal communities in the west Kimberley will save each community up to \$40,000 a year.⁸⁵

Solar is also a great economic stimulator. Last year, roof-top solar systems accounted for 13,070 jobs, while large-scale solar accounted for 4,740 jobs.⁸⁶ Solar projects can be delivered quickly, with systems under 100 kw delivered in four to 5 months, and megawatt projects delivered in eight to ten months.⁸⁷ Local solar projects also generate demand in the local economy, with the Reserve Bank of Australia identifying spill-over to domestic firms, citing some contracts suggesting local content accounts for 25 - 40% of total costs.⁸⁸

Small megawatt solar farms can reduce the power bills of local governments. The \$8 million Newcastle solar farm makes good use of a closed landfill and will save Council around \$9 million over its 25-year lifespan.⁸⁹ Installing local solar right across Australia will bring the benefits of solar to local communities and create much needed jobs over the next two years.

⁸⁵ *Harnessing the sun in remote communities*, <https://horizonpower.com.au/our-community/projects/solar-incentives-scheme/>, Accessed 13 May 2020

⁸⁶ *4631.0 – Employment in Renewable Energy Activities, Australia 2018-19*, Australian Bureau of Statistics, 6 April 2020, <https://www.abs.gov.au/ausstats/abs@.nsf/mf/4631.0>, Accessed 13 May 2020

⁸⁷ *Smart energy webinar: Solar and storage on all public buildings*, Smart Energy Council (speaker: Landon Kahn, Todae Solar), 1 May 2020, <http://smartenergy.org.au/solar-storage-webinar-series#PublicBldgs>, Accessed 13 May 2020

⁸⁸ *Renewable Energy Investment in Australia*, Reserve Bank of Australia, 19 March 2020, <https://www.rba.gov.au/publications/bulletin/2020/mar/renewable-energy-investment-in-australia.html>, Accessed 15 May 2020

⁸⁹ *City powers into sustainable new era*, City of Newcastle, 4 December 2020, <https://www.newcastle.nsw.gov.au/Council?News?Latest-News/City-powers-into-sustainable-new-era>, Accessed 13 May 2020

4.2. Program Aims

The Local Solar program aims are to:

- Create 5,000 jobs
- Reduce power bills for community organisations and state and local governments delivering public services.

4.3. Program investment and job creation

This program will invest \$500 million to put solar on more than 20,000 community roofs across all Federal electorates and incentivise the delivery of 180 small solar farms right across the country, creating around 5,000 installer and construction jobs.

4.4. Part one: Community solar grant extension

This package extends and scales the current *Energy Efficient Communities Program – Community Energy Efficiency and Solar Grants 2020*.

4.4.1. The opportunity

The current *Solar Grants* program offers funding to install two energy efficient projects in each Federal electorate. (The available grant of \$12,500 for up to 100% of costs could be expected install a small, 10kw system.) By leveraging this existing program Government could quickly deploy 130 solar projects in every electorate - big enough to power a small community building such as a kindergarten, community hall, rural fire station or library.

4.4.2. Investment and jobs

This package will allocate \$400 million over one year, creating around 3,000 installer jobs.

4.4.3. What does the package do?

This package provides funding from \$1,000 to \$20,000 to not for profit groups to install solar panels on the roofs of community buildings. While the program can fund up to 100% of the project costs, we recommend that the grant round encourages and prioritises applications that install medium size systems (around 30kw) and contribute funding to the project.

Community groups set to benefit from local solar

Not-for-profit community organisations are the backbone of Australia, bringing Australians together to form communities that look out for each other, while offering vital services.

The Not-for-Profit service providers that are set to benefit from this program include:

- Children's services, such as Kindergartens, day-care, maternal and child health centres, playgroups, Scouts, and toy libraries
- Community support, such as Senior Citizen Centres, women's support services, Men's sheds, multicultural services and community and neighbourhood houses
- Cultural services, such as community galleries, University of the Third Age, libraries, dance schools and theatre groups

- RSL and other service clubs
- Country fire stations
- Sports clubs like surf lifesaving clubs, netball, football and cricket clubs, community gyms
- Religious organisations
- Environment groups, like conservation volunteers and indigenous plant nurseries.

This package has the potential to generate up to \$390 million in community investment.

Ensuring Aboriginal and Torres Strait Islanders access solar

The package also sets aside \$70 million to ensure remote Aboriginal and Torres Strait communities benefit from this grant round. This will include resourcing a steering group to support overall program design and outreach. The funding will cover feasibility, capacity building and capital works for Aboriginal and Torres Strait community solar projects.

The steering group will also work with Aboriginal and Torres Strait communities to design a longer-term remote solar program that incorporates the knowledge and experience gathered during this grant round.

4.4.4. Participation requirements

We recommend that the current grant round requirements govern this special funding round.

4.4.5. How will the package be delivered?

This package will be delivered by establishing a special new funding round of the *Energy Efficient Communities Program – Community Energy Efficiency and Solar Grants 2020* (administered by the Department of Industry, Science, Energy and Resources). There may be opportunities to refine the grant program design to reduce the administration burden for grant seekers and grantees based on feedback from the current community grant round (closing 18 May 2020).

The Department of Industry, Science, Energy and Resources, should seek the advice of the National Indigenous Australians Agency in establishing the Steering Group and program design and delivery.

4.5. Part Two: Large rooftop solar and solar farms

This package offers low cost finance for large solar systems and offers small grants to incentivise rapid uptake.

4.5.1. The opportunity

Important community assets like schools, hospitals, closed landfills, and retail can be transformed into solar farms, providing competitively priced energy where it is needed and avoiding short-term grid congestion issues.

4.5.2. Investment and jobs

This package will allocate \$100 million over two years and provide \$400 million in finance through the Clean Energy Finance Corporation's Sustainable Cities fund. The initiative will create up to 2,000 construction jobs.

4.5.3. What does the package do?

This package will incentivise landowners and developers to install large scale local solar. We have assumed the package would result in 2,000 large (100kw) roof systems and 180 small (1- 15 MW) solar farms.

Organisations set to benefit from local solar

Organisations that provide vital services can access this large solar program, including:

- Public and privately owned:
 - hospitals and health centres
 - schools, TAFE and Tertiary institutions
 - retirement centres
 - train, tram, and bus depots
 - retail centres
 - large sports centres like swimming pools and gyms
 - Councils.

Up to \$100 million in grant funding will be offered, covering up to 10% of a project's development and capital cost. A purpose-built asset fund will be established by the CECF to offer a competitive financing option. We have assumed around half of all projects would access this option. The grant design will ensure developers and building owners have maximum flexibility to deliver a business model that works for their community. Solar systems can be developed and owned by the property owner or can be developed and owned by a third party. WWF-Australia recommends that regions hardest hit by COVID19 shutdowns be prioritised for funding and finance.

This program has the potential to unlock \$8 billion in community and private investment. If the asset fund is 100% subscribed, around \$400 million in private/state and local government investment can be unlocked. The grant has the potential of incentivising projects that would add an additional \$400 million in investment.

4.5.4. Industry participation requirements

To be eligible for funding, participants:

- Must be delivering either a commercial rooftop solar array greater than 100kW or a solar farm between 1-15MWs.
- Must be a state, local government or not-for-profit in ownership of the asset
- Can be a private developer that demonstrates they have:
 - the approval of government and / or not-for-profit asset owner, and/or
 - secured the partnership of a major community leader (for example, a Council or Chamber of Commerce), and that the energy offtake will be offered at a competitive rate for use by government and / or not-for-profit asset owners
- must demonstrate that the project will generate direct local jobs and indirect jobs through local procurement

- must demonstrate compliance with regulatory requirements and use installers certified by the Clean Energy Council.

4.5.5. How will the package be delivered?

This package will be administered by the Department of Industry, Science, Energy and Resources, who will administer the grant funding, and work with the CEFC to engage a finance partner to deliver the purpose-built asset fund.

4.6. CASE STUDIES

4.6.1. Council solar farms

Councils seeking to reduce greenhouse gas emissions and operational costs are turning to solar.

Newcastle City Council recently opened an \$8 million, 5MW solar farm at its Summerhill Waste Management Centre. The \$8 million, 25-year asset was financed with a \$6.5 million CECF loan, \$1 million grant funding from the NSW Government and \$0.5 million from the council. The farm produces enough energy to power 1,300 households.⁹⁰ The farm will be saving Council \$9 million over the asset life.

Sunshine Coast Council was the first Australian council to build a solar farm. The 15 MW farm will save council \$30 million over 30 years.⁹¹ Albury City Council is the first to build a solar farm on a former landfill.⁹²

Other councils are in the early stages of delivering a farm. The Nillumbik Shire Council has agreed to go to market to secure a developer to fund and operate a solar farm (up to 5MW) and provide a power purchase agreement for council to offtake electricity.⁹³ South Freemantle Council is perusing a farm on a former landfill site.⁹⁴

4.6.2. Remote Solar

Horizon Power is partnering with remote Aboriginal communities to deliver local solar. After partnering with the Djarindjin and Lombadina Corporations to install 160kW of solar, Horizon has used this model to offer the *Solar Incentives Scheme*.⁹⁵ A Queensland Scheme is installing solar in four remote communities, and an ARENA / NT Government project has delivered 10MW of solar for remote communities. This program will save 94 million litres of diesel over the life of the program.⁹⁶

⁹⁰ Ibid

⁹¹ *Solar farm overview*, Sunshine Coast Council, <https://www.sunshinecoast.qld.gov.au/Environment/Sunshine-Coast-Solar-Farm/Solar-Farm-Overview>, Accessed 13 May 2020

⁹² *Australia's first Operational Reclaimed Landfill Solar Farm*, Solarquotes Blog, <https://www.alburycity.nsw.gov.au/services/waste-and0recycling/alternative-energy>, Accessed 13 May 2020

⁹³ *Solar farm development shines light on Council climate action*, Nillumbik Shire Council, <https://www.nillumbik.vic.gov.au/News/Solar-farm-development>, Accessed 13 May 2020

⁹⁴ *South Freemantle Solar Farm*, City of Freemantle, mysay.freemantle.wa.au, Accessed 13 May 2020

⁹⁵ *Solar Incentive Scheme*, <https://horizonpower.com.au/our-community/projevcts/solar-incentives-scheme/>, Accessed 13 May 2020

⁹⁶ *Transforming the way we power the Territory*, ARENA, <https://arena.gov.au/assets/2017/02/pwc-solar-setup-fact-sheet.pdf>

5. ACCELERATE RENEWABLE HYDROGEN

Accelerating Renewable Hydrogen will increase Australian fuel security, increase energy reliability, and position Australia at the forefront of an expanding global hydrogen market, capitalising on our world-leading renewable resources.

At-a-glance

- \$225 million in Commonwealth investment over two years to unlock short-term renewable hydrogen jobs and opportunities;
- This will leverage \$765 million in private sector investment over two years;
- At least 1200 jobs created;
- Accelerating Renewable Hydrogen would be delivered by the Australian Renewable Energy Agency (ARENA).

5.1. The case for renewable hydrogen

As the world moves to a low-carbon future, countries with the best renewable resources have a comparative advantage. Renewable hydrogen is a critical energy pathway for unlocking this comparative advantage.

A recent report by Bloomberg New Energy Finance[i] (BNEF) found that if the world is to keep warming to below 1.5 degrees, renewable hydrogen will be needed to meet between 7% and 24% of global energy needs by 2050. This percentage could be higher if all the unlikely to electrify sectors in the economy substitute fossil fuels with renewable hydrogen.

Under the Bloomberg New Energy Finance strong policy scenario an additional 11TWs of wind and solar capacity will also be required just for hydrogen production over the next 30 years. To put this in perspective this is more electricity than is currently generated globally from all sources for all applications. If we unlock this opportunity BNEF projects US\$11 trillion in hydrogen production, storage and transport infrastructure investment will be required.

Australia can be at the forefront of this renewable hydrogen market and strong progress is already being made through:

- The National Hydrogen Strategy;
- ARENA's \$70 million hydrogen round;
- A commitment of \$300 million for hydrogen finance by the CEFC;
- Renewable hydrogen strategies and programs by all state and territory governments;
- A range of feasibility, research, and demonstration projects around the country.

However, more needs to be done to unlock new demand sectors for renewable hydrogen and ensure Australia can establish job-rich supply chains for this emerging global industry. Due to the work already delivered by ARENA and the CEFC there are several advance development projects in Australia. These can be converted into near term investment opportunities. Specifically, Australia must unlock short-term demand for renewable hydrogen, helping to accelerate it down the cost curve.

We must also position ourselves as global leaders in the most promising long-term market applications for renewable hydrogen, namely those traditionally 'hard-to-decarbonise' sectors such as steel production and shipping.

5.2. Program Aims

The Accelerating Renewable Hydrogen program aims are to:

- Unlock demand for renewable hydrogen
- Accelerate renewable hydrogen down the cost curve (below \$2/kg)
- Position Australia as a global leader in sectors such as green steel, hydrogen exports and low-carbon shipping
- Ensure Australian businesses are well positioned to benefit from a global renewable hydrogen industry
- Upskill Australia's renewable hydrogen workforce.

5.3. Program investment and job creation

WWF-A propose that the Commonwealth invest the following amounts:

- \$25 million for a renewable hydrogen mining trucks program over the next two years and
- \$200 million over the next two years to take proposed projects and hydrogen hubs from feasibility to implementation

Based on a market sounding WWF estimates that at least 1200 jobs will be created in the construction of hydrogen production facilities and installation of electrolyzers, the construction of associated renewable generation and the retooling of existing industries such as mining trucks to use renewable hydrogen. Where new industry is attracted to a renewable hydrogen hub created through this program, more jobs will be unlocked.

5.4. Unlocking hydrogen demand in the short-term

5.4.1. What does the package do?

Renewable hydrogen for trucking

The National Hydrogen Strategy acknowledges that renewable hydrogen production is still expensive and as such most Government initiatives in Australia are helping to reduce the cost of renewable hydrogen to below \$2/kg.

However, energy insiders suggest that renewable hydrogen production is nearly cost-competitive with expensive diesel for trucks in remote mines in Australia where the wind and solar resources are excellent.

The Renewable Hydrogen for Trucking program would provide \$25 million in matched grants through ARENA for mining and trucking companies for renewable hydrogen powered mining truck and on-road truck demonstration projects. This will create jobs in the construction of

the hydrogen production facilities, renewable generation and the retooling or assembly of hydrogen trucks in Australia.

This project in turn would help kick-start a renewable hydrogen trucking industry in Australia and decrease our reliance on diesel fuel imports which currently pose a threat to fuel security.

Establishing renewable hydrogen hubs

The National Hydrogen Strategy identifies the establishment of hydrogen hubs as critical to the success of an Australian renewable hydrogen industry. These hubs would co-locate hydrogen businesses, supply chains and end users into a geographic location to better achieve economies of scale.

There is significant activity around renewable hydrogen and hydrogen hubs, including:

- A COAG Energy Council Hydrogen Hub Study,
- Hydrogen industry development work through NERA,
- A number of ARENA co-funded renewable hydrogen feasibility studies by some of Australia's largest existing hydrogen users and
- Federal and state-based funding programs.

However, none of these has yet targeted the establishment of physical renewable hydrogen hubs, nor prioritised skill development in the potential location for these hubs that would help ensure local businesses and local people are able to secure jobs in this emerging industry.

We propose the establishment of a \$200 million Renewable Hydrogen Hub seed fund over two years. This would be used to take renewable hydrogen projects from feasibility to implementation and in the process use these projects as anchor projects for a Renewable Hydrogen Hub.

Funding would also be provided for targeted training and skills development in the likely locations of the Hubs.

This Renewable Hydrogen Hub fund should work to leverage maximum impact by funding synergistically with state government hydrogen programs.

5.4.2. How will the package be delivered?

The Accelerate Renewable Hydrogen package will be delivered by providing additional funding to ARENA.

It is recommended that the renewable hydrogen funding proposed in this stimulus measure, be additional to a broader budget recommitment that would see the life of ARENA extended to 2030 or beyond.

5.4.3. Industry participation requirements

Industry participants will need to comply with ARENA's usual funding guidelines and processes.

This will include providing matching funding. To date, ARENA has leveraged \$3.4 per \$1 of matched investment. Based on these figures the additional \$115 million proposed in this program will leverage \$765 million in private sector investment over two years.

5.5. CASE STUDIES

5.5.1. Renewable hydrogen projects in Australia

According to analysis by the Smart Energy Council there are 26 renewable hydrogen projects in Australia. At least one of these is operating, many others are in active development, with the remainder undergoing feasibility assessment.

These projects vary from renewable hydrogen production for fertilizer production by industry heavyweights such as Yarra (WA) and Incetiv Pivot (Qld) to renewable hydrogen injection into the gas grid in NSW and South Australia. The majority of these projects have received support from ARENA and more details can be found at <https://arena.gov.au/renewable-energy/hydrogen/>.

Currently, South Australia, Queensland, Tasmania, the ACT and WA have all opened or undertaken renewable hydrogen funding programs. We understand similar programs are in development in NSW and Victoria.

5.5.2. Trucking

Around the world leading trucking and mining companies are starting to develop and test zero carbon trucking solutions. For example, Anglo American are developing a hybrid mining dump truck powered by both electricity and hydrogen fuel, which will be tested at their mining operations in South Africa towards the end of 2020.^[i] Meanwhile [Bosch](#), [Kenworth/Toyota](#) and a Canadian consortium [AZETEC](#) (Alberta Zero-Emissions Truck Electrification Collaboration) are all working on long range fuel cell electric trucks to be powered with hydrogen.

Just recently, Singapore-based hydrogen trucking company Hyzon Motors announced it was opening an office in Australia. Hyzon is "also considering the options for locating its first fuel cell commercial vehicle integration facility in Australia."^[iii]

[i] <https://data.bloomberglp.com/professional/sites/24/BNEF-Hydrogen-Economy-Outlook-Key-Messages-30-Mar-2020.pdf>

[ii] <https://www.popularmechanics.com/technology/infrastructure/a30873539/electric-mining-truck/>

[iii] <https://www.h2-view.com/story/hyzon-motors-australia-launched/>

A RENEWABLE FUTURE

CLIMATE CHANGE

As the world moves to act on climate change and fulfil the promise of the Paris Climate Agreement, places that have the best renewable resources in the world have a significant opportunity.

CLEAN ENERGY

Renewable energy such as solar and wind is critical to decarbonising more than two thirds of global emissions, in the electricity, transport, building and industrial sectors.



POPULAR CHOICE

With over 2.1million rooftop solar systems, you just have to walk down the street to see how Australians have embraced renewable energy.

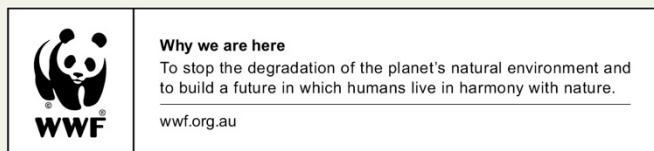
A JUST TRANSITION

WWF-Australia supports a climate action plan that ensures nobody is left behind.

RENEWABLE LEADER

Our goal is for Australia to be a leading exporter and investor in renewable energy with a zero-carbon economy achieved well before 2050.

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Hydrogen Position Paper – WWF Australia

May 2020

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1. Introduction

In 2019 WWF Australia launched its Renewable Powerhouse Campaign seeking to make Australia the world's leading renewable exporter by 2030. The generation of cost competitive renewable hydrogen is critical to several of Australia's renewable export pathways including:

- The direct export of renewable hydrogen,
- The creation and export of derivative chemical products such as ammonia, and
- The manufacture and export of green steel and green cement.

As with all potential renewable exports, it is essential that Australia also benefit domestically and by growing domestic applications of renewable hydrogen to develop expertise in 'learning by doing' so we can in turn create cost competitive export capabilities.

In November 2019, the Council of Australian Governments (COAG) Energy Council endorsed a National Hydrogen Strategy. However, there is a lot of hype about hydrogen, some of it is warranted, some of it is not.

This document sets out WWF Australia's position on hydrogen, the opportunities, issues and required interventions in advocating for this critical industry. This will be the first in a series of papers outlining WWF's positions on the multiple renewable export opportunities arising from a planned renewable exports program.

2. WWF Australia's position

WWF-Australia believes renewable hydrogen is essential to the full decarbonisation of the global economy and ought to be supported subject to:

1. **Being renewable only.** Renewable hydrogen is the only hydrogen production method that is zero carbon. Hydrogen from coal and gas contribute to dangerous climate change and are a distraction from establishing new renewable hydrogen-based industries essential to the full decarbonisation of the global economy.
2. **Being traceable.** If we are to ensure that only renewable hydrogen is supported, it is essential that guarantee of origin schemes be put in place.
3. **Stringent public, worker and environmental safety practices being adopted.** Hydrogen is highly combustible and in many cases its derivatives are toxic; as such, it is essential that safety measures be instituted through the supply chain.
4. **Being developed in accordance with sustainability principles.** Renewable hydrogen and the associated infrastructure, like all forms of energy production, are not free from environmental or social impacts. Efforts must be taken to reduce negative environmental and social externalities and maximising the biodiversity and social co-benefits associated with hydrogen project and industry development.
5. **Being pursued as a complementary strategy to electrification.** For many applications and sectors directly powering them with renewable electricity is the easier, more efficient, and cost-effective pathway to decarbonisation than renewable hydrogen. However, Australia currently lags much of the OECD in pursuing electrification. It is essential that the pursuit of hydrogen is not used as a delay tactic or comes at the expense of electrification opportunities.
6. **The industry being structured so as to lower energy costs to Australian consumers.** In the past the pursuit of fossil fuel energy export industries has happened at the expense of Australian consumers; WWF wants to ensure that the development of a renewable hydrogen industry benefits Australians.

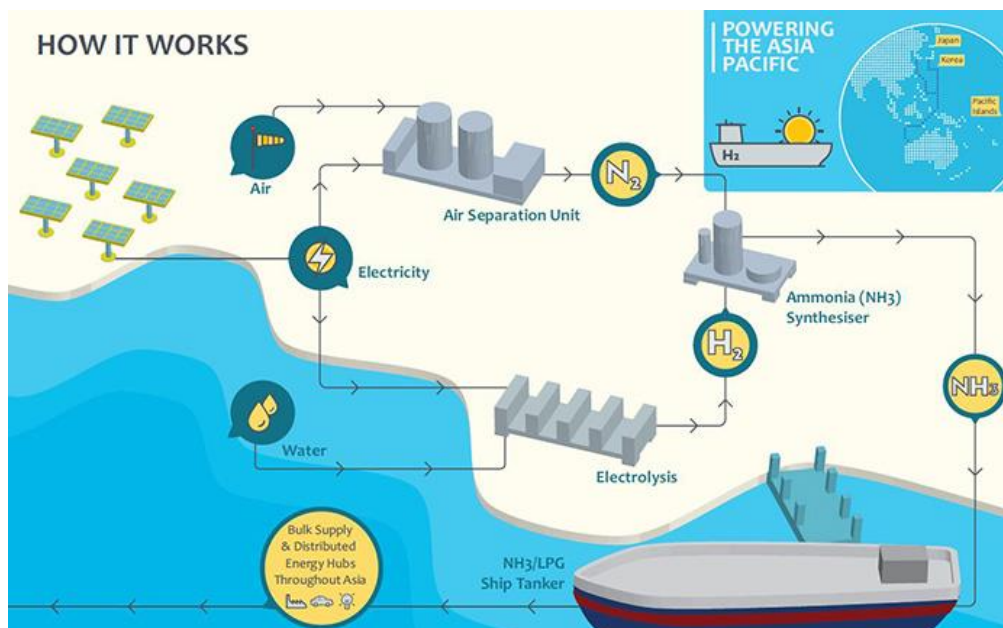


3. What is hydrogen?

Hydrogen is the smallest molecule in the universe and is the most common chemical element. While not naturally occurring on its own on Earth, it can be produced as a gas. When hydrogen gas is burnt, it burns cleanly, producing only water vapour and no greenhouse gas emissions.

Renewable hydrogen is produced when renewable electricity powers an electrolyser which splits water molecules into its constituent parts – hydrogen and oxygen. The renewable hydrogen is then captured and used for a range of applications.

Figure 1: How is renewable hydrogen made? (Source: Renewable Hydrogen 2017)



Hydrogen can be produced using a number of other chemical processes, including steam reforming of methane and gasification of coal; both of these processes produce greenhouse gas emissions.

Hydrogen can be thought of like electricity - it doesn't occur naturally on Earth, it has to be created and just like electricity it can be made in ways that are highly polluting or it can be made in ways that are zero carbon. As such, like electricity, hydrogen is not inherently polluting or clean – it depends primarily on how it is made.

4. The current global hydrogen industry

While hydrogen is being touted as a new opportunity, the reality is that the hydrogen industry is already a large and important global industry and, unfortunately, a highly carbon polluting industry.

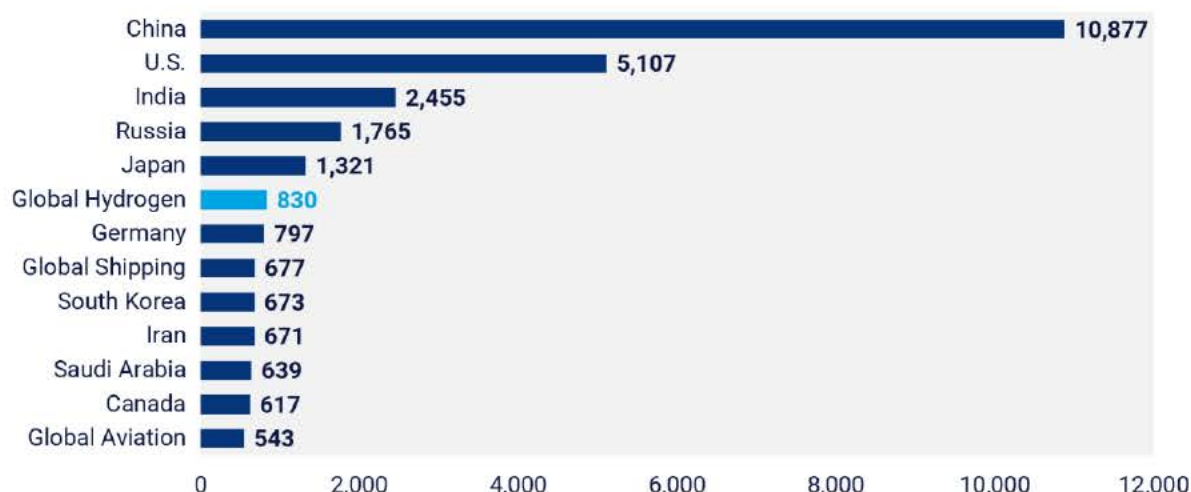
Currently, 99% of global hydrogen is produced from fossil gas and coal and accounts for approximately one percent of global greenhouse gas emissionsⁱ— see Hydrogen is currently used as a fundamental building block in the chemical industry for the manufacture of ammonia and methanol. Ammonia is one of the world's most globally traded commodities and is used to make fertilizers that are essential to global agriculture and food production.



Figure 2.

Hydrogen is currently used as a fundamental building block in the chemical industry for the manufacture of ammonia and methanol. Ammonia is one of the world's most globally traded commodities and is used to make fertilizers that are essential to global agriculture and food production.

Figure 2: 2017 CO₂ emission by country and sector (Mt CO₂/year) (Source: Wood Mackenzie, 2019)



Refineries, where hydrogen is used for the processing of intermediate oil products, are another area of use.ⁱⁱ Table 1 outlines what current hydrogen production globally and in Australia is used for. The International Energy Agency (IEA) estimates current global hydrogen production is 70million tonnes per annum.ⁱⁱⁱ

Table 1: Global and Australian uses of hydrogen (Source: Hydrogen Europe, 2019 and ANT Energy Solutions, 2020)

Hydrogen Use	Global Percentage	Australian Percentage
Ammonia Synthesis	55%	65%
Refineries	25%	33%
Methanol Production	10%	0%
Other	10%	~1%

According to chemical company Incitec Pivot,^{iv} Australia produces 550,000 to 600,000 tonnes of hydrogen per annum, more than 98% of which is used in the chemical industry for oil refining and to produce explosives and fertilizers. All of Australia's current hydrogen production is made via steam reforming of methane which is an emissions-intensive process.

5. The role of hydrogen in global climate action

Currently, the world is at 1 degree of warming and impacts from bushfires, to droughts, to floods are devastating to both human life and the precious ecosystems on which life depends.



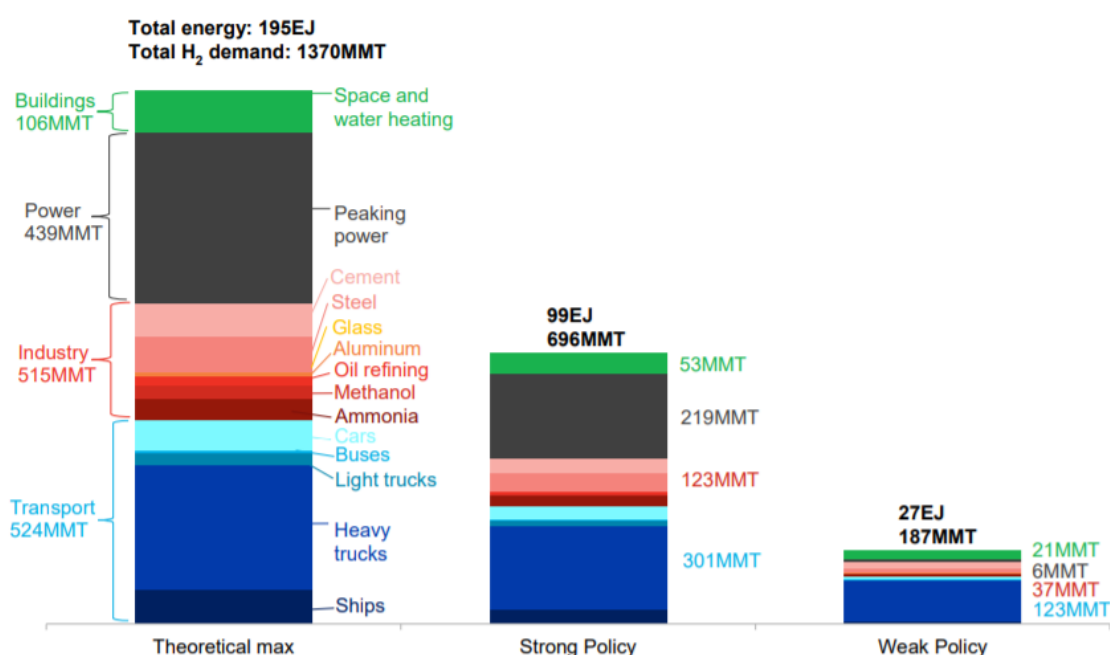
The climate science says that the world must achieve net zero emissions of greenhouse gases before 2050 if the world hopes to stay below 2 degrees of global heating and must decarbonise even more rapidly to stay below 1.5 degrees.

In order to achieve net zero emissions there must be zero emissions options and technologies for all sectors of the economy. Historically, however, there are several economic sectors that are both emissions-intensive and have been considered “hard to decarbonise.” These sectors include the manufacture of steel, aluminium and cement, the chemical industry, shipping, and other heavy transport.

These sectors are considered hard to decarbonise because they cannot easily be directly powered, or their emissions removed using renewable electricity by electrification or fuel-switching.

Recent research has found that the creation of a global renewable hydrogen industry presents the biggest opportunity to decarbonise all of these “hard to decarbonise” sectors. Indeed, research and development is currently underway to create hydrogen alternatives to fossil fuels in all these sectors.

Figure 3: Potential demand for hydrogen in different scenarios, 2050 (Source: BNEF, 2020)



Source: BloombergNEF. Note: Aluminum demand is for alumina production and aluminum recycling only. Cement demand is for process heat only. Oil refining demand is for hydrogen use only. Road transport and heating demand that is unlikely to be met by electrification only: assumed to be 50% of space and water heating, 25% of light-duty vehicles, 50% of medium-duty trucks, 30% of buses and 75% of heavy-duty trucks.

Renewable hydrogen may also play a role in providing seasonal storage and peaking power to the electricity sector and some role in other transport and heating applications where direct electrification is not possible. See Appendix A for a full list of critical hydrogen applications for global decarbonisation.

A recent report by Bloomberg New Energy Finance^v found that if the world is to keep warming to below 1.5 degrees, renewable hydrogen will be needed to meet between 7% (under the weak policy

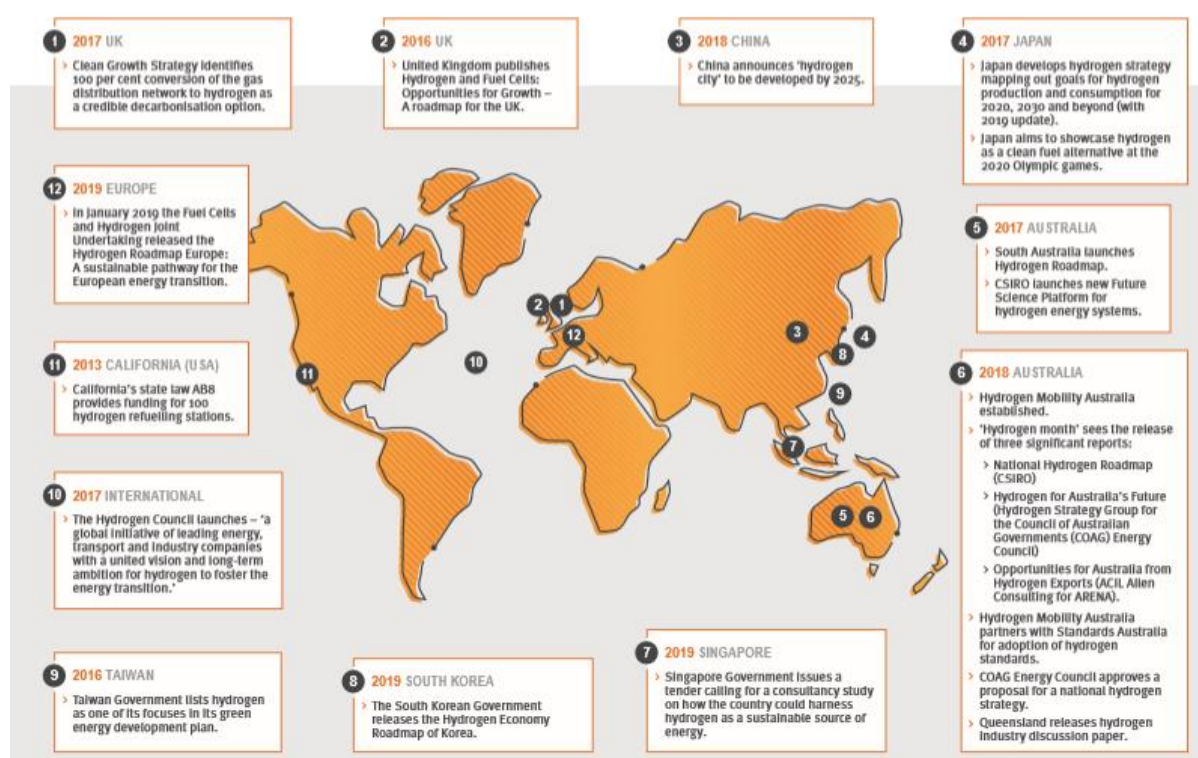


scenario in Figure 3) and 24% of global energy needs by 2050 (under the strong policy scenario in Figure 3). This percentage could be higher if all the 'unlikely to electrify' sectors in the economy substitute fossil fuels with renewable hydrogen (theoretical maximum scenario in Figure 3).

Under the strong policy scenario (middle column in Figure 3), an additional 11TWs of wind and solar capacity will also be required just for hydrogen production over the next 30 years, to generate 31,320TWh. To put this in perspective, this is more electricity than is currently generated globally from all sources for all applications. If we are to unlock this opportunity, BNEF projects US\$11 trillion in hydrogen production, storage and transport infrastructure investment will be required.

Australia is not the only country to have understood both the need and opportunity for renewable hydrogen as Figure 4 shows.

Figure 4: Global Hydrogen Agenda 2017-January 2019 (Source: Queensland Government, 2019)^{1 vi}



6. Opportunities for Australia

6.1. Why Australia?

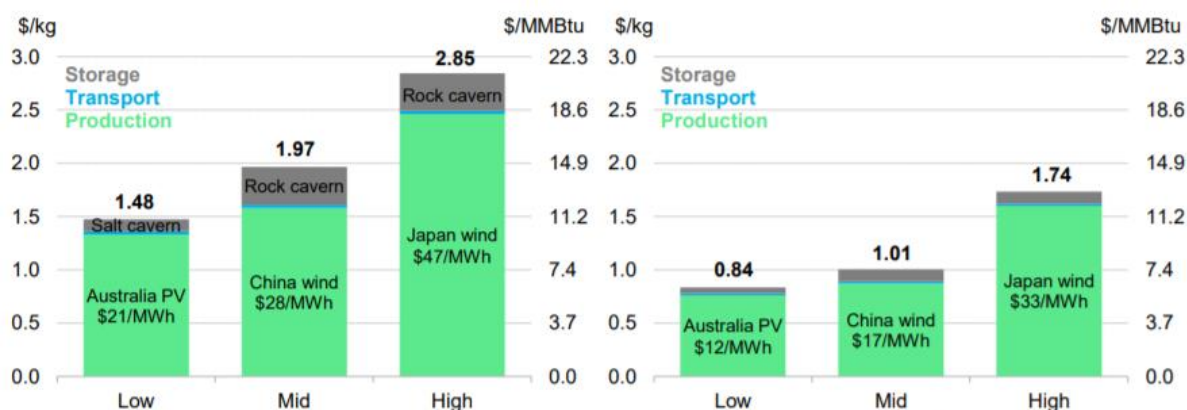
Few places in the world are as well endowed with the resources needed to position themselves as a global leader in renewable hydrogen as Australia. Australia has a large land area and some of the best solar and wind resources in the world, and world's fourth largest capital market more than capable of cost-effectively funding this infrastructure development at the scale required. Through water recycling and desalination of sea water we have abundant water resources.

¹ This image highlights some recent hydrogen policies or policy positions both in Australia and globally, it is not an exhaustive list.



We have expertise, trust, a stable democracy and strong existing trade relationships. This means that Australia has the potential to produce some of the cheapest renewable hydrogen in the world (see Figure 5).

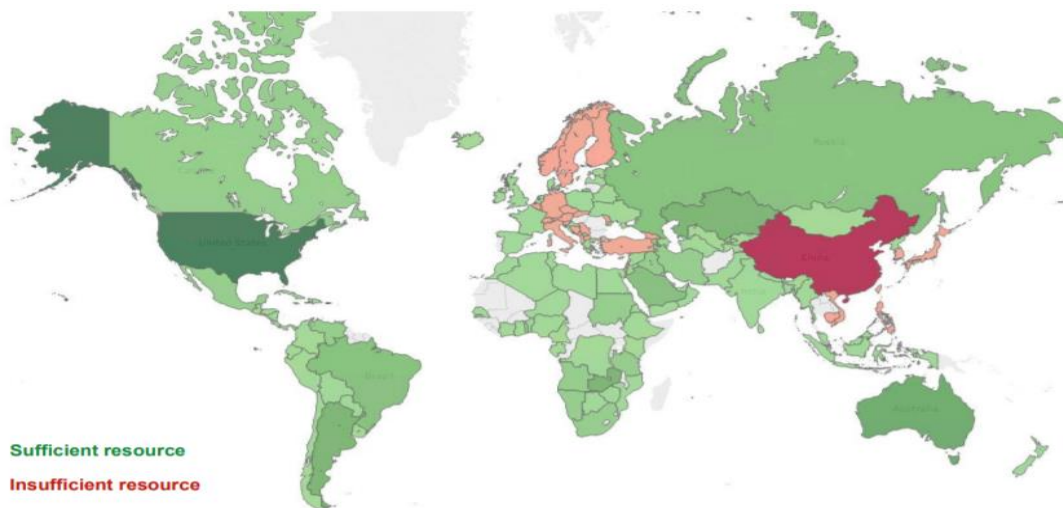
Figure 5: Estimated delivered renewable hydrogen costs to large-scale industrial users in 2030 (left) & 2050 (right) (Source: BNEF, 2020)



Source: BloombergNEF. Note: Power costs depicted are the LCOE used for electrolysis, and are lower than the BNEF's standard LCOE projections in 2050 due to savings from integrated design of the electrolyzer and generator, and anticipated additional learning from increased renewable deployment for hydrogen production. Production costs are based on a large-scale alkaline electrolyzer with capex of \$135/kW in 2030 and \$98/kW in 2050. Storage costs assume 50% of total hydrogen demand passes through storage. Transport costs are for a 50km transmission pipeline movement. Compression and conversion costs are included in storage. Low estimate assumes a salt cavern, mid and high estimate a rock cavern for both 2030 and 2050.

Meanwhile, some of our biggest trading partners such as Japan, South Korea, Singapore and even countries in Europe face significant challenges decarbonizing their energy sectors (see Figure 6). They have higher populations, less land, and a lot less sunshine. BNEF concludes that a number of places around the world will not have enough wind and/or solar resources to produce sufficient renewable electricity for direct domestic use in the power, transport and industry sectors, while also having enough renewable capacity to produce hydrogen for the remaining applications.

Figure 6: Indicative estimate of the ability for major countries to generate 50% of electricity and 100% of hydrogen from wind and solar PV in a 1.5 degree scenario (Source: BNEF, 2020)^{vii}



Source: BloombergNEF, Baruch-Mordo et. al, 2019. Note: **Green** = Country has sufficient estimated solar and wind resources and **Red** = Country has insufficient resources to generate 50% of electricity and 100% of hydrogen by 2050. The methodology used to estimate potential renewable generation is conservative, and may underrepresent achievable generation in specific locations. In some countries the estimate for potential generation is below current levels. These countries are not given a sufficiency rating.

As such, Australia has the opportunity to capture a significant share of what BNEF projects could become a \$700 billion per year global industry, sufficient to offset the inevitable technology driven progressive decline in our LNG (A\$49 billion in 2019/20) and thermal coal exports (A\$21 billion^{viii}).

By aggressively developing a renewable hydrogen industry, we can help our neighbours and key trading partners decarbonise, while underpinning the economic competitiveness of Australia's manufacturing, resources, and agricultural sectors in a low-carbon world. We can also use Australia's abundant renewable resources and cost-competitive renewable hydrogen to attracting new industries to the Australian economy.

6.2. Early market opportunities

While there are many possible markets for renewable hydrogen, WWF-Australia believes the following three represent the greatest short-term opportunities or "use-cases" for Australia to grow domestic demand for renewable hydrogen at scale, and in the process create a cost-competitive renewable hydrogen sector, positioning ourselves as a global leader in this emerging green industry.

Decarbonising the fertilizer industry

The global fertilizer industry is currently the largest end-user of hydrogen. Hydrogen is used to create ammonia – a nitrogen-rich chemical, which in turn is used to make nitrogen-based fertilizers.

Unlike some potential applications for renewable hydrogen, where the technology is not yet commercial, because the fertilizer industry already relies on hydrogen production at scale, it is a relatively simple process to progressively replace fossil-fuel based hydrogen with renewable hydrogen to create ammonia.

Around the world and across Australia we are seeing many feasibility studies and renewable ammonia pilot projects for the fertilizer industry, including in [Queensland](#) and [Western Australia](#).

While one of Australia's seven ammonia facilities supplies approximately 5% of the global market, Australia is actually a net importer of ammonia. As such, by investing in renewable ammonia



production and the creation of a renewable fertilizer industry, Australia could go from net importer to net exporter of ammonia and fertilizer and help decarbonise this global industry in the process.

ANT Energy Solutions (2020) agrees, identifying the replacement of current hydrogen production particularly for ammonia with renewable hydrogen as the greatest hydrogen market opportunity in Australia by scale between 2020-2025. Ammonia is far more stable and compact than hydrogen, making export transportation significantly more cost-competitive today.

Heavy Vehicle Transport

Conversations with investors investigating hydrogen opportunities in Australia suggests that renewable hydrogen production in places with excellent wind and solar resources is likely to be cost-competitive or nearly cost-competitive with expensive imported diesel for trucks at remote mine sites. Indeed, Aurecon Australasia^{ix} recommends focusing on back-to-base transport fleets and transitioning bulk handling in the mining and heavy industry sectors for early investment in hydrogen for transport.

Already, Anglo American are developing a hybrid mining dump truck powered by both electricity and hydrogen fuel, which will be tested at their mining operations in South Africa towards the end of 2020.^x Meanwhile [Bosch](#), [Kenworth/Toyota](#) and a Canadian consortium [AZETEC](#) (Alberta Zero-Emissions Truck Electrification Collaboration) are all working on long-range fuel cell electric trucks to be powered with hydrogen.

Given that Australian fuel consumption, including diesel, is highly reliant on imports^{xi}, and the fact that Australia has high quality renewable resources and many remote mines and communities, there is an opportunity to increase energy security by growing a commercial renewable hydrogen trucking industry in Australia, starting with mining trucks. In the longer-term, hydrogen fuel cells for long haul trucks represent a significant market opportunity.

It should be noted that WWF does not see the same opportunity for hydrogen fuel cell passenger and light vehicles in Australia, as the evidence suggests that electric vehicles are a more efficient and cost-effective zero-carbon solution being deployed at a rapidly increasing scale today (see Appendix A).

Gas injection

Injecting renewable hydrogen directly into the gas grid is another area where we are seeing a significant number of pilot projects globally and in Australia, including in [South Australia](#) and [NSW](#). Injecting renewable hydrogen into the gas grid has the potential to create both early demand at scale for renewable hydrogen, and also build broad industry experience in creating and using hydrogen.

However, there are limits to this application. Depending on the age of the gas infrastructure and the materials it is made of, the limits to injecting hydrogen into the existing gas infrastructure range from 5-20%, with most industry experts suggesting 10% is the average limit. Beyond these limits, both the gas grid and end-use equipment (stoves in households to gas boilers) will require significant upgrades and often wholesale replacement.

It is likely, that in many domestic and industry applications, directly converting to renewable electricity (electrify/fuel switch) rather than upgrade to renewable hydrogen will be a more cost-effective way to decarbonise. Indeed, analysis by Renew found that it was much more cost-effective for new homes to go all-electric with solar, rather than connecting to the gas grid. Indeed, the



savings are above \$10,000 per household over ten years.^{xii} Meanwhile, Beyond Zero Emissions has identified electrification options for almost all industrial uses of gas, particularly many low and medium temperature industry processes.^{xiii}

There are concerns that a renewable hydrogen gas injection strategy will be used to extend the life of the gas industry and justify opening new gas reserves. As such, WWF only supports renewable hydrogen gas injection if jurisdictions are also pursuing renewable electrification strategies for households, commercial buildings, and industry.

6.3. Longer-term opportunities

Some of the largest renewable hydrogen opportunities are in sectors where hydrogen applications are still in the research, development, and early deployment stages. However, if Australia wants to ensure it captures these likely future hydrogen markets, it is essential that it is involved in the early stages of the industries development, given the global technology race that is already well underway. Of the many potential applications for renewable hydrogen WWF-Australia has currently identified the following three as the most promising use-cases for an Australian domestic and export hydrogen industry.

Green building materials

Steel, aluminium and cement are critical materials for the construction of most buildings and infrastructure globally. Manufacturing of steel and cement represents about 14% of global emissions. In Australia, we are globally significant exporters of iron ore (37% of global production) and bauxite (28% of global production) - the raw materials used to manufacture steel and aluminium.^{xiv} We also produce steel, cement, and aluminium domestically.

The use of renewable hydrogen as both a heat source and reductant has been identified as the most promising decarbonisation pathway for these difficult-to-decarbonise industries. These three sectors represent significant economic opportunities for Australia. For example, the Energy Transition Hub found that by converting just 18% of the iron ore that Australia exports annually into green steel, using renewable hydrogen, would almost double Australia's current iron ore and steel export revenue.^{xv} Further, the Grattan Institute has found that value-adding our domestic resource industries and creating a new green steel industry in Central Queensland and the Hunter Valley could replace the coal mining jobs in these regions.^{xvi}

Internationally, we are seeing renewable hydrogen pilot projects, particularly in the steel industry in Europe, but Australia is yet to follow suit, though the Liberty Steel Group project in Whyalla could be the first example.^{xvii} If Australia wants to capture a significant global share of the renewable hydrogen industry for green building materials, it is important that Australia invests in research and development to modernise our steel, cement, and aluminium industries. It is also important to grow local demand for zero carbon building materials domestically.

Decarbonising shipping

Green ammonia presents one of the most promising pathways to decarbonise the deep-ocean shipping industry. If Australia pursues the development of a green ammonia industry, we will be well placed to help supply the global shipping industry. However, to position Australia as a green ammonia supply country of choice, it will be important to play a role in shipping demonstration projects fuelled by green ammonia. It will also be important to develop strategic bilateral collaborations with countries like Singapore, which are currently global shipping and oil bunkering hubs, and work with the International Maritime Organization.



Exporting to other countries

While producing goods and commodities with renewable hydrogen onshore is likely to be a greater medium-term opportunity for Australia, several of our key trading partners have flagged the intention to import renewable hydrogen or ammonia from Australia.

However, BNEF warns that shipping hydrogen is the least efficient or cost-effective approach to renewable hydrogen distribution (well behind direct use locally and pipes). Nevertheless, they agree that due to renewable resource availability in import countries as well as geopolitical considerations, some renewable hydrogen is likely to be shipped globally. As such, continuing to build strategic bi-lateral and multi-lateral agreements and partnerships with likely renewable hydrogen import nations such as Japan, Singapore and South Korea will be critical, particularly as they are already key energy trade partners for Australia.

6.4. Where will the Australian hydrogen industry be located?

Australia's existing hydrogen industry is located in coastal, urban industrial centres such as Gladstone, Newcastle and Kwinana in Perth. Early indications suggest that these locations and other similar industrial centres such as Bell Bay in Tasmania and Whyalla in South Australia are likely to be the main locations for renewable hydrogen production in Australia. However, given that Australia's best renewable resources are inland, this will require additional investment in transmission infrastructure.

One opportunity would be to use renewable hydrogen pilot projects and hubs to help foster broader renewable industry precincts, which could jointly benefit from the infrastructure required to service multiple low-carbon industries, including:

- Transmission lines to transport renewable electricity for direct industrial use and hydrogen production,
- Hydrogen pipelines,
- Water infrastructure for hydrogen production (see Section 7.2),
- A port where both hydrogen and other green commodities can be exported, and
- A skilled workforce.

6.5. Additional benefits – lower cost electricity

As Australia moves to ever higher penetrations of renewable energy, particularly solar and wind, there will be an increase in periods when electricity supply could exceed demand. This phenomenon is called the “duck-curve.” One solution to the duck-curve is “flexible demand” – these are electricity-using processes that can turn on when electricity prices are low and there is excess generation, and turn off when prices are high. If incentivised correctly, for example through targeted tariffs, electrolyzers creating renewable hydrogen could be an excellent use for this excess electricity generation. According to Wood Mackenzie, electrolyzers “used for green hydrogen production can operate dynamically, requiring only seconds to be able to operate at maximum capacity. As such, they can be easily paired with renewable assets that are frequently curtailed for either a long or short duration.”^{xviii}

Incentivising electrolyzers to act flexibly on-demand would in turn enable “overbuilding” of renewables and the long overdue grid modernisation investments now required. Analysis by ClimateWorks suggests that taking an over-building renewable energy to 200% capacity – double



what the country currently needs – “could be more cost-effective than building to 100%, and would spark new clean export opportunities”,^{xix} such as hydrogen.

In addition, this increased demand for electricity could help cover more of the fixed costs of transmission and other electricity system upgrades, lowering network and system costs for all electricity users.^{xx}

This co-benefit is an example of ‘sector coupling’ whereby building shared infrastructure and allowing optimization not just within sectors, but across sectors, lowers the cost of decarbonization for all sectors. That is, the hydrogen production that, for example, is needed by the steel sector helps lower the cost of renewable energy integration for the power sector.

However, if incentivised inefficiently, electrolyser use could drive up electricity demand at peak times, exacerbating the duck-curve and driving up electricity prices for consumers. This would be tantamount to prioritising export hydrogen customers over domestic energy customers, which is what has occurred in the LNG industry on the east coast and should be avoided at all costs.

7. Issues to be addressed

Renewable energy and other zero-emissions technology solutions including renewable hydrogen are clearly solutions to climate change, helping countries and industries move away from carbon polluting alternatives. However, that does not mean these technologies and associated infrastructure come without other environmental and social impacts. It is essential that as we transition to clean energy, new clean industries including hydrogen are developed sustainably, with all efforts taken to reduce or eliminate negative environmental, social, health and safety impacts and externalities. Indeed, opportunities for co-benefits and net-positive sustainability outcomes should be actively pursued.

In relation to hydrogen, there are three major issues that WWF-Australia believe must urgently be addressed that are outlined in more detail below.

7.1. Fossil fuel hydrogen

Currently, the fossil fuel industry is promoting hydrogen from fossil gas and coal, both with and without carbon capture and storage (CCS) technology. Their argument is that it is important to establish a fossil hydrogen industry now, on the basis that a renewable hydrogen industry will develop later.

As the Australia Institute argues “this approach is likely to lock in high carbon infrastructure and undermine the green hydrogen opportunity. For example, hydrogen made from fossil fuel methods and electrolysis use different processes and require different infrastructure. Furthermore, fossil fuel-based hydrogen requires proximity to fossil fuel sources and carbon storage sites where renewable hydrogen requires proximity to water and renewable energy sources”.^{xxi}

From a carbon pollution perspective, as Table 2 outlines, the only form of zero-emissions hydrogen production is renewable hydrogen, through the electrolysis of water using renewable electricity. The alternative proposed is to apply CCS measures to gas and coal-based hydrogen. Internationally,



there is only one project – Quest that does this at scale. However, the application of CCS currently only reduces the project's emissions by 24%.

Despite the first CCS project starting operation in 1972, globally there are just 19 large-scale operating CCS projects across all applications – coal power, oil and gas extraction and industrial emissions.^{xxii} The majority of these projects use the captured CO₂ for enhanced oil recovery, which further contributes to climate change through the combustion of oil products and in some cases freeing up natural gas to be burnt as well.

In Australia, the Gorgon LNG project is the only operational large-scale CCS project. The project, which received a \$60million grant from the Federal Government, and ran three years behind schedule,^{xxiii} at best hopes to capture 40% of the carbon dioxide released when the natural gas is extracted and processed into LNG (Scope 1).^{xxiv} This means that to become a low-carbon project the application of CCS technology is also required at the end-use stage, whether that be the combustion of natural gas or steam reforming it to create hydrogen. Indeed, analysis suggests that the Gorgon CCS project will only have a CO₂ capture rate of 3.3% when Scope 3 emissions are considered.^{xxv} To date the Australian Commonwealth Government has invested \$1.3 billion in government funds in CCS technology, with very little to show for it.^{xxvi}

Even, if coal and gas hydrogen were to achieve the maximum theoretical CO₂ capture rates of 85-95%^{xxvii} which are significantly higher than any currently operating project globally, they will not be zero emissions projects.

Table 2: Emissions and % Reduction in Emissions of Different Hydrogen Production Technology in Australia (Source: [COAG, 2019^{xxviii}](#))

Production technology	Emissions (kg CO ₂ -e/kg hydrogen)	% reduction in emissions (relative to SMR without CCS)
Electrolysis – NEM average electricity	54.6	-542% (increase in emissions)
Coal gasification, no CCS	12.7 – 16.8	-49% — -98% (increase in emissions)
Quest project, Canada (SMR, partial CCS)	6.5	24%
Steam methane reforming (SMR), no CCS	8.5	--
CertifHy threshold for 'low-emissions'	4.4	48%[vi]
SMR + CCS – best case	0.76	91%
Coal gasification + CCS – best case	0.71	92%



Electrolysis – 100% renewable electricity	0	100%
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Bloomberg New Energy Finance project that by 2030 renewable hydrogen will be cheaper to produce than hydrogen from gas or coal with CCS, particularly in countries like Australia where there are abundant, low cost and high-quality renewable resources.^{xxxix} As such, there is a high risk that investments in new coal and gas to hydrogen infrastructure will become stranded assets.

The International Renewable Energy Agency (IRENA) also suggests that investment in fossil fuel hydrogen may divert limited capital away from renewable energy deployment back to fossil fuels. Given the significant increase in renewable energy deployment required to meet emission reduction targets, this would be a backwards step that would lock in emissions.^{xxx}

As such, supporting the expansion of hydrogen from coal and gas is synonymous with supporting the expansion of the fossil fuel industry, which is incompatible with a safe climate and the need to decarbonise our economy. If CCS is required for global decarbonisation, for example for industrial emissions capture, it should be limited to sectors where there are no renewable alternatives. This is not the case in the hydrogen sector.

7.2. Water

Water is a critical input for the hydrogen industry, with around nine litres of water needed to produce 1 kg of hydrogen through the electrolysis process.^{xxxi}

According to the National Hydrogen Strategy, producing “enough hydrogen to satisfy Japan’s projected annual imports in 2030 would require less than one per cent of the water now used by Australia’s mining industry each year”.^{xxxii}

Nevertheless, as a dry country regularly faced with drought, water is a significant consideration in the development of a renewable hydrogen industry in Australia. Indeed, the renewable hydrogen industry should look for ways that renewable hydrogen could reduce the energy industry’s use of water currently used for households and farming or even open new water sources.

A study by global consultancy Jacobs into water use in the hydrogen industry found that using recycled water for hydrogen production could be beneficial due to its availability throughout the year, eliminating drinking water supply issues and creating additional opportunities for water businesses.^{xxxiii}

Recycled water could come from wastewater facilities across Australia. Given that wastewater facilities are often located in close proximity to urban centres, hydrogen production facilities could be located near these wastewater facilities and reduce distribution costs. Furthermore, the use of recycled water would reduce the water quality impacts of discharging recycled water to waterways and oceans, resulting in an additional environmental benefit.^{xxxiv}

The potential for renewable hydrogen to help grow the recycled water in Australia showcases the circular economy opportunities associated with this emerging industry if it is done correctly from the beginning.



Desalination is another potential water source for the hydrogen industry. While this would reduce competition for existing potable water sources, there are potential negative ecological consequences associated with highly saline water and scaling chemicals being released into marine ecosystems. Best practice environmental management and looking for opportunities to use this saline by-product (circular economy and industrial ecology options) will be essential for the development of a sustainable renewable hydrogen industry, should desalination be required.

7.3. Safety

Hydrogen is highly flammable so storing, transporting, and using it safely is a significant concern, although its flammability is partly mitigated by its high buoyancy and diffusivity which causes it to disperse quickly.

Ammonia production using hydrogen as a feedstock also presents risks to humans as well as marine life if leakages occur, as it is a highly toxic chemical. It is also a potential source of nitrogen oxide emissions if combustion is not perfectly optimised.^{xxxv}

It is essential that the renewable hydrogen industry and its derivatives are developed safely for workers, consumers, the community at large and the environment. These standards and practices should be as stringent or more so than Australia's existing hydrogen and ammonia industry.

We support the efforts by Australian Governments to put safety, environmental sustainability, and benefits to Australians at the forefront, as identified in the National Hydrogen Strategy. Furthermore, we support the role of governments to coordinate reviews of legal frameworks, where practical, in the development of technical safety standards for the hydrogen industry.

8. Policy and market initiatives

To grow a renewable hydrogen industry of the scale required to help limit climate change to 1.5°C, government policy and support are essential. Wind, solar PV and battery technology, like hydrogen were all identified as essential to a safe climate and as such have enjoyed public policy support in countries around the world. This public policy support has been essential to driving wind, solar and battery technologies down the cost curve to the point where they are the cheapest new build electricity generation options in most jurisdictions globally.

Similar levels of policy support will be required to unlock the potential of renewable hydrogen and if Australia wants to capture a significant market share, governments and industry must play a more proactive role than they have in the past. If Australia is to thrive in a low-carbon world we cannot repeat the mistakes that occurred by not fully commercialising our world-leading solar PV technology.

Given the importance of government policy, it will be important that WWF and other organisations advocate for a range of policies and market shaping initiatives that ensure renewable hydrogen is developed efficiently, safely and at the speed required by the ongoing climate crisis.

The following section outlines key areas for action that will inform WWF-Australia's hydrogen advocacy.



8.1. Reducing the cost of renewable hydrogen

Currently, renewable hydrogen costs \$3.40-\$7.45/kg to produce^{xxxvi} which is more expensive than the \$1-2/kg it costs to produce hydrogen from coal and gas.^{xxxvii} The National Hydrogen Strategy, ARENA and BNEF all suggest that a target of \$2/kg for renewable hydrogen would put it within reach of commercial applications in many industries, particularly when combined with a carbon price. As such, it will be essential to work to halve the cost of renewable hydrogen within the next decade.

To bring down the cost of renewable hydrogen, there are three key outcome areas that should be targeted:

1. Lowering the cost of renewable electricity as the largest cost driver of renewable hydrogen.
2. Lowering the cost of electrolyzers through increasing production scale and through innovation in the electrolysis process (making it more efficient).
3. Creating the infrastructure, equipment, regulatory environment, and workforce able to implement renewable hydrogen projects safely and efficiently.

To achieve these outcomes, governments and industry will need to:

1. Invest in early-stage research, development and deployment (RD&D) in the local context for more efficient renewable hydrogen production processes and essential hydrogen equipment (such as containment, pipes, valves etc).
2. Continue to implement policies that drive demand for renewable electricity.
3. Fund pilot projects that prove applications and help establish supply chains and infrastructure.
4. Stimulate demand for renewable hydrogen by incentivising and mandating the use of renewable hydrogen in the most promising short-term applications (see Section 0 and Appendix A).
5. Put in place standards and regulations for renewable hydrogen that include traceability and certification options.
6. Invest in academic and workforce training programs, that both reskill the existing workforce and train the workers of the future.

8.2. Scaling hydrogen for the long-term

As most of these critical renewable hydrogen applications are not currently commercial, it will take time and enabling pilot investments to build these industries of the future (as has been a feature of ARENA's new \$70m investment program^{xxxviii}). To ensure this work is happening at the pace required to achieve the scale of decarbonisation required to reduce the risk of dangerous climate change, and put Australia in a position to capture significant market share, governments and industry should:

1. Legislate climate policy including net-zero emissions targets by 2050 at the latest. A global renewable hydrogen industry is only going to grow if countries and companies around the world are committed to acting on climate change. Without the climate imperative, there is little need to replace fossil fuels in steel, shipping, and other sectors with renewable hydrogen.
2. Develop sectoral decarbonisation plans for transport and industry that unlock complementary electrification and renewable hydrogen-based decarbonisation pathways. These plans should be accompanied by:



- a. Research, development, and commercialisation funding including for pilot projects which help develop supply chains.
 - b. Targets, mandates and investment policies that stimulate demand for decarbonised transport, products and commodities such as those outlined in Section 6.3 (also see Appendix A). This will likely include the need for a carbon pricing mechanism to ensure renewable hydrogen is used over the emissions intensive alternatives.
 - c. Standards and regulatory development.
3. Develop and implement a Renewable Exports Strategy to accompany the National Hydrogen Strategy, with a focus on unlocking renewable export options, including renewable hydrogen. This strategy and early-stage activity should focus on growing demand internationally for renewable hydrogen and renewable hydrogen-based products and commodities with key trading partners, key industries, and industry leaders.

8.3. Ensuring hydrogen is a climate solution – traceability

As the world moves to decarbonise the economy, it is important to have verification schemes in place to guarantee the origin, and trace the source of hydrogen and the associated environmental impacts (specifically greenhouse gas emissions, but other impacts such as water use should also be considered), providing chain-of-custody assurances. The National Hydrogen Strategy proposes to establish a guarantee of origin scheme. This scheme could be used to comply with regulatory measures designed to reduce emissions, demonstrate corporate commitment to climate change mitigation, or to go beyond compliance towards best practice emissions management. In addition, it may be that blockchain technology, which is already being used for traceability purposes across other global supply chains could be used in the hydrogen industry.

WWF advocates that the guarantee of origin verification stipulates the production technology and the lifecycle emissions (scope 1, 2, 3 emissions and disposal) to ensure that fugitive emissions from CCS are included.



Appendix A: Critical Hydrogen Applications in a Zero Carbon Economy

A.1 Potential applications of hydrogen

Hydrogen is versatile and has the potential to be used in many applications:

- Hydrogen can be used as fuel and replace petrol, diesel and LNG in transport either through direct combustion, creation and combustion of ammonia, or a hydrogen fuel cell.
- Hydrogen can be burnt creating heat, replacing the use of coal, oil and gas in manufacturing processes, domestic and commercial heating.
- Hydrogen can be combined with a range of catalysts to act as a reductant within chemical processes, such as the manufacture of steel.
- Hydrogen is an existing chemical feedstock and as such, renewable hydrogen can replace hydrogen made from coal and gas in this industry.

To date, hydrogen has not been widely used beyond the applications outlined in Table 1 in this report, as it is not as energy-dense, nor as easily manufactured, transported or stored as fossil fuel alternatives. Since it is clean burning, renewable hydrogen presents a zero-carbon alternative to the use of coal, oil and gas. Given that the climate imperative is to move away from carbon-intensive fossil fuels, wide-scale R&D is starting to address these challenges. According to IRENA, in the most suitable locations, renewable hydrogen will start to be competitive with fossil fuels^{xxxix} in a number of applications in the next 3-5 years. It is also an area of growing strategic interest by a rapidly growing list of leading companies and governments globally in the pursuit of the Paris Agreement and in compliance with the growing emphasis by global investors on the implementation of the Taskforce for Climate Related Disclosures (TCFD) and credible pathway to net zero by 2050, or sooner.

A.2 Prioritising applications of hydrogen

While hydrogen has the potential to be used in many applications, there are some applications that are more promising and more critical for decarbonisation than others. In this paper WWF identifies promising short and long-term uses of renewable hydrogen. These applications were chosen based on industry analysis of the following factors:

1. Is the renewable hydrogen technology available for this use-case soon (short-term) or is it likely to be available (long-term)?
2. Is an alternative zero carbon pathway likely to be more cost effective, functional and have less negative externalities?

Two potential applications – light vehicles and shipping – are examined to illustrate the considerations associated with this second factor.

Light vehicles

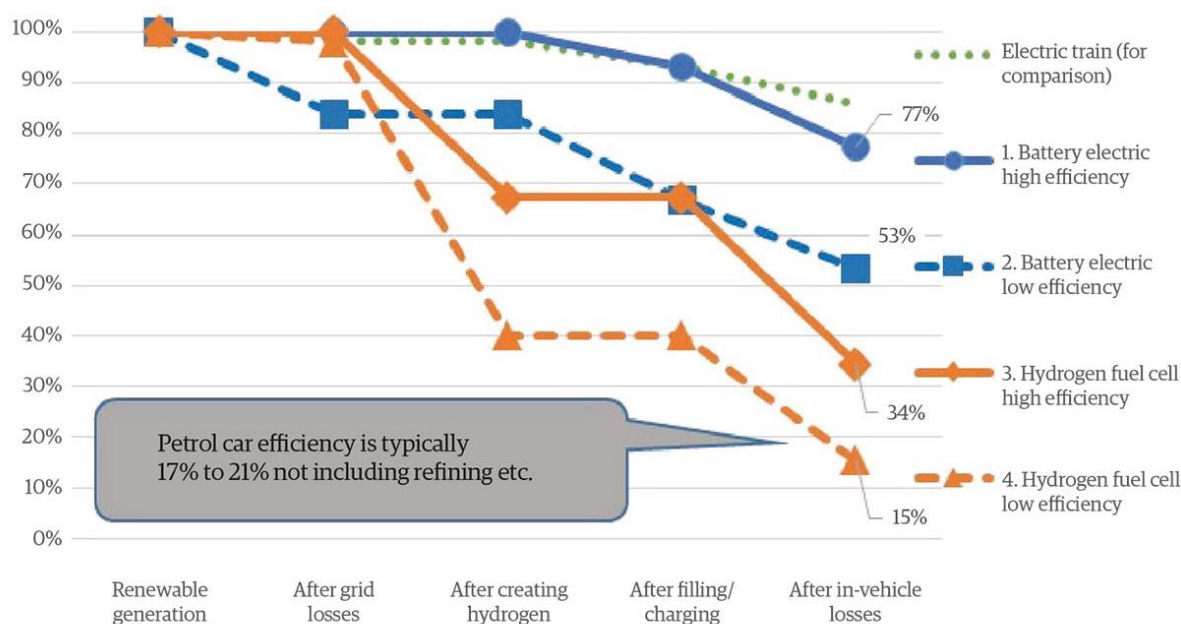
Every energy technology and application has efficiency losses along the supply chain. Coal power, for example, is typically only 37% efficient^{xl} when we use it to light or heat our homes. There are significant concerns about the efficiency of renewable hydrogen when compared to renewable electrification options. Light vehicles are perhaps the best example of this. Analysis by Renew of



renewable hydrogen fuel-cell cars compared to renewable powered electric cars (EVs) found that they are significantly less efficient (see Figure 7).

A lower efficiency typically means that hydrogen vehicles are and will continue to be more costly than EV alternatives. As such, priority should be given to supporting the uptake of EVs over hydrogen fuel-cell cars.

Figure 7: Efficiency of hydrogen fuel cell vehicles compared to electric vehicles (Source: Renew, 2019)



Global shipping

The Global Maritime Forum, a body working to shift the global shipping industry towards zero carbon energy sources, identifies renewable ammonia as one of the most promising pathways.^{xli} While battery powered ships and ferries are likely to be feasible for short routes (like [this one in China](#)), internal industry analysis suggests that for longer trading routes, the number of batteries required would take up much of the available shipping volume.

One consideration as to whether WWF would support the use of renewable ammonia as a fuel for any application, including shipping, is whether the production of NO_x – an air pollutant and greenhouse gas – will be within current IMO and WHO limits. Shipping engine manufacturers suggest that this is possible, but it is an area one which WWF must keep a watching brief.

A.3 List of critical hydrogen applications for a zero-carbon economy

Based on a high-level analysis undertaken across multiple sectors, WWF-Australia has identified the following five applications of renewable hydrogen likely to be critical for decarbonisation.

Table 3: List of critical hydrogen applications for a zero-carbon economy

Hydrogen application	Rational compared to other zero-carbon pathways	Technology availability
1. Chemical feedstock for ammonia and methanol production	There are no current zero-carbon alternatives	Available, but not commercial.



2. Reductant and heat source for the harder-to-decarbonise industry sectors such as steel, alumina and cement	Due to the chemical reactions that occur during the reduction of ores like iron into industrial products like steel, conventional thinking is that a combustion-based approach is required. As such, while electric arc furnaces and similar electrification technologies will likely play a much larger role in the refinement of metals, it is likely hydrogen combustion combined with specific catalysts will be needed for at least some of the process.	Not yet available. Demonstration projects are underway in Germany and Sweden into hydrogen use in the manufacture of steel .
3. Fuel in heavy transport such as mining trucks, long-haul trucking and shipping.	It is likely that batteries will be too heavy and occupy too much space for them to be a functional alternative to renewable hydrogen. Biofuels also have significant environmental and carbon concerns.	Prototype technology exists for trucking. Demonstration projects are being undertaken, particularly in trucking, and shipping pilots are in development.
4. Seasonal storage for the electricity sector	The necessity of hydrogen for seasonal storage depends on the need for such storage (greater in places with short daylight hours in winter) and the availability and relative cost of other storage and firm renewables options, such as sustainable bioenergy and pumped hydro. It is likely that remote grids for communities and mines may require higher levels of seasonal storage and as such, hydrogen could play a critical role.	Technology exists. Pilot projects are being undertaken.
5. Multiple energy applications (transport, electricity and industry) in places that are unlikely to have enough land/renewable resources to electrify domestically.	Some countries (see Figure 6) are unlikely to have sufficient renewable resources to directly electrify their transport, electricity, heating and industrial sectors and as such, importing renewable hydrogen may present one of the only alternative zero-carbon solutions.	Direct hydrogen import is not yet available, ammonia import technology is commercial. Countries like Japan have developed hydrogen import strategies.



Endnotes

- ⁱ <https://www.woodmac.com/news/editorial/the-future-for-green-hydrogen/>
- ⁱⁱ Adapted from <https://www.hydrogeneurope.eu/hydrogen-applications>
- ⁱⁱⁱ <https://www2.deloitte.com/content/dam/Deloitte/au/Documents/future-of-cities/deloitte-au-australian-global-hydrogen-demand-growth-scenario-analysis-091219.pdf>
- ^{iv} ANT Energy Solution, 2020, Renewable Hydrogen Market Report
- ^v <https://data.bloomberglp.com/professional/sites/24/BNEF-Hydrogen-Economy-Outlook-Key-Messages-30-Mar-2020.pdf>
- ^{vi} <https://www.dsdmip.qld.gov.au/resources/strategy/queensland-hydrogen-strategy.pdf>
- ^{vii} Note, this analysis is based on the paper - *Baruch-Mordo et al (2019) From Paris to practice: sustainable implementation of renewable energy goals* and should be considered conservative.
- ^{viii} <https://publications.industry.gov.au/publications/resourcesandenergyquarterlymarch2020/documents/Resources-and-Energy-Quarterly-March-2020.pdf>
- ^{ix} <http://www.coagenergycouncil.gov.au/sites/prod.energycouncil/files/publications/documents/nhs-hydrogen-for-transport-report-2019.pdf>
- ^x <https://www.popularmechanics.com/technology/infrastructure/a30873539/electric-mining-truck/>
- ^{xi} "75 per cent of crude oil and 55 per cent of refined petroleum is sourced overseas." Department of Environment and Energy, 2017 in ABC, 2018 'Fact Check: Does Australia have 3 weeks of petrol in reserve?'
- ^{xii} <https://renew.org.au/renew-magazine/efficient-homes/gas-versus-electricity/>
- ^{xiii} <https://bze.org.au/research/manufacturing-industrial-processes/electrifying-industry/>
- ^{xiv} https://www.energy-transition-hub.org/files/resource/attachment/innovation_and_export_opportunities_of_et_final_0.pdf
- ^{xv} Ibid
- ^{xvi} <https://grattan.edu.au/report/start-with-steel/>
- ^{xvii} <https://www.afr.com/companies/manufacturing/sanjeev-gupta-aims-for-carbon-neutral-steel-in-big-restructure-20191029-p535b3>
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- ^{xix} <https://www.theguardian.com/environment/2020/apr/04/australias-path-to-net-zero-emissions-lies-in-small-stimulus-friendly-steps>
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