PARLIAMENT OF AUSTRALIA

Australia's trade and investment opportunities in a global green economy

Joint Standing Committee on Trade and Investment Growth

October 2023

CANBERRA

ISBN 978-1-76092-551-2 (Printed version)

ISBN 978-1-76092-552-9 (HTML version)

Foreword

Global decarbonisation efforts are having a profoundly transformative effect on the way the world engages in trade and investment. The growing global demand for green energy and green-alternatives to traditionally emissions-intensive exports presents immense opportunities for Australia to be a leading destination for trade and investment in the future global green economy and to establish itself as a 'green energy superpower'.

Australia is well-placed to benefit from global green energy transition given our unique strengths and comparative advantages, such as abundant renewable energy resources, significant criterial minerals reserves, highly skilled workforce, world-class research and development sector and our reputation as a reliable trading partner and attractive investment destination.

Throughout this inquiry, the Committee's attention was drawn to the vast range of existing and emerging opportunities for Australia to develop export-oriented industries and benefit from the global green energy transition. In particular, the opportunities for enhanced value-added manufacturing provide enormous potential for jobs and economic benefits for all Australians.

The Committee sought to understand how the Australian Government can best support Australian companies to capitalise on the global green energy transition. It became clear to the Committee that this could be best achieved by utilising and expanding Australia's existing trade and investment architecture for the green economy, targeted public funding and investment to support emerging green industries, and improved government coordination and consistency across regulatory frameworks.

While Australia is well placed to benefit in the global green economy, the transition is not without challenges, and these must be addressed if Australia is to realise its green energy superpower potential.

The Committee has made 16 recommendations in this report that it hopes will strengthen Australia's transition to a green energy superpower, address challenges and prepare Australian industry to meet the expectations and demands of a future decarbonised global 'green' economy.

On behalf of my Committee colleagues, I would like to thank all those who took part in the inquiry process by providing written submissions, giving evidence at public hearings or hosting the Committee for site visits.

I would also like to thank my Committee colleagues and the Secretariat staff for their work on this inquiry.

Mr Steve Georganas MP
Chair

Terms of reference

The Joint Standing Committee on Trade and Investment Growth shall inquire into how trade and investment can support Australia's transition to a green energy superpower. In conducting its inquiry, the Committee shall have particular regard to:

- where trade and investment activities are already having a positive impact;
- emerging and possible future trends;
- the role of key commonwealth agencies including Austrade, in identifying new trade and inward investment opportunities, and assisting Australian companies to access these opportunities, including through whole of government coordination of investment;
- areas of growth, and how can these be accelerated and/or assisted, including through the use of Commonwealth Special Investment Vehicles; and how Australia can capitalise on existing and future trade agreements and economic frameworks with countries or regions around the world.

In inquiring into this topic, the Committee will have particular regard to the areas that play to Australia's strengths, as identified by the Australian Government in consultation with the states and territories including: renewable energy, battery storage, energy supply and infrastructure, electric vehicle industry, infrastructure; advanced manufacturing, and services and technology.

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Members

Chair

Mr Steve Georganas MP	Adelaide, SA

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Members

Senator the Hon Matthew Canavan	NATS, QLD
Senator the Hon Richard Colbeck	LP, TAS
Senator Dorinda Cox	AG, WA
Hon Dr David Gillespie MP (from 14 February 2023)	Lyne, NSW
Ms Tania Lawrence MP	Hasluck, WA
Mr Jerome Laxale MP	Bennelong, NSW
Senator Helen Polley	ALP, TAS
Senator Jess Walsh	ALP, VIC

Former members

Hon Andrew Gee MP (to 14 February 2023)	Calare, NSW

Abbreviations

AAS	Australian Academy of Science
AATSE	Australian Academy of Technological Sciences and Engineering
ACBC	Australia China Business Council
ACF	Australian Conservation Foundation
ACTU	Australian Council of Trade Unions
AEMO	Australian Energy Market Operator
AEF	Australian Environment Foundation
AHC	Australia Hydrogen Council
AI-ECTA	Australia-India Economic Cooperation and Trade Agreement
ALCA	Australian Land Conservation Alliance
AMBC	Advanced Materials and Battery Council
ANSTO	Australian Nuclear Science and Technology Organisation
APEC	Asia-Pacific Economic Cooperation
APGA	Australian Pipelines and Gas Association
ARENA	Australian Renewable Energy Agency
Austrade	Australian Trade and Investment Commission
BCA	Business Council of Australia
BZE	Beyond Zero Emissions
°C	Celsius
CO_2	carbon dioxide
CBAM	Carbon Border Adjustment Mechanism
CCS	carbon capture and storage

CCUS	Carbon capture, utilisation and storage
CEC	Clean Energy Council
CEIG	Clean Energy Investor Group
CEFC	Clean Energy Finance Corporation
CENRIT	Macquarie University Centre for Energy and Natural Resources Innovation and Transformation
CET	University of Adelaide Centre for Energy Technology
CFD	contract for difference
CIP Australia	Copenhagen Infrastructure Partners Australia
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DACS	direct air capture and storage
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DFAT	Department of Foreign Affairs and Trade
DISR	Department of Industry, Science and Resources
ECA	Export Council of Australia
EFA	Export Finance Australia
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
ESG	Environmental, social and governance
EU	European Union
EV	electric vehicle
EVC	Electric Vehicle Council
FBI CRC	Future Battery Industries Cooperative Research Centre
FFI	Fortescue Future Industries
FNCEN	First Nations Clean Energy Network
Fortescue	Fortescue Metals Group

FTA	free trade agreement
GEA	Singapore-Australia Green Economy Agreement
GO	Guarantee of Origin
HILT CRC	Heavy Industry Low-carbon Transition Cooperative Research Centre
HVDC	high voltage direct current
IEA	International Energy Agency
IPEF	Indo-Pacific Economic Framework
IR Act	Inflation Reduction Act of 2022 (United States)
ISER	University of Adelaide Institute for Sustainability, Energy and Resources
LETA	Low Emission Technology Australia
LNG	liquified natural gas
MPFA	Major Projects Facilitation Agency
MPS	Major Project Status
NAIF	Northern Australia Infrastructure Facility
NEM	National Energy Market
NRF	National Reconstruction Fund
PBC	prescribed bodies corporate
R&D	research and development
REIP	Renewable Energy Industrial Precinct
RET	Renewable Energy Target
REZ	Renewable Energy Zones
SANA	South Australian Nature Alliance
SEC	Smart Energy Council
solar PV	solar photovoltaic
South Korea	Republic of Korea

Star of the South	Star of the South Wind Farm Pty Ltd
UK	United Kingdom
UQ	The University of Queensland
US	United States
WTO	World Trade Organization
WWF	World Wildlife Fund Australia
ZCEAPI	Australian National University Zero Carbon Energy for the Asia-Pacific Initiative

List of recommendations

Recommendation 1

2.68 The Committee recommends that the Australian Government expand expertise and analytical capabilities to better understand the risks and opportunities for Australia's export profile presented by the decarbonisation pathways of its major trading partners.

Recommendation 2

3.116 The Committee recommends that the Australian Government continue to actively pursue opportunities to leverage Australia's existing trade and investment architecture and look to enter new and innovative agreements and partnerships to maximise Australia's opportunities in the global net-zero transition.

Recommendation 3

3.117 The Committee recommends that the Australian Government:

- **Take enhanced measures to improve understanding of the risks and opportunities for Australian exports presented by the European Union Carbon Border Adjustment Mechanism and carbon border tariffs introduced by other countries.**
- **Consider and monitor the need for an Australian carbon border tariff or similar measure to preserve the competitiveness of trade-exposed industries as domestic decarbonisation accelerates.**

Recommendation 4

4.125 The Committee recommends that the National Hydrogen Strategy Review consider measures to ensure there is sufficient hydrogen supply to support domestic decarbonisation and build emerging value-added export opportunities.

Recommendation 5

4.126 The Committee recommends that the Australian Government consider whether measures are required to retain a greater portion of domestically mined critical

minerals and rare earths onshore to encourage the development of downstream industries, such as in the battery supply chain.

Recommendation 6

5.157 The Committee recommends that the Australian Government develop a cross-portfolio national green energy superpower strategy to:

- **Define Australia's long-term green energy superpower vision**
- **Identify Australia's key opportunities with regard to strengths and competitive advantages, as well as the decarbonisation pathways of major trading partners**
- **Determine effective and efficient policy approaches to support priority emerging industries and technologies, with a focus on attracting private sector investment**
- **Connect existing and forthcoming sectoral and industry strategies.**

Recommendation 7

5.158 The Committee recommends that the Australian Government accelerate the development of robust certification and guarantee of origin schemes for renewable energy and products such as hydrogen to maximise Australia's green energy export opportunities. Where relevant, these should be aligned with existing frameworks in key markets and emerging international regulations to ensure export competitiveness in a global green economy.

Recommendation 8

5.159 The Committee recommends that the Department of Foreign Affairs and Trade and Austrade formally align trade and investment promotion and awareness building functions with Australia's green energy superpower ambitions and net-zero commitments.

Recommendation 9

6.164 The Committee recommends that the Australian Government undertake detailed analysis to identify the scale of renewable energy that can credibly be deployed, to underpin and inform the development of Australia's export-oriented green energy industries.

Recommendation 10

6.165 The Committee recommends that efforts by Commonwealth, state and territory, and local governments to develop streamlined and more transparent

regulatory and approval frameworks be consistent and equitable across land uses, including in relation to community engagement and consultation.

Recommendation 11

6.166 The Committee recommends that the Australian Government, in consultation with stakeholders, develop robust and comprehensive national data and mapping to inform land use planning decisions and identify appropriate sites for green energy projects.

Recommendation 12

6.167 The Committee recommends that the Australian Government allocate funding to support research and commercial opportunities to reuse and recycle products, equipment, and infrastructure in Australia's transition to a green energy superpower.

Recommendation 13

6.168 The Committee recommends that the Australian Government examine whether Prescribed Body Corporates are adequately supported to ensure the capacity of First Nations people and communities to engage in and benefit from Australia's green energy transition.

Recommendation 14

6.169 The Committee recommends that the Australian Government, through the First Nations Clean Energy Strategy, consider how First Nations people, communities, and businesses can be supported to increase direct participation and ownership in green energy projects.

Recommendation 15

6.170 The Committee recommends that the Australian Government, in consultation with states and territories, accelerate development of targeted green energy skills and capabilities to ensure that the workforce can support Australia's green energy superpower transition.

Recommendation 16

6.171 The Committee recommends that the National Reconstruction Fund prioritise support for projects that enhance sovereign manufacturing capability in sectors subject to current and potential future global supply chain constraints.

1. Introduction and initial Committee reflections

Overview

1.1 Global efforts to reduce greenhouse gas emissions and commitments to achieving net-zero emissions are transforming world trade. As a result, demand for Australia's traditionally emissions-intensive export industries is changing as many countries, including Australia's major trading partners, seek to replace their imports with 'green' alternatives to assist them to reach their decarbonisation goals.

1.2 To remain competitive in the future global green economy, Australia must realise its potential to transition to a green energy superpower. Australia is well-placed to utilise its strengths and comparative advantages to establish export-oriented green energy industries that can meet the needs of its major trading partners. In doing so, Australia would play a role in global decarbonisation well beyond the size of its emissions and economy, and it would leverage its position to be a trusted, reliable and influential trading partner.

1.3 Activities are already underway to accelerate the transition, support existing industries to decarbonise, and to develop new emerging green industries. Australia is utilising its existing trade and investment architecture as well as its strong relationships with trading partners to leverage opportunities in the global green economy. Several global trade and investment trends in supply chain diversification, green energy competition, and carbon border tariffs also present both risks and opportunities for Australia.

1.4 Australia has many opportunities, based on its strengths and competitive advantages, to decarbonise the domestic economy and develop export-oriented green industries. These include further expanding solar and wind energy generation, extraction and processing of raw minerals, value-added manufacturing in the critical minerals value chain, direct energy imports, green metals and carbon capture and negative emissions technologies. While the Committee acknowledges some of these activities in this report, it recognises the much broader scope of work that will be vital to Australia's green energy future.

1.5 While some activities are underway, many of Australia's most prospective green energy opportunities are in the early stages of development. The Australian Government can encourage investment to assist and accelerate emerging green technologies and industries through taking actions to reduce risk, provide greater certainty, and improve awareness of opportunities. Public funding and investment initiatives, enacting targets, strategies and improved coordination, and certification,

promotion and awareness building can all contribute to ensuring Australia maximises its green energy opportunities.

1.6 However, the transition will not be without challenges. Broader issues regarding the decarbonisation of Australia's electricity grid, regulatory and approval processes for green energy projects, environment and land use, social licence and community engagement, workforce skills and capability, and supply chain constraints need to be considered to ensure the transition benefits all Australians.

About this inquiry

Objectives and scope

1.7 On 11 October 2022, the Joint Standing Committee on Trade and Investment Growth (the Committee), adopted the inquiry following a referral from Senator the Hon Don Farrell, Minister for Trade and Tourism.

1.8 The Committee primarily focused on how trade and investment can support Australia's transition to a green energy superpower with regards to Australia's strengths. Noting the broader context of global greenhouse gas emissions reduction and Australia's commitment to achieving net-zero emissions by 2050, the Committee also considered:

- Trade and investment activities that are already having a positive impact
- Emerging and possible future trends, such as new opportunities presented by Australia's critical minerals; green hydrogen, and green metals
- The role for the Australian Government and key departments and agencies in identifying new trade and inward investment opportunities, and assisting Australian companies to access these opportunities
- Areas of growth, and how these can be accelerated or assisted, such as through the use of Commonwealth Special Investment Vehicles
- How Australia can capitalise on existing and future trade agreements and economic frameworks.

1.9 Much of the evidence received throughout the inquiry addressed Australia's transition to a green energy superpower with respect to the terms of reference. However, the Committee also received and considered a significant amount of evidence that queried the need to transition to green energy and the feasibility to achieve this. Although these matters were not articulated in the terms of reference and therefore not a focus of the inquiry, the Committee acknowledges that the transition to green energy, based on renewable electricity, presents important issues and challenges.

1.10 The transition towards green energy is dynamic. While the inquiry was taking place, there were regular announcements of relevant new initiatives, policies, agreements, research and reports. Where possible, the Committee has attempted to reflect new or updated Australian Government policies. However, readers of this report should

consult websites of relevant Australian Government departments and agencies to find out more information about the status of particular policies.

1.11 State and territory governments play a vital role in Australia's transition to a green energy superpower. In this report, the Committee has not attempted reflect the policies and programs of states and territories. However, the Committee would like to acknowledge the considerable work of all governments across the country to accelerate the green energy transition and encourage the development of emerging industries and technologies.

Terminology

1.12 Throughout the inquiry, submitters and witnesses used a range of terminology including 'green energy', 'clean energy', 'renewable energy', 'zero-emissions', 'low-emissions' and 'zero carbon'. The Committee notes that the terms 'green energy' and 'renewable energy' are often used interchangeably and are closely linked, while the other terms may have different meanings depending on how they are used. For example, 'clean energy' is often used interchangeably with 'green energy' while also being used to refer to lower-emissions versions of high-emissions technologies, including when used in conjunction with carbon capture and storage technology.

1.13 This report predominantly uses the term 'green energy' for consistency with the inquiry's terms of reference. For the purposes of this report, the Committee considers the term 'green energy' to refer to energy resources and technologies utilising renewable sources, such a wind, solar and hydro power, as well as derivative products such as green hydrogen.

1.14 The Committee has attempted to retain original terms used by submitters and witnesses in quotes. While these terms may have different meanings, the Committee has endeavoured to use terms in the context in which they were intended. The Committee uses the term 'green energy' in summarising evidence, where appropriate.

Conduct of the inquiry

1.15 On 18 October 2022 the Committee issued a media release to announce the inquiry and call for submissions. The Committee invited submissions from a range of people and organisations with an interest in trade, investment, energy, mining, critical minerals, technology, research and development by 30 November 2022. This included federal and state government departments and agencies, industry groups and peak bodies, think tanks, academics, unions and the general public. The Committee extended the due date for submissions to 23 December 2022.

1.16 The Committee received 126 submissions and an additional 11 supplementary submissions. The full list of submissions and other additional information presented to the inquiry are available in Appendix A.

1.17 The Committee held ten days of public hearings:

- 23 November 2022 in Canberra, ACT
- 30 November 2022 in Canberra, ACT
- 10 February 2023 in Canberra, ACT
- 17 March 2023 in Perth, WA
- 31 March 2023 in Canberra, ACT
- 5 April 2023 in Melbourne, Vic
- 6 April 2023 in Macquarie Park, NSW
- 16 May 2023 in Brisbane, Qld
- 17 May 2023 in Gladstone, Qld
- 23 June 2023 in Canberra, ACT.

1.18 A list of witnesses who attended these public hearings is available in Appendix B. Transcripts for all public hearings can be found on the Committee's website.

1.19 The Committee also attended site visits at Fortescue Future Industries (FFI) in Perth on 16 March 2023, and Alpha HPA in Gladstone on 17 May 2023.

Acknowledgements

1.20 The Committee would like to thank everyone who provided written submissions and gave evidence at public hearings.

1.21 The Committee would also like to express its thanks to FFI and Alpha HPA for facilitating site visits and sharing their experiences with developing new green technologies. These site visits provided the Committee with valuable firsthand insights into the innovative work being undertaken to support Australia's transition towards green energy.

Report structure

1.22 This report is structured in six chapters, including this introduction:

- Chapter 2 outlines the global and domestic context driving Australia's transition to a green energy superpower with reference to global emissions reduction and net-zero commitments and Australia's green energy superpower opportunity and potential.
- Chapter 3 explores trade and investment activities that are already having a positive impact supporting Australia's transition to a green energy superpower and outlines programs and policies delivered by Australian Government departments and agencies.
- Chapter 4 outlines a wide range of current and emerging opportunities that can capitalise on Australia's strengths to establish export-oriented green energy industries to underpin the transition to a green energy superpower.

- Chapter 5 summarises how the Australian Government's role in assisting and accelerating emerging technologies could be improved through public funding and investment, enacting targets, strategies and coordination, and certification, promotion and awareness building.
- Chapter 6 summarises key challenges to Australia's transition to a green energy superpower broadly relating to the decarbonisation of Australia's electricity grid, regulatory and approval processes for green energy projects, environment and land use, social licence and community engagement, workforce skills and capability, and supply chain constraints.

2. Global context and Australia's superpower opportunity

Overview

2.1 Australia's transition to a green energy superpower is set within the context of global commitments to reduce greenhouse gas emissions and achieve net-zero emissions. These commitments are likely to drive change in global energy demand as countries introduce policies to reduce their emissions. Demand for Australia's traditional emissions-intensive, fossil fuels-based exports, notably coal and natural gas, is anticipated to decline as major trading partners decarbonise their economies and seek to replace their imports with 'green' alternatives.

2.2 Australia is well-placed to utilise its strengths and comparative advantages to establish export-oriented green energy industries aligned with the needs of major trading partners. In this context, Australia's transition to a green energy superpower aims to both manage the risk to Australia's current export portfolio and take advantage of the considerable trade and economic opportunities presented by the shift in global energy demand. Beyond trade and economic benefits, Australia's superpower ambition can accelerate domestic and global decarbonisation, contribute to energy security and have broader strategic and regional security benefits.

2.3 This chapter outlines the global and domestic context driving Australia's transition to a green energy superpower. In doing so, this chapter discusses:

- Global emissions reduction and net-zero commitments, including with respect to the impact of these commitments on Australia's export profile.
- Australia's green energy superpower opportunity, including the potential benefits to Australia such as decarbonisation, economic and trade benefits, energy security, and strategic and regional security benefits.
- Australia's green energy superpower potential, including Australia's natural and developed strengths and comparative advantages that form the basis for its transition to a green energy superpower.

Global emissions reduction and net-zero commitments

2.4 The Australian Government has legislated under the *Climate Change Act 2022* (Cth) its commitment to reduce greenhouse gas emissions by 43 per cent from 2005 levels by 2030 and to achieve net-zero by 2050.[1]

2.5 Countries signatory to the Paris Agreement,[2] including Australia, have set a goal to limit global temperature increases to below 2 degrees Celsius (°C) and to aim for below 1.5 °C.[3] The Climate Council noted that this commitment requires rapid reductions in greenhouse gas emissions this decade and reaching net-zero emissions as soon as possible.[4] A joint submission to the inquiry from the Department of Foreign Affairs and Trade (DFAT), the Australian Trade and Investment Commission (Austrade) and Export Finance Australia (EFA) stated that 140 countries (as at September 2022) have made or have indicated they are considering net-zero emissions commitments, accounting for 90 per cent of global emissions.[5]

2.6 Many submitters to the inquiry observed that net-zero emissions commitments will drive a significant shift in global energy demand, with fossil fuel energy in the form of coal, oil and gas expected to decline significantly, while renewable energy and other zero- or low-emissions technologies are expected to increase.[6] Several submitters pointed to the International Energy Agency's *Net Zero by 2050* report, which outlined that in the context of net-zero commitments global demand for coal could be expected to decline by around 80 per cent and demand for gas by half.[7]

2.7 Others noted, to varying degrees, that coal and natural gas, particularly with carbon capture and storage technology, will continue to play a role in the global energy mix at least until greater firmed renewable energy capacity is deployed and new

1 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 2.

2 The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 countries at the United Nations Climate Change Conference (COP21) in Paris, France, on 12 December 2015. It entered into force on 4 November 2016. See: United Nations Climate Change, *The Paris Agreement,* https://unfccc.int/process-and-meetings/the-paris-agreement, viewed on 5 June 2023.

3 See: Climate Council, Submission 36.1, p. 6. See also Law Council of Australia, Submission 92.1, p. 1, citation omitted.

4 Climate Council, Submission 36.1, p. 6, citations omitted.

5 Department of Foreign Affairs and Trade (DFAT), Australian Trade and Investment Commission (Austrade) and Export Finance Australia (EFA), Submission 31, p. 2, citations omitted.

6 See, for example: DFAT, Austrade and EFA, Submission 31, p. 2; Climate Council, Submission 36, p. 3; Grattan Institute, Submission 37, pp. 4–5; Australian Conservation Foundation, Submission 50, p. 3; The Next Economy, Submission 51, p. 5; Fortescue Future Industries, Submission 93, p. 3.

7 The University of Queensland, Submission 26, p. 2; Climate Council, Submission 32, p. 2; Grattan Institute, Submission 37, p. 5; Australian Conservation Foundation, Submission 50, p. 3; Coalition for Conservation, Submission 75, p. 3; Fortescue Future Industries, Submission 93, p. 3; Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, p. 4.

technologies are developed.[8] Some stakeholders also noted the ongoing role for nuclear power in the global energy mix.[9]

Impact of global emissions reduction and net-zero commitments on Australia's exports

2.8 Submitters identified that the global transition towards net-zero emissions will have a significant impact on Australia's current export market.[10] For example, the Grattan Institute emphasised the transition 'will profoundly change trade'[11] and the Climate Council stated that it '… has fundamentally reshaped Australia's economic prospects.'[12]

2.9 Australia's export profile currently contains a high proportion of fossil fuels, with coal and gas ranked as the second and third largest export earners (see Table 2.1).[13] DFAT, Austrade and EFA advised that in 2021 fossil fuels accounted for 28 per cent of the total value of Australia's exports, with coal comprising 11 per cent and natural gas 10 per cent.[14]

2.10 The Committee received evidence that the high proportion of coal and gas in Australia's export profile leaves Australia economically vulnerable in the face of the decarbonisation of its major trading partners.[15] Australia's major trading partners and largest markets for coal and gas exports—China, Japan, the Republic of Korea (South Korea) and India[16]—have made net-zero emissions commitments.[17] Japan and South Korea have set net-zero emissions target dates of 2050, China by 2060

8 The University of Queensland, Submission 26, p. 2; Woodside Energy, Submission 47, p. 3; Geoscience Australia, Submission 64, p. 6; Dr Andrew Feitz, Director, Low Carbon Geoscience and Advice, Geoscience Australia, *Committee Hansard,* Canberra, 10 February 2023, p. 37; Mr Mark McCallum, Chief Executive Officer, Low Emission Technology Australia, *Committee Hansard,* Brisbane, 16 May 2023, p. 14.

9 The University of Queensland, Submission 26, p. 2; Dr Llewelyn Hughes and Dr Thomas Longden, Submission 70, pp. 3–5; Dr Saul Griffith, Co-founder and Chief Scientist, Rewiring Australia, *Committee Hansard*, Macquarie Park, 6 April 2023, pp. 14, 19.

10 See, for example: DFAT, Austrade and EFA, Submission 31, p. 3; Climate Council, Submission 36, pp. 2–3; Grattan Institute, Submission 37, p. 4; Australian Conservation Foundation, Submission 50, pp. 3–4; Coalition for Conservation, Submission 75, pp. 2–3; Boundless Earth, Submission 76, p. 1.

11 Grattan Institute, Submission 37, p. 4.

12 Climate Council, Submission 36, p. 2.

13 Mr David Woods, Chief Economist and First Assistant Secretary, International Economics and Green Economy Division, Department of Foreign Affairs and Trade, *Committee Hansard,* Canberra, 23 November 2022, p. 4.

14 DFAT, Austrade and EFA, Submission 31, p. 3, citation omitted.

15 See, for example: Climate Council, Submission 36, pp. 2–3; Australian Conservation Foundation, Submission 50, p. 4; Dr Llewelyn Hughes and Dr Thomas Longden, Submission 70, p. 5; Coalition for Conservation, Submission 75, p. 3; Australia China Business Council, Submission 102, p. 7.

16 Dr Llewelyn Hughes and Dr Thomas Longden, Submission 70, pp. 1–2; Department of Industry, Science and Resources, *Resources and Energy Quarterly March 2023*, March 2023, p. 162.

17 Climate Council, Submission 36, p. 3.

and India by 2070.[18] In total, countries with net-zero emissions commitments represent 97 per cent of the value of Australia's exports.[19]

2.11 Dr Simon Bradshaw, Research Director, Projects at the Climate Council, explained that Australia's key export markets in China, India, South Korea and Japan '… are all effectively calling time on fossil fuels on slightly different trajectories. We will see some fluctuations in the near term, but the direction of travel and the momentum are very clear.'[20]

2.12 DFAT, Austrade and EFA advised that in a global net-zero emissions economy, Australia's coal exports are forecast to fall by 80 per cent by 2050, with China, Japan and South Korea accounting for a majority of the reduction in demand.[21] Mr David Woods, Chief Economist and First Assistant Secretary, International Economics and Green Economy Division, at DFAT told the Committee:

> … the issue we have … is that our export profile is emissions intensive. Coal and LNG [liquefied natural gas] are two of our top three export earners. What we're very much alive to is that there will be a transition period, that those fuels will continue to be significant export earners for Australia. But as those 140 countries [who have made or have indicated they are considering net-zero emissions commitments], or a significant proportion of them, follow through on their commitments to net zero there is clearly going to be a risk that the markets for those will be diminished.[22]

2.13 Additionally, Boundless Earth submitted that Australia will face an inevitable change in the demand for its current exports as trading partners look to decarbonise their operations:

> There is … the risk that Australia's biggest exports - which are currently dominated by fossil fuels and high embodied carbon products - are regulated, taxed or even blocked by our trading partners (through mechanisms such as the European Union's Carbon Border Adjustment Mechanism). The Sunshot report [a 2021 commissioned by the WWF-Australia, the Business Council of Australia, the Australian Council of Trade Unions and the Australian Conservation Foundation] estimates that over 50% of Australia's existing export value is exposed to risks from the energy transition. Thus, whether or not we proactively seek to transform our economy now, Australia will be forced to restructure the composition of its

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18 Climate Council, Submission 36, p. 3; Professor Frank Jotzo, Director, Australian National University Zero-Carbon Energy for the Asia-Pacific Initiative, *Committee Hansard*, Canberra, 31 March 2023, p. 45.

19 DFAT, Austrade and EFA, Submission 31, p. 2.

20 Dr Simon Bradshaw, Research Director, Projects, Climate Council, *Committee Hansard*, Macquarie Park, 6 April 2023, p. 10.

21 DFAT, Austrade and EFA, Submission 31, p. 3, citation omitted. See also: Australian Conservation Foundation, Submission 50, p. 4.

22 Mr David Woods, Chief Economist and First Assistant Secretary, International Economics and Green Economy Division, Department of Foreign Affairs and Trade, *Committee Hansard*, Canberra, 23 November 2022, p. 4.

> exports to respond to the decrease in global fossil fuel demand and the increase in emissions reduction ambition.[23]

Australia's green energy superpower opportunity

2.14 Many submitters suggested that while the net-zero emissions commitments and decarbonisation plans of major trading partners present significant risks to Australia's current export profile, they also present immense opportunities.[24] For example, DFAT, Austrade and EFA emphasised that 'Australia stands to gain significant economic benefits from the world's transition to net-zero.'[25] Similarly, the Climate Council declared that 'Australia is well-placed to thrive in a world shifting toward net-zero emissions.'[26]

2.15 It was widely observed that as major trading partners reduce their demand for Australia's coal and gas, they will seek alternatives to meet their energy needs.[27] Importantly for Australia, many countries with strong decarbonisation goals lack sufficient renewable energy resources to meet domestic needs.[28] The Department of Climate Change, Energy, the Environment and Water (DCCEEW) explained that:

> While renewable energy will play a major role in global efforts to reach net-zero emissions, renewable resources are not evenly distributed around the world, and many of Australia's major trading partners have more limited or expensive renewable energy opportunities.[29]

2.16 Consequently, the Grattan Institute observed that countries with lower renewable energy resources '… will look to import energy, or energy-intensive commodities, from renewable-rich countries such as Australia.'[30] DFAT, Austrade and EFA explained that: 'The rapidly growing demand among Australia's partners for clean energy to help drive their respective decarbonisation agendas presents significant opportunities for Australia as a net energy exporter.'[31]

2.17 Ms Rachael de Hosson, Branch Head, Net Zero Innovations and Partnerships Branch at DCCEEW, told the Committee that as countries across the globe, including

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23 Boundless Earth, Submission 76, p. 1. The Sunshot Report was provided as an attachment to a submission to the inquiry from WWF-Australia, the Business Council of Australia, the Australian Council of Trade Unions and the Australian Conservation Foundation. See: WWF-Australia, the Business Council of Australia, the Australian Council of Trade Unions and the Australian Conservation Foundation, Submission 67, Attachment 1.

24 See, for example: Smart Energy Council, Submission 23, pp. 1–2; DFAT, Austrade and EFA, Submission 31, p. 23; Climate Council, Submission 36, p. 5; Grattan Institute, Submission 37, pp. 7–8.

25 DFAT, Austrade and EFA, Submission 31, p. 3.

26 Climate Council, Submission 36, p. 1.

27 See, for example: Australian Hydrogen Council, Submission 39, p. 2; Mr Andrew Morris, Manager, Trade and Investment, Australian Trade and Investment Commission, *Committee Hansard,* Canberra, 30 November 2022, p. 3.

28 Beyond Zero Emissions, Submission 32, p. 7; Grattan Institute, Submission 37, p. 7; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 4; Sun Cable, Submission 71, p. 6.

29 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 4.

30 Grattan Institute, Submission 37, p. 7.

31 DFAT, Austrade and EFA, Submission 31, p. 2.

Australia's major trading partners, transition to net-zero emissions '… there will be many opportunities for Australia to leverage our domestic renewable energy strengths to produce and export energy and energy-intensive products.'[32]

2.18 In their analysis submitted to the Committee, Dr Llewelyn Hughes and Dr Thomas Longden of the Australian National University advised that understanding major trading partners' decarbonisation pathways is vital for managing the risk and taking advantage of the opportunities for Australia in the transition:

> There are large uncertainties in the technology pathways selected by Australia's key trading partners as they decarbonise … Understanding the timing of decreased demand for thermal coal and gas is important in preparing for alternative futures … Information gathering and analysis on regional trading partners' decarbonisation pathways are crucial for Australia's existing energy trade, and the new market opportunities emerging as the region decarbonises.[33]

2.19 DCCEEW summarised the potential benefits of Australia's green energy opportunity, stating that it would '… contribute to domestic and global decarbonisation efforts, increase energy security for Australia and our international partners, and create new domestic economic opportunities, particularly for our regions.[34]

Decarbonisation

2.20 Multiple submitters observed that beyond reducing domestic emissions, Australia's green energy transition could make a significant contribution to global decarbonisation.[35] Mr David Woods, Chief Economist and First Assistant Secretary at DFAT, told the Committee that '… transitioning and diversifying our export base toward green energy exports… will represent a material contribution to global climate action and to the decarbonisation of our trading partners.'[36]

2.21 Similarly, the Clean Energy Council suggested that '… Australia can play an outsized role in both decarbonising its own economy, and assisting other countries to decarbonise…'[37]

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32 Ms Rachael de Hosson, Branch Head, Net Zero Innovations and Partnerships Branch, Department of Climate Change, Energy, the Environment and Water, *Committee Hansard,* Canberra, 10 February 2023, p. 1.

33 Dr Llewelyn Hughes and Dr Thomas Longden, Submission 70, p. 5.

34 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 2.

35 See, for example: DFAT, Austrade and EFA, Submission 31, p. 3; Climate Council, Submission 36, pp. 7–8; Clean Energy Council, Submission 38, p. 1; Queensland Conservation Council, Submission 41, p. 1; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 5: Professor Paul Burke, Project Convenor, Australian University Zero-Carbon Energy for the Asia-Pacific Initiative, *Committee Hansard*, Canberra, 31 March 2023, p. 49; Dr Simon Bradshaw, Research Director, Projects, Climate Council, *Committee Hansard*, Macquarie Park, 6 April 2023, p. 12.

36 Mr David Woods, Chief Economist and First Assistant Secretary, International Economics and Green Economy Division, Department of Foreign Affairs and Trade, *Committee Hansard*, Canberra, 23 November 2022, p. 1.

37 Clean Energy Council, Submission 38, p. 1.

2.22 To demonstrate the scale of the potential contribution to global decarbonisation, the Climate Council outlined estimates that an Australian green steel industry exporting to China could reduce global emissions by around two per cent, almost twice as much as Australia eliminating its own emissions.[38] Further, an established green metals industry exporting to Asia could help to cut global emissions by eight per cent.[39] Green metals are discussed in more detail in Chapter 4.

Economic and trade benefits

2.23 The Committee received considerable evidence that identified the potential for significant economic benefits and job creation from Australia's green energy opportunities.[40] Many submitters pointed to estimates in the 2021 *Sunshot* report that green energy export industries could add $89 billion in value to the Australian economy and create 395,000 jobs by 2040.[41] It was also noted that there is potential for substantial economic benefits and opportunities in regional communities and for First Nations people.[42]

2.24 In terms of Australia's exports, Mr Woods suggested that the development of export-oriented green energy industries would have the dual benefit of taking advantage of growth opportunities in the green economy and managing the downside risk of the carbon intensity of Australia's current export profile.[43]

2.25 The Committee received evidence that export-oriented green energy industries could contribute to building Australia's economic complexity, measured by the number of products a country exports and the number of other countries that export those products.[44] For example, the Australia China Business Council explained to the Committee:

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38 Climate Council, Submission 36, p. 7, citation omitted.

39 Climate Council, Submission 36, p. 8, citation omitted.

40 Electric Vehicle Council, Submission 14, p. 5; Smart Energy Council, Submission 23, p. 1; Beyond Zero Emissions, Submission 32, pp. 3, 6-7; Climate Council, Submission 36, p. 8; Grattan Institute, Submission 37, p. 2; Australian Hydrogen Council, Submission 39, p. 2; Australia Conservation Foundation, Submission 50, pp. 4–5; Department of Climate Change, Energy, the Environment and Water, Submission 62, pp. 3–4; Fortescue Future Industries, Submission 93, pp. 8–9.

41 DFAT, Austrade and EFA, Submission 31, p. 3, citation omitted; Beyond Zero Emissions Submission 32, p. 6; Climate Council, Submission 36, p. 8; Queensland Conservation Council, Submission 41, p. 1; Australian Conservation Foundation, Submission 50, pp. 1–2; The Next Economy, Submission 51, p. 2; Department of Climate Change, Energy, the Environment and Water, Submission 62, pp. 3–4; WWF-Australia, the Business Council of Australia, the Australian Council of Trade Unions and the Australian Conservation Foundation, Submission 67, p. 1.

42 Farmers for Climate Action, Submission 16, pp.1–2; RE-Alliance, Submission 43, p. 4; Australian Conservation Foundation, Submission 50, p. 5; Fortescue Future Industries, Submission 93, pp. 10–11.

43 Mr David Woods, Chief Economist and First Assistant Secretary, International Economics and Green Economy Division, Department of Foreign Affairs and Trade, *Committee Hansard,* Canberra, 23 November 2022, p. 1.

44 Australian Conservation Foundation, Submission 50, p. 3–4; Australia China Business Council, Submission 102, p. 4; Mr Shannon O'Rourke, Chief Executive Officer, Future Battery Industries Cooperative Research Centre, *Committee Hansard*, Perth, 17 March 2023, p. 17; Professor Ian Chubb, Secretary for Science Policy, Australian Academy of Science, *Committee Hansard*, Canberra, 31 March 2023, p. 9.

> … Australia's economy lacks both diversification and sophistication. When compared to other nations in our region, such as Singapore, Japan and [South] Korea, Australia's economic complexity has been declining year on year for 25 years. We've relied far too much on simply exporting raw commodities and agricultural products… we need to move up the value chain. The good news is the green economy presents enormous opportunity to increase sophistication and complexity of our economy across all sectors. It will enable us to build new industries, achieve higher levels of productivity and be even more internationally competitive.[45]

Self-sufficiency and energy security

2.26 Submitters highlighted that the green energy transition and the development of green energy industries could increase Australia's self-sufficiency and energy security.[46] For example, it was suggested that building domestic manufacturing capacity to make products such as solar panels and batteries would decrease Australia's reliance on imported products for renewable energy generation and reduce exposure to supply chain risks.[47] The Next Economy stated that green energy manufacturing and processing opportunities '… offers Australia the potential to strengthen national sovereignty and self-sufficiency at a time when global supply chains are under pressure.'[48]

2.27 The Australian Electric Vehicles Association emphasised that electrification of transport would improve Australia's energy security by reducing reliance on imported crude oil and refined petroleum.[49] Similarly, Mr James Bowen observed that: 'An accelerated domestic energy transition could improve Australia's own energy security… in the context of our inability to maintain sufficient domestic production, refining, or storage capacity for oil.'[50]

Strategic and security benefits

2.28 The Committee received evidence that suggested Australia's transition to a green energy superpower provides broader strategic and regional security benefits.[51]

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45 Mr David Olsson, National President and Chair, Australia China Business Council, *Committee Hansard*, Macquarie Park, 6 April 2023, p. 29.

46 See, for example: The Next Economy, Submission 51, p. 6; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 2; Fortescue Future Industries, Submission 93, p. 4; James Bowen, Submission 115, p. 1.

47 Sun Cable, Submission 71, p. 8; Entura, Submission 79, p. 4; Australia China Business Council, Submission 102, p. 7.

48 The Next Economy, Submission 51, p. 6.

49 Australian Electric Vehicle Association, Submission 19, p. 3.

50 James Bowen, Submission 115, p. 1.

51 See, for example: Star of the South Wind Farm Pty Ltd, Submission 25, p. 4; James Bowen, Submission 115, pp. 1–2.

2.29 DCCEEW explained that '… energy security is now firmly linked to the energy transition, with major economies taking significant steps to shore up their energy security and resilience, and reduce emissions at the same time.'[52]

2.30 DFAT, Austrade and EFA submitted that 'Australia can become a key partner in Southeast Asia's energy transition as a supplier of choice for green energy goods and services.' [53] DFAT, Austrade and EFA further explained that where Australia can build export industries consistent with trading partners' decarbonisation plans, Australia will be directly contributing to both their decarbonisation and their energy security.[54] In this context, Australia's green energy superpower transition '… will provide strategic dividends by supporting partners in the region to decarbonise.'[55]

2.31 Mr James Bowen emphasised that for Australia the transition '… should be considered as much a foreign as domestic priority, and as much a strategic as economic opportunity.'[56]

Australia's green energy superpower potential

2.32 Australia's potential to become a green energy superpower is based on vast strengths and comparative advantages. While many strengths are credited to Australia's natural resources and geography, Australia's potential is also found on strong resources industry experience and a reputation as a reliable trading partner.

2.33 This section summarises Australia's natural and developed strengths that underpin its potential to take advantage of the global green energy transition and become a green energy superpower.

2.34 The Committee received evidence about a wide range of potential green energy export opportunities, built on Australia's strengths and advantages. Some of these include raw and processed materials (e.g. lithium, nickel), direct energy export (e.g. renewable electricity and hydrogen) and export of manufactured goods (e.g. batteries, green metals). Current and emerging green energy industries and technologies are outlined in Chapter 4.

Australia's natural strengths

2.35 Submitters highlighted Australia's considerable natural strengths that underpin the opportunity to become a green energy superpower. These include abundant renewable energy resources (solar and wind), a large land mass with low population

52 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 5.
53 DFAT, Austrade and EFA, Submission 31, p. 3.
54 DFAT, Austrade and EFA, Submission 31, p. 4.
55 DFAT, Austrade and EFA, Submission 31, p. 3.
56 James Bowen, Submission 115, p. 1.

density, extensive marine jurisdiction, significant critical minerals reserves and geographical proximity to key export markets.[57]

2.36 Dr Saul Griffith, Co-founder and Chief Scientist at Rewiring Australia, surmised that Australia's natural strengths make reaching zero emissions readily achievable, perhaps more so than any other nation in the world, and '… in fact, to go beyond that to be able to produce so much renewable energy that we can actually export it in some form.'[58]

Solar

2.37 Australia has the highest solar radiation per square metre of any continent in the world.[59] On average, Australia receives 58 million petajoules of solar radiation per year, which equates to more than 10 000 times Australia's total energy consumption.[60] Figure 2.1 shows Australia's annual average daily solar exposure, with highest exposure occurring across Australia's northern half.

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57 See: Electric Vehicle Council, Submission 14, p. 7; Smart Energy Council, Submission 23, p. 2; Tesla, Submission 24, p. 9; The University of Queensland, Submission 26, p. 6; DFAT, Austrade and EFA, Submission 31, p. 2; Beyond Zero Emissions, Submission 32, p. 3; Ammonia Energy Association, Submission 35, p. 1; Grattan Institute, Submission 37, p. 6; Woodside Energy, Submission 47, p. 2; Australian Conservation Foundation, Submission 50, pp. 2, 7; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 2; Geoscience Australia, Submission 64, p. 15; Australian Academy of Technological Science and Engineering and the Australian Academy of Science, Submission 74, p. 2; Boundless Earth, Submission 76, p. 1; Fortescue Future Industries, Submission 93, p. 2; Rewiring Australia, Submission 118, p. 1; Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, p. 3; Ms Rachael de Hosson, Branch Head, Net Zero Innovations and Partnerships Branch, Department of Climate Change, Energy, the Environment and Water, *Committee Hansard,* 10 February 2023, p. 2; Ms Rebecca Brown, Director General, Department of Jobs, Tourism, Science and Innovation, Western Australia, *Committee Hansard,* Perth, 17 March 2023, p. 1; Dr Mark Hutchinson, Chief Executive Officer, Fortescue Future Industries, *Committee Hansard,* Perth, 17 March 2023, p. 9; Professor Paul Burke, Project Convenor, Zero-Carbon Initiative for Asia Pacific, Australian National University, *Committee Hansard,* Canberra, 31 March 2023, p. 52; Ms Kylie Walker, Chief Executive Officer, Australian Academy of Technological Sciences and Engineering, *Committee Hansard,* Canberra, 31 March 2023, p. 6; Mr Simon Corbell, Chief Executive Officer, Clean Energy Investor Group, *Committee Hansard,* Canberra, 31 March 2023, p. 21; Mr Bradley Riley, private capacity, *Committee Hansard,* Canberra, 31 March 2023, p. 35; Ms Jude Burger, Vice-President, Australia Electric Vehicle Association, *Committee Hansard,* Canberra, 31 March 2023, p. 37; Professor Frank Jotzo, Director, Zero-Carbon Energy for the Asia-Pacific, Australian National University, *Committee Hansard,* Canberra, 31 March 2023, p. 44; Mr Eytan Lenko, Chief Executive Officer, Boundless Earth, *Committee Hansard,* Melbourne, 5 April 2023, p. 16; Ms Nicola Ison, Head of Direct Advocacy, Boundless Earth, *Committee Hansard,* Melbourne, 5 April 2023, p. 17; Ms Sanaya Khisty, Chief Strategy Officer, Beyond Zero Emissions, *Committee Hansard,* Melbourne, 5 April 2023, p. 24; Ms Natalie Thompson, Senior Policy Officer, Electric Vehicle Council, *Committee Hansard,* Macquarie Park, 6 April 2023, p. 21; Mr Rimas Kairaitis, Managing Director, Alpha HPA, *Committee Hansard,* Gladstone, 17 May 2023, p. 3.

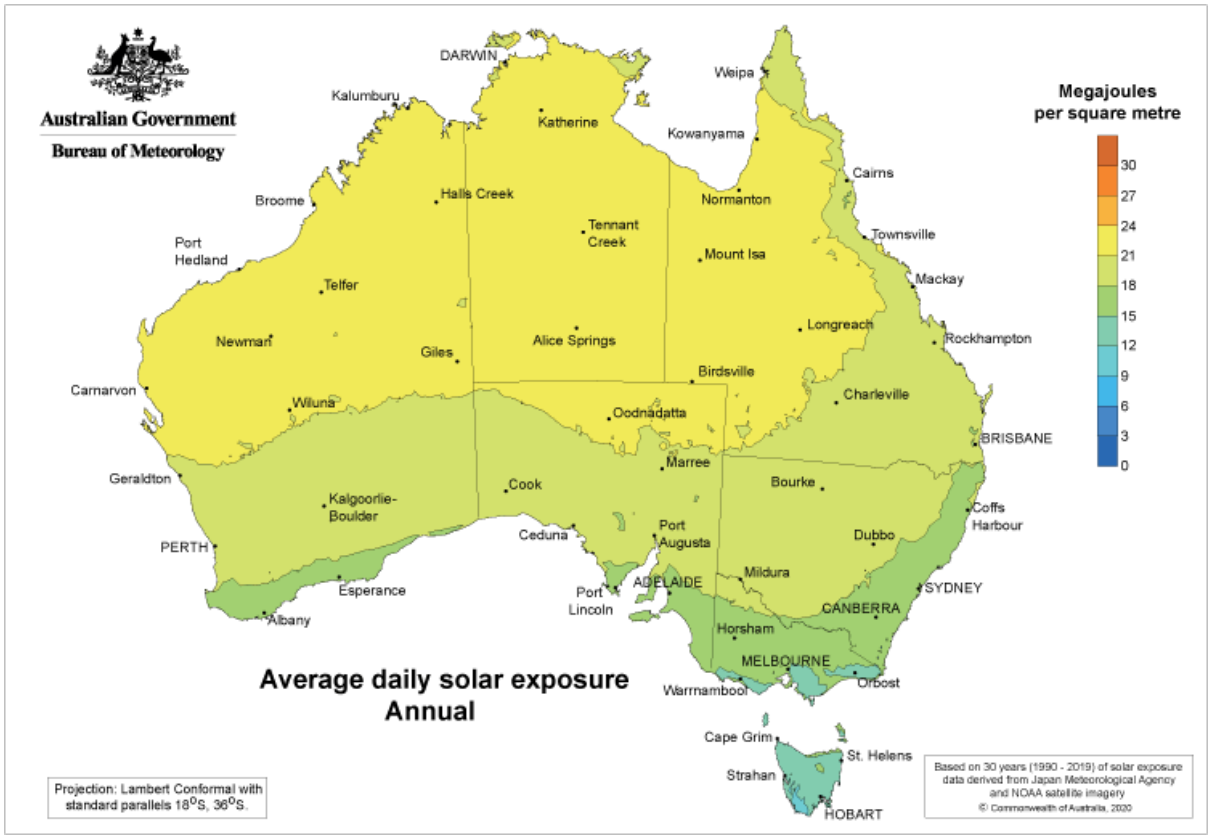
58 Dr Saul Griffith, Co-founder and Chief Scientist, Rewiring Australia, *Committee Hansard,* Macquarie Park, 6 April 2023, p. 14.

59 Geoscience Australia, *Solar energy*, www.ga.gov.au/scientific-topics/energy/resources/other-renewable-energy-resources/solar-energy, viewed 20 June 2023. See also: Australian Electric Vehicle Association, Submission 19, p. 2.

60 Geoscience Australia, *Solar energy,* www.ga.gov.au/scientific-topics/energy/resources/other-renewable-energy-resources/solar-energy, viewed 20 June 2023.

2.38 Solar radiation can be used to produce solar energy, which can then be converted into solar power to create electricity.[61]

Figure 2.1 Annual average daily solar exposure (1990-2019)



Source: Bureau of Meteorology, Average daily solar exposure, www.bom.gov.au/jsp/ncc/climate_averages/solar-exposure/index.jsp, viewed 20 June 2023.

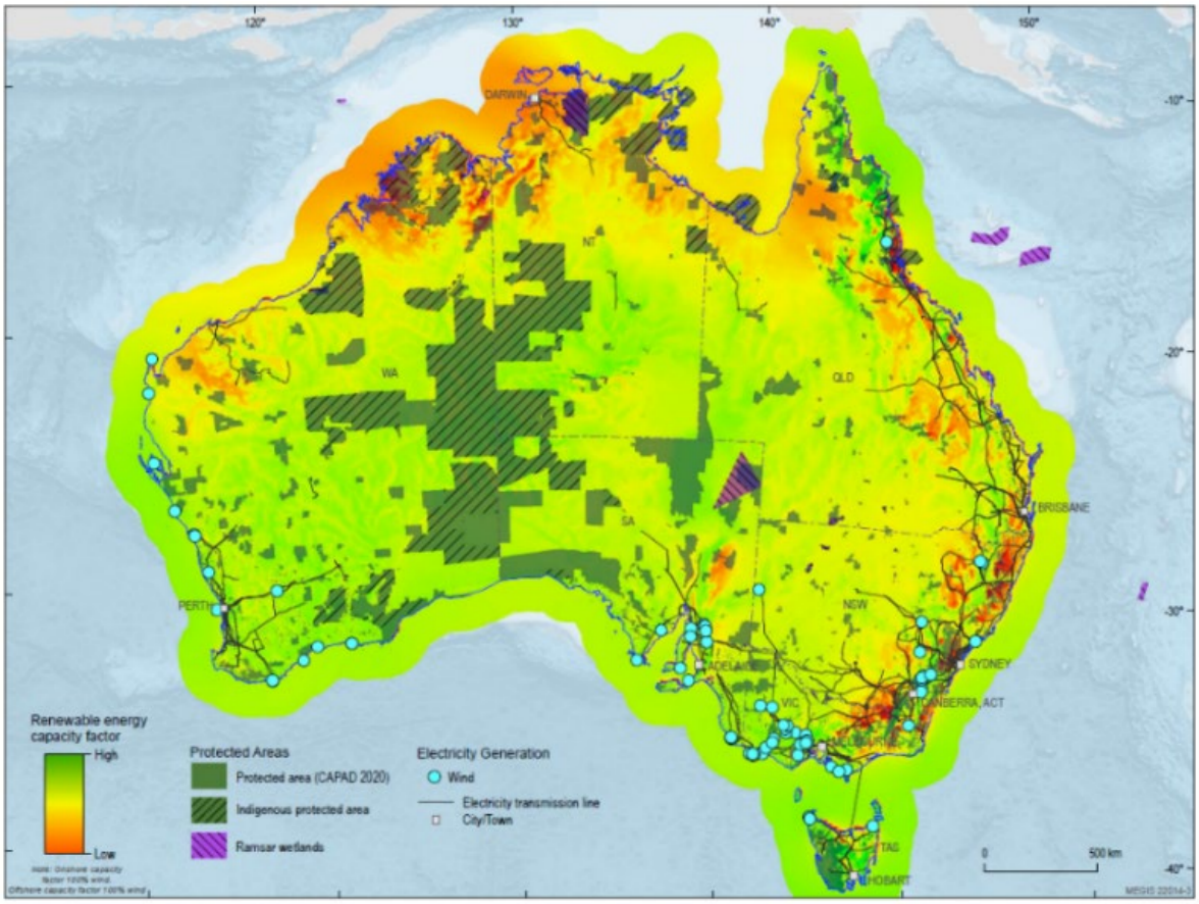
Wind

2.39 Australia's landscape also provides an abundance of wind. A submission from Geoscience Australia provided a map of Australia's onshore and offshore wind capacity. Figure 2.2 shows Australia's wind renewable energy capacity factor, with most wind farms located in southern Australia and along the coastline.[62]

61 Australian Renewable Energy Agency, *Solar energy*, https://arena.gov.au/renewable-energy/solar/, viewed 21 June 2023.

62 Geoscience Australia, Submission 64, p. 8.

Figure 2.2 Onshore and offshore wind capacity factor map with operating wind farms



Source: Geoscience Australia, Submission 64, p. 8.

2.40 Australia's marine jurisdiction is approximately double the size of Australia's land mass, and accounts for four per cent of the world's oceans.[63] Geoscience Australia's marine data assists with informing offshore wind developments.[64] During the inquiry, the Committee heard from Star of the South Wind Farm Pty Ltd (Star of the South) regarding the development of its offshore wind farm off the coast of Gippsland.[65] This project has potential to supply 20 per cent of Victoria's energy needs.[66] The Star of the South project is discussed in more detail in Chapter 4.

2.41 Australia's land mass (7 692 024 km^2) makes it is the sixth largest country in the world after Russia, Canada, China, the United States and Brazil.[67] Australia is also endowed with vast geological reserves and mineral resources, including critical minerals. According to Geoscience Australia:

63 Geoscience Australia, Submission 64, p. 8.
64 Geoscience Australia, Submission 64, p. 8.
65 See: Star of the South Wind Farm Pty Ltd, Submission 54.
66 Geoscience Australia, Submission 64, p. 8.
67 Geoscience Australia, *Australia's size compared*, www.ga.gov.au/scientific-topics/national-location-information/dimensions/australias-size-compared, viewed 20 June 2023.

> Australia is one of the world's leading producers of bauxite (aluminium ore), iron ore, lithium, gold, lead, diamond, rare earth elements, uranium, and zinc. Australia also has large mineral sand deposits of ilmenite, zircon and rutile. In addition, Australia produces large quantities of black coal, manganese, antimony, nickel, silver, cobalt, copper and tin.[68]

Raw materials and critical minerals

2.42 Australia also has an abundance of raw materials that are essential inputs to the production of low emissions technologies that are vital for the world to achieve decarbonisation goals.[69] Geoscience Australia explained that:

> Raw materials, including lithium, copper, nickel, silicon, manganese, graphite, rare earth elements and cobalt are the building blocks of clean energy technologies, such as batteries, electric vehicles (EVs), wind turbines and solar panels.[70]

2.43 Some of these raw materials are defined as 'critical minerals' on the basis that they are both essential for modern technologies, economies or national security and that there is a risk of supply chain disruption or limited availability.[71]

2.44 The Australian Government considers 26 resource commodities to be critical minerals.[72] Australia's list of critical minerals is available in Appendix C of this report. Figure 2.3 shows the location of Australia's critical mineral deposits and operating mines.

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68 Geoscience Australia, *Australian mineral facts,* www.ga.gov.au/education/classroom-resources/minerals-energy/australian-mineral-facts, viewed 20 June 2023. See also: Grattan Institute, Submission 37, p. 6; Australian Conservation Foundation, Submission 50, p. 4.

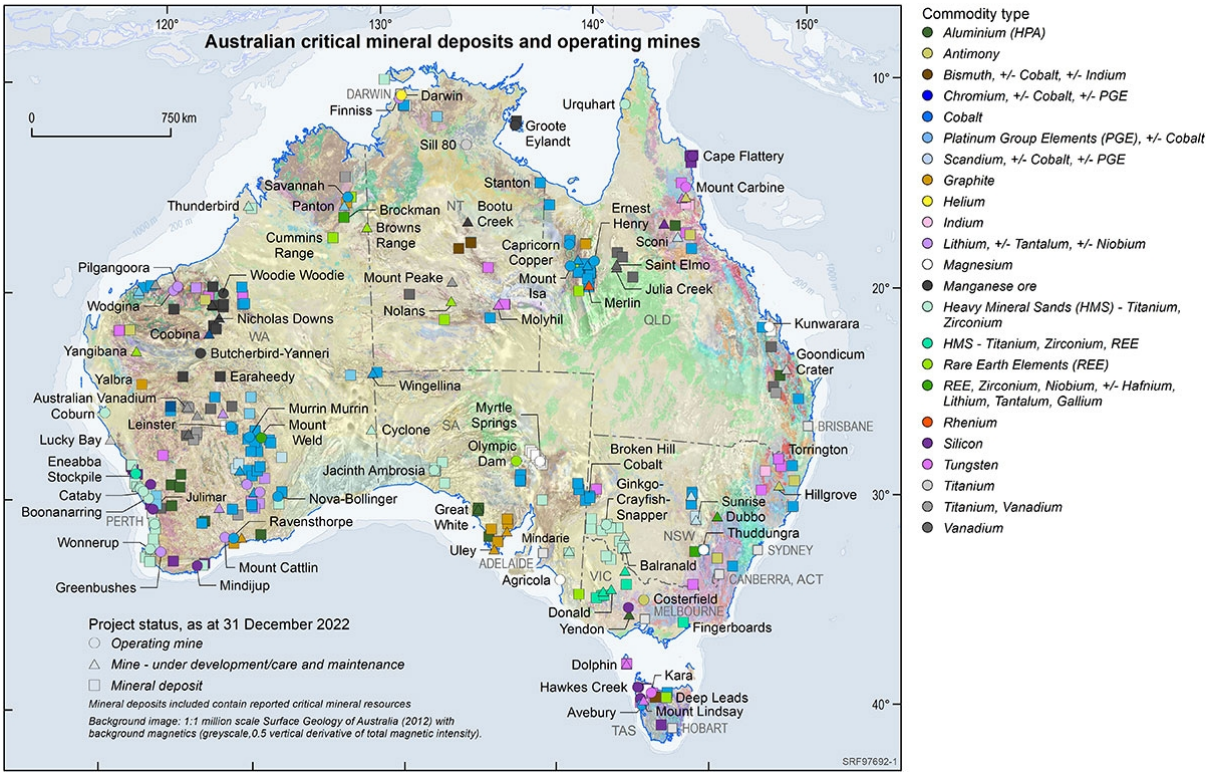
69 Australian Conservation Foundation, Submission 50, p. 4; Geoscience Australia, Submission 64, p. 15.

70 Geoscience Australia, Submission 37, p. 15.

71 Geoscience Australia, *Critical minerals at Geoscience Australia,* www.ga.gov.au/scientific-topics/minerals/critical-minerals, viewed 8 June 2023.

72 Geoscience Australia, Submission 64, p. 15.

Figure 2.3 Australian critical mineral deposits and operating mines



Source: Geoscience Australia, Critical minerals at Geoscience Australia, www.ga.gov.au/scientific-topics/minerals/critical-minerals, viewed 20 June 2023.

2.45 Australia's potential to leverage its critical mineral resources is supported by emerging opportunities to develop Australian processing and value-added manufacturing capabilities. A submission from the Australian Conservation Foundation highlighted that many critical minerals, such as lithium, cobalt and rare earths are needed for specific technologies such as battery storage.[73] Australia's raw materials and critical mineral resources, notably lithium, are discussed further in Chapter 4.

Geographical proximity to key export markets

2.46 Australia's position within the Indo-Pacific places it in close proximity to key prospective export markets. Australia's major export markets are listed in Table 2.2.

2.47 Some submissions discussed Australia's geographical advantages. For example, the joint submission from DFAT, Austrade and EFA advised that: 'Our proximity to North Asian energy import markets including Japan, [South] Korea, Singapore, and Taiwan makes us an attractive location for a future hydrogen industry.'[74]

2.48 Fortescue Future Industries (FFI) noted with regard to the hydrogen industry that Australia's geographical proximity to Asia reduces shipping costs, assisting with

[73] Australian Conservation Foundation, Submission 50, p. 4.
[74] DFAT, Austrade and EFA, Submission 31, p. 3.

viability of an export industry.[75] Dr Andrew Hutchinson, Chief Executive Officer at FFI, explained in relation to potential green hydrogen export markets that:

> The distance, obviously, makes a big difference because you have shipping charges in moving that [green hydrogen]. If we're competing in Australia with Canada or Brazil or Namibia, for example, who are all going to be playing in this space, we have shipping costs to take into consideration as well. Now there are markets which are closer to home which we believe will be big markets for Australia. Singapore, [South] Korea and Japan will be huge markets for us… They need the product to decarbonise their economies… The issue they have is they don't have any capacity to make it themselves, so they're going to have to import from places like Australia.[76]

2.49 The Australian Hydrogen Council (AHC) noted the costs of renewable energy relative to shipping costs are a factor in the potential expansion of domestic production of a range of energy-intensive commodities such as aluminium.[77]

Australia's developed strengths

2.50 In addition to natural strengths, Australia has several well-developed comparative advantages that further enhance the opportunity to become a green energy superpower. These include Australia's mining and resource sector experience, a highly educated and skilled workforce, a world-class research and development sector and a stable political environment with strong institutions as well as a strong reputation as a trusted and reliable trading partner, and as an attractive investment destination.[78]

Reputation as a trusted and reliable trading partner

2.51 Australia has strong trade relationships with many countries in the Asia-Pacific (see Table 2.2) and an extensive trade architecture that can be leveraged to meet export opportunities in the global energy transition. The AHC noted that 'Australia enjoys a reputation as a trusted and respected trading partner.'[79] Further, a

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75 Fortescue Future Industries, Submission 93, p. 2.

76 Dr Andrew Hutchinson, Chief Executive Officer, Fortescue Future Industries, *Committee Hansard*, Perth, 17 March 2023, p. 11.

77 Australian Hydrogen Council, Submission 39, pp. 4–5.

78 See, for example: Electric Vehicle Council, Submission 14, pp. 3, 7; Tesla, Submission 24, p. 9; The University of Queensland, Submission 26, pp. 2, 6; DFAT, Austrade and EFA, Submission 31, pp. 2, 4–5; Beyond Zero Emissions, Submission 32, p. 3; Ammonia Energy Agency, Submission 35, p. 1; Woodside Energy, Submission 47, p. 2; Australian Hydrogen Foundation, Submission 39, p. 2; Australian Conservation Foundation, Submission 50, p. 2; Department of Climate Change, Energy, the Environment and Water, Submission 62, pp. 2–3; Geoscience Australia, Submission 64, p. 15; WA Government, Submission 65, pp. 1, 6; Fortescue Future Industries, Submission 93, pp. 3, 11, 13; Australian Pipeline Limited, Submission 94, p. 6; Macquarie University Centre for Energy and Natural Resources Transformation and Innovation, Submission 125, p. 3; Ms Kylie Walker, Chief Executive Officer, Australian Academy of Technological Sciences and Engineering, *Committee Hansard,* Canberra, 31 March 2023, p. 6; Ms Sanaya Khisty, Chief Strategy Officer, Beyond Zero Emissions, *Committee Hansard,* Melbourne, 5 April 2023, p. 24.

79 Australian Hydrogen Council, Submission 39, p. 2.

submission from the Australian National University's Zero-Carbon Energy for the Asia-Pacific Initiative (ZCEAPI) highlighted that 'Australia has already played a leading role in meeting the Asia-Pacific region's energy and resource needs.'[80]

2.52 Australia's trade and investment architecture is discussed further in Chapter 3.

Table 2.1 Australia's top export markets by top 15 partners

Rank	Share of total (100 per cent)
1. China	30.2%
2. Japan	15.6%
3. Republic of Korea	8.2%
4. India	5.6%
5. United States	4.5%
6. Taiwan	4.1%
7. Singapore	3.6%
8. New Zealand	2.6%
9. Vietnam	2.3%
10. Indonesia	2.1%
11. Malaysia	2.0%
12. Hong Kong (SAR of China)	1.6%
13. Thailand	1.4%
14. United Kingdom	1.3%
15. Netherlands	1.3%

Source: Department of Foreign Affairs and Trade, Australia's trade in goods and services (a)(b) by top 15 partners, www.dfat.gov.au/sites/default/files/australias-goods-services-by-top-15-partners-2021-22.pdf, viewed 20 June 2023.

2.53 Australia has also earned itself a reputation as a trusted and reliable trading partner built on environmental, social and governance standards matching the highest global benchmarks.[81] For example, Ms Simone Spencer, Deputy Director General, Strategy and International Engagement at the Department of Jobs, Tourism, Science and Innovation, Western Australia, highlighted Australia is:

> … a very safe and stable place to do business, and those markets that are looking to engage with us are looking for a very long term relationship. I think that us being able to really emphasise that in [the] market is something we have that a lot of our other counterparts don't.'[82]

80 Australian National University's Zero-Carbon Energy for the Asia-Pacific Initiative, Submission 98, p. 4.
81 DFAT, Austrade and EFA, Submission 31, p. 2.
82 Ms Simone Spencer, Deputy Director General, Strategy and International Engagement, Department of Jobs, Tourism, Science and Innovation, Western Australia, *Committee Hansard,* Perth, 17 March 2023, p. 7.

Strong mining and resources industry

2.54 A number of submitters referred to Australia's strong mining and resources sector experience forming the basis for the development of green energy opportunities.[83] For example, Geoscience Australia stated that Australia's '… world-class mining equipment, technology and services sector and existing infrastructure mean we are well placed to support the growth in demand for critical minerals and development of green energy technologies.'[84]

2.55 Others noted that Australia's mining and resources sectors are supported by highly trained workers, with many skills being transferable to green energy industries.[85] In relation to the hydrogen industry, several submitters identified the potential benefits of utilising existing ports and pipeline infrastructure as well as expertise from the liquified natural gas sector.[86]

2.56 Some submitters encouraged Australia to leverage existing mining and resource strengths to transition to a green energy superpower. For example, Mr Rowan Moorey, Senior Researcher at Beyond Zero Emissions (BZE), said:

> We need to play to our strengths with the resources we've already got. We've had nation-building exercises with iron ore. We export most of the world's iron ore in Australia. There's no reason why we can't make that green ore, but there needs to be a coordinated national approach to doing that.[87]

Research and development

2.57 Australian industry is supported by a world-class research and development sector.[88] The Commonwealth Scientific and Industrial Research Organisation (CSIRO) noted that Australia is a world leader in solar photovoltaics technology and minerals

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83 Ms Kylie Walker, Chief Executive Officer, Australian Academy of Technological Sciences and Engineering, *Committee Hansard*, Canberra, 31 March 2023, p. 6.

84 Geoscience Australia, Submission 64, p. 15.

85 See, for example: Dr Karin Soldenhoff, Manager, Process Development Research, Minerals Business Unit, Australian Nuclear Science and Technology Organisation, *Committee Hansard,* Canberra, 10 February 2023, p. 10; Mr Tony Wood, Program Director, Grattan Institute, *Committee Hansard*, Melbourne, 5 April 2023, pp. 1–2.

86 Australian Pipeline and Gas Association, Submission 42, p. 4; Australian Conservation Foundation, Submission 50, p. 6; Australian Pipeline Limited (APA Group), Submission 94, pp. 8–9.

87 Mr Rowan Moorey, Senior Researcher, Beyond Zero Emissions, *Committee Hansard,* Melbourne, 5 April 2023, p. 26.

88 See, for example: The University of Queensland, Submission 26, p. 1; Mr William Tan, Acting General Manager, National Reconstruction Fund Priorities Branch, Manufacturing and National Reconstruction Fund Division, Department of Industry, Science and Resources, *Committee Hansard,* Canberra, 10 February 2023, p. 11; Mr Wayne Smith, External Affairs Manager, Smart Energy Council, *Committee Hansard,* Canberra, 31 March 2023, p. 28; Mr Wayne Smith, External Affairs Manager, Smart Energy Council, *Committee Hansard*, 31 March 2023, p. 28; Ms Kylie Walker, Chief Executive Officer, Australian Academy of Technological Sciences and Engineering, *Committee Hansard*, Canberra, 31 March 2023, p. 6.

science.[89] Similarly, ZCEAPI underscored that 'Australia is a world-leader in mining technology and Australian developed solar panels dominate global markets.'[90]

2.58 Further, Ms Nicola Ison, Head of Direct Advocacy at Boundless Earth, told the Committee 'Australia has a good reputation… given its critical role since the eighties in developing solar technologies. We have trained so many of the solar engineers globally.'[91]

Capitalising on the opportunity

2.59 Submitters highlighted that while Australia is well-positioned to benefit from the green energy economy, it will need to move swiftly to capitalise on the opportunity or it will miss out to countries with similar potential and ambition.[92] For example, BZE summarised Australia's opportunity and emphasised the need to act:

> Global decarbonisation is driving a rapid shift away from fossil fuel dependent industries and exports… Australia has the opportunity to benefit from the transition to a net-zero world by firmly embedding itself within the supply chain of an international zero-emissions economy, supplying critical materials, energy and green commodities to trading partners. Our unique mix of abundant renewable resources, and strong energy and minerals export history give us the perfect platform to drive economic growth at home and decarbonisation around the world, but we must act now.[93]

2.60 Ms Kylie Walker, Chief Executive Officer at the Australian Academy of Technological Sciences and Engineering, told the Committee that if Australia misses the opportunity to maintain its role as a '… world energy superpower, the global economy will move on and Australia will be left behind. By acting now we can leverage our natural advantages to become a global leader in green energy exports.'[94]

2.61 Similarly, the Climate Council noted the cost of not embracing the green energy transition and declared that Australia could miss out on the opportunity:

> Australia will need to move fast to seize the economic opportunities of the global transition to net-zero emissions. While we have commercially significant advantages in renewable energy, the rest of the world is not waiting for Australia

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89 Dr Peter Mayfield, Executive Director, and Dr Dietmar Tourbier, Director, Commonwealth Scientific and Industrial Resource Organisation, *Committee Hansard*, Canberra, 10 February 2023, pp. 23–24.

90 Australian National University Zero-Carbon Energy for the Asia-Pacific Initiative, Submission 98, p. 6.

91 Ms Nicola Ison, Head of Direct Advocacy, Boundless Earth, *Committee Hansard,* Melbourne, 5 April 2023, p. 16.

92 See, for example: Electric Vehicle Council, Submission 14, p. 9; Beyond Zero Emissions, Submission 32, p. 3; Climate Council, Submission 36, pp. 10–11; Australian Hydrogen Council, Submission 36, p. 3; The Next Economy, Submission 51.1, p. 1; Boundless Earth, Submission 76, p. 2; Fortescue Future Industries, Submission 93, pp. 5–6; WWF-Australia, the Business Council of Australia, the Australian Council of Trade Unions and the Australian Conservation Foundation, Submission 67.1, p. 23.

93 Beyond Zero Emissions, Submission 32, p. 3.

94 Ms Kylie Walker, Chief Executive Officer, Australian Academy of Technological Sciences and Engineering, *Committee Hansard*, Canberra, 31 March 2023, p. 6.

> to develop new clean energy industries… If we don't lean in, we could miss out on a once-in-a-generation opportunity to develop new vibrant export industries.[95]

Committee comment

2.62 The Committee notes the importance of the Australian Government's legislated commitment to reduce emissions by 43 per cent from 2005 levels by 2030 and to achieve net-zero emissions by 2050. These commitments provide certainty and a framework to reduce domestic emissions and enhance Australia's engagement in a decarbonising global economy.

2.63 The Committee recognises that global emissions reduction efforts and net-zero commitments are likely to result in a global shift in energy demand, and that the decarbonisation of Australia's major trading partners will have an impact on Australia's emissions-intensive export profile.

2.64 The Committee notes with some concern that while the direction of Australia's major trading partners toward decarbonisation is clear, the timing and pathways remain uncertain. As Australia's export profile is strongly linked to the decarbonisation pathways of its major trading partners, the Committee believes that Australia must ensure it has the expertise and analytical capabilities to understand the risks and opportunities for Australian exports in the global energy transition.

2.65 The Committee considers it prudent for Australia to pursue growth in green energy exports, aligned with the decarbonisation pathways of major trading partners, to both manage risk and to take advantage of the opportunities presented by the global green energy transition. Further, the potential benefits of Australia's green energy transition are significant, both for decarbonisation and to underpin economic growth, as well as to support Australia's strategic agenda in the Pacific by being a trusted, reliable trading partner committed to responding to climate change.

2.66 The Committee recognises that Australia has the potential to become a green energy superpower based on its vast natural and developed strengths. However, while these strengths place Australia in a position of considerable advantage, they are not sufficient on their own to ensure Australia benefits in a decarbonising global economy and Australia must actively pursue its ambition to become a green energy superpower.

2.67 While Australia's emissions intensive exports are expected to decline over time, the Committee acknowledges the enormous contribution of the resources sector to the Australian economy and society over many decades, and the positive contribution it will continue to make as Australia undergoes its green energy transition.

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95 Climate Council, Submission 36, pp. 10–11.

Recommendations

Recommendation 1

2.68 The Committee recommends that the Australian Government expand expertise and analytical capabilities to better understand the risks and opportunities for Australia's export profile presented by the decarbonisation pathways of its major trading partners.

3. Activities and initiatives paving the way for the transition

Overview

3.1 The Australian Government plays a central role in facilitating Australia's trade, investment, decarbonisation and green energy opportunities, particularly through programs and policies delivered by departments and agencies belonging to the following portfolios:

- Foreign Affairs and Trade
- Climate Change, Energy, the Environment and Water
- Industry, Science and Resources.

3.2 There are many trade and investment activities underway in Australia that are already having a positive impact on Australia's transition to a green energy superpower. Some of these activities are the result of leveraging Australia's existing trade and investment architecture, such as by stating Australia's commitment to achieving net-zero in free trade agreements,[1] and others are the result of new, innovative ways of cooperation.[2]

3.3 The Committee received a wealth of evidence on trade and investment activities, and policies and programs currently underway. The Committee has not attempted to canvas all of these activities and initiatives. The report focusses on those that are most relevant to leveraging Australia's advantages in the global green economy and to supporting Australia's strongest export-oriented green energy opportunities.

3.4 Several emerging trends related to the green energy transition are having an impact on the global trade and investment environment, with implications for Australia's green energy superpower opportunity. These include supply chain diversification, competition for green energy industries and carbon border tariffs.

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1 For example, the Australia-UK Free Trade Agreement and the Comprehensive and Progressive Agreement for Trans-Pacific Partnership contain provisions that commit to cooperation on clean and renewable energy. See: Department of Foreign Affairs and Trade (DFAT), Australian Trade and Investment Commission (Austrade) and Export Finance Australia (EFA), Submission 31, p. 7.

2 For example, the Singapore-Australia Green Economy Agreement and the Indo-Pacific Economic Framework assist Australia to pursue and cooperate on green trade. See: DFAT, Austrade and EFA, Submission 31, p. 7.

Australian Government departments and agencies

3.5 Departments and agencies from across the Australian Government are working together to support Australia's transition to a green energy superpower, given the transition's transformative effect for the Australian economy and society. While each department and agency has their own role and mandate, their work informs and supports other departments and agencies to develop and implement their own policies and programs that together support a whole-of-government approach.

3.6 This section outlines the specific roles of the departments and agencies belonging to three key portfolio areas (mentioned above) who engaged with the Committee during the inquiry. It also includes a high-level overview of the activities they are already undertaking to aid Australia's transition to being a green energy superpower.

Foreign Affairs and Trade portfolio

3.7 The Department of Foreign Affairs and Trade (DFAT), the Australian Trade and Investment Commission (Austrade) and Export Finance Australia (EFA) within the Foreign Affairs and Trade portfolio creates opportunities for green energy trade and investment through:

- Existing trade architecture, such as free trade agreements (FTAs), the World Trade Organization (WTO) and Asia-Pacific Economic Cooperation (APEC)
- New approaches, such as the Indo-Pacific Economic Framework (IPEF) and the Singapore-Australia Green Economy Agreement (GEA)
- Supporting Australian exporters to develop commercial partnerships to participate in new markets.[3]

Department of Foreign Affairs and Trade

3.8 DFAT's large international network supports Australia's transition to a green energy superpower '… by establishing and enhancing vital relationships with trading partners to secure new export markets and ensure access to necessary inputs and technology.'[4]

3.9 DFAT also supports Australia's transition by providing '… the strategic and foreign policy lens on international climate engagement and energy transition which is essential to the whole-of-government efforts need to achieve a successful transition.'[5]

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3 DFAT, Austrade and EFA, Submission 31, p. 2. See also: Mr David Woods, Chief Economist and First Assistant Secretary, International Economics and Green Economy Division, DFAT, *Committee Hansard,* Canberra, 23 November 2022, p. 2.

4 DFAT, Austrade and EFA, Submission 31, p. 6.

5 DFAT, Austrade and EFA, Submission 31, p. 2.

In addition, DFAT works with countries across the Indo-Pacific to support the deployment of renewable technologies and improved energy efficiency to the region.[6]

Australian Trade and Investment Commission

3.10 Austrade promotes and facilitates Australia's trade and investment and delivers services to businesses that create jobs and grow Australia's economic prosperity.[7] Austrade will play a crucial role in Australia's green energy superpower transition by assisting companies to respond to changes in global trade and gain access to new export markets, attracting and promoting foreign direct investment, and promoting awareness of 'Brand Australia'.[8]

3.11 Austrade's work focuses on green export sectors where Australia has a competitive advantage, such as in '… green resource extraction; hydrogen; critical minerals; advanced manufacturing (including turbines); green education and travel; professional services and finance; green agriculture and high-tech renewables technology.'[9] Austrade's work is also increasingly aligned with Australia's net-zero objectives with investments in:

- 161 projects in renewable energy, predominantly hydrogen (76), solar (27) and storage projects (35). 35 of these projects are from Japan, 16 from Canada and 15 from the USA [United States of America].
- 27 projects relate to critical minerals, including battery value chains and development.
- 37 projects relate to waste processing and waste to energy, and a further 13 projects relating to future transport (e.g. EV [electric vehicle] infrastructure).[10]

Export Finance Australia

3.12 EFA is Australia's export credit agency and supports Australia's trade agenda by providing commercial finance for exporting businesses.[11] EFA administers the Australian Government's National Interest Account, which includes facilities such as the Critical Minerals Facility and the Defence Export Facility.[12]

3.13 EFA supports Australian low emission technology exports and delivers finance for renewable energy and green infrastructure in the Indo-Pacific.[13] For example, EFA finances renewable energy throughout the Indo-Pacific through projects such as the

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6 DFAT, *Increasing access to renewable energy*, www.dfat.gov.au/international-relations/themes/climate-change/supporting-indo-pacific-tackle-climate-change/building-climate-resilient-infrastructureincreasing-access-renewable-energy, viewed 13 June 2023.
7 DFAT, Austrade and EFA, Submission 31, p. 9.
8 DFAT, Austrade and EFA, Submission 31, pp. 9–10.
9 DFAT, Austrade and EFA, Submission 31, p. 9.
10 Figures correct as at 30 October 2022. See: DFAT, Austrade and EFA, Submission 31, p. 9.
11 DFAT, Austrade and EFA, Submission 31, p. 11.
12 DFAT, Austrade and EFA, Submission 31, p. 11.
13 DFAT, Austrade and EFA, Submission 31, p. 11.

Lotus Wind Power Project in Vietnam in collaboration with the Asian Development Bank, the Japan International Cooperation Agency and private financiers.[14]

Climate Change, Energy, the Environment and Water portfolio

3.14 The Climate Change, Energy, the Environment and Water portfolio serves a central role in Australia's transition to a green energy superpower. This section outlines the work currently underway by the Department of Climate Change, Energy, the Environment and Water (DCCEEW), the Australian Renewable Energy Agency (ARENA), the Clean Energy Finance Corporation (CEFC) and future Net Zero Authority.

Department of Climate Change, Energy, the Environment and Water

3.15 DCCEEW has primary responsibility for managing the transformation of Australia's energy system towards net-zero.[15] DCCEEW is also responsible for managing risks to Australia's energy security as it transitions 'from a centralised thermal-generating based grid to one that is highly decentralised and driven by variable renewable energy generation.'[16]

Emissions reduction, renewable energy and energy supply

3.16 DCCEEW is responsible for delivering policies and programs to achieve emissions reductions in line with Australia's legislated commitments, increasing deployment of renewable energy generation capacity and storage, and providing '… reliable, secure and affordable' energy supply for Australia.[17] Some of these include the:

- Renewable Energy Target
- Safeguard Mechanism
- Rewiring the Nation
- Powering the Regions Fund
- Capacity Investment Scheme and the
- National Energy Transformation Partnership.[18]

3.17 Together with CEFC, DCCEEW implements the Australian Government's Rewiring the Nation program, which will provide $20 billion in low-cost finance over four years

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14 DFAT, Austrade and EFA, Submission 31, p. 11.
15 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 8.
16 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 10.
17 Department of Climate Change, Energy, the Environment and Water, *Australia's energy strategies and frameworks*, www.energy.gov.au/government-priorities/australias-energy-strategies-and-frameworks, viewed 13 June 2023.
18 Department of Climate Change, Energy the Environment and Water, Submission 62, pp. 8–9; Department of Climate Change, Energy, the Environment and Water, *Australia's energy strategies and frameworks*, www.energy.gov.au/government-priorities/australias-energy-strategies-and-frameworks, viewed 13 June 2023.

to invest in Australia's electricity grid.[19] Rewiring the Nation currently supports two transmission projects: VNI West (KerangLink) between Victoria and New South Wales, and Marinus Link between Tasmania and Victoria.[20] A submission from the Tasmanian Government highlighted:

> Project Marinus will deliver significant downward pressure on wholesale electricity prices, create significant employment and economic stimulus, and unlock Tasmania's world class wind resource, as evidenced by… Tasmanian wind farms that already perform consistently in the top ten in the country. Collectively, this offering can materially assist the Australian transition to become a green energy 'superpower'.[21]

3.18 DCCEEW also administers the $1.9 billion Powering the Regions Fund, which will support the transition to net-zero emissions in regional areas and ensure that they benefit from the economic opportunities of decarbonisation.[22]

3.19 DCCEEW is working with Australia's states and territories as part of the Commonwealth's National Energy Transformation Partnership to co-design a First Nations Clean Energy Strategy, which aims '… to enable First Nations communities to influence and access the benefits of Australia's renewable energy transformation.'[23]

Emerging industries

3.20 DCCEEW delivers policies and programs to support emerging green energy industries, including to underpin future exports of renewable energy, energy carriers such as hydrogen and value-added energy intensive products.[24]

3.21 Australia's National Hydrogen Strategy was first released in 2019 and '… sets a vision for a clean, innovative, safe and competitive hydrogen industry that benefits all Australians.'[25] A review of the strategy was announced in February 2023 during a meeting of the Energy and Climate Ministers Council with the aim '… to ensure it positions Australia on a path to be a global hydrogen leader by 2030 on both an

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19 Department of Climate Change, Energy, the Environment and Water*, Rewiring the Nation supports its first two transmission projects*, www.energy.gov.au/government-priorities/australias-energy-strategies-and-frameworks/powering-australia, viewed 26 June 2023.

20 Department of Climate Change, Energy, the Environment and Water*, Rewiring the Nation supports its first two transmission projects*, www.energy.gov.au/government-priorities/australias-energy-strategies-and-frameworks/powering-australia, viewed 26 June 2023.

21 Tasmanian Government, Submission 29, p. 2.

22 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 11.

23 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 13.

24 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 10.

25 Department of Climate Change, Energy, the Environment and Water, *Australia's National Hydrogen Strategy,* www.dcceew.gov.au/energy/publications/australias-national-hydrogen-strategy, viewed 13 June 2023.

export basis and for the decarbonation of Australian industries.'[26] At the time of this report, the review was open for public consultation.[27]

3.22 DCCEEW is also in the process of designing a $2 billion Hydrogen Headstart Program with ARENA. The program aims to accelerate Australia's hydrogen industry and will focus on large scale hydrogen projects, create funding for green hydrogen projects and connect Australia to global hydrogen supply chains.[28] Ms Jo Evans, Deputy Secretary at DCCEEW, told the Committee that 'Hydrogen Headstart is part of the consideration about what more we need to do to make sure that there's a good probability of success for Australia to become a renewable energy superpower…'[29]

3.23 DCCEEW is also responsible for the ongoing development, implementation and operation of the *Offshore Electricity and Infrastructure Act 2021* (Cth), which provides the legislative framework to enable the development of offshore wind energy and other types of offshore renewable energy projects.[30] The framework is further discussed in Chapter 4.

Electric vehicles

3.24 DCCEEW is leading the development of the Australian Government's National Electric Vehicle Strategy to reduce emissions in the transport sector through three objectives:

- increase the supply of affordable and accessible EVs
- establish the resources, systems and infrastructure to enable rapid EV uptake
- encourage increased EV demand.[31]

Environmental protection and approvals

3.25 DCCEEW is responsible for the administration of the *Environment Protection and Biodiversity Act 1999* (Cth) and therefore '… plays a role in ensuring the protection of

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26 Department of Climate Change, Energy, the Environment and Water, *Australia's National Hydrogen Strategy,* www.dcceew.gov.au/energy/publications/australias-national-hydrogen-strategy, viewed 13 June 2023.

27 See: Department of Climate Change, Energy, the Environment and Water, *Australia's National Hydrogen Strategy,* www.dcceew.gov.au/energy/publications/australias-national-hydrogen-strategy, viewed 19 July 2023.

28 Ms Catherine Zerger, Branch Head, Hydrogen, Adaptation and New industries Division, Department of Climate Change, Energy, the Environment and Water, Department of Climate Change, Energy, the Environment and Water, *Proof Hansard,* Canberra, 23 June 2023, p. 1. See also: Department of Climate Change, Energy, the Environment and Water, *Hydrogen Headstart program,* www.dcceew.gov.au/energy/hydrogen/hydrogen-headstart-program, viewed 26 June 2023.

29 Ms Jo Evans, Deputy Secretary, Department of Climate Change, Energy, the Environment and Water, *Proof Hansard,* Canberra, 23 June 2023, p. 1.

30 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 12.

31 Department of Climate Change, Energy, the Environment and Water, *The National Electric Vehicle Strategy,* www.dcceew.gov.au/energy/transport/national-electric-vehicle-strategy, viewed 23 June 2023.

matters of national environmental significance, including for the renewables industry.'[32]

International partnerships

3.26 DCCEEW manages Australia's international clean energy partnerships, which aim to build new clean energy industries and trade opportunities for Australia.[33] Currently, Australia has partnerships with Germany, India, Japan, Republic of Korea (South Korea), Singapore, the Netherlands, the United Kingdom (UK) and the United States (US).[34] These are listed in Box 3.1.

3.27 DCCEEW also works with DFAT to implement the Australian Government's climate and infrastructure partnership with Indonesia.[35]

Box 3.1 Australia's international clean energy partnerships

- Australia–Germany Hydrogen Accord
- Australia–India Letter of Intent on New and Renewable Energy Technology and the Australia-India Green Hydrogen Taskforce
- Australia–Japan Partnership on Decarbonisation through Technology
- Australia-Republic of Korea Low and Zero Emissions Technology Partnership
- Australia–Singapore Initiative on Low Emissions Technology for Maritime and Port Operations
- Australia–UK Clean Technology Partnership
- Australia-United States Net Zero Technology Acceleration Partnership
- Australia–Netherlands Memorandum of Understanding on Cooperation in the Field of Hydrogen.[36]

Australian Renewable Energy Agency

3.28 ARENA improves competitiveness of renewable energy technologies, increases supply of renewable energy in Australia and provides grant funding to support renewable energy projects.[37] The submission from DCCEEW explained:

32 Department of Climate Change, Energy, the environment and Water, Submission 62, p. 13.
33 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 14. See also: Department of Climate Change, Energy, the Environment and Water, *Australia's international clean energy partnerships,* www.dcceew.gov.au/climate-change/international-commitments/international-partnerships, viewed 6 June 2023.
34 Department of Climate Change, Energy, the Environment and Water, Submission 62,
35 Department of Climate Change, Energy, the Environment and Water, Submission 62, pp. 14, 18.
36 Department of Climate Change, Energy, the Environment and Water, Submission 62,
37 Australian Renewable Energy Agency, *Annual report 2021–22,* October 2022, p. 16.

> The Government has expanded ARENA's mandate to support energy efficiency and electrification technologies that can reduce emissions. To date, ARENA has committed $1.96 billion to 632 projects across Australia. For every $1 invested by ARENA, there has been $3.48 of co-investment resulting in total investment of $8.81 billion. Recently announced projects include AGL's feasibility study into integrating thermal energy storage into the Torrens B Power station, Yuri SPV's deployment of a 10MW hydrogen electrolyser powered by renewable energy in Karratha, and Alcoa's pilot program testing the technical and commercial feasibility of electrifying alumina refining through calcination.[38]

Clean Energy Finance Corporation

3.29 CEFC supports Australia's '… emissions reduction targets by mobilising capital investment in renewable energy, low-emissions technology and energy efficiency in Australia through commercial loans, equity investments, and in limited circumstances, loan guarantees.'[39] The Australian Government provided an additional $20.5 billion to CEFC to '… accelerate progress towards Australia's transition to net zero emissions by 2050.'[40] The funding will assist the delivery of the Rewiring the Nation program, the creation of the Household Energy Upgrades Fund and the Powering Australia Technology Fund.[41]

3.30 DCCEEW described the CEFC as '… a world leading example of a green bank' and noted its role supporting 'investment across solar, energy storage, bioenergy and wind.'[42] DCCEEW also highlighted:

> Over its 10 years of operation, the CEFC has made over $10.76 billion in lifetime commitments, with a lifetime private sector leverage of $2.42 for every $1 in CEFC funding spent. Recently announced projects include $175 million for Stage 1 of the Golden plains Wind Farm, $160 million in financing for the Southern Downs Renewable Energy Zone, and a further $10 million investment in Australian advanced electrolyser technology company Hysata, following an initial $750,00 investment in 2021.[43]

Net Zero Authority

3.31 In May 2023, the Hon Anthony Albanese MP, Prime Minister, the Hon Dr Jim Chalmers MP, Treasurer, and the Hon Chris Bowen MP, Minister for Climate Change

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38 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 10, citations omitted.

39 Climate Change, Energy, the Environment and Water portfolio, *Portfolio Budget Statements 2023–24 Budget Related Paper No. 1.3,* May 2023, p. 4.

40 Clean Energy Finance Corporation, 'Federal Government backs Australia's 'green bank' with $20.5 billion increase in investment capital', *Media Release,* 22 June 2023.

41 Clean Energy Finance Corporation, 'Federal Government backs Australia's 'green bank' with $20.5 billion increase in investment capital', *Media Release,* 22 June 2023.

42 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 10.

43 Department of Climate Change, Energy, the Environment and Water, Submission 62, pp. 10–11, citations omitted.

and Energy announced a National Net Zero Authority to be established through legislation.[44] The joint statement announcing the Net Zero Authority explained:

> The Authority will have responsibility for promoting the orderly and positive economic transformation associated with achieving net zero emissions.
>
> …
>
> The new legislated Net Zero Authority will:
>
> 1. Support workers in emissions-intensive sectors to access new employment, skills and support as the net zero transformation continues.
> 2. Coordinate programs and policies across government to support regions and communities to attract and take advantage of new clean energy industries and set those industries up for success.
> 3. Help investors and companies to engage with net zero transformation opportunities.

3.32 The Net Zero Economy Agency commenced on 1 July 2023 '… as an interim step whilst a statutory Net Zero Authority is established.'[45]

Industry, Science and Resources portfolio

3.33 Agencies across the Industry, Science and Resources portfolio work together to prepare and support Australia's domestic environment to succeed in Australia's transition to a green energy superpower. During the inquiry, the Committee received evidence from multiple agencies from the portfolio about their work supporting the transition and identifying new trade and investment opportunities, including the:

- Department of Industry, Science and Resources (DISR)
- Australian Nuclear Science and Technology Organisation (ANSTO)
- Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- Geoscience Australia.

Department of Industry, Science and Resources

3.34 DISR helps the Australian Government to build 'a productive, resilient and sustainable economy enriched by science and technology.'[46] DISR's work covers a vast range of industries with core roles in Australia's transition to a green energy superpower such as manufacturing, mining, oil, gas, science, technology and trade.

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44 Hon Anthony Albanese MP, Prime Minister, 'National Net Zero Authority'*, Media release,* 5 May 2023.

45 Department of the Prime Minister and Cabinet, *Net Zero Economy Agency Advisory Board – Terms of Reference*, www.pmc.gov.au/resources/net-zero-economy-agency-advisory-board-terms-reference, viewed 18 July 2023.

46 Department of Industry, Science and Resources, *Corporate plan 2022–23,* p. 1.

Critical minerals[47]

3.35 DISR is responsible for managing initiatives regarding Australia's critical minerals industry with the aim to position Australia as a world leader in exploration, extraction, production, and processing. These include:

- Critical Minerals Strategy
- Australian Critical Minerals Research and Development Hub
- Critical Minerals Development Program and the
- Critical Minerals Facility.[48]

3.36 The Critical Minerals Strategy 2023–2030[49] sets the vision to grow Australia's critical minerals sector with objectives to develop supply chains, build critical minerals processing capability, assist Australia's transition to a green energy superpower, and extract more value from Australia's resources onshore.[50]

3.37 DISR supported the Australia-India Economic Cooperation and Trade Agreement (AI-ECTA). The AI-ECTA promotes Australian minerals exports to India and improves access to a diversified market for Australia's critical minerals sector.[51] DISR also supports 'negotiations with the European Union to liberalise tariffs on goods that support the uptake of low and zero emission technologies and the transition towards climate neutrality.'[52]

Supporting Australian industry

3.38 DISR oversees the establishment of the National Reconstruction Fund (NRF). The NRF is a $15 billion fund that '… will provide finance in the form of loans, guarantees and equity for projects that diversify and transform Australia's industry and economy.'[53] DISR submitted:

> The Government has announced target investment levels for specific priority areas, including:
>
> - up to $3 billion for renewables and low emissions technologies;
> - $1 billion for value-adding in resources;
> - $1 billion for critical technologies, and;

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47 Some raw materials are defined as 'critical minerals' on the basis that they are both essential for modern technologies, economies or national security and that there is a risk of supply chain disruption or limited availability. Critical minerals were discussed in more detail in Chapter 2.

48 Department of Industry, Science and Resources, Submission 63, pp. 5–7.

49 The most recent Critical Minerals Strategy 2023–30 was published on 20 June 2023.

50 Department of Industry, Science and Resources, Critical Minerals Strategy 2023–30, https://www.industry.gov.au/publications/critical-minerals-strategy-2023-2030, viewed 19 July 2023.

51 Department of Industry, Science and Resources, Submission 63, p. 8.

52 Department of Industry, Science and Resources, Submission 63, p. 8.

53 Department of Industry, Science and Resources, *National Reconstruction Fund: diversifying and transforming Australia's industry and economy*, www.industry.gov.au/news/national-reconstruction-fund-diversifying-and-transforming-australias-industry-and-economy, viewed 23 June 2023.

- $1 billion for advanced manufacturing.

Through its investment in renewables and low emissions technologies, the NRF will support Australian industry to harness opportunities created by the transition to net-zero.[54]

3.39 As part of the Australian Made Battery Plan, DISR is leading development of Australia's National Battery Strategy to '… capture more value by manufacturing batteries end-to-end onshore.'[55] Public consultation seeking responses to an issues paper closed in March 2023.[56] The Australian Government, as part of the Australian Made Battery Plan, is also establishing an Australian-made Battery Manufacturing Precinct in partnership with the Queensland Government.[57] DISR is also establishing '… a Powering Australia Industry Growth Centre with industry to convert Australia's competitive advantages in renewables into local jobs and investment…'[58]

3.40 DISR manages the Major Projects Facilitation Agency, which provides information and assistance with regulatory approvals for major projects over $20 million.[59] DISR's submission explained:

> The majority of projects in the pipeline are within industries that support the transition to a green energy superpower, including offshore wind, renewable electricity generation and export, hydrogen and ammonia production and export, and carbon capture, use and storage.
>
> Through its facilitation services, the MPFA not only supports projects in the green economy space to navigate their regulatory approvals requirements, it also facilitates business intelligence capture and feeds this into relevant policy areas to support evidence-based policy development, including initiatives within DCCEEW and DFAT portfolios.[60]

Australian Nuclear Science and Technology Organisation

3.41 ANSTO manages Australia's nuclear infrastructure and research facilities and has '… world-leading expertise in the research and development of energy generation and storage systems and in the development and production of materials for use in

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54 Department of Industry, Science and Resources, Submission 63, p. 4–5. See also: Ms Rebecca Manen, Head, Manufacturing and National Reconstruction Fund Division, Department of Industry, Science and Resources, *Committee Hansard,* Canberra, 10 February 2023, p. 18.

55 Department of Industry, Science and Resources, Submission 63, p. 6.

56 Department of Industry, Science and Resources, *National Battery Strategy: issues paper*, consult.industry.gov.au/national-battery-strategy-issues-paper, viewed 19 July 2023.

57 Department of Industry, Science and Resources, Submission 63, p. 7. See also: Mr William Tan, Acting General Manager, National Reconstruction Fund Priorities Branch, Manufacturing and National Reconstruction Fund Division, Department of Industry, Science and Resources, *Committee Hansard,* Canberra, 10 February 2023, p. 12; Hon Ed Husic MP, Minister for Industry and Science, 'Supporting Australia's battery manufacturing industry to charge ahead,' *Media Release,* 3 February 2023.

58 Department of Industry, Science and Resources, Submission 63, p. 7.

59 Department of Industry, Science and Resources, *Major Projects Facilitation Agency*, www.industry.gov.au/major-projects-and-procurement/major-projects-facilitation-agency, viewed 26 June 2023.

60 Department of Industry, Science and Resources, Submission 63, p. 7.

those systems.'[61] ANSTO's submission summarised its expertise in minerals (including rare earths, lithium, speciality and rare minerals, and uranium), materials and manufacturing.[62]

Commonwealth Scientific and Industrial Research Organisation

3.42 CSIRO delivers science and technology to 'enable Australia's transition to a lower emissions energy future.'[63] CSIRO's research functions are progressing a number of projects that support Australia's energy transition. For example, CSIRO is working to accelerate commercial uptake of its technologies through Endua, which is developing '… electrolysers and hydrogen-based power generation systems specifically for the diesel replacement market for remote/off-grid and backup power applications'.[64]

3.43 CSIRO's research assists with identifying future trends and opportunities. As part of this, CSIRO is considering technologies that will meet different energy demand settings to improve energy security for remote communities and exploring how to optimise the digital transformation of the energy system.[65]

3.44 CSIRO also works with Austrade '… to attract investment to scale, grow and complement our research and science capability to effectively tackle global challenges.'[66] For example:

> … CSIRO together with Austrade arranged a delegation of industry and academics to visit… Japan, in December 2018. The visit served to highlight Australia's capabilities in electrochemical energy storage both in R&D [research and development] and in supply chains and opened doors to key companies in the Osaka region involved in energy storage materials and devices. More recently, Austrade supported the CSIRO-hosted International Meeting on Lithium Batteries… [in 2022] in Sydney, helping to promote the meeting through their offices overseas.[67]

3.45 Additionally, CSIRO entered strategic international partnerships to support Australia's energy transition such as with the National Science Foundation and the US Department of Energy labs including the National Renewable Energy Laboratory.[68]

3.46 CSIRO also has a range of Mission Programs that aim '… to build Australia's energy and resource security and competitiveness, while lowering emissions, through missions including the Hydrogen Industry Mission, Towards Net Zero Mission, Renewable Energy Powerhouse Mission and Smart Energy Mission.'[69]

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61 Australian Nuclear Science and Technology Organisation, Submission 34, p. 1.
62 Australian Nuclear Science and Technology Organisation, Submission 34.
63 Commonwealth Scientific and Industrial Research Organisation, Submission 66, p. 1.
64 Commonwealth Scientific and Industrial Research Organisation, Submission 66, p. 3.
65 Commonwealth Scientific and Industrial Research Organisation, Submission 66, p. 3.
66 Commonwealth Scientific and Industrial Research Organisation, Submission 66, p. 3.
67 Commonwealth Scientific and Industrial Research Organisation, Submission 66, p. 3.
68 Commonwealth Scientific and Industrial Research Organisation, Submission 66, p. 3.
69 Commonwealth Scientific and Industrial Research Organisation, Submission 66, p. 2.

Geoscience Australia

3.47 Geoscience Australia provides information about Australia's geology and geography for government, industry and community decision making through data and advice that assists Australia to address challenges and enhance opportunities.[70]

3.48 Geoscience Australia made a submission to the inquiry about the strategic opportunities it has identified to enhance Australia's competitive advantage as an investment destination to support its transition to a green energy superpower.[71] These opportunities included:

- Energy storage, including compressed air energy storage, battery energy storage, hydrogen storage
- Offshore wind
- Critical minerals
- Capture technologies, such as carbon capture and storage
- Digital platforms.[72]

3.49 Geoscience Australia's Exploring for the Future program '… helps to pinpoint new mineral deposits, identify potential locations for hydrogen and carbon storage, and discover naturally occurring sources of hydrogen… [T]his data drives exploration and helps to create the pipeline of new energy and resource projects required to support Australia's transition to net zero and grow the green economy.'[73]

Australia's trade and investment architecture

3.50 Australia has 18 bilateral and plurilateral FTAs that aim to reduce or eliminate certain barriers between economies in the trade of goods and services, as well as investment. Australia's FTAs are negotiated to benefit Australian exports, importers, producers and investors.[74] Australia's trade and investment architecture also includes engagement with international and regional trade and investment organisations such as the WTO, APEC, the Organisation for Economic Cooperation and Development, and the Group of 20.[75]

3.51 To support Australia's green energy transition DFAT is:

> … actively promoting Australia's network of free trade agreements [FTAs] to support two-way trade and investment flows for green energy, goods and

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70 Geoscience Australia, Submission 64, p. 4.
71 Geoscience Australia, Submission 64.
72 Geoscience Australia, Submission 64, pp. 12–17.
73 Department of Industry, Science and Resources, Submission 63, p. 4. See also: Geoscience Australia, Submission 64, p. 7.
74 Department of Foreign Affairs and Trade, *Australia's Free Trade Agreements (FTAs)*, www.dfat.gov.au/trade/agreements/trade-agreements, viewed 20 July 2023.
75 DFAT, Austrade and EFA, Submission 31, p. 6; Department of Foreign Affairs and Trade, *WTO, G20, OECD, APEC and IPEF*, www.dfat.gov.au/trade/organisations/wto-g20-oecd-apec, viewed 20 July 2023.

> services. FTAs can be utilised to attract inbound investment for domestic renewable infrastructure through creating certainty and predictability for investors that their investments into green energy overseas will be protected and compensated under international law.[76]

3.52 The Australian Government's commitment to meeting its net-zero targets and transitioning towards green energy is increasingly reflected in many of Australia's trade agreements.[77] Ms Juliana Nam, Assistant Secretary, Free Trade Agreements Policy and Economic Cooperation Branch at DFAT, explained that:

> We look to reduce and eliminate tariffs, of course, as well as the behind-the-border barriers but what we also seek to do in the new trade agreements is include more cooperative provisions on renewable energy, climate change action and environmental factors. It is early days, but we've got the platform in a number of these agreements… in four of our 16 FTAs, we do have specific provisions on such matters.[78]

3.53 Trade agreements such as the Australia-UK Free Trade Agreement and the Comprehensive and Progressive Agreement for Trans-Pacific Partnership contain provisions that commit to cooperation on clean and renewable energy.[79] Further, Parties agreed to include a Trade and Sustainable Development Chapter during upgrade negotiations held in 2022 for the ASEAN-Australia-New Zealand Free Trade Agreement.[80] DFAT submitted that economic cooperation activities, such as through '… the Regional Trade for Development initiative… can also focus on cooperation on green energy.'[81]

3.54 Australia is a member of the Minerals Security Partnership, which seeks to strengthen critical minerals supply chains for the global clean energy transition. Other countries participating in this partnership include Canada, Finland, France, Germany, Japan, the South Korea, Sweden, the UK, the US and the European Commission.[82] In addition, Australia has further strategic engagement on critical minerals with partners such as the US, Japan, South Korea, the UK, India and EU member states.[83]

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76 DFAT, Austrade and EFA, Submission 31, p. 6.

77 DFAT, Austrade and EFA, Submission 31, p. 6; Ms Juliana Nam, Assistant Secretary, Free Trade Agreements Policy and Economic Cooperation Branch, Free Trade Agreements and Stakeholder Engagement Division, Department of Foreign Affairs and Trade, *Committee Hansard,* Canberra, 23 November 2022, p. 7.

78 Ms Juliana Nam, Assistant Secretary, Free Trade Agreements Policy and Economic Cooperation Branch, Free Trade Agreements and Stakeholder Engagement Division, Department of Foreign Affairs and Trade, *Committee Hansard*, Canberra, 23 November 2022, p. 7.

79 DFAT, Austrade and EFA, Submission 31, pp. 6–7.

80 DFAT, Austrade and EFA, Submission 31, p. 7.

81 DFAT, Austrade and EFA, Submission 31, p. 7.

82 DFAT, Austrade and EFA, Submission 31, p. 6. See also: US Department of State, *Minerals Security Partnership,* www.state.gov/minerals-security-partnership/, viewed 13 June 2023.

83 DFAT, Austrade and EFA, Submission 31, p. 6.

3.55 Australia also has a range of low and zero-emissions technology partnerships with several countries. These are listed in Box 3.1 earlier in this chapter. DFAT supports these partnerships by '… promoting two-way trade and investment in green energy, goods and services, including skills and labour.'[84] DFAT explained in its joint submission with Austrade and EFA that existing trade and economic architecture 'can be leveraged, for example to minimise tariff and non-tariff barriers to trade, and to identify and ensure access to new markets for Australian exports[.][85]

3.56 DFAT also leads Australia's work in the WTO and APEC.[86] Australia cosponsored the Trade and Environmental Sustainability Structured Discussions in December 2021, which explored the role of trade in supporting the global response to climate change.[87] APEC is on track to achieve goals to double the share of renewables by 2023.[88]

Leveraging Australia's existing trade and investment architecture

3.57 Submitters and witnesses generally agreed that Australia should leverage existing trade relationships and agreements to drive the transition to a green energy superpower.[89] Mr Sam Guthrie, General Manager, Government and Policy Division at Austrade, told the Committee '… we are looking at… existing trade agreements and what can be done with the future of those.'[90]

3.58 Some submitters and witnesses suggested ways that DFAT, Austrade and EFA can enhance their support for Australia's transition to a green energy superpower. For example, Beyond Zero Emissions (BZE) recommended the Australian Government 'set green export investment as a priority for DFAT…'[91] BZE explained there is:

> … a key role for government departments such as… (DFAT) to help secure offtake agreements with countries such as Japan, South Korea, Taiwan, Europe and UK are existing trade partners, are renewable poor and have strong decarbonisation targets. There is also the opportunity to secure Australia's place in key renewable supply chains (e.g.. [sic] critical minerals, lithium-ion batteries, aluminium). Locking in strong trade partnerships builds investor confidence and can be further supported by agencies such as [EFA] and the Clean Energy Finance Corporation.[92]

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84 DFAT, Austrade and EFA, Submission 31, p. 6.
85 DFAT, Austrade and EFA, Submission 31, p. 6.
86 DFAT, Austrade and EFA, Submission 31, p. 7.
87 DFAT, Austrade and EFA, Submission 31, p. 7.
88 DFAT, Austrade and EFA, Submission 31, p. 7.
89 See, for example: Electric Vehicle Council, Submission 14, p. 4; Beyond Zero Emissions, Submission 32, pp. 3, 6; Grattan Institute, Submission 37, p. 10; Australian Conservation Foundation, Submission 50, pp. 6–7; Australia China Business Council, Submission 102, p. 14.
90 Mr Sam Guthrie, General Manager, Government and Policy Division, Australian Trade and Investment Commission, *Committee Hansard,* Canberra, 30 November 2022, p. 6.
91 Beyond Zero Emissions, Submission 32, p. 1.
92 Beyond Zero Emissions, Submission 32, p. 7.

3.59 The Australian Conservation Foundation suggested that DFAT and Austrade work with trading partners to develop '… arrangements that support both countries' critical minerals priorities, including supporting critical minerals investment and reliable supply.'[93]

3.60 The Grattan Institute suggested that Australia's free trade agreements could be revised beyond a focus on improved market access and two-way investment flows, specifically that:

> Australia should make better use of its trade and investment framework to secure access to the materials, equipment and labour we will need to reach our own net-zero ambitions and become a renewable energy superpower. This could mean accelerating tariff removals in free trade agreements, or establishing separate agreements with like-minded countries to secure supply chains.
>
> It should also revisit existing energy and resource co-operation agreements with Germany, India, Japan, Republic of Korea and Taiwan and identify pathways to move those agreements away from promoting coal and gas exports. Future agreements should focus on securing trade in areas of competitive advantage in a net-zero global economy; and securing Australia's access to the materials and technology we will need. Similarly, international partnerships on clean energy innovation should identify practical pathways to move beyond technical co-operation and towards greater trade.[94]

New innovative approaches to promoting green energy trade and investment

3.61 The Australian Government is pursuing new ways to create green energy trade and investment opportunities. DFAT is leading work to create innovative economic frameworks that '… seek to combine trade, economic and climate agendas.'[95]

3.62 Recent measures to promote green energy trade and investment include the:

- Singapore-Australia GEA
- Indo-Pacific Economic Framework
- Australia–United States Climate, Critical Minerals and Clean Energy Transformation Compact
- Australia–United States Net Zero Technology Acceleration Partnership
- future Australia–India Renewable Energy Agreement

3.63 A number of these partnerships and agreements capitalise on the economic and strategic benefits of countries' desire to secure resilient and diversified supply chains

93 Australian Conservation Foundation, Submission 50, p. 7.
94 Grattan Institute, Submission 37, p. 10.
95 DFAT, Austrade and EFA, Submission 31, p. 7.

for inputs needed in the green energy economy.[96] Global trends toward greater supply chain diversification are discussed later in this chapter.

3.64 Several submitters mentioned the need for a greater focus on climate change in Australia's foreign policy and diplomacy.[97] The Climate Council recommended the Australian Government invest in climate diplomacy and suggested that the role of DFAT and Austrade 'must explicitly be redefined – to use Australia's diplomatic resources to promote clean energy exports and to pursue an ambitious climate agenda.'[98] Dr Simon Bradshaw, Research Director, Projects at the Climate Council, elaborated:

> … we really need to make sure our whole trade and foreign policy is fully aligned with climate and energy goals. That could mean giving a further boost to our climate diplomacy capabilities, climate and energy specialists and all the key missions to make sure we're really promoting opportunities for Australian clean exports and understanding what we need to do to help unlock some of those markets.[99]

3.65 Similarly, Mr James Bowen suggested that the Australia Government should 'develop an Indo-Pacific-centric clean energy diplomacy program' that could 'facilitate continued growth, and formation of new, cross-border partnerships to develop supply chains and provide financial and technical support to developing economies.'[100]

Singapore-Australia Green Economy Agreement

3.66 The Singapore-Australia GEA, signed in October 2022, builds on Australia's bilateral relationship with Singapore and existing areas of cooperation: the Singapore-Australia Free Trade Agreement, Low Emissions Solutions Memorandum of Understanding and the 2021 Australia-Singapore Partnership on Hydrogen for Maritime Use.[101] DFAT summarised the GEA:

> … is a first-of-its-kind agreement that combines trade, economic and climate change policy objectives. The GEA facilitates green trade and investment by developing a foundational list of environmental goods and services based off existing APEC and WTO lists. This list will ensure the prioritisation of these goods and services in facilitating two-way trade flows between Australia and Singapore to accelerate the decarbonisation of our respective economies. The GEA also includes a bilateral mechanism to identify and address non-tariff

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96 DFAT, Austrade and EFA, Submission 31, p. 2; Ms Helen Stylianou, First Assistant Secretary, Trade Resilience and Indo-Pacific Economic Cooperation Division, Department of Foreign Affairs and Trade, *Committee Hansard,* Canberra, 23 November 2022, p. 3.

97 Climate Council, Submission 36, pp. 8–9; Australian Conservation Foundation, Submission 50, pp. 6–7; Coalition for Conservation, Submission 75, p. 3; James Bowen, Submission 115, p. 2.

98 Climate Council, Submission 36, pp. 8–9.

99 Dr Simon Bradshaw, Research Director, Projects, Climate Council, *Committee Hansard,* Melbourne, 6 April 2023, p. 10. See also, Climate Council, Submission 36, p. 1.

100 James Bowen, Submission 115, p. 2.

101 See: DFAT, *Singapore-Australia Green Economy Agreement*, www.dfat.gov.au/geo/singapore/singapore-australia-green-economy-agreement, viewed 13 June 2023.

> barriers to the trade of environmental goods and services. The agreement serves as a potential model for international cooperation on the green economy with other countries.[102]

3.67 The Committee received evidence that highlighted the GEA as a positive step supporting Australia's transition to a green energy superpower.[103] For example, the Export Council of Australia explained:

> Such deals help open markets and facilitate trade in environmental goods and services, including by having consistent regulations and standards across partner countries, and building goodwill through grant funding of joint projects. Similar agreements must be pursued or extended to other parties.[104]

3.68 Mr Guthrie from Austrade told the Committee that the GEA is '… a new type of agreement that Australia hasn't done before. I think that it sets a model that can be used elsewhere, including, importantly, across South-East Asia.'[105]

3.69 Sun Cable 'applauded' the GEA and recommended the Australian Government negotiate more green economy agreements with partners across the Indo-Pacific, such as Indonesia.[106] The Australia China Business Council suggested Australia should consider a green economy agreement with China.[107]

Indo-Pacific Economic Framework

3.70 The IPEF aims to build cooperation and economic integration in the Indo-Pacific.[108] Formal negotiations commenced in September 2022 across four areas, including trade (and digital trade); supply chains; clean energy, decarbonisation; and infrastructure and tax and anti-corruption.[109] DFAT told the Committee the IPEF:

> … presents a flexible and innovative framework for Australia to work with its key partners in the Indo-Pacific on shared interests in diversifying clean energy supply chains and advancing decarbonisation and clean energy transition agendas. IPEF members include India, Indonesia, Japan, [South Korea], Singapore, [US], Fiji, Malaysia, New Zealand, Philippines, Thailand, Vietnam, and Brunei.[110]

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102 DFAT, Austrade and EFA, Submission 31, p. 7.

103 See, for example: Sun Cable, Submission 71, pp. 3,9; Export Council of Australia Submission 72, p. 3; Australian National University Zero Carbon Energy for the Asia-Pacific Initiative, Submission 98, p. 7.

104 Export Council of Australia, Submission 72, p. 3.

105 Mr Sam Guthrie, General Manager, Government and Policy Division, Australian Trade and Investment Commission, *Committee Hansard,* Canberra, 30 November 2022, p. 6.

106 Sun Cable, Submission 71, pp. 3, 9.

107 Mr David Olsson, National President and Chair, Australia China Business Council, *Committee Hansard,* Macquarie Park, 6 April 2023, p. 30; Mr Anthony Coles, Net Zero Working Group, Australia China Business Council, *Committee Hansard,* Macquarie Park, 6 April 2023, p. 30.

108 DFAT, Austrade and EFA, *Indo-Pacific Economic Framework*, www.dfat.gov.au/trade/organisations/wto-g20-oecd-apec/indo-pacific-economic-framework, viewed 13 June 2023.

109 DFAT, *Indo-Pacific Economic Framework*, www.dfat.gov.au/trade/organisations/wto-g20-oecd-apec/indo-pacific-economic-framework, viewed 13 June 2023.

110 DFAT, Austrade and EFA, Submission 31, pp. 7–8.

3.71 IPEF negotiations have a focus on supporting '… clean energy, to develop new standards for the membership of that agreement.[111]

3.72 The Australian National University Zero Carbon Energy for the Asia-Pacific Initiative suggested that Australia build on low-emissions technology partnerships and the GEA, including through the Green Economy Pillar of the IPEF. Specifically, it was recommended that Australia use international green economy collaborations 'to minimise unnecessary barriers to trade and investment arising from poor co-ordination of domestic initiatives and regulation' as well as 'to address market failures… that inhibit the growth of cross border green supply chains.'[112]

Australia–United States Climate, Critical Minerals and Clean Energy Transformation Compact

3.73 In May 2022, Australia and the US agreed to a Climate, Critical Minerals and Clean Energy Transformation Compact, which established climate and clean energy as a central pillar of the Australia–US alliance.[113] The Compact seeks to:

- Accelerate expansion and diversification of end-to-end clean energy supply chains
- Promote responsible, sustainable and stable supply of critical minerals
- Drive development of emerging battery technologies
- Support development of emerging markets for clean hydrogen and its derivatives.[114]

Australia–United States Net Zero Technology Acceleration Partnership

3.74 The Hon Chris Bowen MP, Minister for Climate Change and Energy, and Jennifer M. Granholm, US Secretary of Energy, announced the Australia–United States Net Zero Technology Acceleration Partnership in July 2022.[115] The partnership will '… accelerate the development and deployment of zero emissions technology and cooperate on critical minerals supply chains to reduce greenhouse gas emissions while supercharging economic growth.'[116]

Future Australia–India Renewable Energy Agreement

3.75 Further to the Australia–India Letter of Intent on New and Renewable Energy Technology (see Box 3.1 later in this chapter), DFAT is also working to develop a

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111 Ms Helen Stylianou, First Assistant Secretary, Trade Resilience and Indo-Pacific Economic Cooperation Division, Department of Foreign Affairs and Trade, *Committee Hansard,* Canberra, 23 November 2022, p. 3.

112 Australian National University Zero Carbon Energy for the Asia-Pacific Initiative, Submission 98, pp. 7–8.

113 Hon Anthony Albanese, Prime Minister, 'Australia-United States Climate, Critical Minerals and Clean Energy Transformation Compact', *Media Release,* 20 May 2023.

114 Hon Anthony Albanese, Prime Minister, 'Australia-United States Climate, Critical Minerals and Clean Energy Transformation Compact', *Media Release,* 20 May 2023.

115 Hon Chris Bowen MP, Minister for Climate Change and Energy, 'Joint media release: Australia and US join forces on path to net zero', *Media Release,* 12 July 2022.

116 Hon Chris Bowen MP, Minister for Climate Change and Energy, 'Joint media release: Australia and US join forces on path to net zero', *Media Release,* 12 July 2022.

'… renewable energy partnership with India to enhance cooperation on the production and deployment of renewable technologies…'[117]

Key trade and investment trends

3.76 There are a number of trade and investment trends driving activity in the global trade environment, namely a desire for supply chain diversification, competition for green energy industries, and carbon border tariffs. These developments may present both opportunities and challenges for Australia's green energy superpower transition.

Supply chain diversification

3.77 Submitters highlighted the desire for countries to diversify from highly concentrated global supply-chains for many low-emissions technologies as an important trend shaping the global trade and investment environment.[118] The COVID-19 pandemic and the invasion of Ukraine by Russia have also played a role in highlighting global supply chain risks.[119]

3.78 Supply chain vulnerabilities were identified in relation to the critical minerals, solar photovoltaic (PV), wind turbines and battery supply chains.[120] Highlighting an example of supply chains concentration, the Australian Conservation Foundation stated that in 2019 China's market share of the critical minerals processing industry was 65 per cent for cobalt, 58 per cent for lithium and 87 per cent for rare earths.[121] DCCEEW also advised that: 'China has over 80% market share of the solar manufacturing stages from the production of polysilicon to panels.'[122]

3.79 The high level of concentration was noted to increase the risk of supply chain disruption, the ability to influence markets, and create critical dependencies for decarbonisation and the green energy transition.[123] As a result, DCCEEW observed that: 'Major economies are looking to improve the resilience of these supply chains

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117 Mr David Woods, First Assistant Secretary, Chief Economist, International Economics and Green Economy Division, Department of Foreign Affairs and Trade, *Proof Hansard,* Canberra, 23 June 2023, p. 17.

118 See, for example: Electric Vehicle Council, Submission 14, p. 5; Advanced Materials and Battery Council, Submission 16, p. 4; University of Queensland, Submission 26, p. 10, citation omitted; DFAT, Austrade and EFA, Submission 31, p. 5; Climate Council, Submission 36, p.4; Australian Conservation Foundation, Submission 50, p. 4; Boundless Earth, Submission 76, p. 1; James Bowen, Submission 115, p. 1–2.

119 Electric Vehicle Council, Submission 14, p. 5; University of Queensland, Submission 26, p. 6; DFAT, Austrade and EFA, Submission 31, p. 5; Sun Cable, Submission 71, p. 11; Mr James Bowen, Submission 115, p. 1.

120 The University of Queensland, Submission 26, pp. 9–10; Climate Council, Submission 36, p. 4; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 5; James Bowen, Submission 115.1, p. 13.

121 Australian Conservation Foundation, Submission 50, p. 4.

122 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 3, citation omitted.

123 The University of Queensland, Submission 26, p. 9; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 5; James Bowen, Submission 115.1, pp. 11–12.

by identifying and scaling diverse innovative and alternative sources of clean energy technology components.'[124]

3.80 The focus on building diverse and resilient green energy supply chains presents significant opportunities for Australia.[125] Mr Andrew Morris, Manager, Trade and Investment at Austrade, explained that: 'Countries like Germany are now looking, as the rest of Europe is, to remove themselves from a single-supply relationship with countries like Russia, for example, and looking at alternative like-minded partners like Australia.'[126]

3.81 The Advanced Materials and Battery Council expressed a similar view: 'As China dominates global manufacturing, companies in Europe and North America wish to build resilience to reliance on a single supplier. Private and government investors are actively seeking opportunities in and partnerships with ideologically aligned countries like Australia.'[127]

3.82 Boundless Earth suggested that: '[Australia] can benefit from our international partners' push to diversity global supply chains – including by our key trading partners in the Asia-Pacific, the European Union, United States and other Quad members.'[128]

3.83 The Climate Council identified supply chain diversification as a motivator for the introduction of the US Inflation Reduction Act 2022 (IR Act) (discussed later in this chapter).

> The US legislation [IR Act] is intended in part to address China's dominance over global clean energy supply chains, including the supply of clean energy technology and components to the US market.

3.84 DCCEEW observed a broader connection to energy security:

> Energy security is now firmly linked to the energy transition, with major economies taking significant steps to shore up their energy security and resilience, and reduce emissions at the same time. Clean energy, particularly in the form of renewables, is seen as a way to achieve both of these aims.[129]

3.85 Mr Warren Hauck, Acting First Assistant Secretary at DFAT, noted that previous experience is informing decisions in the formation of green energy supply chains:

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124 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 5.

125 Advanced Materials and Battery Council, Submission 16, p. 4; Climate Council, Submission 36, pp. 4–5; Department of Climate Change, Energy, the Environment and Water, Submission 62, pp. 5–6; James Bowen, Submission 115, pp. 1–2.

126 Mr Andrew Morris, Manager, Trade and Investment, Australian Trade and Investment Commission, *Committee Hansard*, Canberra, 30 November 2022, p. 3.

127 Advanced Materials and Battery Council, Submission 16, p. 4.

128 Boundless Earth, Submission 76, p. 1.

129 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 5.

> If I could use the EU as an example, they have recognised that their reliance on Russian energy has been a significant problem, so diversifying the supply chains for the renewable sector is fundamental to their approach moving forward.[130]

3.86 Mr James Bowen indicated that there may be more than diversification motivating a country's choice of trading-relationships:

> What's interesting is that if you look at Japan's relationship with us, Japan has about the same level of dependence on Australian gas, through LNG [liquefied natural gas], as Europe did on Russian gas. So its not really about the dependence you have on a single supplier, its about the trustworthiness of that supplier.[131]

Green energy superpower competition

3.87 Countries such as the US, Canada, Chile and Saudi Arabia also have potential to meet increased global demand for green energy and have expressed green energy superpower ambitions.[132] Japan, South Korea, and the EU have additionally been identified as having potential to lead in the future global green economy.[133]

3.88 DFAT, Austrade and EFA advised that: 'Some of these competitors are injecting significant economic stimulus into their clean energy transition and building their clean energy export sectors.'[134] Measures seeking to attract green energy investment in these countries are presented in Box 3.2 below.

Box 3.2 Measures attracting green energy investment in countries with potential to be leaders in the green economy

- Canada: C$100 billion invested for climate action and 'clean growth' since 2015; investment tax credits to be introduced for renewable energy technologies.[135]
- Chile: 20 per cent of energy is generated by renewables; all coal-fired power plants to be closed by 2040; US$77 million Investment Plan targeted at stimulating market development.

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130 Mr Warren Hauck, Acting First Assistant Secretary, Trade Resilience and Indo-Pacific Economic Cooperation Division, Department of Foreign Affairs and Trade, *Proof Hansard*, Canberra, 23 June 2023, p. 21.

131 Mr James Bowen, Policy Fellow, Perth USAsia Centre, *Committee Hansard*, Perth, 17 March 2023, p. 28.

132 DFAT, Austrade and EFA, Submission 31, pp. 4–5. See also: Mr David Woods, Chief Economist and First Assistant Secretary, International Economics and Green Economy Division, Department of Foreign Affairs and Trade, *Committee Hansard*, Canberra, 23 November 2022, p. 6; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 6.

133 DFAT, Austrade and EFA, Submission 31.2, pp. 1–2.

134 DFAT, Austrade and EFA, Submission 31, pp. 3–4.

135 Government of Canada, *Minister Guilbeault highlights the big five new Clean Investment Tax Credits in Budget 2023 to support sustainable made-in-Canada clean economy,* www.canada.ca/en/environment-climate-change/news/2023/04/minister-guilbeault-highlights-the-big-five-new-clean-investment-tax-credits-in-budget-2023-to-support-sustainable-made-in-canada-clean-economy.html, viewed 4 July 2023.

- EU: European Green Deal Investment Plan (also referred to as the Sustainable Europe Investment Plan), which includes the Just Transition Mechanism initiative to target a fair green transition.
- Japan: Green Growth Strategy through Achieving Carbon Neutrality in 2050, which includes a US$16 billion Green Innovation Fund to assist Japan to achieve carbon neutrality by 2050.
- Saudi Arabia: SR700 billion Saudi Green Initiative; US$2.5 billion to support Middle East Green Initiative projects and governments.
- South Korea: Green New Deal, a techno-industrial transformation strategy valued at US$61.9 billion to strengthen South Korean exports of the future.
- US: Introduction of the IR Act in 2022, a US$391 billion package of incentives to drive 'clean energy' generation and manufacturing and reduce US greenhouse gas emissions to between 30 and 44 per cent by 2023.

3.89 Other measures noted in submissions included export controls on Indonesian nickel,[136] REPowerEU Plan[137] and European Rules of Origin regarding originating battery packs.[138]

3.90 Submitters acknowledged that policy measures taken by other countries may increase competition and divert capital, materials and equipment, and skilled labour that Australia requires to build its nascent industries and realise its green energy superpower potential.[139]

United States Inflation Reduction Act

3.91 The introduction of the IR Act in 2022 was widely identified as accelerating US decarbonisation and being a globally significant policy in the green energy transition.[140] DFAT explained the IR Act '… includes an estimated USD391 billion package of incentives to drive clean energy generation and manufacturing; energy efficiency improvements; and industrial decarbonisation in the US.'[141]

136 Future Battery Industries Cooperative Research Centre, Submission 46, p. 1.
137 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 6.
138 Future Battery Industries Cooperative Research Centre, Submission 46, p. 1.
139 See, for example: DFAT, Austrade and EFA, Submission 31, pp. 4–5; Clean Energy Council, Submission 38, p. 3; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 6; Mr James Bowen, Submission 115.1, p. 23.
140 See, for example: DFAT, Austrade and EFA, Submission 31, p. 4; Climate Council, Submission 36, p. 4; Clean Energy Council, Submission 38, p. 3; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 6; Mr Eytan Lenko, Chief Executive Officer, Boundless Earth, *Committee Hansard,* Melbourne, 5 April 2023, p. 22; Dr Fiona Simon, Chief Executive Officer, Australian Hydrogen Council, *Committee Hansard,* Melbourne, 5 April 2023, p. 22; Ms Anna Freeman, Policy Director, Decarbonisation, Clean Energy Council, *Committee Hansard,* Melbourne, 5 April 2023, p. 52; Dr Simon Bradshaw, Research Director, Projects, Climate Council, *Committee Hansard,* Melbourne, 5 April 2023, p. 10.
141 DFAT, Austrade and EFA, Submission 31.2, p. 1.

3.92 DCCEEW told the Committee about the IR Act's significance to the global energy transition:

> The IR Act is fundamentally reshaping the US tax system to incentivise the manufacturing industry and clean energy generation critical to achieving net zero emissions by 2050, transforming the operating context for business at an economy-wide level. It is an historic inflection point in the global energy transformation.[142]

3.93 A submission from Fortescue Future Industries highlighted how the IR Act will generate green energy investment:

> The recent [US] Government passage of the [IR Act] is the prime example of government intervention that will attract green technology and green energy investment at scale – and spur the creation of significant numbers of jobs across regional [US] – to set the conditions to create a globally dominating green energy industry in that country. The [IR Act] establishes tax credits and funding that is available for green manufacturing, renewable energy and low emissions hydrogen production that is estimated to reach US$374 billion. However, the production tax credits are uncapped, so in reality a much greater level of support to green hydrogen and green ammonia production in the [US] could be provided.[143]

3.94 Submitters advised that the IR Act will attract capital, technology, and labour to the US, with the potential to impact on Australia's green energy opportunities such as value-added manufacturing and hydrogen production.[144] The Committee received evidence suggesting that the IR Act may already be influencing decision making and investment decisions to Australia's disadvantage.[145]

3.95 It was noted that the IR Act is particularly focussed on the creation of local industries to fulfil domestic needs, rather than building export-oriented industries.[146]

3.96 As well as challenges, the Climate Council observed significant opportunities for Australia presented by the IR Act:

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142 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 6.

143 Fortescue Future Industries, Submission 93, p. 5.

144 See, for example: DFAT, Austrade and EFA, Submission 31, p. 5; Beyond Zero Emissions, Submission 32, p. 9; Australian Hydrogen Council, Submission 39, p. 3; Woodside Energy, Submission 47, p. 3; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 6; Fortescue Future Industries, Submission 93, p. 5; James Bowen, Submission 115, p. 2.

145 See, for example: Woodside Energy, Submission 47, p. 3; Mr Wayne smith, External Affairs Manager, Smart Energy Council, *Committee Hansard*, Canberra, 31 March 2023, p. 23; Professor Frank Jotzo, Director, Zero Carbon Energy for the Asia-Pacific Initiative, Australian National University, *Committee Hansard*, Canberra, 31 March 2023, p. 47; Ms Sanaya Khisty, Chief Strategy Officer, Beyond Zero Emissions, *Committee Hansard*, Melbourne, 5 April 2023, p. 29; Mr David Woods, First Assistant Secretary and Chief Economist, Department of Foreign Affairs and Trade, *Proof Hansard*, Canberra, 23 June 2023, p. 20.

146 Professor Frank Jotzo, Director, Zero Carbon Energy for the Asia-Pacific Initiative, *Committee Hansard*, Canberra 31 March 2023, p. 47.

> The [IR Act] legislation contains provisions for 'friendshoring' production, as part of a strategy of diversifying clean energy supply chains away from China. Carve-outs to local content provisions under the legislation include international partners that have signed free trade agreements with the US, such as Australia. This provides potentially lucrative opportunities for Australia to export critical minerals and develop value-added clean energy production for export to the [US] (including for example, by moving up the value chain for battery production).[147]

3.97 Similarly, BZE highlighted opportunities for Australia as a free-trade partner, particularly in supplying critical minerals.[148]

3.98 Mr Shannon O'Rourke, Chief Executive Officer at the Future Battery Industries CRC described the IR Act's subsidies as a 'double-edged sword' and explained that 'They are advantageous because they improve demand for our upstream industries but disadvantageous because they take away investment from our midstream and downstream industries.'[149]

3.99 Mr James Bowen expressed a similar view:

> There is assured to be increased ability to attract investment in critical minerals to service other countries' manufacturing desires. The IRA [IR Act], for example, allows US companies to source inputs from free trade agreements partners (such as Australia) where domestic capacity is lacking…
>
> There could, on the other hand, be increasingly strong competition for capital, labour and other inputs necessary to develop Australia's strengths in key sectors. There is assured to be an influx of new entrants to international markets where Australian companies are looking to build strong positions.[150]

3.100 Some submitters and witnesses suggested that Australia should consider developing its own version of the IR Act, or adopt aspects of the IR Act, to assist its transition to a green energy superpower.[151] For example, the Australian Hydrogen Council recommended 'Investment attraction mechanisms in the vein of the US Inflation Reduction Act. These could include fiscal or other incentives to draw foreign capital to Australia…'[152] Potential mechanisms to support emerging industries and technologies are discussed further in Chapter 5.

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147 Climate Council, Submission 36, pp. 4–5, citations omitted.

148 Beyond Zero Emissions, Submission 32, pp. 8–9.

149 Mr Shannon O'Rourke, Chief Executive Officer, Future Battery Industries CRC, *Committee Hansard,* Perth, 17 March 2023, p. 19.

150 James Bowen, Submission 115, p. 2.

151 See, for example: Climate Council, Submission 36, p. 10; Australian Hydrogen Council, Submission 39, p. 5; Marghanita Johnson, Chief Executive Officer, Australian Aluminium Council, *Committee Hansard,* Canberra, 31 March 2023, p. 3; Mr Wayne Smith, External Affairs Manager, Smart Energy Council, *Committee Hansard,* Canberra, 31 March 2023, p. 26; Mr Craig Nichol, Chair, Advanced Materials and Battery Council; and Founder, Managing Director and Chief Executive Officer, Graphene Manufacturing Group, *Committee Hansard,* Brisbane, 16 May 2023, 1.

152 See, for example: Australian Hydrogen Council, Submission 39, p. 5; Boundless Earth, Submission 76, p. 3.

3.101 Mr James Bowen noted that other jurisdictions including the EU have pledged to implement measures in response to the IR Act.[153]

Carbon border tariffs

3.102 The introduction of carbon border tariffs,[154] such as the EU Carbon Border Adjustment Mechanism (CBAM), were identified by some submitters and witnesses as having a potential impact on the global trade environment and on Australia's exports.[155] The EU CBAM is scheduled to commence in October 2023,[156] and will initially apply to cement, iron, steel, aluminium, fertilisers, electricity and hydrogen products such as ammonia imported into the EU.[157]

3.103 Several submitters suggested that a wider introduction of carbon border tariffs and similar policies could reduce Australia's export competitiveness and pose a greater risk to Australia's high carbon content exports.[158] For example, Dr Bradshaw at the Climate Council told the Committee:

> … we're going to see more of these carbon border adjustment mechanisms. The EU's is the first cab off the rank. We know there has been significant consideration within the Biden administration and various other key markets. So I think we'll see more of these, and that's going to start to change that trade

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153 James Bowen, Submission 115, p. 2.

154 A carbon border tariff is a tax placed on imported products based on the embodied emissions content of that product, aimed at pricing emissions into imports at a level equivalent to a carbon price incurred by domestic producers. The purpose is to provide a level playing field for domestic producers, remove incentives to relocate production offshore and prevent emissions leakage whereby demand is substituted for cheaper, higher emissions imported products with no overall reduction in emissions. See, for example: Climate Council of Australia, Submission 36, p. 5; Climate Council of Australia, Submission 36.1, p. 13, citation omitted; Grattan Institute, Submission 37, p. 11; Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, p. 7.

155 See, for example: DFAT, Austrade and EFA, Submission 31, p. 3; Climate Council, Submission 36, p. 5; Grattan Institute, Submission 37, p. 11; Australian Hydrogen Council, Submission 39, p. 4; Australian Conservation Foundation, Submission 50, p. 6; The Next Economy, Submission 51, p. 7; WWF-Australia, the Business Council of Australia, the Australian Council of Trade Unions and the Australian Conservation Foundation, Submission 67, Attachment 1, p. 8; Coalition for Conservation, Submission 75, p. 3; Boundless Earth, Submission 76, p. 1; Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, p. 7; Mr Rowan Moorey, Senior Researcher, Beyond Zero Emissions, *Committee Hansard,* Melbourne, 5 April 2023, p. 29; Dr Simon Bradshaw, Research Director, Projects, Climate Council, *Committee Hansard,* Macquarie Park, 6 April 2023, p. 11; Mr Matthew Hingerty, Deputy Chair, Deputy Chief Executive Officer and Head of Business Development, Star Scientific, *Committee Hansard,* Brisbane, 16 May 2023, p. 32.

156 At commencement in October 2023 reporting and monitoring obligations will apply before the mechanism commences in full from 2026 when exporters will need to declare annually the quantity of goods exported into the European Union, and the level of embedded greenhouses gas emissions.

157 See, for example: The Next Economy, Submission 51.2, pp. 150–151; Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, pp. 1, 7.

158 Climate Council, Submission 36, p. 5; Climate Council, Submission 36.1, p. 13, citation omitted; DFAT, Austrade and EFA, Submission 31, p. 3; Australian Hydrogen Council, Submission 39, p. 4; Australian Conservation Foundation, Submission 50, p. 3; The Next Economy, Submission 51, p. 7; WWF-Australia, the Business Council of Australia, the Australian Council of Trade Unions and the Australian Conservation Foundation, Submission 67.1, p. 4; Coalition for Conservation, Submission 75, p. 3; Boundless Earth, Submission 76, p. 1.

> environment generally. We are also seeing a trend towards carbon pricing regimes generally, globally. I think it's one of those things that will progressively become more of reality.[159]

3.104 Mr David Olsson, National President and Chair of the Australia China Business Council, suggested that EU CBAM '… will add significant cost to our [Australian] exports unless we can demonstrate that we have lowered our carbon usage…'[160] However, DFAT, Austrade and EFA stated that as currently designed the EU CBAM is not likely to have a substantial impact on Australia's exports, while acknowledging that it may have a greater impact if its scope is expanded.[161]

3.105 Star Scientific noted the potential for carbon border tariffs may already be a factor in driving some businesses to reduce the carbon content of their products to limit their exposure to future measures.[162] Speaking about the EU CBAM, Mr Matthew Hingerty, Deputy Chair, Deputy Chief Executive and Head of Business Development at Star Scientific, advised that a common view among a lot of producers of food and other manufacturers is that 'it's coming their way, and they need to find a way to remove carbon from their products.'[163]

3.106 A wider introduction of carbon border tariffs could present significant opportunities and be to Australia's advantage.[164] This is because Australia has the potential to produce many of the products likely subject to carbon border tariffs with considerably lower embodied emissions than other countries, thereby increasing the demand for Australian exports. Mr Tony Wood, Program Director of Energy and Climate Change at the Grattan Institute, described that: 'Those sorts of mechanisms are more likely to be things that level the playing field – but to our advantage, if we get it right.'[165]

3.107 DCCEEW advised that reforms to the Australian Government's Safeguard Mechanism, which provides a framework to reduce the emissions of large industrial facilities,[166] will reduce exposure to carbon border tariffs:

> By establishing a stable and predictable framework to drive emissions reductions, the reforms to the Safeguard Mechanism will strengthen the international competitiveness of our industry as the global economy.

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159 Dr Simon Bradshaw, Research Director, Projects, Climate Council, *Committee Hansard,* Macquarie Park, 6 April 2023, p. 11.

160 Mr David Olsson, National President and Chair, Australia China Business Council, *Committee Hansard*, Macquarie Park, 6 April 2023, p. 32.

161 DFAT, Austrade and EFA, Submission 31, p. 3.

162 Star Scientific, Submission 25, p. 3.

163 Mr Matthew Hingerty, Deputy Chair, Deputy Chief Executive Officer and Head of Business Development, Star Scientific, *Committee Hansard*, Brisbane, 16 May 2023, p. 32.

164 Mr Tony Wood, Program Director Energy and Climate Change, Grattan Institute, *Committee Hansard*, Melbourne, 5 April 2023, p. 8; Mr Rowan Moorey, Senior Researcher, Beyond Zero Emissions, *Committee Hansard*, Melbourne, 5 April 2023, p. 29.

165 Mr Tony Wood, Program Director Energy and Climate Change, Grattan Institute, *Committee Hansard*, Melbourne, 5 April 2023, p. 8.

166 The Safeguard Mechanism limits the emissions of large industrial facilities producing more than 100,000 tonnes of carbon dioxide equivalent (t CO_2-e) each year, covering around 215 facilities. Emissions limits, known as baselines, will gradually and predictably decline on a trajectory to net-zero by 2050.

> Reducing emissions will also help to protect Australian industry against transition risks arising from global climate action. These include potential trade measures, such as the European Union's proposed Carbon Border Adjustment Mechanism, and reduced access to private capital due to investors limiting their own exposure to risk.[167]

3.108 Submitters noted that as Australian industry decarbonises it may face higher costs than producers elsewhere, potentially to the disadvantage of domestic producers subject to import competition. As such, evidence indicated it may be appropriate for Australia to consider the introduction of a carbon border tariff or similar measure to ensure domestic producers are not disadvantaged.[168] The Grattan Institute suggested that such measures may be more suitable in the long-term than providing ongoing assistance to trade-exposed domestic producers.[169]

Committee comment

3.109 The Committee acknowledges the wide range of work across Australian Government departments and agencies contributing to Australia's green energy superpower transition. Given the vast activities underway across government to support Australia's energy transition, the Committee welcomed the announcement of the intention to establish a Net Zero Authority to '… have responsibility for promoting the orderly and positive economic transformation associated with achieving net zero emissions.'[170]

3.110 The Committee notes that Australian Government departments and agencies used varying terminology in their evidence to the inquiry to broadly refer to 'green energy', such as 'renewable energy', 'clean energy' and 'low emissions'. The Committee believes that greater consistency in terminology and definition use across the Australian Government would assist to ensure policy coordination.

3.111 The Committee appreciates that Department of Foreign Affairs and Trade, Austrade and Export Finance Australia are leveraging Australia's existing trade and investment architecture to assist Australia's transition to a green energy superpower. The Committee was particularly pleased to see that Australia has already entered into and is looking to pursue further new and innovative agreements and partnerships to accelerate Australia's green energy superpower transition. Such mechanisms must focus on Australia's comparative advantages, as well as seeking to further capitalise on Australia's position as a preferred trading partner and trends toward supply chain diversification.

3.112 The Committee recognises potential for greater alignment of Australia's foreign policy and diplomatic program with Australia's green energy superpower ambitions. A

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167 Department of Climate change, Energy, the Environment and Water, Submission 62, p. 15.

168 Grattan Institute, Submission 37, p. 11; Dr Simon Bradshaw, Research Director, Projects, Climate Council, *Committee Hansard*, Macquarie Park, 6 April 2023, p. 11.

169 Grattan Institute, Submission 37, p. 11.

170 Hon Anthony Albanese MP, Prime Minister, 'National Net Zero Authority', *Media release,* 5 May 2023.

diplomatic program focussed on strong climate change action and leading the development of global green energy supply chains could enhance Australia's strategic interests, particularly in the Asia-Pacific region.

3.113 The Committee notes that while Australia is endowed with many natural and developed strengths, other countries such as the US, Canada, Chile and Saudi Arabia are also progressing their green energy transition with superpower ambitions. The Committee encourages Australia to identify ways to capitalise on its early mover advantage to maximise its green energy capability and take to advantage of the opportunity to be a regional, and ultimately, global leader in the future green economy.

3.114 The Committee acknowledges the potential impact of carbon border tariffs on Australian exports. While current exposure may be limited, and the Safeguard Mechanism reforms may further reduce exposure, it will be important to monitor and understand the risks and opportunities for Australian exports. This will be particularly important if the scope of the EU CBAM expands and if carbon border tariffs are introduced in other jurisdictions.

3.115 The Committee also has some concern that Australia's stronger emissions reduction commitments could expose domestic producers to cheaper imports from countries not taking equivalent climate action and result in emissions leakage. It is noted that the Safeguard Mechanism reforms include provisions to preserve the competitiveness of trade-exposed industries. It will be important to ensure that these provisions are adequate or whether additional measures, including an Australian carbon border tariff are required.

Recommendations

Recommendation 2

3.116 The Committee recommends that the Australian Government continue to actively pursue opportunities to leverage Australia's existing trade and investment architecture and look to enter new and innovative agreements and partnerships to maximise Australia's opportunities in the global net-zero transition.

Recommendation 3

3.117 The Committee recommends that the Australian Government:

- **Take enhanced measures to improve understanding of the risks and opportunities for Australian exports presented by the European Union Carbon Border Adjustment Mechanism and carbon border tariffs introduced by other countries.**

- **Consider and monitor the need for an Australian carbon border tariff or similar measure to preserve the competitiveness of trade-exposed industries as domestic decarbonisation accelerates.**

4. Current and emerging green energy opportunities

Overview

4.1 The Committee received evidence of a wide range of current and emerging opportunities for Australia to establish export-oriented green energy industries to underpin its transition to a green energy superpower. These opportunities seek to maximise and capitalise on Australia's strengths and comparative advantages discussed in Chapter 2 of this report.

4.2 The pursuit of many of these opportunities is already underway – some in the early stages and others may be longer term prospects. Many of the opportunities identified focussed on the importance of value-adding to Australia's raw materials and critical minerals.

4.3 This chapter summarises the current and emerging green energy opportunities discussed in the evidence received by the Committee. It focuses on activities broadly falling into six categories:

- Solar and wind energy generation
- Extraction and processing of raw minerals, including critical minerals
- Value-added manufacturing in the critical minerals value chain, including battery manufacturing and solar panels
- Direct energy exports, such as renewable electricity, hydrogen and ammonia
- Green metals, such as green steel and green aluminium; and
- Carbon capture and negative emissions technologies.

4.4 The Committee received a wealth of evidence on current and emerging opportunities in Australia's transition to a green energy superpower, and is aware of many other activities and technologies that may ultimately have a role in Australia's green energy transition, for example geothermal energy and natural hydrogen. The Committee has not attempted to canvas all potential opportunities; the report has focused on those that are most relevant to supporting the development of export-oriented green energy industry and meeting the needs of Australia's major trading partners.

Solar and wind generation

4.5 Australia will need to further develop its solar and wind generation capability to underpin its transition to a green energy superpower and creation of export-oriented green industries. Australia's abundance of natural solar and wind resources was discussed in Chapter 2.

Solar generation

4.6 Solar photovoltaic (solar PV) technology converts the energy created by the heat and light of the sun directly into electricity.[1] The most common form of solar PV is solar panels, installed on residential and commercial buildings, or aggregated into large-scale solar farms.[2]

4.7 Solar generated ten per cent of Australia's total electricity generation in 2022.[3] Mr William Tan, Acting General Manager, Manufacturing and National Reconstruction Fund Division at the Department of Industry, Science and Resources (DISR), said Australians are '… among the most enthusiastic adopters of household solar, and there are extensive solar farms…'[4] More than 30 per cent of Australian homes have rooftop solar PV and the number of large-scale solar farms across Australia is growing.[5]

4.8 The Australian Government, through the Australian Trade and Investment Commission (Austrade), is supporting 27 large-scale solar projects through its green economy investment pipeline.[6] Austrade also works with Neon, a French renewable energy company, that has invested more than $3 billion in Australian wind, solar and battery storage projects. Neon's investments support Australia's ability to meet its emissions reductions targets and build new capability for Australia's renewable sector.[7]

4.9 Australia's opportunities to develop its solar panel manufacturing capability are discussed in more detail later in this chapter.

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1 Australian Renewable Energy Agency, *Solar energy*, https://arena.gov.au/renewable-energy/solar/, viewed 21 June 2023.

2 Australian Renewable Energy Agency, *Solar energy*, https://arena.gov.au/renewable-energy/solar/, viewed 21 June 2023.

3 Department of Climate Change, Energy, the Environment and Water, *Australian Energy Update 2022,* September 2022, p. 3.

4 Mr William Tan, Acting General Manager, National Reconstruction Fund Priorities Branch, Manufacturing and National Reconstruction Fund Division, Department of Industry, Science and Resources, *Committee Hansard,* Canberra, 10 February 2023, p. 11. See also: Westpac, Submission 57, p. 5.

5 Australian Renewable Energy Agency, *Solar energy*, https://arena.gov.au/renewable-energy/solar/, viewed 21 June 2023.

6 Department of Foreign Affairs and Trade (DFAT), Australian Trade and Investment Commission (Austrade) and Export Finance Australia (EFA), Submission 31, p. 9.

7 DFAT, Austrade and EFA, Submission 31, p. 10.

Wind generation

4.10 Wind energy refers to electricity generated by harnessing the wind, most commonly through wind turbines.[8] According to Geoscience Australia, wind energy contributes 1.4 per cent to the total amount of energy produced in Australia.[9] Australia is already pursuing opportunities to increase its wind generation capacity, which will support its transition to a green energy superpower.

4.11 In June 2022, the *Offshore Electricity Infrastructure Act 2021* (Cth) established a legislative framework to enable the development of offshore renewable energy projects in Commonwealth waters, including offshore wind projects using Geoscience Australia's marine data.[10] This legislative framework is implemented by the Department of Climate Change, Energy, the Environment and Water (DCCEEW).[11] DCCEEW is also preparing guidance for the offshore wind sector in collaboration with the National Offshore Petroleum Safety and Environmental Management Authority.[12]

4.12 DCCEEW's submission explained that in August 2022 its Minister proposed an area offshore from Gippsland, Victoria, as the first of six priority areas potentially suitable for the development of an offshore renewable energy industry, and that such a declaration provides:

> … investment certainty to international developers and support Victoria's ambitious clean energy target which looks to establish 9 GW of offshore renewable energy supply by 2040. Other priority areas will be assessed over the next 18 months. As these areas are declared, this will open up Australia's marine estate for the clean energy industry development with the potential to scale rapidly and address Australia's energy security and the development of new renewable energy exports.[13]

4.13 The Committee received evidence from Star of the South Wind Farm Pty Ltd (Star of the South), which is based in Gippsland, Victoria, and employs local workers, supports local businesses and is invests in the local community.[14] Its submission said:

> Star of the South has established an Industry Capability Network… Gateway to enable suppliers to register their interest in working on the project and

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8 Australian Renewable Energy Agency, *Wind energy,* https://arena.gov.au/renewable-energy/wind/, viewed 22 June 2023.

9 Geoscience Australia, Submission 64, p. 7.

10 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 12; Geoscience Australia, Submission 64, p. 9. See also: Western Australian Department of Jobs, Tourism, Science and Innovation, Submission 65, p. 6; Ms Erin Coldham, Chief Development Officer, Star of the South Wind Farm Pty Ltd, *Committee Hansard,* Brisbane, 16 May 2023, p. 8.

11 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 12.

12 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 12. See also: Western Australian Department of Jobs, Tourism, Science and Innovation, Submission 65, p. 6.

13 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 12.

14 Star of the South Wind Farm Pty Ltd, Submission 54, p. 2.

participating in the emerging offshore wind industry. We currently have over 100 expressions of interest from the Gippsland area specialising in different areas of the supply chain including electrical equipment, steel and transport. More than 1,000 suppliers have registered to date.[15]

Box 4.1 Star of the South Wind Farm Pty Ltd

Star of the South is Australia's most advanced offshore wind project with potential to power almost 20 per cent of Victoria's electricity.[16] The project is currently undergoing environmental assessment with construction expected to commence '…in the middle of the decade, generating power by 2030.'[17] Star of the South estimates the project will deliver:

- ~$8.7 billion in investment in Victoria
- ~$6.4 billion to the Gippsland economy
- ~$10.4 billion for Victoria in wider economic benefits
- ~2000 jobs in Victoria, including 760 in Gippsland during the construction phase and 200 ongoing local jobs during operation.[18]

4.14 The Western Australian Government is also seeking to develop its wind generation capacity and has established a Local Industry Participation in Wind Farm Supply Action Group.[19] A submission from the Western Australian Department of Jobs, Tourism, Science and Innovation explained:

> The Group provides advice and recommendations on the establishment and development of a wind turbine manufacturing industry in Western Australia. This initiative is underpinned by cross-sector collaboration and is a showcase of partnership to achieve a wind turbine manufacturing industry in Western Australia that will contribute to more affordable clean energy and future-proofed jobs.[20]

15 Star of the South Wind Farm Pty Ltd, Submission 54, p. 2.
16 Star of the South Wind Farm Pty Ltd, Submission 54, p. 2.
17 Star of the South Wind Farm Pty Ltd, Submission 54, p. 2.
18 Star of the South Wind Farm Pty Ltd, Submission 54, p. 2.
19 Western Australian Department of Jobs, Tourism, Science and Innovation, Submission 65, p. 6.
20 Western Australian Department of Jobs, Tourism, Science and Innovation, Submission 65, p. 6.

Extraction and processing of raw materials, including critical minerals

4.15 While Australia is already producing and exporting large quantities of raw materials, including critical minerals, many submitters and witnesses emphasised the sector's significant potential to expand as the green energy transition accelerates.[21]

4.16 Australia is well-placed to pursue opportunities to develop extraction and processing of raw materials, including critical minerals, due to its natural abundance of many of the key resources necessary to develop the products and infrastructure in the future green energy economy. For example, Australia has the world's largest lithium reserves and is the largest producer of lithium, accounting for almost half of the world's production.[22] Australia is also a significant producer and exporter of other commodities required in greater volume to support the green energy transition, namely copper and nickel.[23]

4.17 Australia's abundance of raw materials and critical minerals resources was outlined in Chapter 2 of this report. A list of the 26 resource commodities identified by the Australian Government to be critical minerals is available in Appendix C.

Demand for Australia's critical minerals

4.18 Demand for Australia's critical minerals[24] is anticipated to significantly increase during the global green energy transition to support the deployment of low and zero emissions technologies.[25] For example, DISR noted Australia's exports of lithium, nickel and copper, are expected to increase by a third and reach a value of $31 billion by 2024.[26]

4.19 The Grattan Institute estimated that if Australia maintains its market share of critical minerals as demand grows over coming decades, the market will be worth double the present-day value of the coal market.[27] Similarly, Tesla emphasised that the size of the lithium market is projected to grow 'over 25-fold by 2035.'[28]

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21 See, for example: Electric Vehicle Council, Submission 14, p. 3; Department of Industry, Science and Resources, Submission 63, p. 3; Geoscience Australia, Submission 64, p. 15.

22 Tesla, Submission 24, p. 9; RE Alliance, Submission 43, p. 3; Department of Industry, Science and Resources, Submission 63, p. 3.

23 Department of Industry, Science and Resources, Submission 63, p. 3.

24 As outlined in Chapter 2, critical minerals are those that are both essential for modern technologies, economies or national security and that there is a risk of supply chain disruption or limited availability.

25 See, for example: Climate Council, Submission 36, pp. 7–8; Australian Conservation Foundation, Submission 50, p. 4; Geoscience Australia, Submission 64, p. 15; Department of Industry, Science and Resources, Submission 63, p. 5; Geoscience Australia, Submission 64, p. 15.

26 Department of Industry, Science and Resources, Submission 63, pp. 3–5. See also: Grattan Institute, Submission 37, p. 8; Australian Conservation Foundation, Submission 50, p. 4.

27 Grattan Institute, Submission 37, p. 8.

28 Tesla, Submission 24, p. 9.

4.20 In addition to increasing current production, further potential for expansion lies in underdeveloped and undiscovered reserves.[29] The Electric Vehicle Council (EVC) observed that:

> There remains significant, unrealised potential for Australia to capture more of the critical minerals market share as global demand for battery minerals increases. The strength of Australia's mining sector is demonstrated by its existing production of lithium relative to the rest of the world, however this is not represented in domestic nickel or cobalt production, which is significantly lower relative to existing reserves.[30]

4.21 Geoscience Australia also highlighted this point and told the Committee there were '… vast areas of Australia that remain underexplored and unexplored, including the 80% of our landmass where the resources may be buried deep underground.'[31] Geoscience Australia also outlined programs underway to assess the technological and economic factors in the extraction of critical minerals from mine waste, which may further add to Australia's critical minerals potential.[32]

Refining and processing of Australia's resources

4.22 Australia's resources sector has historically focussed on extraction and exporting raw materials to be processed overseas. This largely remains the case with minerals and metals required for low emissions technologies such as lithium, cobalt, nickel, copper and rare earth elements.[33] For example, while Australia is a global leader in lithium production, most Australian lithium spodumene, the ore from which battery grade lithium hydroxide is refined, is exported to be processed overseas.[34] As a result, a large proportion of the potential value of Australia's lithium deposits are not retained onshore.[35]

4.23 Many submitters and witnesses acknowledged the importance of capitalising on opportunities to value-add to Australia's raw materials, with the first step being an expansion of refining and processing for critical minerals and metal ores.[36]

4.24 Some stakeholders proposed refining and processing opportunities could be underpinned by reduced energy costs where energy is provided by low-cost wind and

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29 Electric Vehicle Council, Submission 14, p.4; Geoscience Australia, Submission 63, p. 15; Mr Andrew Hutchinson, General Manager, Critical Minerals Office, Minerals and Resources Division, Department of Industry, Science and Resources, *Committee Hansard*, Canberra, 10 February 2023, p. 14.

30 Electric Vehicle Council, Submission 14, p. 4.

31 Geoscience Australia, Submission 64, p. 15.

32 Geoscience Australia, Submission 63, p. 15.

33 Smart Energy Council, Submission 23, p. 7; Australia Conservation Council, Submission 50, p. 5; Rewiring Australia, Submission 118, p. 2.

34 Tesla, Submission 24, p. 9; Ms Natalie Thompson, Policy Officer, Electric Vehicle Council, *Committee Hansard*, Macquarie Park, 6 April 2023, p. 22.

35 Electric Vehicle Council, Submission 14, p. 7; Tesla, Submission 24, p. 9; Australian Conservation Foundation, Submission 50, p. 5.

36 See, for example: Electric Vehicle Council, Submission 14, pp. 4–5; Australian Conservation Foundation, Submission 50, p. 5; Tesla, Submission 24, p. 9, The Next Economy, Submission 51, p. 2.

solar, including co-location of generation.[37] It was also suggested that Australia's ability to utilise renewable energy to reduce emissions from extraction and processing has the potential to further increase demand for Australia's minerals and metals as export customers seek lower emissions supply chains.[38]

4.25 The Australian Conservation Foundation pointed to potential advantages for companies focussed on extraction to expand through vertically integrated operations:

> Mining companies that expand down the value chain into refining have competitive advantages from secure supply of raw materials, reduced input costs for the raw material over companies that are not integrated, and lower logistics costs from on-site refining, and of course strengthening domestic supply chains without the need for increasing competitive inputs. Furthermore, transportation of raw materials is often highly inefficient, since often the ore contains a very small percentage of the final metal.[39]

4.26 High purity alumina was also discussed as an opportunity supporting the development of Australia's future green exports.[40] Demand for high purity alumina is growing due to its use in new technologies.[41]

4.27 The Committee also heard from Alpha HPA, which is supporting the global decarbonisation effort through its work with high purity aluminium materials, including high purity alumina and high purity aluminium salts.[42] Ultra-high purity aluminium oxides, nitrates and sulphates can be used for LED lighting, synthetic sapphire and lithium-ion battery markets.[43]

Box 4.2 Alpha HPA

Alpha HPA is an Australian business based in Gladstone, Queensland, that has developed a 'world-first' process for aluminium purification and production of ultra-high purity aluminium products.[44] First production commenced in November 2022 and full-scale production is scheduled to commence by early 2025.[45] The full-scale plant commencing in early 2025 is expected to manufacture 10 000tpa high purity alumina/boehmites/precursors including >5000tpa Aluminium precursors.[46]

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37 Electric Vehicle Council, Submission 14, p. 7; Grattan Institute, Submission 37, p. 6; Tesla, Submission 24, p. 9; Australian Conservation Foundation, Submission 50, pp. 2, 5.

38 See, for example: Electric Vehicle Council, Submission 14, p. 7; Climate Council, Submission 36.1, p. 49; Grattan Institute, Submission 37, pp. 2 and 6.

39 Australian Conservation Foundation, Submission 50, p. 5.

40 See, for example: Australian Aluminium Council, Submission 17, p. 5; Beyond Zero Emissions, Submission 32.2, pp. 3, 7, 16; Advanced Materials and Battery Council, Submission 15, p. 4;

41 Australian Aluminium Council, Submission 17, p. 5.

42 Alpha HPA, Submission 27, p. 2.

43 Alpha HPA, Submission 27, p. 2

44 Alpha HPA, Submission 27, p. 2.

45 Alpha HPA, Submission 27, p. 3.

46 Alpha HPA, Submission 27, p. 3.

Alumina refining is a highly carbon-intensive industry and accounts for around three per cent of emissions. Alpha HPA's applied technology will lower CO2 emissions by approximately 70 per cent compared to the incumbent process.[47] This is achieved by:

- Not using energy-intensive aluminium metal as feedstock
- Recycling reagents and selling them back to Orica
- Using 100 per cent renewable energy to power its plant in Gladstone, Queensland, due to a memorandum of understanding with CleanCo.[48]

4.28 Several stakeholders mentioned the continued role for nuclear power in the global energy mix.[49] Subsequently, it was noted there is potential for Australia to increase its uranium exports.[50] For example, the University of Queensland (UQ) explained that 'A key green export growth market is uranium and Australia has the world's largest known reserves.'[51] Similarly, Save Our Surroundings suggested that 'Demand for nuclear materials is a future long-term growth industry of which Australia should take greater advantage of now.'[52]

Value-added manufacturing

4.29 Submitters widely identified that to fully capitalise on its advantages and to realise green energy superpower ambitions, Australia needs move further along the value chain beyond extraction and processing, to explore downstream opportunities in manufacturing of intermediate and ultimately final products. [53]

4.30 For example, the Smart Energy Council highlighted:

> Australia has a long history of successfully mining raw materials and exporting them for value-add overseas. In this next phase of Australia's story, we must move up the value chain and produce more of the end products onshore capturing more of the benefits from these minerals for the advancement of all Australians.[54]

47 Alpha HPA, Submission 27, p. 4.
48 Alpha HPA, Submission 27, p. 4.
49 Dr Llewelyn Hughes and Dr Thomas Longden, Submission 70, pp. 3–5; Dr Saul Griffith, Co-founder and Chief Scientist, Rewiring Australia, *Committee Hansard*, Macquarie Park, 6 April 2023, p. 19
50 The University of Queensland, Submission 26, p. 2; Submission 28, p. 5.
51 The University of Queensland, Submission 26, p. 2; Save Our Surroundings, Submission 28, p. 5.
52 Save Our Surroundings, Submission 28, p. 5.
53 See, for example: Electric Vehicle Council, Submission 14, p. 4; Smart Energy Council, Submission 23, p. 7, Grattan Institute, Submission 37, pp. 2, 6; Department of Industry, Science and Resources, Submission 63, pp. 6–7.
54 Smart Energy Council, Submission 23, p. 7.

Battery manufacturing

4.31 Many stakeholders identified the opportunity for Australia to move further down the critical minerals value chain and develop a significant battery manufacturing industry across a range of battery chemistries for applications including transport, industrial and stationary storage.[55]

4.32 For example, UQ stated that the manufacture of batteries in Australia 'plays to all its strengths and could become the cornerstone of a resurgence in manufacturing capacity across Australia'.[56]

4.33 Mr Shannon O'Rourke, Chief Executive Officer, Future Battery Industries CRC (FBI CRC), outlined Australia's opportunity across the battery value-chain:

> About the battery industry, we produce roughly 50 per cent of the world's battery minerals, but only receive a small percentage of that total industry value. It would be our view that Australia's not adding enough value to its resources. We can capture more value by building a diversified battery industry.
>
> There are critical minerals, and Australia is the only country in the world which has leading resources of the breadth of critical minerals required for manufacturing batteries—so this is nickel, cobalt et cetera. From the point of mining there's refining, then advanced materials which take the refined products and turn them into specialty, very high technology particles and materials. After that, cell components and cells and then packs and systems.[57]

4.34 Dr Lynette Molyneux, Director at the Advanced Materials and Battery Council (AMBC), expressed a similar view that Australia could be doing a lot more local manufacturing of batteries, in turn capturing greater value from critical minerals before they leave Australia:

> On the basis that about 10 to 15 per cent of the value of a lithium-ion battery is associated with the minerals, we could be doing far greater in terms of manufacturing locally and capturing the value of the lithium-ion battery before it leaves our shores so that we can actually build a significant manufacturing sector as the cornerstone to additional manufacturing in Australia.[58]

4.35 The Western Australian Department of Jobs, Tourism, Science and Innovation advised that two processing plants are currently under construction in the state, in addition to the existing five lithium mines in operation.[59] Further, DISR noted that

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55 See, for example: Advanced Materials and Battery Council, Submission 15, p. 1; Smart Energy Council, Submission 23, p. 7; The University of Queensland, Submission 26, pp. 6 and 10; Department of Industry, Sciences and Resources, Submission 63, pp. 6–7; Export Council of Australia, Submission 72, p. 2.

56 The University of Queensland, Submission 26, p. 10.

57 Mr Shannon O'Rourke, Chief Executive Officer, Future Battery Industries CRC, *Committee Hansard,* Perth, 17 March 2023, p. 17.

58 Dr Lynette Molyneux, Director, Advanced Materials and Battery Council, *Committee Hansard*, Brisbane, 16 May 2023, p. 4.

59 Western Australian Department of Jobs, Tourism, Science and Innovation, Submission 65, p. 3.

'Australia is fast developing downstream processing capacity' and that within the next five years Australia is forecast to produce up to one-fifth of the world's battery grade lithium hydroxide.

4.36 Building Australia's battery manufacturing capability creates opportunities for Australia to contribute to EV batteries and components. DCCEEW suggested:

> Governments and industry could unlock further growth and innovation in the full lifecycle of the EV value chain, which could include expanding extraction, processing and refining of critical minerals for global demand, and developing, designing and manufacturing EV components, control systems and batteries.[60]

4.37 DISR's submission drew attention to Australia's minerals sector being a major supplier of key inputs to electric vehicle manufacturers.[61] For example, Australia supplies 75 per cent of the lithium and 40 per cent of the copper used in their vehicles globally, as noted by Tesla, the world's largest electric vehicle manufacturer.[62]

Box 4.3 Tesla

Tesla is a US-based automotive and energy company that designs and manufacturers fully electric vehicles and energy generation and storage systems.[63] Tesla:

- Employs more than 600 people in Australia
- Purchases over $1 billion worth of Australian minerals annually
- Operates the largest network of electric vehicle chargers in Australia
- Developed the Hornsdale Power Reserve in South Australia (once the world's largest battery in 2017) and the Victoria Big Battery
- Installed 'hundreds of thousands' of Powerwall battery units and 26MW of Virtual Power Plant capacity registered with the Australian Energy Market operator across New South Wales, Victoria and Queensland.[64]

4.38 Tesla acknowledged the expansion, while indicating that more is needed: 'There are three lithium refineries underway in Australia, with more under construction but a great number more will be required to absorb a larger portion of domestic spodumene production.'[65]

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60 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 15.
61 Department of Industry, Science and Resources, Submission 63, p.3
62 Tesla, Submission 24, p. 9. See: One Step Off the Grid, *Tesla reveals huge number of Powerwall home batteries installed in Australia,* https://onestepoffthegrid.com.au/tesla-reveals-huge-number-of-powerwall-home-batteries-installed-in-australia/, accessed 14 August 2023.
63 Tesla, Submission 24, p. 1.
64 Tesla, Submission 24, pp. 1–2.
65 Tesla, Submission 24, p. 9.

4.39 The EVC advised that following an expansion of refining and processing capability for battery minerals such as lithium, there are opportunities for Australia to capture more of the EV value chain by moving further downstream into the production of battery cathodes and anodes.[66]

4.40 The EVC told the Committee about the work of one of its members: Tritium, an Australian company leading the downstream EV value chain established in Brisbane during the early 2000s.[67] Tritium manufacturers around 5000 DC fast chargers each year and has expanded to the US and Europe.[68]

4.41 DISR also told the Committee about firms like Energy Renaissance in Tomago, which is producing lithium-ion batteries and doing battery cell assembly.[69] The Commonwealth Scientific and Industrial Research Organisation also explained that it is supporting Energy Renaissance:

> They've got their first stage up and running. At the moment they're assembling packs using batteries from another provider. But in time they intend to produce those in Newcastle. That's the start of a lithium-iron industry in Australia.[70]

4.42 A submission from the AMBC discussed Redflow, an Australian based global flow battery company, that is already deploying energy storage projects across Australia and internationally.[71]

4.43 Tesla agreed, stating that: 'If Australia can successfully ramp up lithium, nickel and other critical minerals refining in the coming years it can build a strong foundation for further progress in the EV value chain.'[72] Tesla further emphasised that following an expansion of refining on shore, Australia should plan for cathode precursor production at scale.[73]

4.44 Ms Natalie Thompson, Policy Officer at the EVC, underlined the importance of initial value-added processes to capturing further downstream opportunities:

> There is significant opportunity in exporting our raw minerals, but we're missing out on this value-adding opportunity. The critical problem is that without developing downstream onshore-processing and refining of those battery minerals, we're very unlikely, further downstream, to be manufacturing any

66 Electric Vehicle Council, Submission 14, p. 5.
67 Electric Vehicle Council, Submission 14, p. 6.
68 Electric Vehicle Council, Submission 14, p. 6.
69 Mr William Tan, Acting General Manager, National Reconstruction Fund Priorities Branch, Manufacturing and National Reconstruction Fund Division, Department of Industry, Science and Resources, *Committee Hansard,* Canberra, 10 February 2023, p. 11.
70 Dr Peter Mayfield, Executive Director, Environment, Energy and Resources, Commonwealth Scientific Industrial Research Centre, *Committee Hansard,* Canberra, 10 February 2023, p. 21.
71 Advanced Materials and Battery Council, Submission 15, p. 5.
72 Tesla, Submission 24, p. 10.
73 Tesla, Submission 24, p. 10.

> battery cells and components as well. That midstream processing and refining is going to play a really key role.[74]

4.45 Mr Shannon O'Rourke, Chief Executive Officer of the FBI CRC, highlighted the need to retain lithium onshore to develop downstream capabilities:

> I think the most important point is that we need to retain some level of lithium within Australia to make the most of that because lithium is then used, in the second stage, in making cathode materials… We won't be able to do those things unless we retain some feedstock in Australia.[75]

Solar panel manufacturing

4.46 Enhancing domestic solar panel manufacturing capabilities was identified by some stakeholders as another opportunity to capture greater value from Australia's critical mineral resources.[76] China currently produces approximately 80 per cent of the world's solar panels.[77] Given Australia's resource and industrial strengths, supported by its highly skilled workforce, Australia is looking for opportunities to build its own solar PV manufacturing capability.

4.47 For example, Mr Wayne Smith, External Affairs Manager at the Smart Energy Council told the Committee about the work of one of its member companies, SunDrive. SunDrive, based in South Sydney, is working to manufacture solar cells and solar panels in Australia using technology developed at the University of New South Wales.[78] South Australian based company Tindo Solar is already producing solar panels from its Adelaide factory using components from imported from overseas.[79]

4.48 Westpac Group highlighted the case of Tindo Solar, Australia's only domestic solar panel manufacturer, to demonstrate that Australia is missing out on the economic benefits of value-added opportunities:

> Despite Australia's extensive supply of critical minerals that go into the solar panel manufacturing process, Tindo is required to source its components from overseas providers. In practice, Australia is mining many of these critical

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74 Ms Natalie Thompson, Policy Officer, Electric Vehicle Council, *Committee Hansard*, Macquarie Park, 6 April 2023 p. 23.

75 Mr Shannon O'Rourke, Chief Executive Officer, Future Battery Industries CRC, *Committee Hansard*, Perth, 17 March 2023, p. 19.

76 See, for example: Westpac, Submission 57, p. 5; Sun Cable, Submission 71, p. 8; Ms Nicola Ison, Head of Direct Advocacy, Boundless Earth, *Committee Hansard*, Melbourne, 5 April 2023, p. 17.

77 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 3. See also: Save Our Surroundings, Submission 28, p. 5; Mr Dennis Armstrong, Member, Save Our Surroundings, *Committee Hansard,* Macquarie Park, 6 April 2023, p. 5.

78 Mr Wayne Smith, External Affairs Manager, Smart Energy Council, *Committee Hansard,* Canberra, 31 March 2023, p. 24. See also: Ms Nicola Ison, Head of Direct Advocacy, Boundless Earth, *Committee Hansard,* Melbourne, 5 April 2023, p. 17.

79 Westpac, Submission 57, p. 7.

> minerals, only to ship them overseas to be manufactured and then imported back by Tindo Solar.[80]

4.49 Fortescue Future Industries (FFI), together with Windlab, has commenced work to create a North Queensland Super Hub. FFI submitted that the Super Hub will be '… one of the largest wind and solar generation projects ever undertaken in Queensland which stands to generate ~10GW.'[81]

4.50 The Committee also received evidence from Transgrid, who operates and manages the high voltage network that connects electricity generators in New South Wales and the Australian Capital Territory, with connections to Victoria and Queensland.[82] Mr Craig Stallan, Executive General Manager, Delivery at Transgrid, explained as part of its network, it has '… 17 gigawatts of large-scale wind and solar already connected to the network and five gigawatts of rooftop solar…'[83]

4.51 Ms Marghanita Johnson, Chief Executive Officer at the Australian Aluminium Council, noted the potential for Australia's aluminium industry to produce solar panel components:

> … aluminium represents more than 80 per cent of the metal used in solar panels and Australia's aluminium extruders already have the capability to produce both solar frame and solar racking for the sector. It's an area where we should have comparative advantage as the solar panel industry develops in Australia. But we must ensure that Australia's solar panels are Australian made with Australian content.[84]

Direct energy exports

4.52 The Committee received evidence that Australia has opportunities for direct export of energy or energy carriers, such as renewable electricity, hydrogen, and natural gas.

Renewable energy

4.53 Direct transfer of renewable electricity generated in Australia to South-East Asia, transmitted by subsea high voltage direct current (HVDC) cable was identified as an export opportunity.[85]

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80 Westpac, Submission 57, pp. 7.

81 Fortescue Future Industries, Submission 93, p. 8.

82 Transgrid, Submission 52, p. 1.

83 Mr Craig Stallan, Executive General Manager, Delivery, Transgrid, *Committee Hansard,* Macquarie Park, 6 April 2023, p. 35.

84 Ms Marghanita Johnson, Chief Executive, Australian Aluminium Council, *Committee Hansard*, Canberra, 31 March 2023, p. 1.

85 See, for example: Australian Electric Vehicle Association, Submission 19, p. 4; Smart Energy Council, Submission 23, p. 2; DFAT, Austrade and EFA, Submission 31, p. 31; Grattan Institute, Submission 37, p. 8; Clean Energy Council, Submission 38, p. 1; RE-Alliance, Submission 43, p. 3; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 4; Sun Cable, Submission 71, p. 1;

4.54 Sun Cable stated that direct export of renewable electricity is '… an industry with potential to be one of the world's largest, with hundreds of billions of potential value for Australia in revenue, foreign investment and IP [intellectual property] developed through harnessing our renewable resources.'[86]

4.55 Some submitters noted economic, engineering and security challenges with direct export of renewable electricity.[87] Notably, the distance required to reach export markets, greater security risks of a cable as single piece of infrastructure, and the absence of appropriate regulatory frameworks.

Green hydrogen and green ammonia

4.56 Hydrogen can be produced using a range of energy sources and processes, which are commonly referred to by colours. The Climate Council explained:

- Green hydrogen is produced from renewable energy (e.g. wind and solar)
- Brown hydrogen is produced from brown coal
- Black hydrogen is produced from black coal
- Grey hydrogen is produced from natural gas
- Pink hydrogen is produced from nuclear power
- Blue hydrogen is produced from fossil fuels (e.g. coal and natural gas) accompanied by carbon capture and storage (CCS).[88]

4.57 This report does not propose to traverse in detail each of the different 'colours' of hydrogen. The Committee received evidence on 'green' hydrogen primarily, thus this is the focus of the Committee's consideration. The term 'renewable hydrogen' refers to green hydrogen, while 'clean hydrogen' is generally used to refer to both green and blue hydrogen.

4.58 Green hydrogen is produced through a process called electrolysis, in an electrolyser, using renewable electricity (e.g. from wind or solar) to split water molecules into hydrogen and oxygen.[89] As the electricity is sourced from renewables, the process does not generate emissions.

Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering, Submission 74, p. 2; Boundless Earth, Submission 76, p. 2.

86 Sun Cable, Submission 71, p. 7.

87 See, for example: Dr Mark Hutchinson, Chief Executive Officer, Fortescue Future Industries, *Committee Hansard*, 17 March 2023, p. 11; Dr Bin Lu, Senior Research Fellow, Zero-Carbon Energy for the Asia-Pacific Initiative, *Committee Hansard*, Canberra, 31 March 2023, p. 50; Mr Steven Davies, Chief Executive Officer, Australian Pipeline and Gas Association, *Committee Hansard*, Canberra, 31 March 2023, p. 58; Dr Peter Mayfield, Commonwealth Scientific and Industrial Research Organisation, *Proof Hansard*, Canberra, 23 June 2023, p. 13.

88 Climate Council, Submission 36, p. 7.

89 Climate Council, Submission 36, p. 6; Australian Pipeline and Gas Association, Submission 24, p. 2; Fortescue Future Industries, Submission 93, p. 4.

4.59 As a zero-emissions source of energy, submitters and witnesses suggested green hydrogen will play a considerable role in decarbonisation. Consequently, demand is expected to increase dramatically as the world transitions to a net-zero economy.[90] Green hydrogen is likely to be of particular interest to countries that do not have their own capacity to generate high amounts of renewable energy and will likely continue to be energy importers.[91]

4.60 For Australia, green hydrogen has been identified as an important means to decarbonise domestic industrial sectors such as chemical manufacturing, heavy and long-distance transport and steelmaking.[92] It may have a particularly important role in decarbonising industrial sectors where electrification is difficult.[93]

4.61 Green hydrogen is also widely considered to have significant export potential for Australia.[94] Japan, Korea, Singapore, and Taiwan were consistently identified during the inquiry as key export destinations for Australian produced green hydrogen.[95] FFI said: '… Australia is well positioned as a prospective green hydrogen exporter.'[96]

4.62 FFI outlined a wide range of potential applications for green hydrogen:

> Green hydrogen is an increasingly important part of the climate transition. It has a high energy-density, which makes it suitable for energy generation either through combustion or as a substitute for gas in pipeline networks. Green hydrogen can also be used within fuel cells to cleanly and efficiently produce electricity, which has applications across transportation, industrial, residential, and commercial buildings, and long-term energy storage for electricity grids.
>
> … Hydrogen produced from renewable energy is a critical enabler for future-facing goods such as green iron for decarbonised steel-making and green ammonia for decarbonised fertiliser and presents a substantial export opportunity for Australia.[97]

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90 See, for example: Climate Council, Submission 36, p. 6; Australian Conservation Foundation, Submission 50, pp. 5–6; WWF-Australia, the Business Council of Australia, the Australian Council of Trade Unions and the Australian Conservation Foundation, Submission 67.1, p. 43; Fortescue Future Industries, Submission 93, pp. 2–3; Australia China Business Council, Submission 102, p. 6.

91 DFAT, Austrade and EFA, Submission 31, pp. 3–4; Beyond Zero Emissions, Submission 32, p. 8.

92 Smart Energy Council, Submission 23, p. 9; Climate Council, Submission 36, p. 6; Beyond Zero Emissions, Submission 32, p. 8; Australian Conservation Foundation, Submission 50, p. 5; Geoscience Australia, Submission 64, p. 6; Sun Cable, Submission 71, pp. 5–6; Fortescue Future Industries, Submission 93, p. 4.

93 Beyond Zero Emissions, Submission 32, p. 7; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 3; WWF-Australia, the Business Council of Australia, the Australian Council of Trade Unions and the Australian Conservation Foundation, Submission 67.1, p. 44; Fortescue Future Industries, Submission 93, p. 4; Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, p. 4.

94 See, for example: Smart Energy Council, Submission, 23, p. 2; Beyond Zero Emissions, Submission 32, p. 8; Australian Hydrogen Council, Submission 39, pp. 2–3; Department of Climate Change, Energy, the Environment and Water, Submission 62, pp. 4–5; Fortescue Future Industries Pty Ltd, Submission 93, pp. 2 and 11–12.

95 DFAT, Austrade and EFA, Submission 31, p. 4; Fortescue Future Industries Pty Ltd, Submission 93, pp. 11–12.

96 Fortescue Future Industries Pty Ltd, Submission 93, p. 2.

97 Fortescue Future Industries Pty Ltd, Submission 93, p. 4.

Box 4.4 Fortescue Future Industries Pty Ltd

Fortescue Metals Group (Fortescue), an Australian owned company, is the fourth largest producer of iron ore in the world.[98] Each year, Fortescue exports more than 185 million tonnes of iron ore from the Pilbara.[99] Through FFI, Fortescue is '…establishing a global portfolio of renewable energy, green hydrogen production and manufacturing projects and operations [to position itself] at the forefront of the global green energy industry.'[100]

In its submission, FFI listed key green energy and green technology initiatives that are currently underway in partnership with other companies:

- In partnership with Incitec Pivot Limited,[101] FFI is planning to convert Incitec Pivot Limited's Gibson Island ammonia facility to run on green hydrogen.
- FFI has commenced construction of the world's largest electrolyser facility in Gladstone, Queensland, which will be vital to the production of 'renewable hydrogen'.
- In partnership with Windlab,[102] FFI has commenced construction on a North Queensland Super Hub, which is anticipated to be capable of generating the wind and solar power needed to underpin green hydrogen production.
- In partnership with E.ON,[103] FFI will deliver up to 5 million tonnes per annum of green hydrogen to Europe by 2020, making it Europe's largest green hydrogen supplier and distributer.
- In partnership with Liebherr,[104] FFI will support the development and supply of green mining haul trucks.[105]

4.63 It was broadly acknowledged that Australia has a comparative advantage in the production of green hydrogen and is well-placed to develop a significant green hydrogen industry. This advantage is based on access to low-cost renewable energy and suitable land as well as existing infrastructure, expertise, and supply chains developed by the resources and LNG sectors.[106] Proximity to key Asian export markets is also an important factor for the development of an export industry.[107]

98 Fortescue Future Industries Pty Ltd, Submission 93, p. 6.
99 Fortescue Future Industries Pty Ltd, Submission 93, p. 6.
100 Fortescue Future Industries Pty Ltd, Submission 93, p. 6.
101 Incitec Pivot Limited is an industrial chemicals manufacturer supplying the agriculture and mining industries.
102 Windlab is an Australian owned renewable energy company developing renewable generators.
103 E.On is a multinational electric utility company based in Germany.
104 Liebherr is a multinational equipment manufacturer based in Switzerland.
105 Fortescue Future Industries Pty Ltd, Submission 93, pp. 14–15.
106 DFAT, Austrade and EFA, Submission 31, p. 3; Australian Conservation Foundation, Submission 50, p. 6; Department of Climate Change, Energy, the Environment and Water, Submission 62, pp. 4–5; Geoscience Australia, Submission 64, p. 6; Australian Academy of Science & Australian Academy of Technological Sciences and Engineering, Submission 74, p. 3; Fortescue Future Industries, Submission 93, p. 2; APA Group, Submission 94, p. 3.
107 DFAT, Austrade and EFA, Submission 31, p. 3; Australian Conservation Foundation, Submission 50, p. 7.

4.64 The production of 'green ammonia' by combining green hydrogen and nitrogen is significant to the hydrogen export opportunity, as it offers an energy efficient, low cost and safe way to transport green hydrogen over long distances (it can then be converted back into hydrogen).[108] The Ammonia Energy Association advised that: 'liquid ammonia carries 1.69 times the energy of liquid hydrogen and 2.5 times the energy of compressed hydrogen.'[109]

4.65 Green ammonia may also have existing and new domestic applications in decarbonising the production of fertiliser, the manufacture of chemicals, and transport as a replacement for diesel fuel. It may also have considerable demand as an export product, particularly in Asian markets, where potential applications also include use as a maritime fuel and in electricity generation.[110]

Limitations of green hydrogen

4.66 Rewiring Australia suggested that producing green hydrogen is an inefficient use of renewable energy resources compared to electrification using renewable electricity and battery storage:

> Hydrogen is an incredibly inefficient energy storage or delivery mechanism. More than twice the electricity needs to be used to power practically anything with hydrogen compared to electricity stored in a battery. The idea that hydrogen will play a large role in the energy future does not make economic or thermodynamic sense. It will play a small role, but attempting to carve out a large role for it represents a wasteful way to achieve clean energy goals. Three times as much electricity will be needed to produce the hydrogen that eventually powers a machine that could have been powered with just one third of the starting electricity if it was stored in a battery not a hydrogen cell. Over-investment in hydrogen is likely to leave Australian homes and Australian businesses with less economic savings and fewer emissions reductions.[111]

4.67 Some submitters were cautious about the potential for green hydrogen as an export product.[112] Some suggested uncertainty about the size and viability of export markets, while others advocated that Australian produced green hydrogen should be used to decarbonise domestic industry including to underpin high-value manufacturing opportunities such a green steel and aluminium. Green steel and aluminium are discussed in more detail later in this chapter.

4.68 The University of Adelaide's Institute for Sustainability, Energy and Resources (ISER) stated that as the export potential of hydrogen as a molecule will last a

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108 Australian Electric Vehicle Association, Submission 19, p. 5; Beyond Zero Emissions, Submission 32, p. 8; Ammonia Energy Association, Submission 35, p. 2; Climate Council, Submission 36.1, pp. 41, 43.

109 Ammonia Energy Association, Submission 35, p. 2.

110 Australia Electric Vehicle Association, Submission 19, p. 4; Ammonia Energy Association, Submission 35, pp 1, 5; Climate Council, Submission 36.1, p. 41; Grattan Institute, Submission 37, p. 6.

111 Rewiring Australia, Submission 118, p. 3.

112 See, for example: University of Adelaide's Institute for Sustainability, Energy and Resources, Submission 18, pp. 1–2; Star Scientific Ltd, Submission 25, p. 2; Rewiring Australia, Submission 118, p. 3.

decade at best, it is 'better to export decarbonised commodities and value-added products from green hydrogen rather than the bulk molecule or some low-value derivative of it.'[113]

4.69 Star Scientific Ltd suggested that the scope for export may be limited because the renewable energy resources required to produce green hydrogen are more widely available than fossil fuels. Its submission stated '…you can make hydrogen in a lot more places than you can find fossil fuels, and it will be cheaper to acquire.'[114] Star Scientific Ltd also suggested the value of green hydrogen '…is as embedded as process heat or energy in our manufactured and agricultural exports.'[115]

4.70 Rewiring Australia suggested there would be greater economic benefit in utilising abundant renewable energy domestically, for example in the refining of metal ores, rather than to produce green hydrogen for export.[116]

> As a large fossil fuel exporter it is natural for Australia to identify another fuel we can export, which has been identified by some to be hydrogen. However, Australia has a far better opportunity in the export of embodied energy rather than exporting energy as fuel.[117]
>
> …
>
> Australia being an island at great distance from most hydrogen customers means the delivery cost of any hydrogen produced in Australia could be higher than locally produced hydrogen elsewhere. It is questionable that Australia can really deliver cheaper hydrogen to other continents at a cheaper price than renewable production on those continents can produce it.[118]

4.71 The Australian Aluminium Council recognised green hydrogen's export potential, but proposed that domestic application should be prioritised '… to capitalise on [Australia's] strategic advantage and maximise economic value.'[119]

> There has been considerable focus on the creation of an internationally traded hydrogen export industry… The Council believes that while Australia is well placed to be a major exporter, increased focus needs be on hydrogen as an input into downstream products in Australia, reducing emissions associated with their production...
>
> … The Council believes Australia should seek to maximise its own value adding domestic sectors, providing them with internationally competitive zero emissions hydrogen, prioritised over exports; including through a domestic hydrogen

113 University of Adelaide's Institute for Sustainability, Energy and Resources, Submission 18, pp. 1–2.
114 Star Scientific Ltd, Submission 25, p. 2.
115 Star Scientific Ltd, Submission 25, p. 2.
116 Rewiring Australia, Submission 118, p. 3.
117 Rewiring Australia, Submission 118, p. 1.
118 Rewiring Australia, Submission 118, p. 3.
119 Australian Aluminium Council, Submission 17, p. 6.

> reservation scheme. This would capitalise on Australia's national advantage providing jobs and value to the economy.[120]

4.72 UQ concluded that work needs to be done to better understand Australia's hydrogen export opportunity:

> Like Australia, many countries have ambitions to produce and export their own hydrogen energy carrier. Further analysis is required to assess the realistic scale of an export market, both the scale of production and requirements to achieve scale, as well as the contribution to global supply and potential replacement of current energy export earnings.[121]

Manufacturing electrolysers

4.73 Some submitters identified an opportunity for Australia to develop its manufacturing equipment, such as electrolysers, to support green hydrogen production.

4.74 The Australian Government, through the Modern Manufacturing Initiative grant agreement, is supporting a Green Hydrogen Gigafactory Electrolyser Manufacturing Facility in Gladstone executed by Gladstone FFI.[122] The National Reconstruction Fund also includes funds to invest in hydrogen electrolysers.[123]

4.75 FFI's submission explained that electrolyser capacity remains a challenge, even though the cost of generating the renewable energy required to produce green energy hydrogen has decreased substantially over recent times:

> According to the IEA's Net Zero by 2050 scenario, more than 700GW of installed electrolytic capacity will be required by 2030. This gap in electrolyser capacity provides Australia with an opportunity to manufacture and supply both domestic and global markets with electrolyser and associated green hydrogen and green electricity supply chain inputs. As Australia develops large scale renewables and hydrogen generating capacity it in turns becomes an attractive location for manufacturing of electrolysers.[124]

Blue hydrogen

4.76 In addition to Australia's green hydrogen opportunities, Australia also has a comparative advantage in the production of blue hydrogen due to its substantial coal and natural gas resources as well as strong potential for geological storage.[125] Many of the advantages with green hydrogen exports regarding infrastructure, expertise and supply chains also apply to blue hydrogen.

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120 Australian Aluminium Council, Submission 17, p. 6.
121 The University of Queensland, Submission 26, p. 2.
122 Department of Industry, Science and Resources, Submission, p.
123 Western Australian Department of Jobs, Tourism, Science and Innovation, Submission 65, p. 5.
124 Fortescue Future Industries Pty Ltd, Submission 93, p. 5, citations omitted.
125 Save Our Surroundings, Submission 28, pp. 4–5; Woodside Energy, Submission 47, p. 4; Geoscience Australia, Submission 64, p. 6.

4.77 While some countries are focussed on green hydrogen, other countries such as Japan have shown interest in blue hydrogen as part of their decarbonisation strategies.[126] Woodside Energy pointed to estimates that blue hydrogen using natural gas and CCS will account for half of global hydrogen production by 2030.[127]

4.78 Low Emission Technology Australia (LETA) advised that blue hydrogen presents a significant export opportunity for Australia and suggested that it has a role to play in meeting the increased demand in the development of storage and transport infrastructure, building demand and establishing supply chains for the future green hydrogen industry.[128] In its submission, LETA explained:

> The most competitive sources of clean hydrogen are from hydrocarbons including coal, gas and biomass coupled with CCUS [carbon capture, utilisation and storage][129]… Fossil fuel-based hydrogen with CCS can also be scaled up to meet the likely commercial demands in the near future, providing a platform for export markets to develop as costs come down for renewable energy-based hydrogen.[130]
>
> Commercial ready LETs [low emission technologies], such as those that produce hydrogen from fossil fuels with CCUS, will be the precursor to green alternatives, and will establish supply chains and embed a new cleaner energy market globally. To move towards being a green energy superpower, Australia must harness this energy momentum whilst utilising our existing resources to stake a market position in the race to net-zero.[131]

Natural gas and liquified natural gas

4.79 Several submitters observed an ongoing role for natural gas in the energy transition both globally and in Australia.[132] Natural gas was mentioned in particular as being a lower emissions energy source compared to coal, bridging the gap in energy demand while renewable energy generation expands, and playing a role in firming renewable

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126 Low Emission Technology Australia, Submission 21, p. 6; Professor Ken Baldwin, Fellow, Australian Academy of Technical Sciences and Engineering, *Committee Hansard*, Canberra, 31 March 2023, p. 11.

127 Woodside Energy, Submission 47, p. 4, citation omitted.

128 Professor Ken Baldwin, Fellow, Australian Academy of Technical Sciences and Engineering, *Committee Hansard*, Canberra 31 March 2023, p. 11.

129 The terms carbon capture and storage (CCS) and carbon capture, utilisation and storage (CCUS) are sometimes used interchangeably. Generally, CCS refers to the process of capturing CO_2 from stationary emissions sources and injecting into underground geological formations for long-term storage. CCUS includes utilising captured CO_2 for enhanced oil recovery or as an input in the production of fertiliser, fuel or food. Both are considered under negative emissions and capture technologies discussed later in this chapter. See: www.ga.gov.au/scientific-topics/energy/resources/carbon-capture-and-storage-ccs/what-is-ccs.

130 Low Emission Technology Australia, Submission 21, p. 3.

131 Low Emission Technology Australia, Submission 21, p. 2.

132 Woodside Energy, Submission 47, p. 3.

electricity generation.[133] Natural gas was also mentioned as a source of producing blue hydrogen, in combination with CCS.[134]

4.80 Geoscience Australia provided an overview of the role of natural gas. It referred to predictions of future global energy supply and demand indicating that while the consumption of fossil fuels will peak at around 2030 and then begin to decrease with an upswing in renewable and other green energy sources, fossil fuels, and natural gas in particular, will remain part of the energy equation:

> … natural gas remains the most in-demand energy resource, replacing other, more emissions intensive fossil fuels (fuel switching), providing dispatchable electricity, and potentially providing feedstock for the generation of (blue) hydrogen.
>
> … Greenhouse gas emissions from the consumption of natural gas are less than half of the emissions from the consumption of coal. Technologies such as… (CCS) used in conjunction with the extraction and/or consumption of gas/LNG resources can further reduce the generation of greenhouse gas emissions from this fuel source.
>
> These considerations are important for noting the value of LNG exports to Australia's economy and the role it has in supplying energy and decarbonising Australia and the Asia-Pacific region, by providing a lower emissions fuel than the alternatives (such as coal and oil).
>
> Australia has a wealth of gas resources, and further opportunities for trade and investment. Enabling technologies, such as CCS, to decarbonise the scope 1, 2, and potentially scope 3 emissions, can be instrumental to supporting Australia and the region's future net zero emissions target.[135]

4.81 Submitters noted continued demand for natural gas/liquified natural gas (LNG) as an export product.[136] Woodside Energy described Australia's trading partners in the Asia-Pacific region, including Japan, as being '… clear that they need Australia to continue as a secure, affordable supplier of energy, including liquified natural gas (LNG) as a key transition fuel in their economy.'[137]

4.82 UQ observed that Australia could capitalise on the continued role of natural gas in the global energy mix:

> Australia's relatively low gas emissions intensity compared to other suppliers could be considered in trade policies favouring inward investment in Australian gas, with regulations aimed to promote greater decarbonisation than alternative suppliers with higher emissions intensity gas. Being lowest emitter should benefit Australia's energy export trade position. To support this, Australia should also

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133 Woodside Energy, Submission 47, pp. 3–4; Geoscience Australia, Submission 64, p. 6: APA Group, Submission 94, p. 4.

134 Woodside Energy, Submission 47, p. 4.

135 Geoscience Australia, Submission 64, p. 6, citations omitted.

136 Woodside Energy, Submission 47, p. 4; Geoscience Australia, Submission 64, p. 6.

137 Woodside Energy, Submission 47, p. 4.

develop auditable/verifiable emissions intensity reporting to differentiate its industry in the export market.[138]

Biogas and biomethane

4.83 Some submitters and witnesses discussed biomethane as a possible 'green' substitute for natural gas.[139] Biomethane is created by converting organic matter, such as food and agricultural waste, into biogas through a process known as anaerobic digestion. Biogas can be used to produce heat and generate electricity and once upgraded to biomethane it can be used as a substitute for natural gas without any upgrades to gas infrastructure or changes in equipment or appliances.[140]

4.84 Biomethane production is limited in Australia but has considerable potential, particularly where there are high quality inputs and proximity to existing infrastructure.[141] For example, Mr Steven Davies, Chief Executive Officer at the Australian Pipeline and Gas Association (APGA), told the Committee:

> … as we turn our attention to the prospects of biomethane, we are seeing that there are some areas where there is a lot of potential. If you have a farm in the Bega Valley—famous for its dairies—there's a lot of material right there ready to go. I know that for New South Wales the gas network company runs the Sydney network. You could look at the Australian Bioenergy Roadmap and it might say that New South Wales has about 180 petajoules of bioenergy potential, but Jemena has taken it a step further and had a look at quality of raw materials, proximity to existing infrastructure and it's established that there are materials to make about 34 petajoules of methane, which is roughly the residential demand of Sydney gas now. So there are opportunities.[142]

Gas infrastructure

4.85 Evidence from APA Group and the APGA highlighted the role that Australia's extensive gas pipeline infrastructure can play in transportation and storage to support Australia's green hydrogen industry. APA Group and APGA argued that utilising existing infrastructure reduces the need for expensive investment in new energy assets for both hydrogen and electricity.[143]

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138 The University of Queensland, Submission 26, p. 2.

139 See, for example: Australian Pipelines and Gas Association, Submission 42, pp. 1–2; Mr Steven Davies, Chief Executive Officer, Australian Pipeline and Gas Association, *Committee Hansard*, Canberra, 10 February 2023, p. 59.

140 See, for example: DFAT, Austrade and EFA, Submission 31, p. 11; Australian Pipeline and Gas Association, Submission 42, p. 3; Farmers for Climate Action, Submission 16.1, p. 15.

141 See, for example: Mr Steven Davies, Chief Executive Officer, Australian Pipeline and Gas Association, *Committee Hansard*, Canberra, 10 February 2023, pp. 58–59.

142 Mr Steven Davies, Chief Executive Officer, Australian Pipeline and Gas Association, *Committee Hansard*, Canberra, 10 February 2023, p. 59.

143 Australian Pipeline and Gas Association, Submission 42, p. 4; APA Group, Submission 94, pp. 4, 9.

4.86 Dr Mark Hutchinson, Chief Executive Officer at FFI, also commented on the ability to, and the importance of utilising existing gas infrastructure for green hydrogen, emphasising that the goal is to replace the molecule:

> There are ways being looked at that you can transport hydrogen as synthetic LNG, which means you could use all the LNG infrastructure globally and you're just replacing a fossil fuel molecule with a green renewable molecule and you're feeding into the same users that use LNG.[144]

Green metals

4.87 A widely identified opportunity for new green energy export industries in Australia is the production of green metals, notably in the steel and aluminium value chains.[145] Production processes for steel and aluminium are highly emissions intensive. To be competitive in a global net-zero economy, steel and aluminium production will need to decarbonise.[146] The green metals industry presents Australia with an immense value-adding opportunity, capitalising on resources and renewable energy strengths.[147]

4.88 Globally, Australia accounts for around 27 per cent of bauxite production and 38 per cent of iron ore production.[148] While Australia has significant domestic steel and aluminium industries, most of these ores are exported to be processed into metals overseas.[149]

4.89 Producing green metals would enable Australia to produce high energy-intensive, low embedded emissions products. Being high-value exports, green metals could enable Australia to capture the greatest value from its metal ores and renewable energy resources, providing substantial economic benefits.[150]

4.90 Many submitters and witnesses discussed green steel and green aluminium production as a possible future trend supporting Australia's transition to a green energy superpower.[151] For example, Mr Eytan Lenko, Chief Executive Officer at Boundless Earth, stated that:

> The thesis of the reindustrialisation component of Australia becoming a renewable energy superpower is that we've got this amazing renewable

144 Dr Mark Hutchinson, Fortescue Future Industries, *Committee Hansard*, Perth, 17 March 2023, p. 14.

145 See, for example: Beyond Zero Emissions, Submission 32, p. 8; Climate Council, Submission 36, p. 6; Grattan Institute, Submission 37, p. 7; Australian Conservation Foundation, Submission 50, p. 5; The Next Economy, Submission 51, p. 6; Transgrid, Submission 52, p. 4; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 2; Rewiring Australia, Submission 118, p. 2.

146 Grattan Institute, Submission 37, pp. 5–6; Climate Council of Australia, Submission 36.1, p. 21.

147 Beyond Zero Emissions, Submission 32, p. 8; Australian Conservation Foundation, Submission 50, p. 5; Rewiring Australia, Submission 118, p. 2.

148 Grattan Institute, Submission 37, p. 8.

149 Rewiring Australia, Submission 115, p. 2.

150 Climate Council, Submission 36, p. 7; Rewiring Australia, Submission 118, p. 2.

151 See, for example: Dr Simon Bradshaw, Research Director, Projects, Climate Council, *Committee Hansard*, Macquarie Park, 6 April 2023, p. 12.

> resource. We've got the world's best solar and wind. If we develop that correctly, we should have access to some of the cheapest electricity and energy in the world… Then, once you've got access to that cheap energy, you've got the opportunity to create energy-intensive products for export—things like green steel, things like aluminium; products that are energy intensive—where we're effectively embodying that cheap, clean energy into those products and exporting them overseas.[152]

4.91 Similarly, Rewiring Australia observed that about a third of the cost of making steel is actually the cost of the energy needed to refine the ore, and that as Australia has the ore and the energy, it should be refining its ores with its excess energy:

> If we embed our energy in the manufacturing process and export more refined metals (which sell for a much higher price), we have a superpower opportunity well suited to Australia's natural resource advantages - metal ores and low-cost energy.[153]

4.92 Rewiring Australia also estimated that Australia's steel exports could be worth approximately ten times the value of current iron ore exports, while exporting aluminium could be worth three times the value of bauxite and alumina exports.[154]

4.93 The Grattan Institute suggested that using green hydrogen to produce green steel is the largest and most economically viable of Australia's green energy opportunities.[155]

4.94 Ms Nicola Ison, Head of Direct Advocacy at Boundless Earth, identified multiple potential export markets and opportunities for partnerships and stated:

> … the green metals space is both an export and an investment opportunity. The best pathway is for us to think about playing a role in renewable iron production, green iron production using renewable hydrogen, but also renewable alumina production, and the opportunities for joint ventures—particularly with partners from Germany, Korea and Japan—I think are significant and substantial.

4.95 Mr Andrew Morris, Manager, Trade and Investment at Austrade, told the Committee that while green metals were '… not a near-term proposition…' for Australia at the moment, Austrade was working '… to attract the right interest from… steel mill producers… who are seriously contemplating whether it makes more economic sense to be in Australia.'[156] DCCEEW also noted that an Australian green metals export industry requires continued research and innovation into new methods of production and transportation, including the utilisation of green hydrogen.[157]

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152 Mr Eytan Lenko, Chief Executive Officer, Boundless Earth, *Committee Hansard*, Melbourne, 5 April 2023, p. 18.

153 Rewiring Australia, Submission 118, p. 2.

154 Rewiring Australia, Submission 118, p. 2.

155 Grattan Institute, Submission 37, p. 7.

156 Mr Andrew Morris, Manager, Trade and Investment, Australian Trade and Investment Commission, *Committee Hansard*, Canberra, 30 November 2022, pp. 5–6.

157 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 3.

4.96 With further research and investment in production processes, metals and materials such as aluminium, lime, cement and steel have the potential to be produced with low carbon emissions.[158] Other items include door and window frames, bricks, glass bottles, fertilisers, copper and plastics.[159]

4.97 The Climate Council advised that due to the high level of emissions associated with steel production, the production and export of Australian green steel could have a significant impact on the decarbonisation of Australia's major trading partners and make a substantial contribution to global emissions reductions.[160]

4.98 However, some submitters noted that countries such as Japan, South Korea and China place strategic value on their steel industries and may be hesitant to replace their domestic production for imported green steel.[161] Given this, it was suggested that the export of intermediate products such as hot briquetted iron, a form of direct reduced iron and an input into steel, may be a more likely prospect than finished steel.[162]

4.99 Professor Ken Baldwin, Fellow at the Australian Academy of Technological Science and Engineering, outlined the opportunity for hot briquetted iron:

> It's the early stage of the iron and steel manufacturing process where you generate what's called hot briquetted iron, which is the most energy intensive. It makes enormous sense for mining–which, in Australia, is co-located with the best solar and wind resources–to then process iron ore into hot briquetted iron on site, using our vast resources in renewable energy. We could then export the hot briquetted iron to these countries that have the rest of the value-add and steel production process, the transportation is cheaper that way, as well. It's an advantage for them, because they get a cheaper product in their production line at the special entry point, but they then keep the higher-end, value-add part of the production chain for their own purposes. It's an advantage for Australia, because we can do the conversion from iron ore to hot briquetted iron and sell that as a value-added product.[163]

4.100 Some submitters suggested exporting both renewable energy and metal ores from Australia to other countries, for them to manufacture decarbonised metals, is not likely to be economically viable and that producing value-added products is much more prospective. For example, the Grattan Institute noted:

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158 Heavy Industry Low-carbon Transition Cooperative Research Centre, Submission 30, pp. 1–2.
159 Centre for Energy Technology, Submission 33, p. 4.
160 Climate Council, Submission 36, p. 6.
161 WWF, ACTU, BCA and ACTU, Submission 67.1, p. 52; Dr Peter Mayfield, Executive Director, Environment, Energy and Resources, Commonwealth Scientific and Industrial Research Organisation, *Proof Hansard*, Canberra, 23 June 2023, p. 13.
162 WWF, ACTU, BCA and ACTU, Submission 67.1, p. 52.
163 Professor Ken Baldwin, Fellow, Australian Academy of Technological Sciences and Engineering, *Committee Hansard*, Canberra, 31 March 2023, p. 9.

> With globally cost-competitive hydrogen, it will be cheaper to produce green steel here than to ship hydrogen and iron ore to countries such as Japan or Indonesia that have inferior renewable resources.[164]

4.101 Similarly, the Heavy Industry Low-carbon Transition Cooperative Research Centre (HILT CRC) suggested that the export opportunity for green metals may be more prospective for Australia than direct energy exports:

> Value-added, low-carbon commodities are expected to become a major, and potentially even the major, carrier of green energy exports for Australia. This is primarily because, unlike coal, both the transport and storage of green energy carriers (i.e. both renewable electricity and hydrogen) is not only expensive, it is also not yet proven at scale and will require substantial investment in new infrastructure. This means that it is likely to be lower in cost and risk for many of Australia's trading partners (e.g. in Japan, Korea, Germany and, potentially, China) to decarbonise a significant fraction of their steel production by embedding the renewable energy directly into the traded materials, such as by importing DRI [direct reduced iron], or other types of green ferrous feed, rather than to simply replace their coal imports with hydrogen. Such a scenario would generate significant new opportunities for countries, like Australia with coincident resources of minerals and green energy.

4.102 Dr Saul Griffith, Co-founder and Chief Scientist at Rewiring Australia, agreed while emphasising that the green metals opportunity should be underpinned by electrification:

> If the idea is that we're going to use hydrogen as the heating component to make steel or aluminium, it will double the price of aluminium and steel…The cheapest way to do everything is going to be through electrification. There are all-electric pathways to steel. Aluminium is already an all-electric process, so it can easily be made 100 per cent renewable. The cheapest way to do it is without putting hydrogen in the middle of that process.
>
> … The idea is that we would ship this expensive hydrogen, plus our red dirt, to Japan or China or Germany to make steel. It would make the steel even more expensive. So the structural advantage that Australia has is in domestically producing metals with renewable electricity. This should temper some of our enthusiasm for hydrogen, because there's every reason to believe that it will never be cost-effective compared to existing processes, whereas electrification of those processes can work.[165]

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164 Grattan Institute, Submission 37, pp. 6–7.

165 Dr Saul Griffith, Co-founder and Chief Scientist, Rewiring Australia, *Committee Hansard*, Macquarie Park, 6 April 2023, p. 15.

Carbon capture and negative emissions technologies

4.103 Submitters identified carbon capture and negative emissions technologies[166] as having a role in the global net-zero transition and in contributing to Australia's green energy transition, particularly in hard to abate sectors.[167] Australia has extensive potential for geological storage of carbon dioxide (CO_2) to support emissions reduction from stationary sources and removal from the atmosphere.[168] Geoscience Australia stated that: 'Improved understanding of Australia's geological storage potential underpins our low emission energy production and export industry.'[169]

4.104 Geoscience Australia described carbon capture and negative emissions technologies as '… the process of capturing carbon dioxide (CO_2) from stationary emission sources and injecting it deep underground into porous and permeable sedimentary rocks.'[170] It went on to add that CCS can be used to:

> … mitigate emissions from stationary sources such as power stations, natural gas production, hard to abate sectors in manufacturing such as steel and cement plants, and for negative emissions, that is, to remove CO_2 directly from the atmosphere and store it permanently underground.[171]

4.105 Noting this, Dr Andrew Feitz, Director, Low Carbon Geoscience and Advice at Geoscience Australia, told the Committee it sees CCS as part of the energy mix - a solution to Australia transitioning to a green-energy superpower; he went further and stated 'all the modelling around the world has said that fossil fuels are going to be part of the energy mix into the future, and so we've got to really focus on the emissions.'[172]

4.106 Similarly, Mr Mark McCallum, Chief Executive Officer at LETA, stated its support for CCS being the 'most practical and technical viable solution for reducing emissions in many essential sector' including:

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166 The term carbon capture and negative emissions technologies broadly includes those that capture CO_2 from industrial process and remove CO2 from the atmosphere. These include technologies such as carbon capture and storage (CCS), carbon capture, utilisation and storage (CCUS) and direct air capture and storage (DACS). See: Geoscience Australia, Submission 64, p. 16.

167 See, for example: Low Emission Technology Australia, Submission 21, pp. 1-2; Woodside Energy, Submission 47, p. 4; Department of Climate Change, Energy, the Environment and Water, Submission 62, pp. 12–13; Geoscience Australia, Submission 64, p. 16; Sun Cable, Submission 71, p. 6; Australian Academy of Science and Australian Academy of Technical Sciences and Engineering, Submission 74, pp. 2–3.

168 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 13; Geoscience Australia, Submission 64, p. 16.

169 Geoscience Australia, Submission 62, p. 16.

170 Geoscience Australia, Submission 64, p. 16.

171 Geoscience Australia, Submission 64, p. 16.

172 Dr Andrew Feitz, Director, Low Carbon Geoscience and Advice, Geoscience Australia, *Committee Hansard*, 10 February 2023, Canberra, p. 37.

> … our vital steel, chemical and cement industries as well as aviation, trucking and shipping.
>
> … While endowed with a wealth of renewable energy resources, Australia also has a competitive advantage to implement CCS with our known high-quality, stable geological storage basins, existing infrastructure, world-class technical expertise and regulatory regimes. [173]

4.107 The HILT CRC noted that, in combination with renewable electricity and green hydrogen, CCUS will be necessary in heavy industries producing energy-intensive materials by high temperature processing, particularly where CO_2 is derived directly from the materials being processed, such as in the production of cement and lime.[174]

4.108 DCCEEW observed the potential for carbon storage and noted the scope for Australia to play a role in deployment of the technology across the region:'[175]

> Australia is well-suited to large-scale deployment of CCUS to facilitate domestic CO_2 abatement and to support emissions reduction in our region…
>
> Australia can play a role in developing a regionally cooperative approach toward CCUS commercialisation and deployment in the Asia-Pacific region. Australia is working with like-minded nations to help accelerate deployment of CCUS, including supporting knowledge exchange; research and development to support technical advances and reduce costs; and driving regional CCUS policy and regulatory framework development.[176]

4.109 LETA suggested Australia's role in the region could extend to storing CO_2 produced in other countries that have limited storage capability such as Japan, South Korea and Singapore.[177]

4.110 Submitters outlined the potential for CCUS to reduce emissions from the extraction and consumption of natural gas[178] as well as in facilitating the production of blue hydrogen.[179]

4.111 Geoscience Australia advised that captured CO_2 has the potential to be utilised to replace the use of natural sources of CO_2 in the production of some products, for example in fertiliser, fuel or food production.[180] Similarly, LETA noted the potential to

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173 Mr Mark McCallum, Chief Executive Officer, Low Emission Technology Australia, *Committee Hansard*, Brisbane, 16 May 2023, p. 14.

174 Heavy Industry Low-Carbon Transition CRC, Submission 30, pp. 1–2.

175 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 13.

176 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 13.

177 Mr Mark McCallum, Chief Executive Officer, Low Emission Technology Australia, *Committee Hansard*, Brisbane, 16 May 2023, p. 19.

178 Geoscience Australia, Submission 62, p. 16; Woodside Energy, Submission 47, p. 4; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 13; Mr David Lawrence, Head, Oil and Gas Division, Department of Industry, Sciences and Resources, *Committee Hansard*, Canberra, 10 February 2023, p. 19.

179 Low Emission Technology Australia, Submission 21, p. 2; Woodside Energy, Submission 47, p. 4.

180 Geoscience Australia, Submission 62, p. 16.

repurpose captured CO_2 for use in manufacturing processes such as for cement and construction materials.[181]

4.112 Geoscience Australia described global research in the development of negative emissions technologies, directly extracting CO_2 from the air to generate new products or for permanent geological storage (known as direct air capture and storage or DACS).[182]

Committee comment

4.113 The Committee notes that some of the emerging opportunities discussed in this chapter are the subject of recently announced or updated Australian Government strategies and policies.[183]

4.114 Australia is a world-leader in the deployment of renewable energy and is a globally renowned supplier of raw materials and critical minerals that are vital for the green energy transition. The Committee believes that this provides an exceptionally strong basis on which to build future high-value export-oriented green energy industries.

4.115 The Committee acknowledges the potential of the vast range of opportunities that were put forward throughout the inquiry. Whether each of these opportunities prevail for Australia will ultimately depend on a complex range of factors, including economics (infrastructure, production, and transport costs), technological development, the strength of trade relationships, and the chosen decarbonisation pathways of trading partners.

4.116 The Committee believes that Australia must pursue additional value-added opportunities if it is to maximise the benefits of its natural strengths and make the transition to green energy superpower.

4.117 The Committee recognises the importance of value-adding to Australia's critical minerals to capture a greater share of the value chain. The Committee welcomes the recently released Critical Minerals Strategy 2023–2030, which includes an objective to build domestic capabilities in critical minerals processing.

4.118 The Committee believes there are strong prospects for Australia to build value-added manufacturing capabilities in the battery value-chain. The National Battery Strategy currently in development must build on the Critical Minerals Strategy 2023–2030 to provide a clear pathway for Australia to move to the next stage in the battery value-chain.

4.119 The Committee notes that the recently established National Reconstruction Fund will allocate $1 billion for value-adding in resources and up to $3 billion to support the

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181 Low Emission Technology Australia, Submission 21, p. 2.

182 Geoscience Australia, Submission 62, p. 16.

183 Recently announced or updated policies include the Critical Minerals Strategy, National Battery Strategy, Review of the National Hydrogen Strategy and the National Reconstruction Fund.

production of technologies such as batteries, solar panels, electrolysers, and wind turbine components, as well as to modernise the production of steel and aluminium.

4.120 The Committee acknowledges the tension between meeting export demand for raw materials and utilising those products onshore to develop value-added industries. If new production is locked into long-term supply contracts to meet growing demand in export markets, there is risk that this comes at the expense of higher value economic opportunities. For this reason, it may be prudent to consider how a greater portion of some raw materials, such as lithium, and in the future green hydrogen, could be retained onshore. However, the Committee notes that there are potential downsides to approaches such as reservation policies.

4.121 The Committee recognises the immense opportunity for an Australian green hydrogen export industry as well as the range of applications to support domestic decarbonisation and value-added exports. While blue hydrogen may have an export market and may play a role in establishing global supply chains, Australia's long-term focus must be on green hydrogen.

4.122 The Committee appreciates the concerns expressed by some stakeholders about the focus on green hydrogen production for export, potentially reducing options for domestic decarbonisation and opportunities for value-added manufacturing. It is encouraging that a stated aim of the Review of the National Hydrogen Strategy is to ensure that Australia is a global hydrogen leader on both an export basis and in the decarbonisation of domestic industries.

4.123 The Committee recognises Australia's opportunity to produce green metals, building on abundant metal ore deposits, renewable energy and well-established industries in the steel and aluminium value-chains. These are potentially Australia's highest value-added manufacturing export opportunities.

4.124 The Committee acknowledges evidence to the inquiry highlighting the considerable work being undertaken across nascent and emerging industries through activities such research and development, pilot and demonstration projects, precursor production facilities, and agreements and partnerships.

Recommendations

Recommendation 4

4.125 The Committee recommends that the National Hydrogen Strategy Review consider measures to ensure there is sufficient hydrogen supply to support domestic decarbonisation and build emerging value-added export opportunities.

Recommendation 5

4.126 The Committee recommends that the Australian Government consider whether measures are required to retain a greater portion of domestically mined critical minerals and rare earths onshore to encourage the development of downstream industries, such as in the battery supply chain.

5. Assisting emerging industries and technologies

Overview

5.1 As outlined in Chapter 3, Australian Government departments and agencies are already undertaking a considerable amount of work to support Australia's transition to a green energy superpower. This chapter summarises evidence from submitters and witnesses to the inquiry outlining how the development of emerging green energy industries and technologies, including some of those outlined in Chapter 4, could be further assisted and accelerated.

5.2 This chapter summarises evidence received during the inquiry about the Australian Government's role in assisting and accelerating emerging technologies through:

- Public funding and investment
- Enacting targets, strategies and coordination; and
- Certification, promotion and awareness building.

Public funding and investment

5.3 The Committee received considerable evidence calling for the Australian Government to play a role in funding and supporting investment in emerging green industries and technologies. A range of mechanisms were put forward, including the expansion of grants, debt and equity financing traditionally provided by specialist Australian Government agencies and investment vehicles, as well as alternative approaches.

5.4 The Grattan Institute described the need for public investment in emerging green industries and technologies:

> First, markets do not generally provide adequate incentives for research and development of new technologies, because knowledge is often intangible, risky, and difficult to appropriate. Low-emission technologies are particularly complex and uncertain.
>
> Second, many of the technologies that might produce large emissions reductions are expensive and high-risk. Early investors face high costs, low returns, and the

> risk of competitors free-rising on their initiative…For both these reasons, investment in low-emission technologies is and will remain critically inadequate.[1]

5.5 Similarly, the Australian National University Zero Carbon Energy for the Asia-Pacific Initiative (ZCEAPI) noted that: 'The growth rate of new industries is typically limited by the availability of low-cost credit due to higher perceived risk of novel industries.'[2]

Co-investment between the government and private sector

5.6 Many stakeholders identified the need for public funding to support emerging green industries and technologies in the form of co-investment between government and the private sector.[3] A co-investment approach aims to provide initial funding support and share risk, which encourages private sector investment, in turn catalysing and accelerating the development of emerging industries.[4]

5.7 The Australian Hydrogen Council (AHC) stated that: 'In order to capture the vast opportunity presented to Australia, bold policy and significant public sector investment will be required to unlock an even greater quantum of private sector investment.'[5]

5.8 In relation to the critical minerals sector, Mr Andrew Hutchinson, General Manager, Critical Minerals Office, Minerals and Resources Division at the Department of Industry Science and Resources (DISR), explained the potential role for government in supporting investment in emerging industries:

> In any emerging sector there's always the question of what is the role for government… I think there is a role for government, and it can take several different forms... Australia has always been reliant on foreign direct investment, particularly in the resources sector, because the scale of what we do is so much large than the scale of what we can finance domestically. The feedback we get from industry is that government need to think carefully about how they play a catalysing role and how they can help crowd in that private sector finance wherever possible.[6]

5.9 Sun Cable emphasised in their submission that the focus for government should be to encourage greater private sector investment:

> … the Commonwealth already coordinates finance for green energy projects with complementary private investment. For instance, catalysing private finance

1 Grattan Institute, Submission 37, p. 8.
2 Australian National University Zero Carbon Energy for the Asia-Pacific Initiative, Submission 98, p. 7.
3 See, for example: Electric Vehicle Council, Submission 14, p. 8; Heavy Industry Low-Carbon Transition CRC, Submission 30, pp. 5–6; Australian Conservation Foundation, Submission 50, p. 2; Sun Cable, Submission 71, p. 12; WWF-Australia (WWF), Australian Conservation Foundation (ACF), the Business Council of Australia (BCA), and the Australian Council of Trade Unions (ACTU), Submission 67.1, p. 100.
4 WWF, ACF, BCA and ACTU, Submission 67.1, p. 100.
5 Australian Hydrogen Council, Submission 49, p. 3.
6 Mr Andrew Hutchinson, General Manager, Critical Minerals Office, Minerals and Resources Division, Department of Industry, Science and Resources, *Committee Hansard*, Canberra, 10 February 2023, p. 13.

> informs the Clean Energy Finance Corporation's investment decisions. Sun Cable strongly supports an expansion of efforts to 'crowd in' private finance… this approach supports an increased dividend for industry and the taxpayer alike. Catalysing co-investment from the private sector should be an objective of all Commonwealth investment funds supporting the green economy…[7]

5.10 Some submitters noted that in comparison to subsidies and tax incentives, co-investment mechanisms represent better value for money and provide returns to government on successful investments.[8]

Expanding Australian Government investment vehicles

5.11 Stakeholders widely acknowledged the success of Australian Government agencies and investment vehicles[9] such as the Australian Renewable Energy Agency (ARENA), the Clean Energy Finance Corporation (CEFC), Export Finance Australia (EFA), and the Northern Australia Infrastructure Facility (NAIF) in providing funding through grants as well as debt and equity financing for projects to accelerate the development of emerging green industries and technologies.[10] For example, the Macquarie University Centre for Energy and Natural Resources Innovation and Transformation (CENRIT) explained that:

> The success of government grant programs to accelerate the deployment of new energy technologies is clearly evident in the portfolio of projects enabled through both ARENA and the [CEFC]. For the former, the successful leveraging of a private consortium through public funding to bridge the bankability gap of a first mover project was exemplified by Australia's first large-scale hydrogen facility in Pilbara, Western Australia. To address the two major cost drivers of hydrogen, being electrolyser construction expenditure ('capex') and electricity operating expenditure ('opex'), ARENA funding was able to step in where traditional financiers would be difficult to secure.[11]

5.12 The roles of ARENA, CEFC, EFA and the NAIF are outlined in Chapter 3.

5.13 Many submitters suggested that support provided by specialist Australian Government agencies and investment vehicles for emerging green energy industries and technologies could be improved by increasing funding, expanding remit, and

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7 Sun Cable, Submission 71, p. 12.

8 Sun Cable, Submission 71, p. 12; Australian National University Zero Carbon Energy for the Asia-Pacific Initiative, Submission 98, p. 7.

9 For more information on Australian Government investment funds and special investment vehicles see: https://www.finance.gov.au/government/australian-government-investment-funds.

10 See, for example: Electric Vehicle Council, Submission 14, p. 8; RE-Alliance, Submission 43, p. 5; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 10; Department of Industry, Science and Resources, Submission 63, p. 6; Entura, Submission 79, p. 2; Law Council of Australia, Submission 92.1, pp. 6–7; Australian National University Zero-Carbon Energy for the Asia-Pacific Initiative, Submission 98, p. 7; Industry Super Australia, Submission 117, pp. 9–10.

11 Macquarie University Centre for Energy and Natural Resources Transformation and Innovation, Submission 125, p. 6.

aligning objectives with export opportunities.[12] For example, the Electric Vehicle Council (EVC) submitted: 'To support industry development, the Government (through ARENA, the CEFC or other investment vehicles) can provide further debt and equity financing to innovative projects to accelerate the clean energy transition.'[13]

5.14 Entura explained that low interest loans from the CEFC provide many projects a greater level of surety of proceeding to financial close. Entura also suggested that maintaining and broadening the access to the CEFC '… will further support continued growth in the sector, particularly as new, pre-commercial technologies emerge that need initial investment support and de-risking.'[14]

5.15 The ZCEAPI suggested that increased funding through specialist agencies and investment vehicles could accelerate the development of the green hydrogen industry:

> More emphasis should be placed on funding and supporting targeted schemes for prototyping and first-of-a-kind scale-up of new technologies. While many of the technologies required for green hydrogen scale up are relatively mature, they are not yet widely deployed. Much of the required learnings in this area will be in integration of technologies and scaling up capacity. Funding to de-risk deployment, such as those that have been run through ARENA and the CEFC, should be increased and extended to support first movers in this space.[15]

5.16 Mr Leigh Heaney, Government Relations Manager at the Smart Energy Council (SEC), told the Committee that funding support could be extended to smaller projects:

> The CEFC requires a $20 million minimum loan. It's an unofficial minimum, but that's what everybody understands. We would like to see that be made smaller, so that it captures some of those smaller projects, or bundled together or however they want to do it, to bring those smaller projects or keep those smaller projects that we know have an awful lot of Australian IP [intellectual property], mostly paid for out of ARENA grants. We want to keep those here, and we think that's one mechanism to do it.[16]

5.17 The Grattan Institute identified gaps in the remit of specialist agencies and investment vehicles, including support to bring forward investment in low or zero carbon refurbishments of existing facilities.[17]

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12 See, for example: Electric Vehicle Council, Submission 14, pp. 8–9; Australian Electric Vehicle Association, Submission 19, p. 6; The University of Queensland, Submission 26, p. 7; Grattan Institute, Submission 37, p. 9; Boundless Earth, Submission 76, p. 3; Entura, Submission 79, p. 2; Australian National University Zero-Carbon Energy for the Asia-Pacific Initiative, Submission 98, p. 7.

13 Electric Vehicle Council, Submission 14, p. 8.

14 Entura, Submission 79, p. 2.

15 Australian National University Zero-Carbon Energy for the Asia-Pacific Initiative, Submission, 98, p. 7.

16 Mr Leigh Heaney, Government Relations Manager, Smart Energy Council, *Committee Hansard,* Canberra, 31 March 2023, p. 27.

17 Grattan Institute, Submission 37, p. 9.

5.18 Several submitters proposed that the remit of specialist agencies and investment vehicles be extended to provide grants and finance for domestic manufacturing, particularly for the battery sector.[18] For example, the Advanced Materials and Battery Council (AMBC) called for a bespoke investment vehicle to assist '… multiple battery chemistry ecosystems grow [and] streamline investment decisions for project and companies from extraction to manufacturing that are on the critical path for successful local battery supply chain development.'[19]

5.19 Ms Rebecca Manen, General Manager, NRF Strategy, Manufacturing and National Reconstruction Fund Division at DISR, described the role of the $15 billion National Reconstruction Fund (NRF), which includes renewable energy and low-emissions technologies, as well as value-adding in resources as priority funding areas:

> [The NRF] can really play a role in crowding-in private sector investment across the seven areas. The transformation, and developing emerging technologies and innovative processing methods and things like that, can be risky. It can take time. The NRF can play a particular role in helping to de-risk some of those investments so that were able to co-invest with more traditional lenders to really pull through those technologies, bring those to market and scale them in a way that they can go on to be commercial.[20]

Additional co-investment mechanisms and incentives

5.20 The Committee received evidence suggesting that additional types of co-investment mechanisms and incentives could be introduced to attract greater investment in emerging green industries and technologies. These were often raised in the context of responding to policies adopted by other countries such as those contained in the United States (US) Inflation Reduction Act (IR Act).[21] For example, the Clean Energy Council (CEC) advised that the green energy transition will require Australia to adopt policy settings that maintain its investment attractiveness in the context of increased global competition for capital:

> These superpower scenarios also demand very large amounts of capital investment, much of which will need to come from offshore. While there is no apparent shortage of clean energy finance…Australia is in competition with other markets for these funds, and we need to take active steps to ensure that our mix

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18 Advanced Materials and Battery Council, Submission 15, p. 3; The University of Queensland, Submission 26, p. 7; WWF, ACF, BCA and ACTU, Submission 67.1, p. 74; Mr Shannon O'Rourke, Chief Executive Officer, Future Battery Industries CRC, *Committee Hansard*, Perth, 17 March 2023, p. 19.

19 Advanced Materials and Battery Council, Submission 15, p. 3.

20 Ms Rebecca Manen, General Manager, NRF Strategy, Manufacturing and National Reconstruction Fund Division, Department of Industry, Science and Resources, *Committee Hansard*, Canberra, 10 February 2023, p. 13.

21 See, for example: Clean Energy Council, Submission 38, p. 2; Australia Hydrogen Council, Submission 39, p. 3; Woodside Energy, Submission 47, pp. 4–5; WWF, ACF, BCA and ACTU, Submission 67.1, p. 74, Boundless Earth, Submission 76, p. 3.

of policy settings and incentives provide an internationally-competitive investment environment.[22]

5.21 Dr Madeline Taylor, Deputy Director of the CENRIT, explained the need to move beyond traditional support such as grants and expand measures aimed at de-risking investment:

> …in order for us to actually seize upon our competitiveness we need to do more, because business and commerce and financing are now flowing to these other regions, like Canada and the US, where there is a clear multidecade framework around regulation, tax incentives, tariffs and offtaking, contracts for difference and things like this. So I think a more positive policy instrument along those lines is needed, as opposed to just banking projects, to really de-risk some of these technologies.[23]

5.22 Regarding the electric vehicle value chain, the EVC indicated the need for additional government support to de-risk commercialisation and attract private investment:

> Government investment must also look to move beyond research, development and trials, and actively support commercial operations across the full EV value chain. This could be via grants, tax concessions, or public investment in infrastructure. Government has a key role to play in de-risking investment in a domestic EV supply chain to attract both domestic and international private investment.[24]

5.23 The Heavy Industry Low-Carbon Transition Cooperative Research Centre (HILT CRC) advised that co-investment from government is required to support the development of technologies to decarbonise heavy industry:

> …given that the technologies needed for the low-carbon transition of high temperature process industries are not yet commercially available at scale, government co-investment will be required to de-risk their development and demonstration.[25]

Addressing the 'cost gap' and 'chicken and egg problem'

5.24 The Committee received evidence explaining that the development of emerging green industries is inhibited by the gap in the cost of production (or 'cost gap') between traditional products and green alternatives, which also results in what was often referred to as the 'chicken and egg problem'.[26]

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22 Clean Energy Council, Submission 38, p. 2.

23 Dr Madeline Taylor, Deputy Director, Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, *Committee Hansard*, Macquarie Park, 6 April 2023, p. 43.

24 Electric Vehicle Council, Submission 14, p. 9.

25 Heavy Industry Low-Carbon Transition Cooperative Research Centre, Submission 30, p. 5.

26 WWF, ACF, BCA and ACTU, Submission 67.1, pp. 93–95; Australian National University Zero Carbon Energy for the Asia-Pacific Initiative, Submission 98, p. 8; Professor Ken Baldwin, Fellow, Australian Academy of Technological Sciences and Engineering, *Committee Hansard*, Canberra, 31 March 2023, p. 11;

5.25 The chicken and egg problem arises where there is a substantial difference between the price at which producers are willing to sell into the market and the price that buyers are willing to pay. This leads to uncertainty and creates a stalemate between supply and demand, which constrains the development of the market.[27]

5.26 The ZCEAPI provided an example of the chicken and egg problem in that there is a reluctance of downstream hydrogen users to invest in the transition to hydrogen because of an uncertainty about the price and availability of green hydrogen, and explained:

> …Australian project developers face challenges in obtaining investment and credit because of concerns about the extent of the downstream markets. Collaborations between governments in exporting and importing countries can provide clear signals to supply chain participants and de-risk these co-dependent investments.[28]

5.27 Similarly, Professor Ken Baldwin, Fellow at the Australian Academy of Technological Sciences and Engineering (AATSE), told the Committee that:

> You'll… remember back to the start of LNG and the whole exercise of getting a supplier that is willing to provide at a particular price, which then incentivises demand, but at the same time the customer wants to know what the price is, and therefore there's this chicken-and-egg situation to kick things off at the beginning of industry. Creating demand for these new renewable energy products is going to be the key. That's certainly true in hydrogen. The [IR Act] in the US might have kicked that off and helped to break the Gordian knot at the very beginning, in some sense. But it's demand creation that is really important for Australia. We've got to be out there on the front foot talking to industry in other countries that are going to use the export products that we'll produce using renewables.[29]

5.28 Dr Fiona Simon, Chief Executive Officer of the AHC, summarised the situation in the hydrogen industry, where a gap between supply and demand is constraining the development of the market:

> The idea is, if you've got the demand saying, 'We're prepared to sign on the dotted line for this price, for this amount of hydrogen or its derivatives,' then that's going to kick everything back through the supply chain and we're going to have the production and the means of doing it. But no-one's prepared to lock into the

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Ms Catherine Zerger, Acting Branch Head, Transport and Regions, Department of Climate Change, Energy, the Environment and Water, *Proof Hansard*, Canberra, 23 June 2023, p. 3.

27 See, for example: Australian National University Zero Carbon Energy for the Asia-Pacific Initiative, Submission 98, p. 8; Mr Simon Corbell, Chief Executive Officer, Clean Energy Investor Group, *Committee Hansard*, Canberra, 31 March 2023, p. 18; Dr Fiona Simon, Chief Executive Officer, Australian Hydrogen Council, *Committee Hansard*, Melbourne, 5 April 2023, pp. 38–41; Ms Jo Evans, Deputy Secretary, Department of Climate Change, Energy, the Environment and Water, *Proof Hansard*, Canberra 23 June 2023, p. 2.

28 Australian National University Zero Carbon Energy for the Asia-Pacific Initiative, Submission 98, p. 8.

29 Professor Ken Baldwin, Fellow, Australian Academy of Technological Sciences and Engineering, *Committee Hansard*, Canberra, 31 March 2023, p. 11.

> sorts of significant volumes we're talking about because we're also not evolved enough, at this stage, to know how much it does cost. So much of the cost that would go into what the offtakers would agree to is, itself, dependent on how everyone sees this emerging. So we have a gap. We have a gap between people's willingness to sell and people's willingness to pay...[30]
>
> No one at this stage is setting forth a compelling enough case as to what they're prepared to actually use and pay. That's the offtake that people are looking for. What we do know is when people do have the discussions about what people are likely to pay, it's vastly less than what it takes to make the hydrogen, which is why we're back in this world of: can we bridge the gap? What are the mechanisms to allow that to be the case?[31]

5.29 Similarly, Mr Simon Corbell, Chief Executive Officer of the Clean Energy Investor Group (CEIG), described the role for governments to develop the market by providing revenue support to bridge the gap:

> At the moment, the price that you can get for green hydrogen is not sufficient basically because of a lack of a market to really make that proposition commercial at any scale in the domestic economy, let alone for exports. So there is an opportunity for governments to have regard to how they provide some level of price support, in the same way that governments in Australia and overseas have done for large-scale wind and solar in the last two decades, to help bring down the cost of green hydrogen manufacture and bridge the gap between the delivery cost and what the market would pay. That revenue support is potentially quite an important role for governments to play.[32]

Contracts for difference

5.30 Contracts for difference (CFDs) were identified as a co-investment mechanism to support investment in emerging green products or technologies.[33] Through CFDs the government underwrites investment by guaranteeing the seller a fixed price for their product. If the price in the market falls below an identified 'floor' price the government will pay the difference, and if the market price moves above a 'ceiling' price then the government is entitled to share in the profits.[34]

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30 Dr Fiona Simon, Chief Executive Officer, Australian Hydrogen Council, *Committee Hansard*, Melbourne, 5 April 2023, pp. 38–39.

31 Dr Fiona Simon, Chief Executive Officer, Australia Hydrogen Council, *Committee Hansard*, Melbourne, 5 April 2023, p. 41.

32 Mr Simon Corbell, Chief Executive Officer, Clean Energy Investor Group, *Committee Hansard*, 31 March 2023, p. 18.

33 See, for example: Woodside Energy, Submission 47, p. 4; Australian Conservation Foundation, Submission 50, p. 2; Boundless Earth, Submission 76, p. 3; Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, p. 11; Dr Fiona Simon, Chief Executive Officer, Australian Hydrogen Council, *Committee Hansard*, Melbourne, 5 April 2023, p. 37.

34 Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, p. 11; Ms Nicola Ison, Head of Direct Advocacy, Boundless Earth, *Committee Hansard*, Melbourne, 5 April 2023, p. 21.

5.31 CFDs support the development of emerging industries by bridging the cost gap between traditional products and new green alternatives.[35] The Australian Conservation Foundation (ACF) explained that CFDs offer price stability, which then attracts investment by improving the risk profile and suggested that CFDs could be used to '…bridge the cost gap between hydrogen produced with renewable energy and hydrogen from fossil fuels, helping support demand for the zero-carbon fuel.'[36]

5.32 Some submitters noted that CFDs have been used successfully by a number of state and territory governments to underwrite renewable electricity generation, generally by awarding contracts through a competitive reverse auction process.[37]

5.33 Ms Nicola Ison, Head of Direct Advocacy at Boundless Earth, explained how the CFD approach could be used in Australia beyond the electricity sector:

> The idea is you could then expand it to the carbon market, say we could do a similar thing for the production of renewable ammonia or green iron and go, 'We will provide a carbon contract for difference; what's the carbon price you might need?' We're not talking about creating a whole economy wide carbon pricing; you would pick a couple of sectors you thought were really important to incentivise the decarbonisation of and do so in a way that encourages trade export competitiveness— green iron being a great example; green ammonia being another good example. It's just a targeted way of using a semi-government lever and a semi-market lever to encourage that additional investment and create that investment certainty in the industry space.[38]

5.34 Mr Eytan Lenko, Chief Executive Officer of Boundless Earth, explained further:

> For a clear example, if ammonia is able to be produced normally for a dollar a kilo, say, and to do it in a decarbonised way is $1.50 a kilo, then maybe they would bid $1.60, then every time they get a price, international markets will pay a premium for decarbonised products, so if they're getting $1.90 a kilo, they're paying back the 30c. If there's a flood in the market of non-decarbonised ammonia, at a dollar a kilo, and the government's topping up that 60c, then that's what enables that project to get off the ground.[39]

5.35 Some stakeholders pointed to Germany's introduction of CFDs to incentivise development of their green steel and chemical industries as successful approach that

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35 Australian Conservation Foundation, Submission 50, p. 2; WWF, ACF, BCA and ACTU, Submission 67.1, pp. 50, 65; Mr Eytan Lenko, Chief Executive Officer, Boundless Earth, *Committee Hansard*, Melbourne, 5 April 2023, pp. 21–22.

36 Australian Conservation Foundation, Submission 50, p. 2.

37 Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, p. 11; Ms Nicola Ison, Head of Direct Advocacy, Boundless Earth, *Committee Hansard*, Melbourne, 5 April 2023, p. 21.

38 Ms Nicola Ison, Head of Direct Advocacy, Boundless Earth, *Committee Hansard*, Melbourne, 5 April 2023, pp. 21–22.

39 Mr Eytan Lenko, Chief Executive Officer, Boundless Earth, *Committee Hansard*, Melbourne, 5 April 2023, pp. 21–22.

could be informative for Australia.[40] Dr Fiona Simon, Chief Executive Officer of the AHC, explained that:

> The sorts of things that we are really supportive of are subsidies through market creation mechanisms like a contract-for-difference type approach. There's a German initiative called H2Global, for example, where they're going out to the market and acting as an intermediary between the buyers of hydrogen derivatives in Germany and the sellers from overseas of those same hydrogen derivatives and then filling the gap, which then reduces over time as the market gets up. This is the sort of thing we need in Australia, where ideally we partner to do a shared contract-for-difference, according to certain parameters, with the Koreans or with the Germans.[41]

Tax credits and incentives

5.36 The Committee received evidence that described production tax credits as a mechanism to accelerate emerging industries and technologies, often in the context of policies introduced by the US and Canada.[42] A production tax credit effectively provides a financial contribution from government towards each unit produced, lowering the cost of production.[43]

5.37 Dr Maia Schweizer, Director, Western States at Fortescue Future Industries (FFI), explained the benefits of a production tax credit with regard to the green hydrogen industry:

> Why do we see that as a promising way to potentially achieve this outcome? It helps to close the gap between hydrogen—green hydrogen in particular—and fossil fuels. It's a very efficient and simple policy to implement because it's linked directly to something that's easily evidence based. So it's linked to the production of hydrogen, which is ultimately what we're aiming for, as opposed to, for example, capital grants or investment credits that would force the government to

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40 Australian Conservation Foundation, Submission 50, p. 6; Boundless Earth, Submission 76, p. 3; WWF-Australia, the Business Council of Australia, the Australian Council of Trade Unions and the Australian Conservation Foundation, Submission 67.1, p. 107; Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, p. 11.

41 Dr Fiona Simon, Chief Executive Officer, Australian Hydrogen Council, *Committee Hansard*, Melbourne, 5 April 2023, p. 39.

42 See, for example: Dr Maia Schweizer, Director, Western States, Fortescue Future Industries, Committee Hansard, Perth, 17 March 2023, p. 11; Mr Shannon O'Rourke, Chief Executive Officer, Future Battery Industries CRC, *Committee Hansard*, Perth, 17 March 2023, p. 19; Mr Wayne Smith, Smart Energy Council, *Committee Hansard*, Canberra, 31 March 2023, p. 24; Dr Madeline Taylor, Deputy Director, Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, *Committee Hansard*, Macquarie Park, 6 April 2023, pp. 42–43.

43 Dr Simon Bradshaw, Research Director, Projects, Climate Council, *Committee Hansard*, Macquarie Park, 6 April 2023, p. 10; Dr Maia Schweizer, Director, Western States, Fortescue Future Industries, *Committee Hansard*, Perth, 17 March 2023, p. 11.

pick a winner and evaluate in detail significant numbers of projects. So we see it as a very simple and elegant policy measure to implement.[44]

5.38 Mr Wayne Smith, External Affairs Manager at the SEC, explained that a production tax credit could encourage investment in advanced manufacturing by providing greater certainty:

> In the US Inflation Reduction Act, there is very specific language about an advanced manufacturing tax credit, and an important bit about it is that it only provides a tax credit once something is manufactured. Once something is actually produced, you could have a tax credit that lasts, for example, for 10 years. The thing that's really important about it is that it provides investment certainty for companies that are looking to manufacture. They know that they're only going to get that tax credit once they start manufacturing and they're actually producing products, but they know that it's coming as well.[45]

5.39 Beyond production tax credits, the AMBC proposed that tax concessions available to the resources sector could be extended to the manufacturing sector:

> There are substantial numbers of levers for attracting finance that already exist in our economy that aren't actually provided to manufacturers. One is exploration capital for mining and gas companies. It is not actually provided to manufacturing companies. So you can write off your whole exploration costs whereas a manufacturing company can't when it's looking to develop a new product. It is similar for mining as for gas. You can also, in some countries, provide a tax loss through for investors, which is what a called a flow-through tax. So when your company is not cash flow positive, which is usually the case for early stage battery companies, they can provide that tax loss through to their shareholders. Canada already has this. It means that the tax losses for the company can be given to the shareholders in a very tax effective way. It doesn't actually increase the tax effect or the share of wallet for the government either.[46]

5.40 Submitters suggested other tax-based incentives including royalty discounts to encourage downstream capabilities in the critical minerals sector,[47] tax concessions to increase uptake of new technologies such as electric vehicles,[48] tax deductions for project feasibility assessments and expenditure on pilot facilities,[49]accelerated tax

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44 Dr Maia Schweizer, Director, Western States, Fortescue Future Industries, *Committee Hansard,* Perth, 17 March 2023, p. 11.

45 Mr Wayne Smith, Smart Energy Council, *Committee Hansard*, Canberra, 31 March 2023, p. 24.

46 Mr Craig Nicol, Advanced Materials and Battery Council, *Committee Hansard*, Brisbane, 16 May 2023, p. 1.

47 Australian Conservation Foundation, Submission 50, p. 1; WWF, ACF, BCA and ACTU, Submission 67.1, p. 41.

48 Tesla, Submission 24, pp. 3–4.

49 Woodside Energy, Submission 47, p. 4.

depreciation for green energy assets,[50] and targeted research and development tax concessions.[51]

Local content and procurement

5.41 Submitters identified local content and procurement requirements as a mechanism for governments to support the development of emerging industries and technologies by building demand.[52] Local content policies involve incentives or requirements to use domestically produced inputs or products, generally in government procurement and where public funding or finance is involved. For example, a certain percentage of green steel and aluminium could be required in publicly funded infrastructure projects.[53]

5.42 Westpac Group proposed that introducing local content requirements as a component of relevant Australian Government renewable energy initiatives could accelerate the domestic solar panel manufacturing industry:

> With the large-scale investments in solar panels planned by the Commonwealth Government, such as the community solar banks policy, one way to kick start the value-adding process is for those solar panels to be Australian made. Adopting a local content policy for renewable energy projects would be a key way to not only directly support Australia businesses, but also create the scale required for ancillary advanced manufacturing.[54]

5.43 Star of the South advised that local content requirements have been a key component of government and industry collaboration to successfully expand local supply chains in the United Kingdom's (UK) offshore wind industry.[55]

5.44 In relation to battery storage, the University of Queensland (UQ) explained the benefit of building domestic demand through local procurement policies, whilst noting the need to consider requirements of export markets:

> Although trade with international partners is the goal, access to domestic markets through beneficial procurement policies to support locally made batteries, provides valuable learnings about customer requirements and deployment challenges to become more globally competitive. Thus, procurement policies to

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50 Woodside Energy, Submission 47, p. 4

51 The University of Queensland, Submission 26, p. 6; Woodside Energy, Submission 47, p. 5; Industry Super Australia, Submission 117, p. 9.

52 See, for example: Electric Vehicle Council, Submission 14, p. 8; Advanced Materials and Battery Council, Submission 15, p. 2; The University of Queensland, Submission 26, p. 8; University of Adelaide Institute for Sustainability, Energy and Resources, Submission 33, p. 3; Star of the South Wind Farm Pty Ltd, Submission 54, p. 2; Westpac Group, Submission 57, p. 6; WWF, ACF, BCA and ACTU, Submission 67.1, p. 104; Boundless Earth, Submission 76, pp. 2–3.

53 WWF, ACF, BCA and ACTU, Submission 67.1, p. 104.

54 Westpac Group, Submission 57, p. 6.

55 Star of the South Wind Farm Pty Ltd, Submission 54, p. 2.

> support locally made batteries… need to consider international trade partner requirements and global market expectations.[56]

5.45 Local content and procurement policies were mentioned as a mechanism to support the development of various emerging industries including electric vehicles,[57] battery storage,[58] solar power,[59] wind power,[60] and construction and building materials (e.g. aluminium, steel, cement).[61]

5.46 Submitters noted that local content requirements are a key feature of the policy framework introduced by the US IR Act to support their emerging green industries, with carve outs for international trading partners such as Australia.[62]

5.47 Ms Jo Evans, Deputy Secretary at the Department of Climate Change, Energy, the Environment and Water (DCCEEW), described the aim of the Hydrogen Headstart program announced in the 2023–24 Budget:

> That's [the cost gap] what Hydrogen Headstart is targeting…we don't have any significant scale of hydrogen production in Australia yet. Partly, that's because in the financial industry there's a lack of confidence to put the money into these projects if they don't have a proper offtake…So some form of revenue support was clearly something that was needed to try to lift it off the ground, and that's what the Hydrogen Headstart program attempts.[63]

Shared infrastructure and industrial hubs

5.48 Several submitters outlined the need for public investment and coordination in the establishment of shared infrastructure and industrial hubs as an approach to support emerging technologies and industries.[64]

5.49 Beyond Zero Emissions (BZE) described the concept of Renewable Energy Industrial Precincts (REIP) as clusters of manufacturers powered by renewable energy and storage. These would provide 'a unified and coordinated vision' to overcome barriers

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56 The University of Queensland, Submission 26, p. 8.
57 Electric Vehicle Council, Submission 14, p. 8.
58 Advanced Materials and Battery Council, Submission 15, p. 2; The University of Queensland, Submission 26, p. 8.
59 Westpac Group, Submission 57, p. 6.
60 Star of the South Wind Farm Pty Ltd, Submission 54, p. 2.
61 University of Adelaide, Submission 33, p. 3; WWF-Australia, the Business Council of Australia, the Australian Council of Trade Unions and the Australian Conservation Foundation, Submission 67.1, p. 104.
62 Boundless Earth, Submission 76, pp. 2-3; Dr Maia Schweizer, Director, Western States, Fortescue Future Industries, *Committee Hansard*, Perth, 17 March 2023, p. 11.
63 Mrs Jo Evans, Deputy Secretary, Climate Group, Department of Climate Change, Energy, the Environment and Water, *Proof Hansard*, Canberra, 23 June 2023, p. 2.
64 See, for example: Heavy Industry Low-Carbon Transition CRC, Submission 30, p. 6; Beyond Zero Emissions, Submission 32, pp. 2–5; Queensland Conservation Council, Submission 41, p. 1; WWF, ACF, BCA and ACTU, Submission 67, p. 2; Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering, Submission 74, p. 4; Professor Michael Goodsite, Pro Vice-Chancellor and Director, University of Adelaide Institute for Sustainability, Energy and Resources, *Committee Hansard*, Brisbane, 16 May 2023, pp. 25–26.

to establishment and 'enable the coordination of infrastructure, energy and skills' required to develop green manufacturing industries.[65] BZE also suggested that the REIP model assists to develop community support and maintain economic prosperity in regional areas transitioning from traditional industrial sectors.[66]

5.50 In relation to the development of green metals industries, Mr Rowan Moorey, Senior Researcher at BZE, told the Committee that:

> We think a focus on certain projects like green steel–green alumina has a huge potential to pay massive dividends…We need to play to our strengths with the resources we've already got. We've had nation building exercises with iron ore. We export most of the world's iron ore in Australia. There's no reason why we can't make that green ore, but there needs to be a coordinated national approach to doing that. Using our REIP model to focus on those shared co-benefits with an ecosystem industrial precinct approach means that lots of industries benefit from the manufacturing of green ore, not just one or two companies.[67]

5.51 The HILT CRC outlined the need for co-investment in the establishment of low-carbon industrial hubs and explained that the approach can accelerate emerging industries by:

- Lowering the investment barrier by increasing the number of partners who can benefit and/or share in the investment and creating economies of scale;
- Generating innovation by knowledge sharing, cross-fertilisation, increased capacity and greater critical mass;
- Lowering the cost of managing industrial byproducts, to generate value from materials that are considered to be 'byproducts' in traditional industrial processes;
- Increasing public good by generating new jobs in the circular economy and hence greater potential for government co-investment.[68]

5.52 Professor Michael Goodsite, Pro Vice-Chancellor and Director at the University of Adelaide Institute for Sustainability, Energy and Resources (ISER), suggested that incentives should be used to attract nascent industries to industrial hubs and explained that: 'If you cluster companies and cluster and import-export activities, you create a critical mass that enables trade and enables people to learn from one another.'[69]

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65 Beyond Zero Emissions, Submission 32, p. 3.

66 Beyond Zero Emissions, Submission 32, pp. 3–4.

67 Mr Rowan Moorey, Senior Researcher, Beyond Zero Emissions, *Committee Hansard*, Melbourne, 5 April 2023, pp. 25–26.

68 Heavy Industry Low-Carbon CRC, Submission 30, p. 6.

69 Professor Michael Goodsite, Pro Vice-Chancellor and Director, University of Adelaide Institute for Sustainability, Energy and Resources, *Committee Hansard*, Brisbane, 16 May 2023, pp. 25–26.

5.53 Ms Sanaya Khisty, Chief Strategy Officer at BZE, further explained the REIP model, with particular focus on the need for coordination:

> That's when we come back to the precinct [REIP] model, because we really need to think about the transformations were going to use–repurposing infrastructure, brownfield sites and transmission. We want to make sure that we are working with what we've got–those highly skilled workforces in those existing regions–and we want to set up those conditions so that it is really clear how we're going to actually make this work. It can't be left to every individual business to work that out. They want more coordination and they want that to come from the government…It needs to be federal, state and local, and its already happening in some states.[70]
>
> So it's happening, but the role of the federal government is really to make sure that our states don't compete against each other–that we don't have the Hunter and the Illawarra competing against each other–and that we are playing to our strengths and competing in an international market. That is something that only the federal government can do in setting up the architecture for a national program…it is really about making sure that the federal government leads that coordination piece that has to happen at the local level as well.[71]

5.54 In their joint submission, the Australia Academy of Science (AAS) and AATSE also highlighted the need for shared and coordinated infrastructure:

> It is essential that Australian green energy infrastructure is developed and utilised in a coordinated manner. Co-locating manufacturing with extraction increases efficiency…At the same time, coordinated use of infrastructure minimises duplication, both improving cost competitiveness. Previous energy projects have seen the siloing of infrastructure, resulting in unnecessary duplication…This inefficiency results in increases capital and operational costs, potentially undermining cost competitiveness and endangering future green energy projects.[72]

5.55 BZE recommended that the Australian Government create a 'REIP activation plan' including investment to establish two first mover locations, coordinate and launch additional locations over the next decade, and work toward further locations longer-term.[73]

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70 Ms Sanaya Khisty, Chief Strategy Officer, Beyond Zero Emissions, *Committee Hansard*, Melbourne, 5 April 2023, p. 27.

71 Beyond Zero Emissions, 5 April 2023, p. 28.

72 Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering, Submission 74, p. 4.

73 Beyond Zero Emissions, Submission 32, p. 3.

5.56 The AAS and AATSE suggested that the Australian Government focus on 'developing a plan to coordinate and support development of green energy and green mineral hubs across companies to ensure maximum cost competitiveness.'[74]

5.57 The Committee received evidence outlining the Australian Government's recent support for industrial hubs, including the Australian-made Battery Manufacturing Precinct, the Powering Australia Industry Growth Centre, and hydrogen hubs.[75] In relation to hydrogen hubs, DCCEEW stated that:

> The Government has committed $525 million to establish hydrogen hubs and to support the growth of Australia's clean hydrogen industry in places such as Gladstone, Townsville, the Hunter Valley, Bell Bay, and the Pilbara. Hubs will co-locate hydrogen users, producers and potential exporters.[76]

5.58 Stakeholders noted that several state governments are also enacting shared infrastructure and industrial hub policies, for example, the New South Wales Clean Manufacturing Precinct Policy under which precincts are being designed in the Hunter and the Illawarra, and Queensland Government initiatives in Gladstone and Townsville.[77]

5.59 The Grattan Institute proposed a more targeted approach for public funding to support large transformative industrial projects, initially focussed on the steel industry:

> Australia should use the next decade to create a foothold in the emerging green steel market. The best way to do this is through direct government funding to support private investment in higher-cost, but lower-emissions, steel production – a steel 'flagship' project.
>
> The government funding required to support a low-emissions steel project is not small. Government funding in the order of $500 million is likely to be necessary to underpin a multi-billion dollar modernisation of Australia's steel industry.[78]
>
> …
>
> Much of the capital required to transform the sector will come from private investment. However, there will be a risk gap for first-of-a-kind and first-in-country transformation of industrial facilities. Making concessional finance available is one way to share this risk. The CEFC, provided it has access to enough funds and can prudently manage the risk, would be the ideal vehicle, and could aim to

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74 Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering, Submission 74, p. 4.

75 Department of Industry, Science and Resources, Submission 63, p. 7; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 11.

76 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 11.

77 Beyond Zero Emissions, Submission 32, p. 4; Ms Sanya Khisty, Chief Strategy Officer, Beyond Zero Emissions, *Committee Hansard*, Melbourne, 5 April 2023, p. 28.

78 Grattan Institute, Submission 37, p. 8.

> make between 5 and 10 'big bets' on big net-zero industrial facilities…a green steel flagship projects would be one such opportunity.[79]

5.60 Similarly, the World Wildlife Fund (WWF), ACF, Business Council of Australia (BCA), and the Australian Council of Trade Unions (ACTU) suggested that: 'Government co-investment in green metal production facilities may have high upfront investment costs but are effective in catalysing development. Co investment in flagship refineries and smelters for proof-of-concept green metal production can enable the industry to grow.'[80]

Research and Development

5.61 The Committee received evidence that highlighted Australia's world class research and development (R&D) sector and emphasised the importance of R&D to Australia's green energy superpower transition.[81]

5.62 DCCEEW acknowledged in its submission the need for further investment in R&D to support the realisation of many of Australia's green energy export opportunities:

> Export industries of the future like green iron and steel production and green alumina and aluminium production require continued innovation and research into new methods of production and transportation, including the use of hydrogen. Many of these technologies are at early stages and further investment is required for development and commercial deployment.[82]

5.63 Sun Cable explained the need for public investment in R&D: '… promising technologies such as green steel production systems, require support for earlier-stage R&D to advance through the innovation pipeline. Given the elevated risk and protracted time sale over which any return would be realised, the private sector is often reluctant to provide such support.'[83]

5.64 The ZCEAPI outlined the need for public investment and noted R&D achievements in the mining and renewable energy industries:

> Without research and development investments by government, Australia's renewable-based industries will not develop at the speed required to successfully compete. While Australia's relatively small population means it cannot match the dollar amount of R&D funding of majors such as the EU and US our track record

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79 Grattan Institute, Submission 37, p. 9.

80 WWF, ACF, BCA and ACTU, Submission 67.1, p. 65.

81 See, for example: The University of Queensland, Submission 26, pp. 1, 10; Climate Council, Submission 36, p. 10; Australian Hydrogen Council, Submission 39, p.p. 5–6; Australian Conservation Foundation, Submission 50, p. 2; The Next Economy, Submission 51, p. 4; WWF, ACF, BCA and ACTU, Submission 67.1, p. 81; Boundless Earth, Submission 76, p. 3; APA Group, Submission 94, pp. 4–5; Mr William Tan, Acting General Manager, National Reconstruction Fund Priorities Branch, Department of Industry, Sciences and Resources, *Committee Hansard*, 10 February 2023, Canberra, p. 11; Mr Wayne Smith, External Affairs Manager, Smart Energy Council, *Committee Hansard*, Canberra, 31 March 2023, p. 28.

82 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 3.

83 Sun Cable, Submission 71, p. 10.

> has shown that R&D funding targeted at industries in which we have potential comparative advantage can be hugely successful. Australia is a world-leader in mining technology and Australian developed solar panels dominate global markets.[84]

5.65 UQ also highlighted the success of Australia's R&D sector and suggested that R&D spending as a proportion of gross domestic product should be increased:

> An increase in national R&D spending from <2% towards the OECD's 2020 average of 2.67% would be a powerful stimulus for research and innovation activities aligned with areas of national priority, including energy transformations. The embedded capability and quality in our national research sector provides a robust platform to support expanded priority-driven and industry-engaged R&D activities nationally.[85]

5.66 In their submission, the AHC proposed that assisting business to invest in R&D would have both decarbonisation and economic benefits:

> The Australian economy could benefit by supporting businesses who develop cutting edge technology. Establishing the right environment to invest in research and development will enable more enterprising Australians to make the breakthrough which will both smooth the path to decarbonisation and benefit the economy.[86]

5.67 The ISER explained that there is a need to link investment into emerging green energy industries with ongoing R&D support in those industries:

> Australia has the potential to become globally-leading in next generation future energy technologies and storage, as well as direct measures of generating hydrogen from photovoltaics and seawater, provided that trade and investment activities also resource research and innovation. [87]

5.68 A few submitters mentioned the importance of local R&D to the development of products and technologies best suited to Australia's green energy sector opportunities, for example, in relation to Australia's specific mineral ores.[88] The AAS and AATSE described that: '… Australia's green energy sector has unique needs and cannot rely on overseas researchers or innovations to provide our solutions, including for domestic consumption and export of green energy and green energy commodities.'[89]

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84 Australian National University Zero Carbon Energy for the Asia Pacific Initiative, Submission 98, pp. 6–7.
85 The University of Queensland, Submission 26, p. 3.
86 Australian Hydrogen Council, Submission 39, p. 5.
87 University of Adelaide Institute for Sustainability, Energy and Resources, Submission 18, p. 1.
88 Australian Conservation Foundation, Submission 50, p. 2; Australian Academy of Science and the Australian Academy of Technological Sciences and engineering, Submission 74, p. 3; Australian National University Zero Carbon Energy for the Asia Pacific Initiative, Submission 98, pp. 6–7.
89 Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering, Submission 74, p. 3.

5.69 Public-private partnerships and models for collaboration between government, industry and research were identified as having an important role in R&D, such as through the Cooperative Research Centre (CRC) model.[90] Professor Michael Goodsite, Pro Vice-Chancellor, Energy Futures and Director at ISER, observed that: 'CRCs are excellent examples of cooperative efforts where people who normally compete invest together to achieve and deliver for the benefit of Australia.'[91]

5.70 UQ suggested the need for funding to be targeted at program rather than project-based R&D activities:

> Project-by-project investment will not support the conditions required to achieve research missions that seek to bring technological developments through TRL [Technology Readiness Level] and CRL [Commercial Readiness Level] levels. Large scale programmatic efforts are more responsive to the needs of the research workforce, which is essential to deliver transformative research translation and commercialisation.
>
> …
>
> Programmatic R&D effort and funding is a stabilising and risk mitigating factor for both industry investments and research. Providing a policy platform for such funding would require the government…to define and set targets around the ambition to become a 'green energy superpower.' [92]

5.71 Professor Ian Chubb, Secretary for Science Policy at the AAS, told the Committee that collaboration between government, industry and research could be improved:

> The American government agencies put in three per cent of their R&D budget per annum, so it's a lot bigger. But it's not so much that; it's the fact that there is the initiative to do it, and you're changing the game by doing that. We need a game changer that says, 'This is an opportunity to change the game and establish policies, programs and strategies that say it is worthwhile working together to do this.' There is skill based in all of the elements–government, industry and the researching sector. How do we get it to work together better than we ever have before? It'll take a policy drive, and it'll take a strategy to do it. There are initiatives–we've had the CRC programs since 1988. Every year there are industries and academic institutions working together. But since 1988 to now, we still as the same question; how do we make it better? So there is room for improvement, and this is an opportunity to change the paradigm.[93]

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90 Electric Vehicle Council, Submission 14, p. 8; Heavy Industry Low-Carbon Transition CRC, Submission 30, p. 1; University of Adelaide Institute for Sustainability, Energy and Resources, Submission 18, p. 1; Mr Dan Tebbutt, Head, Expanding Exporters, Austrade, *Committee Hansard*, Canberra, 30 November 2022, p. 7.

91 Professor Michael Goodsite, University of Adelaide Institute for Sustainability, Energy and Resources, *Committee Hansard*, Brisbane, 16 May 2023, p. 23.

92 The University of Queensland, Submission 26, pp. 4–5.

93 Professor Ian Chubb, Secretary for Science Policy, Australian Academy of Science, *Committee Hansard*, Canberra 31 March 2023, p. 10.

5.72 Dr Fiona Simon, Chief Executive Officer of the AHC, described competition in the R&D sector and suggested that there would be benefit in better coordination in the sector:

> I imagine it has an impact on the quality of the science and the ability for people to do things if you have many more dedicated facilities with a lot of money that are pulling in the same direction. I observe the R&D situation in Australia with some concern because of how fragmented it is and the degree to which every institution is competing with another institution for the same dollars and the same PHD students. In an environment where they are already inefficiencies and there are already channellings and where we actually need to be pulling together, that's a pretty difficult one to overcome because everyone's competing.[94]

Approaches to public funding and investment

Supporting demand creation

5.73 Some submitters emphasised that there is a need for government support measures to be targeted at demand creation, or the uptake of emerging products and technologies.[95] For example, Mr Matthew Hingerty, Deputy Chief Executive Officer and Head of Business Development at Star Scientific, told the Committee that:

> A lot of government funding…is focusing on the supply side, on the creation of hydrogen, electricity, or other areas. Not enough support, in my view, is given to existing companies which want to transition themselves—particularly from what we see in the food sector and others. A bit of help on the demand side would go a long way.[96]

5.74 The University of Adelaide Centre for Energy Technology (CET) observed a connection between measures to build domestic demand and the development of green export industries:

> Supporting the transition of local heavy industry to operate with hydrogen will assist the establishment of a hydrogen export market. Australia's high temperature industrial processes can be an anchor tenant in the establishment of a hydrogen supply chain at GW scale, which can underpin the investment needed to unlock an export industry.[97]

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94 Dr Fiona Simon, Chief Executive Officer, Australian Hydrogen Council, *Committee Hansard*, Melbourne 5 April 2023, p. 44.

95 University of Adelaide Centre for Energy Technology, Submission 33, pp. 3–4; Grattan Institute, Submission 37, p. 9; WWF, ACF, BCA and ACTU, Submission 67.1, p. 104; Mr Matthew Hingerty, Deputy Chief Executive Officer and Head of Business Development, Star Scientific, *Committee Hansard*, Brisbane, 16 May 2023, pp. 32–33.

96 Mr Matthew Hingerty, Deputy Chief Executive Officer and Head of Business Development, Star Scientific, *Committee Hansard*, Brisbane, 16 May 2023, pp. 32–33.

97 University of Adelaide Centre for Energy Technology, Submission 33, p. 3.

5.75 Similarly, Mr Jordie Pettit, Research Assistant at the CENRIT, explained to the Committee that:

> The export question is more around creating demand domestically in the first instance. Once that production – and a price, more importantly – is established for a product like renewable hydrogen, then you're going to see offtake contracts being brokered more at the international level. But, certainly, the establishment of the market is pivotal in the first instance.[98]

Technological readiness

5.76 Professor Emma Aisbett, Associate Director (Research) at the ZCEAPI, advised that certain support mechanisms are required for products and technologies at different stages of technological readiness:

> Of course, the appropriate green industrial policy depends on the technology readiness of the technology involved. Because different steel technologies are at different stages, some of them will be more appropriate to support with grants because they are just very high risk at the moment. Later on, when you're getting closer to scaling, I think government should think seriously about ways that it can de-risk upfront but also ensure that Australia gains benefits, including Australian taxpayers, from those investments as things are closer to maturity and scale. That could mean direct co-investment or it could mean equivalent things like…some sort of contingent loan for those scaling technologies.[99]

5.77 Sun Cable also commented on the need for different approaches: 'These industries are at varying stages of technical and economic maturity, and so require funding in various forms rather than a one size fits all approach.'[100]

Technological neutrality

5.78 Several submitters emphasised the need for a technology neutral approach in the design of mechanisms to support emerging industries and technologies.[101] For example, Mr Arnold Jorge, Chief Executive Officer of the Export Council of Australia (ECA), explained that:

> There are pros and cons with any technology, and the market can suddenly shift from one preference to another. With that perspective, we would therefore discourage the government from betting on any specific technology. That said,

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98 Mr Jordie Pettit, Research Assistant, Centre for Energy and Natural Resources Innovation and Transformation, *Committee Hansard*, Macquarie Park, 6 April 2023, p. 43.

99 Associate Professor Emma Aisbett, Associate Director (Research), Zero-Carbon Energy for the Asia-Pacific, Australian National University, *Committee Hansard*, Canberra, 31 March 2023, pp. 51–52.

100 Sun Cable, Submission 71, p. 12.

101 Low Emissions Technology Australia, Submission 21, p. 5; Heavy Industry Low-carbon Transition Cooperative Research Centre, Submission 30, p. 6; Woodside Energy, Submission 47, p. 4.

there is much it can do to provide support that is cross-cutting while remaining technology agnostic.[102]

5.79 Mr Mark McCallum, Chief Executive Officer of Low Emission Technology Australia, told the Committee that:

> …we would like to see a more technology neutral approach taken to these things. If the goal…of the Paris Agreement is emission reduction, we should be focussed on and supporting all technologies that allow us to do that as quickly and affordably as we can.

5.80 Referring to the design of the US IR Act, Woodside Energy suggested that the objective of policy mechanisms should be to 'incentivise lower carbon intensity, rather than narrowing technology options and eligibility… Focusing on carbon intensity captures a wider range of opportunities, investors and proponents.'[103]

Specific targets, one strategy and better coordination

5.81 The Committee obtained evidence proposing that the Australian Government could assist emerging green industries and technologies by setting targets, developing strategies and improving coordination. These types of measures were recognised as providing clear signals and greater certainty to attract investment.

Setting targets

5.82 Submitters identified setting targets as an important policy tool that could encourage the development of emerging green products and technologies.[104]

5.83 In their joint submission, the WWF, ACF, BCA and ACTU stated that '… targets will be important to galvanise industry and signal our ambition to investors.'[105] It was further explained how targets can support emerging industries:

> Targets are required where reaching outcomes requires coordinated effort between stakeholders to achieve. In this case, targets serve as a coordination mechanism that signals intent and provides certainty about national priorities. This certainty helps stakeholders to work collaboratively toward the announced goal. Timebound targets allow other parties to transparently assess progress

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102 Mr Arnold Jorge, Chief Executive Officer, Export Council of Australia, *Committee Hansard*, Canberra, 31 March 2023, p. 61.

103 Woodside Energy, Submission 47, p. 4.

104 See, for example: Beyond Zero Emissions, Submission 32, p. 8; University of Adelaide Centre for Energy Technology, Submission 33, pp. 3–4; Woodside Energy, Submission 47, p. 4; Australian Conservation Foundation, Submission 50, p. 1; The Next Economy, Submission 51, p. 5.

105 WWF, ACF, BCA and ACTU, Submission 67,1, p. 5.

towards the goal. For a target to be effective, it must be clear and timebound, and supported by credible policies and actions.[106]

5.84 In regard to the Australian Government's targets to reduce emissions by 43 per cent on 2005 levels by 2030 and to reach net-zero emissions by 2050, DCCEEW stated that 'legislating these targets provides certainty to Australia's commitment to decarbonise our economy to business and the community.'[107] Similarly, the Law Council of Australia observed the importance of enshrining these targets into legislation: 'a legislated target would provide increased certainty to policy makers, businesses, investors, and community sectors.'[108]

5.85 Targets were suggested across a range of emerging industries and technologies for both domestic production and uptake of new technologies, as well as specifically for export. These included renewable electricity generation (including extending the existing Renewable Energy Target),[109] renewable energy and battery storage,[110] electric vehicles,[111] hydrogen and biomethane as substitutes for natural gas,[112] green hydrogen production and electrolyser capacity,[113] and green metals.[114]

5.86 The ACF recommended: 'Specific, measurable, and time-bound targets for electrolyser capacity underpinned by credible policies would encourage the expansion of hydrogen production capacity.'[115]

5.87 The SEC and Tesla proposed the introduction of a renewable energy storage target to encourage investment in the deployment of storage capacity.[116]

5.88 UQ submitted that in addition to assistance from agencies and investment vehicles 'clearly defined targets are required to increase investment for domestic manufacturing (of batteries and renewable energy) which also align with global achievement of net-zero targets.'[117]

5.89 The CET stated the need for the government to introduce '…a series of targets for the transformation of the production of our local materials to progressively lower levels of carbon intensity until we reach net-zero.' It was suggested that targets be developed for all major products manufactured in Australia including construction

106 WWF, ACF, BCA and ACTU, Submission 67.1, p. 106.
107 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 2.
108 Law Council of Australia, Submission 92.1, p. 2.
109 Mr Eytan Lenko, Mr Eytan, Chief Executive Officer, Boundless Earth, *Committee Hansard*, Melbourne, 5 April 2023, p. 19; Ms Anna Freeman, Policy Director, Decarbonisation, Clean Energy Council, *Committee Hansard*, Melbourne 5 April 2023, p. 55.
110 Smart Energy Council, Submission 23, p. 4; Tesla, Submission 24, pp. 6–7.
111 Electric Vehicle Council, Submission 14, p. 8; Tesla, Submission 24, p. 4.
112 Australian Pipeline and Gas Association, Submission 47, p. 7.
113 Australian Hydrogen Council, Submission 39, p. 5; Australian Conservation Foundation, Submission 50, p. 2.
114 University of Adelaide Centre for Energy Technology, Submission 33, pp. 3–4.
115 Australian Conservation Foundation, Submission 50, p. 2.
116 Smart Energy Council, Submission 23, p. 4; Tesla, Submission 24, pp. 6–7.
117 The University of Queensland, Submission 26, p. 7.

materials such as cement and steel as well as copper, fertilisers, plastics, and glass bottles.[118]

5.90 BZE specifically recommended that the Australian Government set a green commodity export target of $100 billion by 2035 covering critical minerals, green hydrogen, green steel and green aluminium.[119]

The need for one transition strategy

5.91 As outlined in Chapter 3, the Australian Government has multiple existing and forthcoming strategies in green energy related industries. Stakeholders suggested further strategies be developed to support certain emerging industries and technologies such as the direct export of renewable electricity,[120] as well as for the domestic manufacturing of high voltage direct current (HVDC) cables,[121] batteries,[122] and solar panels.[123]

5.92 Some submitters expressed concerns that Australia's transition to a green energy superpower was not supported by a clearly defined, coordinated strategy.[124]

5.93 The Committee received considerable evidence that called for a dedicated and overarching strategy to guide Australia's transition to a green energy superpower, including the development of export-oriented green energy industries.[125] For example, the Western Australian Department of Jobs, Tourism, Science and Innovation stated that to accelerate the transition the Australian Government could consider developing 'a clear national roadmap to becoming a green energy superpower.'[126]

5.94 Submitters also specified that an overarching strategy should include targets and policies to achieve them, including mechanisms to attract investment.[127] For example, BZE recommended that: '…the government develop a unified Renewable Export Strategy for Australia to ensure that we become a prosperous zero-emissions

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118 University of Adelaide Centre for Energy Technology, Submission 33, pp. 3–4.
119 Beyond Zero Emissions, Submission 32, p. 8.
120 Sun Cable, Submission 71, p. 8.
121 Sun Cable, Submission 71, p. 8
122 Electric Vehicle Council, Submission 14, p. 8; The University of Queensland, Submission 26, p. 8.
123 Sun Cable, Submission 71, p. 8.
124 See, for example: The Next Economy, Submission 51.1, pp. 21–22; Mr Eytan Lenko, Chief Executive Officer, Boundless Earth, *Committee Hansard,* Melbourne, 5 April 2023, p. 16; Ms Anna Freeman, Policy Director, Clean Energy Council, *Committee Hansard*, Melbourne, 5 April 2023, p. 53; Mr Craig Stallan, Executive General Manager, Delivery, Transgrid, *Proof Hansard,* Macquarie Park, 6 April 2023, p. 40.
125 See, for example: Beyond Zero Emissions, Submission 32, p. 6; Australian Conservation Foundation, Submission 50, p. 1; The Next Economy, Submission 51.1, p. 27; WWF-Australia, the Business Council of Australia, the Australian Council of Trade Unions and the Australian Conservation Foundation, Submission 67, p. 2; Coalition for Conservation, Submission 75, p. 1; Boundless Earth, Submission 76, p. 2.
126 Western Australian Department of Jobs, Tourism, Science and Innovation, Submission 65, p. 7.
127 Beyond Zero Emissions, Submission 32, p. 6; Australian Conservation Foundation, Submission 50, p .7; Boundless Earth, Submission 76, p. 3.

economy… This strategy should be created in association with a range of key stakeholders and include both ambitious growth targets and strong policies.'[128]

5.95 Similarly, Industry Super Australia submitted that '…a clear national energy policy vision supported by a strategy, targets and roadmap supporting an investment pipeline would help guide the investment needed to realise Australia's green energy ambitions.'[129]

5.96 The ACF recommended that the Australian Government develop a legislated 'Renewable Exports Strategy' in consultation with key stakeholders to support the development of a range of export industries:

> A Renewable Exports Strategy builds on domestic renewable energy and decarbonisation strategies but goes much further to unlock Australia's massive potential to thrive in a decarbonising world. It is a comprehensive strategy to develop a wide range of renewable-powered export industries and establish international markets for renewable energy products and services and is a cooperative, unifying national approach bringing together governments, industry, unions, First Nations people, R&D and the education sector. A Renewable Export Strategy must include clear growth targets and be backed up by credible policies including co-investment and financial incentives to unlock the scale of the opportunity.[130]

5.97 Similarly, Boundless Earth suggested that the Australian Government create a shared national vision through a green energy export strategy that '… would identify opportunities, risks, priority markets and describe a policy framework to guide government agency planning and support and incentivise private sector investment.'[131]

5.98 Ms Anna Freeman, Policy Director at the CEC, emphasised the need for a comprehensive strategy to determine how Australia's green energy superpower ambition will be achieved and outlined what it could include:

> …the most important point for this committee… relates to the urgent need for a long-term strategic plan to guide Australia's aspiration to become a green energy superpower. We can all see the potential from green hydrogen and ammonia, for steel, iron aluminium and energy-transition minerals. But, although we have now been speaking about the opportunity for a number of years, we do not as yet have an articulation by our federal government of what Australia is actually trying to do and how we intend to achieve it.
>
> …To give you a taste of what we think should be in such a strategy, we would expect it to cover an outline of the priority markets in which we wish to compete and the market share that we would hope to capture in these markets. It should

128 Beyond Zero Emissions, Submission 32, p. 6.
129 Industry Super Australia, Submission 117, p. 1.
130 Australian Conservation Foundation, Submission 50, p. 7.
131 Boundless Earth, Submission 76, p. 2.

> answer: What policy setting will be needed to incentivise that investment? What would the land use implications be? How much electricity generation and transmission would be required? Where would it be located? How is this co-located with value-added production? What water resources would be required? What would the supply chain needs be? What workforce scale and skills mic would be required, and have we got those workers? And, very importantly, what consultation would be required with regional communities and First Nations peoples, who will be essential partners for realising that vision?[132]

5.99 Boundless Earth also suggested that a green export strategy could be utilised to better align existing funding initiatives with green energy export opportunities. This could include R&D support, grant funding, debt and equity financing through agencies such as the Commonwealth Scientific and Industrial Research Organisation, ARENA, CEFC, NRF and the NAIF.[133]

5.100 Noting the implications of the transition to green energy for Australia's national security, Mr James Bowen suggested the Australian Government 'develop an expansive green energy superpower strategy that engages multiple portfolios and agencies' in recognition of the mutually reinforcing outcomes of climate, energy and national security offered by the green energy transition.[134]

Better government coordination of the transition

5.101 Some submitters and witnesses to the inquiry raised the need for improved coordination of Australia's green energy transition at the Australian Government level. For example, Ms Sanaya Khisty, Chief Strategy Officer at BZE, explained to the Committee that the level of coordination and planning required can only be achieved at the Australian Government level:

> The challenge for policymakers is this: realising a green energy superpower vision requires immediate support, coordination and planning. As policy shifts in the US, the EU, South Korea, China and Japan demonstrate, coordination and funding from the federal government is critical if Australia is to play a leading role as the global economy decarbonises.[135]
>
> …
>
> That level of coordination and planning has to be led by the federal government. There will be implications for the EPBC Act [*Environment Protection and Biodiversity Conservation Act 1999 (Cth)*]. There will be implications for the whole of government. It's not just trade and investment; it becomes a real whole-of-

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132 Ms Anna Freeman, Policy Director, Decarbonisation, Clean Energy Council, *Committee Hansard*, Melbourne, 5 April 2023, p. 53.

133 Boundless Earth, Submission 76, p. 3.

134 Mr James Bowen, Submission 115, p. 2.

135 Ms Sanaya Khisty, Chief Strategy Officer, Beyond Zero Emissions, *Committee Hansard,* Melbourne, 5 April 2023, p. 24.

> government focus, and workforces and all of the planning pieces really sit at the Commonwealth level.[136]F

5.102 Several submitters suggested the need for a dedicated body to coordinate, manage and oversee Australia's green energy transition, including with regard to the transition in regional areas.[137] For example, RE-Alliance suggested a 'National Energy Transition Authority' with local offices to manage and support the deployment of renewable energy projects, with a focus on assisting regional communities in their transition in the green energy economy.[138]

5.103 The AAS and AATSE suggested a 'Green Energy Commissioner' or utilising an existing body such as Infrastructure Australia to 'coordinate investment, development, and use of green energy infrastructure and resources…'[139]

5.104 The ISER submitted that Australia's green energy transition could benefit from a dedicated green energy technology research and innovation body as well as a single government department:

> Australia does not yet have a "go-to" energy transition institute that can inform, develop and demonstrate the transition and investment required across the Technology Readiness Levels (TRL) from basic research to industrial application. Such an Institute should establish an organisation responsible to Government and Industry that cohesively assembles future focused capability across the TRL, and across all domains, including social science and system design to regulation as well as STEM. The Institute would deliver the necessary innovation to effectively deliver Commonwealth hydrogen strategies. It would work together with the already-funded CRCs, hydrogen hubs, clusters and research networks, to deliver the research, development, demonstration and translation required for a green and more complex economy. Australia should also consider a dedicated agency for energy, an Australian equivalent to the Department of Energy.[140]

5.105 The Coalition for Conservation put forward a new independent export focussed body that would work alongside existing government agencies and industry bodies. It was recommended that the government set up '… a Clean Industries Export Council that will support Australian exporters in the green transformation process and create export markets for Australian technologies, energy, resources, products and services that align with sustainable requirements, utilising funding from a Clean Industries Export Fund.'[141]

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136 Ms Sanaya Khisty, Chief Strategy Officer, Beyond Zero Emissions, *Committee Hansard,* Melbourne, 5 April 2023, p. 29.

137 Queensland Conservation Council, Submission 41, p. 1; RE-Alliance, Submission 43, p. 4; The Next Economy, Submission 51.1, pp. 34–42; WWF, ACF, BCA and ACTU, Submission 67, p. 2.

138 RE-Alliance, Submission 43, p. 4.

139 Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering, Submission 74, p. 4.

140 University of Adelaide Institute for Sustainability, Energy and Resources, Submission 18, p. 2.

141 Coalition for Conservation, Submission 75, p. 1.

5.106 As outlined in Chapter 3, the Australian Government has announced its intention to establish a National Net-Zero Authority.[142]

Collaboration with state and territory governments

5.107 Throughout its inquiry the Committee heard about many activities underway in states and territories that are driving Australia's green energy transition. Submissions to the inquiry were received from the New South Wales, Northern Territory, Tasmanian and Western Australian governments.[143]

5.108 Stakeholders noted the importance of collaboration and coordination between all levels of government to support emerging industries and technologies.[144]

5.109 Consistency and coordination in planning and regulations between levels of government is discussed in Chapter 6.

5.110 In relation to the development of a domestic battery industry, the EVC described the coordination required between the levels of government:

> In order to achieve its vision of supporting the delivery of Australian-made batteries, the Government will need to collaborate with state and territory governments to setup a national plan for a domestic battery industry. This would require jurisdictions to cooperate on developing the required infrastructure and ensuring efficiencies are achieved so that instead of competing for market share, the relative strengths of each jurisdiction are recognised and enhanced through cooperation.[145]

5.111 Tesla highlighted the importance of collaboration between the Australian and state and territory governments, and with industry, '…to expedite projects, mobilise capital, and prepare Australian workers to make the most of [the opportunity presented by Australian lithium and nickel].'[146]

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142 The Net-Zero Authority will have responsibility for promoting the orderly and positive economic transformation associated with achieving net zero emissions by supporting workers in emissions-intensive sectors to access new employment, coordinating programs and policies across government to take advantage of new industries, and helping investors and companies to engage with net-zero transformation opportunities. See: Hon Anthony Albanese MP, Prime Minister, 'National Net Zero Authority', Media release, 5 May 2023.

143 All state and territory governments were invited to make a submission to the inquiry. See: New South Wales Government, Submission 116; Northern Territory Government, Submission 56; Tasmanian Government, Submission 29; Western Australian Government, Submission 65.

144 See, for example: Electric Vehicle Council, Submission 14, p. 8; Tesla, Submission 24, p. 9; RE-Alliance, Submission 43, p. 9; Export Council of Australia, Submission 72, p. 1; Dr Frances van Ruth, Head of EMEA Desk, Australian Trade and Investment Commission, *Committee Hansard,* Canberra, 30 November 2022, p. 8; Ms Rebecca Brown, Director General, Department of Jobs, Tourism, Science and Innovation, Western Australia, *Committee Hansard,* Perth, 17 March 2023, pp. 1–2.

145 Electric Vehicle Council, Submission 14, p. 2.

146 Tesla, Submission 24, p. 9.

5.112 Ms Rebecca Brown, Director General of the Western Australian Department of Jobs, Tourism, Science and Innovation, outlined the importance of collaboration between governments:

> Becoming a global leader in green energies will require coordinated action between all levels of government. The Western Australian government has welcomed the Australian [G]overnment's national hydrogen strategy and its refresh, investments through the National Reconstruction Fund, the development of energy hubs and other important initiatives.
>
> To be successful, all levels of government will need to work collaboratively, including by setting a clear direction for industry, proactively attracting investment, establishing appropriate standards and regulations, and developing the capacity of the workforce. We welcome the ongoing engagement with the Australian government in realising our shared ambition to be a major global supplier of clean energy.[147]

5.113 Additionally, Ms Brown explained the role of the WA Government and how it works with the Australian Government to develop green energy projects in the state:

> The first [role that the state government plays] is in terms of attracting investment interest into the state…[that] will happen through international delegations or interest through into our department through the investment and trade network that we have established across a range of regions. We also work closely with Austrade in particular, who will be marketing globally. We will be working in partnership with them in markets or in bringing interest into Western Australia. I think that Albemarle and its presence in Kemerton is a good example where the state government worked with Austrade in facilitating Albemarle in looking at sites and options in Western Australia and then establishing.

5.114 Mr David Woods, Chief Economist and First Assistant Secretary, International Economics and Green Economy Division at the Department of Foreign Affairs and Trade (DFAT), also emphasised the importance of collaboration between governments and noted measures for improvement:

> Obviously, there's a rich history of over 120 years of federation of not the best coordination between different levels of government—something that we will need to do better for this purpose. One of the partial responses to that is the decision by the government to establish a new trade and investment ministerial committee—a committee chaired by the trade minister but drawing on ministerial representatives from all the state and territories. That's partly been established more broadly to respond to an appetite by the states and territories to move on from a purely competitive model around attracting investment to recognising that

147 Ms Rebecca Brown, Director General, Department of Jobs, Tourism, Science and Innovation, Western Australia, *Committee Hansard,* Perth, 17 March 2023, p. 1.

it can come at some cost to themselves and that there might be a role for coordination.[148]

5.115 Dr Frances van Ruth, Head of EMEA Desk at the Australian Trade and Investment Commission (Austrade), told the Committee that Austrade works in close partnership with state and territory governments. Dr van Ruth explained that Austrade might lead, or alternatively the state government might lead, depending upon the issue, but she noted that the state government would lead in providing advice where regulation is state-based.'[149]

Certification, promotion and awareness building

5.116 The Australian Government can assist and accelerate emerging green industries and technologies through establishing certification and guarantee of origin frameworks, as well as through the promotion and awareness building of Australia's green products and investment opportunities.

Certification and guarantee of origin schemes

5.117 Several submitters noted the importance of robust product certification frameworks to many of Australia's green energy export opportunities.[150]

5.118 The Committee received evidence that to maximise competitive advantage in the growing market for green products, Australian exporters must be able to demonstrate and provide assurance of the low or zero emissions credentials of their export products. This can be achieved through certification schemes or what are known as guarantee of origin (GO) schemes, that determine the embodied emissions of raw materials and manufactured products to provide trusted and comparable information for governments, investors, and consumers.[151]

5.119 The Australian Government is currently developing GO schemes for hydrogen and renewable electricity.[152] DCCEEW explained that these schemes will 'provide

148 Mr David Woods, Chief Economist and First Assistant Secretary, International Economics and Green Economy Division, Department of Foreign Affairs and Trade, *Committee Hansard,* Canberra, 23 June 2023, p. 12.

149 Dr Frances van Ruth, Head of EMEA Desk, Australian Trade and Investment Commission, *Committee Hansard,* Canberra, 30 November 2022, p. 8.

150 For example: Clean Energy Investor Group, Submission 10, p. 2; Smart Energy Council, Submission 23, p. 9; Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering, Submission 74, p. 6; Australian National University Zero-Carbon Energy for the Asia Pacific, Submission 98, p. 6; Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, p. 7.

151 See, for example: Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering, Submission 74, p. 6; Australian National University Zero-Carbon Energy for the Asia Pacific Initiative, Submission 98, p. 6; Dr Lee White, Fellow, School of Regulation and Global Governance, Australian National University, *Committee Hansard*, Canberra, 31 March 2023, p. 49.

152 Department of Climate Change, Energy, the Environment and Water, Submission 62, p.11; Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, p. 7.

transparency and certainty over claims of renewable electricity and the emissions associated with hydrogen production.'[153]

5.120 The CEIG highlighted the importance of a renewable electricity GO scheme to support investment in generation capacity in the context of the expiry of the Renewable Energy Target (RET) and Large-Scale Generation Certificate framework in 2030.[154]

5.121 While some industry-led initiatives are being developed and may play a role in some sectors, the ZCEAPI explained that there are advantages to government-led certification schemes:

> A high-quality government-led scheme has the advantages of:
>
> - Reducing customer and investor confusion about which scheme to trust,
> - Reducing regulatory burden for participating producers and suppliers, and
> - Increasing the ability to negotiate mutual recognition agreements and interoperability with relevant schemes and regulations in the destination markets.[155]

5.122 Several submitters emphasised the need to align Australia's certification schemes with international frameworks and emerging regulation to maximise the export potential of green products.[156] The CENRIT stated that: '…it is critical that that robustness of GO schemes successfully interface with the important requirements of international laws such as the CBAM [Carbon Border Adjustment Mechanism] and other emerging trade challenges.'[157]

5.123 Similarly, the AAS and AATSE submitted that aligning certification schemes with other countries will ensure Australian exports are able to meet and even benefit from increasing requirements to demonstrate the carbon content of products in jurisdictions such as the EU:

> As part of the European Green Deal, the European Union is currently examining laws that will require environmental impact information on imported goods (Centre for the Promotion of Imports 2021) and thus accounting for the carbon footprint of individual products may be necessary to engage with the global economy. This could include emissions along the entire value chain for the product, from feedstock production to delivery at the customer gate. A certification scheme developed in cooperation with Australia's global trading

153 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 11.
154 Clean Energy Investor Group, Submission 10, p. 2.
155 Australian National University Zero-Carbon Energy for the Asia Pacific Initiative, Submission 98, p. 6.
156 Australian Academy of Science and the Australian Academy of Technological Science and Engineering, Submission 74, p. 6; Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, p. 7; Professor Gus Nathan, Research Director, Heavy Industry Low-Carbon Transition Cooperative Research Centre, *Committee Hansard*, Melbourne, 5 April 2023, p. 48.
157 Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, p. 8.

> partners will be able to establish the carbon content of our export products and make it easier for Australian exporters to demonstrate the comparable advantage of their products in a low-carbon economy.[158]

5.124 DCCEEW advised that the hydrogen GO scheme in development '… aligns with the work of the IPHE (International Partnership on Hydrogen Fuel Cells in the Economy) and we are engaging with key trading partners to ensure acceptance of the scheme.'[159]

5.125 Stakeholders suggested that there is scope for the expansion of certification schemes. For example, UQ suggested that verification of the emissions intensity could support export of Australia's comparatively lower emissions gas[160] and the Australia Pipeline and Gas Association proposed the introduction of a gas certification scheme to support the use of biomethane and hydrogen in the gas supply chain.[161]

5.126 The HILT CRC noted that international certification frameworks could accelerate decarbonisation of Australia's heavy industries and support export opportunities, stating that Australia should participate in the:

> … establishment of an internationally accepted framework for Green Certification program targeted to introduce progressively more stringent steps of carbon mitigation for products across the iron-ore-to-steel, alumina/aluminium and cement/lime value chains including raw material inputs for all key commodities within Australia's balance of trade. The introduction of such certification programs could accelerate investment in the heavy industry sector to address measurable market opportunities and deliver decarbonised products, while minimising regulatory barriers for Australian industry.[162]

5.127 Professor Gus Nathan, Research Director at the HILT CRC, further explained to the Committee that at the moment, while there are some industry certification frameworks, there is no international framework per se:

> For example, in aluminium you can buy a certified not net zero but 4.0, which is four tonnes of CO2 per tonne of alumina. But that's not yet an internally certified framework. Its an industry certified process. So we absolutely need to embark on that and be part of that process to make sure that we have compatible processes and we also engage to make sure that our products don't artificially get cut out by one of those lines.[163]

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158 Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering, Submission 74, p. 6.

159 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 11.

160 The University of Queensland, Submission 26, p. 2.

161 Australian Pipeline and Gas Association, Submission 42, p. 7.

162 Heavy Industry Low-carbon Transition Cooperative Research Centre, Submission 30, p. 5.

163 Professor Gus Nathan, Research Direction, Heavy Industry Low-Carbon Transition Cooperative Research Centre, *Committee Hansard*, Melbourne, 5 April 2023, p. 48.

5.128 Beyond emerging green products and industries, the Australia China Business Council (ACBC) noted that Australia's primary export products, including agricultural products and processed products such as wine, will increasingly benefit from being able to, or may even be required to, demonstrate embodied carbon content to customers.[164]

Promotion and awareness building of Australia's opportunities and advantages

5.129 DFAT and Austrade are actively working to promote Australia's trade and investment opportunities and build international awareness of Australia's competitive advantage in the green economy.[165] Austrade's marketing plays an important role in promoting Australian export products and investment opportunities to international markets, including through initiatives such as Australia's Nation Brand and the Global Australia website.[166] The roles of DFAT and Austrade are further outlined in Chapter 3.

5.130 Submitters acknowledged the positive impact that Austrade has in promoting and facilitating export opportunities and inbound investment.[167] For example, the Australia China Business Council stated that: 'Austrade plays an invaluable role in the promotion of Australian products and services to global markets, and the attraction of inbound investment.'[168] Likewise, Mr Matthew Hingerty, Deputy Chief Executive Officer and Head of Business Development at Star Scientific, told the Committee that: 'Australia is unbelievably well serviced by our trade officials…Austrade in particular provide an incredibly valuable service, and I cannot praise them enough.'[169]

5.131 The Committee received evidence suggesting that there is scope to expand the promotion and awareness building of export products and investment opportunities in Australia's emerging green energy industries.[170] For example, in relation to the electric vehicle supply chain, the Electric Vehicle Council noted that: 'To attract investment, Austrade can play a central role in promoting Australia's capabilities to accelerate the global transition to a low-carbon future…'[171] Similarly, UQ indicated that '… the world is well aware of Australian mineral wealth, but has little visibility of Australian metal processing and battery-tech credentials. Only with international investment and trade assistance, will todays metal processing and battery-tech start-ups evolve into a battery manufacturing ecosystem.'[172]

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164 Australia China Business Council, Submission 102, p. 7.

165 Department of Foreign Affairs (DFAT), Australian Trade and Investment Commission (Austrade) and Export Finance Australia (EFA), Submission 31, p. 10.

166 DFAT, Austrade and EFA, Submission 31, p. 10.

167 See, for example: Electric Vehicle Council, Submission 14, p. 4; Star Scientific, Submission 25, p. 3; Australia China Business Council, Submission 102, p. 13.

168 Australia China Business Council, Submission 102, p. 13.

169 Mr Matthew Hingerty, Deputy Chief Executive Officer and Head of Business Development, Star Scientific, *Committee Hansard*, Brisbane, 16 May 2023, p. 32.

170 See, for example: Electric Vehicle Council, Submission 14, p. 9; The University of Queensland, Submission 26, pp. 7, 9; Climate Council, Submission 36, pp. 9–10; Western Australia Department of Jobs, Tourism, Science and Innovation, Submission 65, p. 7; Export Council of Australia, Submission 72, p. 3; WWF, ACF, BCA and ACTU, Submission 67.1, p. 74.

171 Electric Vehicle Council, Submission 14, p. 9.

172 The University of Queensland, Submission 26, p. 7.

5.132 The ECA suggested that Australia's brand could be enhanced to better connect with green credentials: 'Trade partners must consider Australian exporters involved in green energy as the preferred suppliers…The marketing of Australia's credentials in green energy must be strategic and should commence immediately.'[173] Mr Arnold Jorge, Chief Executive Officer of the ECA, further explained to the Committee '…if Australia's potential buyers are not aware of how great we are or do not recognise our strengths and capabilities then it will be difficult for us to compete…being a quiet achiever does not work in exporting. International marketing and promotion of Australia's brand will, therefore, be critical.[174]

5.133 ISER proposed that: 'Austrade could expand its focus on export of green goods or targeting existing supply chains where having green goods from Australia would improve Scope 3 emissions, and thereby incentivise green products that are reliably sourced from Australian suppliers.'[175]

5.134 In their joint submission DFAT, Austrade and EFA stated that Austrade's could increase its focus on Australia's opportunities in the global net-zero economy:

> Austrade can learn from global and domestic best practice to re-focus its trade and investment effort to prioritise the most strategically significant and promising projects in support of the Government's net-zero objective. To deliver this, Austrade could re-calibrate client portfolios, potential through a new targeting and assessment model. Austrade can also develop a comprehensive communications and branding strategy through Australia's national Brand platform, that positions Austrade as a leader in net-zero.[176]

5.135 The ACBC suggested that Austrade faces a challenge in the global green economy transition that has 'accelerated pace of change in the investment landscape, and the depth of technical expertise required in the consideration of the solutions for promotion.' Further, the ACBC proposed 'that Austrade develops a global Green Economy strategic development team to identify opportunities, including through whole of government coordination of investment & trade focus.'[177]

5.136 Several submitters identified that there are challenges attracting domestic investors in green energy manufacturing industries, in comparison to the resources sector. Ms Sanya Khisty, Chief Strategy Officer at BZE, told the Committee that:

> When it comes to manufacturing, the investment community, from what we're being told by the companies we work with, is not well versed in what that means in Australia, which is why a lot of those companies end up talking to foreign investments… There is a literacy piece that is really important to take on with the

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173 Export Council of Australia, Submission 72, p. 3.

174 Mr Arnold Jorge, Chief Executive Officer, Export Council of Australia, *Committee Hansard*, Canberra, 31 March 2023, p. 61.

175 University of Adelaide Institute for Sustainability, Energy and Resources, Submission 18, p. 2.

176 DFAT, Austrade and EFA, Submission 31, p. 10.

177 Australia China Business Council, Submission 102, p. 13.

> investor community in Australian about what diversifying our exports could look like and where the opportunities are.[178]

5.137 In relation to the experience of two advanced manufacturing companies aiming to commercialise research, Mr Dan Tebbutt, Head, Expanding Exports at Austrade. explained that:

> Both of those companies are looking to raise private financing. They've actually been the beneficiary of a huge amount of government funding over the years. Its fair to say that both of them said the same thing: they're finding really strong interesting from foreign private investors but finding it hard to get traction with Australian private investors in that area. Its not a failure of government funding. Actually, the government funding has been really ample. But they're at that point of trying to connect with Australia financiers.[179]

5.138 Mr Craig Nicol, Chair of the AMBC, told the Committee that is important to attract investors that understand the nature of investment and risk in the manufacturing sector, including in relation to management of the NRF.[180]

Securing offtake agreements

5.139 In their submission, FFI outlined the importance of securing offtake agreements for the development of the green hydrogen industry and emphasised the benefits of first-mover advantage in securing long-term market share:

> The emerging market structure for green hydrogen appears likely to be a race to scale and offtake, similar to the Liquid Natural Gas (LNG) industry where first movers can expect to lock in significant and persistent advantages. Early years of the Australian LNG industry (e.g., North West Shelf) were dominated by projects with 20-year offtake agreements to the Japanese market – and Australia's first mover advantage here has persisted to greater market share today… By reaching scale early and locking users into long term supply contracts, first movers can strengthen their client relationships, build a brand and track record of delivery, and credibility with investors. This will position them to capture post-2030 offtake agreements as demand starts to scale more substantially. By contrast, those who fail to move early will have to develop differentiated capabilities to challenge incumbent advantages and will be locked out of a significant share of the market.[181]

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178 Ms Sanaya Khisty, Chief Strategy Officer, Beyond Zero Emissions, *Committee Hansard*, Brisbane, 16 May 2023, p. 26.

179 Mr Dan Tebbutt, Head, Expanding Exports, Austrade, *Committee Hansard*, Canberra, 30 November 2022, p. 7.

180 Mr Craig Nicol, Chair, Advanced Materials and Battery Council, *Committee Hansard*, Brisbane, 16 May 2023, p. 6.

181 Fortescue Future Industries, Submission 93, p. 2.

5.140 As outlined earlier in this chapter, co-investment mechanisms and incentives such as CFDs may contribute to reducing the cost gap and enable producers reach a point where they are able to secure offtake agreements.

5.141 BZE described a more direct role for the government to assist with securing offtake agreements: 'In line with green hydrogen opportunities, there is also a key role for government departments such as the Department of Foreign Affairs and Trade (DFAT) to help secure offtake agreements with countries such as Japan, the Republic of Korea, Taiwan, Europe and UK [that] are existing trade partners, are renewable poor and have strong decarbonisation targets.'[182]

5.142 Mr Andrew Hutchinson, General Manager, Critical Minerals Office, Minerals and Resources Division at DISR, noted that facilitating offtake agreements is one form of assistance the Australian Government can provide in relation to critical minerals sector:

> … There are also always discussions around whether there's a role for linking the sector through to foreign markets to create offtake and pull-through, which can be very important in allowing a project to secure financing, knowing that that customer is there.[183]

5.143 Mr Xavier Simonet, Chief Executive Officer of Austrade, explained that Austrade's support in securing offtake agreements is an important element for the development of Australian projects:

> … Austrade actively engages with overseas customers for both renewable energy and key inputs to the energy transition, such as critical minerals, to deliver offtake agreements and accelerate project development. A combination of equity and offtake agreements is most important for Australian project proponents to de-risk their projects and access the necessary capital for development.[184]

Committee comment

5.144 The Committees agrees that there is a role for public funding and investment to support certain emerging green industries and technologies. Where appropriate, public funding and investment should seek to attract and catalyse private sector investment.

5.145 The Committee acknowledges the demonstrated track record of Australian Government specialist agencies and investment vehicles such as ARENA, CEFC, EFA and the NAIF in supporting innovation and catalysing private investment in emerging industries and technologies. The Committee welcomes the establishment of the $15 billion NRF to provide targeted support in the development of industries

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182 Beyond Zero Emissions, Submission 32, p. 7.

183 Mr Andrew Hutchinson, General Manager, Critical Minerals Office, Minerals and Resources Division, Department of Industry Science and Resources, *Committee Hansard*, Canberra, 10 February 2023, p. 13.

184 Mr Xavier Simonet, Chief Executive Officer, Australian Trade and Investment Commission, *Committee Hansard*, Canberra, 30 November 2022, p. 2.

and technologies aligned to its seven priority areas, including renewable energy and low-emissions technologies, value-adding in resources and advanced manufacturing.

5.146 The Committee notes that additional co-investment mechanisms and investment attraction measures are likely required if Australia is to maximise its opportunities in the global green energy transition. This is particularly important to ensure that Australia can maintain its status as an attractive investment destination in an increasingly competitive global investment environment.

5.147 The Committee welcomes the announcement of the $2 billion Hydrogen Headstart program that will provide revenue support to accelerate the development of Australia's green hydrogen industry. The Committee considers that the approach could be a model for other emerging sectors, such as in the steel and aluminium value chains.

5.148 The Committee believes that local content and procurement requirements could be an appropriate tool to ensure demand for Australian manufactured products, such as those supported by the NRF and the National Battery Strategy. Going forward, such approaches could also be important to establish demand for green construction materials and metals.

5.149 The Committee agrees that some sectors of domestic industry will need support to decarbonise and notes the measures provided through the $1.9 billion Powering the Regions Fund as well as the Hon Chris Bowen MP, Minister for Climate Change and Energy's commitment to develop six sectoral decarbonisation plans. Initiatives such as these are essential for domestic decarbonisation, maintaining export-competitiveness and developing green export opportunities.

5.150 The Committee considers that greater focus on a shared infrastructure and industrial hubs approach may have considerable benefits in supporting certain emerging industries through coordination, cost-effectiveness, and knowledge sharing. The Committee believes it would be worthwhile to evaluate the effectiveness of industrial hubs, building on the development of hydrogen hubs and the planned Australian Made Battery Precinct.

5.151 The Committee recognises that Australia's domestic decarbonisation and many of its most promising green export opportunities require further R&D. Australia must continue to invest in and incentivise R&D to encourage the development of emerging technologies and realise its green energy superpower ambition.

5.152 The Committee recognises the role that setting targets and implementing strategies have in providing certainty and clear signals to attract investment. The Committee notes the recently updated Critical Minerals Strategy, the Review of the National Hydrogen Strategy and forthcoming National Battery Strategy.

5.153 The Committee agrees that Australia would benefit from an overarching national green energy superpower strategy to define and provide a framework to achieve Australia's green energy superpower status. Such a strategy should focus on Australia's green energy export opportunities, based on key strengths. However, it

must have regard to domestic decarbonisation needs and ensuring that all Australians benefit from the green energy transition. It should also connect industry strategies and plans.

5.154 The green energy transition cuts across all sectors of the economy and society. The Committee welcomes the announcement of the intent to establish a Net Zero Authority that will play an important role in managing and coordinating the net-zero transition across the government, the economy and regional communities.

5.155 The Committee recognises that robust and internationally aligned certification and guarantee of origin schemes are important for Australian exporters to be able to maintain their competitiveness and leverage their competitive advantages in the global green energy economy. Current schemes in development should be accelerated and opportunities to cover additional green energy products and technologies should be considered.

5.156 The outstanding work of both DFAT and Austrade in promoting Australia's trade and investment interests has been observed in the positive reflections of many stakeholders during the inquiry. The Committee believes that there is further opportunity to align trade an investment promotion and awareness building efforts with Australia's green energy superpower ambitions and net-zero commitments. This includes efforts to actively connect Australia's international brand with the future global green economy.

Recommendations

Recommendation 6

5.157 The Committee recommends that the Australian Government develop a cross-portfolio national green energy superpower strategy to:

- **Define Australia's long-term green energy superpower vision**
- **Identify Australia's key opportunities with regard to strengths and competitive advantages, as well as the decarbonisation pathways of major trading partners**
- **Determine effective and efficient policy approaches to support priority emerging industries and technologies, with a focus on attracting private sector investment**
- **Connect existing and forthcoming sectoral and industry strategies.**

Recommendation 7

5.158 The Committee recommends that the Australian Government accelerate the development of robust certification and guarantee of origin schemes for renewable energy and products such as hydrogen to maximise Australia's green energy export opportunities. Where relevant, these should be aligned

with existing frameworks in key markets and emerging international regulations to ensure export competitiveness in a global green economy.

Recommendation 8

5.159 The Committee recommends that the Department of Foreign Affairs and Trade and Austrade formally align trade and investment promotion and awareness building functions with Australia's green energy superpower ambitions and net-zero commitments.

6. Broader impacts of the transition

Overview

6.1 While there are immense opportunities and significant work is underway, submitters and witnesses identified a range of issues and challenges that must be addressed to ensure Australia's transition to a green energy superpower.

6.2 This chapter summarises key challenges to Australia's transition to a green energy superpower broadly relating to the following issues:

- Decarbonising Australia's electricity grid
- Regulatory and approval processes for green energy projects
- Environment and land use
- Social licence and community engagement
- Workforce skills and capability
- Supply chain constraints.

Decarbonising Australia's electricity grid

6.3 The decarbonisation of Australia's electricity grid is a key part of Australia's transition to net-zero emissions and is the foundation for Australia's future green energy export industries. The challenges associated with decarbonising Australia's domestic electricity grid were expressed to the Committee throughout the inquiry. These challenges related to:

- Reaching renewable energy commitments
- Expanding access to renewable energy supply
- Scale of renewable energy supply
- Impact on energy security, reliability and affordability.

Renewable energy commitments

6.4 Electricity from renewable sources has grown significantly in Australia, reaching 32 per cent of generation in the National Energy Market (NEM) in 2021–22.[1] The Australian Government has committed to achieving 82 per cent renewable electricity

[1] Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 2.

by 2030, as a key element of transforming Australia's energy system to meet legislated targets to reduce emissions by 43 per cent by 2030 (on 2005 levels) and reach net-zero emissions by 2050.[2]

6.5 Ms Rachael de Hosson, Branch Head at the Department of Climate Change, Energy, the Environment and Water (DCCEEW), told the Committee that realising Australia's ambition to become a green energy superpower will involve '… transforming our domestic energy system to use renewable generation, decarbonising the economy and building new clean energy industries for domestic and export markets…'[3]

6.6 Achieving this ambition and meeting Australia's emissions reductions targets are supported by a range of measures and policies such as the Rewiring the Nation program, the Safeguard Mechanism reforms and the Powering the Regions Fund.[4]

6.7 DCCEEW advised that it is working with state and territory governments under the *National Energy Transformation Partnership* to '… support the sustainable transformation of Australia's energy system to net-zero and maximise the economic opportunities offered by the transformation.'[5] As part of this work, DCCEEW is focusing on planning for generation and storage adequacy, and accelerated delivery of priority transmission as well as the development of the Capacity Investment Scheme, a revenue underwriting mechanism to reduce uncertainty and accelerate investment in generation.[6]

6.8 Relevant measures and policies delivered by Australian Government departments and agencies as part of the transition to net-zero were discussed in Chapter 3.

6.9 The Australian Government's renewable energy commitments were identified as important to providing policy certainty and a more encouraging investment environment for renewable energy.[7] For example, Mr Simon Corbell, Chief Executive Officer at Clean Energy Investor Group, told the Committee:

> … improved conditions around the transition pathway for the sector do provide greater predictability for everyone in the market, both investors and consumers, because everyone can see what the trajectory is. So there's no doubt that the government's commitment to achieve that 82 per cent on renewables over the

2 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 2.
3 Ms Rachael de Hosson, Branch Head, Net Zero Innovations and Partnerships Branch, Department of Climate Change, Energy, the Environment and Water, *Committee Hansard*, Canberra, 10 February 2023, p. 1.
4 Ms Rachael de Hosson, Branch Head, Net Zero Innovations and Partnerships Branch, Department of Climate Change, Energy, the Environment and Water, *Committee Hansard*, Canberra, 10 February 2023, p. 1.
5 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 8.
6 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 8.
7 Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, p. 3.

> next decade is a really clear signal that the transition is occurring, and that gives greater certainty to investors and to other participants in the market.[8]

6.10 Some stakeholders suggested that reaching the 82 per cent target by 2030 is a significant challenge and others advocated for additional policy drivers if the target is to be achieved.[9]

6.11 For example, Mr Tony Wood, Program Director, Energy and Climate Change at the Grattan Institute, told the Committee that in his view, the government's 2030 renewable target for 82 per cent is out of reach because it should have commenced 10 years ago:

> If you look at the numbers at the moment, the costs of things like transmission are going through the roof and that is true of all infrastructure. It is not criticising anybody in particular but that is the nature of the beast. Therefore, in thinking that we can build the transmission grid, it is not the availability of funding that is the issue; it is the basically the coordination and planning of these things.[10]

6.12 Similarly, Ms Anna Freeman, Policy Director, Decarbonisation at the Clean Energy Council (CEC), told the Committee that the CEC is concerned that new large-scale generation is not coming online at a sufficient rate to reach 82 per cent by 2030:

> The renewable energy plants that our members are working to build and operate are capital-intensive long-life assets which are expected to operate for 25 to 30 years. Therefore, it follows that we need long-term policy settings and market signals that will take us beyond the end of this decade.[11]

6.13 Several stakeholders identified that extending the RET to align with the increased targets could be an appropriate mechanism to improve certainty and encourage greater investment in renewable energy.[12] Evidence suggested that while the RET remains an important driver for large-scale project development, it is due to end in 2030 and with the target having been exceeded, the incentives provided under scheme are now largely being supported by voluntary purchases from the private sector.[13]

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8 Mr Simon Corbell, Chief Executive Officer, Clean Energy Investor Group, *Committee Hansard*, Canberra, 31 March 2023, p. 22.

9 See, for example: Smart Energy Council, Submission 23, p. 2; Mr Tony Wood, Program Director, Energy and Climate Change, Grattan Institute, *Committee Hansard*, Melbourne, 5 April 2023, p. 2; Ms Anna Freeman, Policy Director, Clean Energy Council, *Committee Hansard*, Melbourne, 5 April 2023, p. 52.

10 Mr Tony Wood, Program Director, Energy and Climate Change, Grattan Institute, *Committee Hansard,* Melbourne, 5 April 2023, p. 2.

11 Ms Anna Freeman, Policy Director, Decarbonisation, Clean Energy Council, *Committee Hansard,* Melbourne, 5 April 2023, p. 52.

12 Mr Eytan Lenko, Chief Executive Officer, Boundless Earth, *Committee Hansard*, Melbourne, 5 April 2023, p. 19; Ms Susan Jeanes, Chair, Heavy Industry Low-Carbon Transition Cooperative Research Centre, *Committee Hansard*, Melbourne, 5 April 2023, p. 49; Ms Anna Freeman, Policy Director, Clean Energy Council, *Committee Hansard*, Melbourne, 5 April 2023, pp. 52, 57.

13 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 9; Ms Anna Freeman, Policy Director, Clean Energy Council, *Committee Hansard*, Melbourne, 5 April 2023, p. 52.

6.14 For example, Ms Freeman of the CEC indicated the need for clearer long-term policy settings to encourage the required deployment of renewable energy. Ms Freeman told the Committee:

> … new large-scale generation is not currently coming online at a sufficient rate to reach the government's forecast of 82 per cent by 2030. The renewable energy plants that our members are working to build and operate are capital-intensive long-life assets which are expected to operate for 25 to 30 years.[14]
>
> … we don't have any visibility of what will be driving renewable energy deployment after 2030. We have an assumption that it will just get built because its cheaper to operate, but it's still a highly capital-intensive process to build a wind or solar farm, or hydro or batteries or whatever they might be. We need incentives or at least a certain way of valuing the asset beyond the 2030 mark…
>
> There's just a great deal of uncertainty about what green value would be worth post 2030, and that makes it difficult to work out what that revenue source is worth to the project and how much that helps. When there's that level of uncertainty, inherently the banks will value it in a very conservative way…that's one of the reasons why we think its [sic] important that the government look at extending the RET – because it provides us with a way to be able to maintain that value for projects over time.[15]

6.15 Factors identified as assisting with the expansion of renewable energy generation capacity included continued decrease in cost of solar, wind and battery storage,[16] continued technology and efficiency improvements,[17] and significant potential for new generation sources such as offshore wind.[18]

6.16 The Committee also received evidence emphasising the need for firming technology such as battery storage and transmission infrastructure to support the expansion of the electricity grid with a high penetration of renewable energy.[19]

6.17 For example, Dr Bin Lu, Senior Research Fellow at the Australian National University Zero Carbon Energy for the Asia-Pacific Initiative (ZCEAPI), explained that according to ZCEAPI's research, more storage and transmission will be needed to support the transition, given the variable nature of renewable energy, 'So we need storage for

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14 Ms Anna Freeman, Policy Director, Clean Energy Council, *Committee Hansard*, Melbourne, 5 April 2023, p. 52.

15 Ms Anna Freeman, Policy Director, Clean Energy Council, *Committee Hansard*, Melbourne, 5 April 2023, p. 55.

16 See, for example: Sun Cable, Submission 71, p. 4; ANU Zero-Carbon Energy for the Asia-Pacific Initiative, Submission 98, p. 6; Rewiring Australia, Submission 118, p. 1.

17 ANU Zero-Carbon Energy for the Asia-Pacific Initiative, Submission 98, p. 6.

18 Star of the South, Submission 54, p. 1; Mr Matthew Stuchbery, Vice President, Copenhagen Infrastructure Partners, *Committee Hansard*, Melbourne, 5 April 2023, pp. 60–61.

19 See, for example: Climate Council, Submission 36, p. 6; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 2; Sun Cable, Submission 71, pp. 5–6; Entura, Submission 79, p. 4; ANU Zero Carbon Energy for the Asia-Pacific Initiative, Submission 98, p. 6.

energy time shifting and transmission for energy geographic shifting. This will also benefit the future green energy exports industry.[20]

6.18 Similarly, on the need for storage, Mr Wayne Smith, External Affairs Manager at the Smart Energy Council (SEC), told the Committee:

> To get to 82 per cent renewables by 2030 we need something like 20 gigawatts of renewable energy storage to make sure we're matching it. About half of that renewable energy storage is going to come from the household level and probably through electric vehicles, those batteries on wheels. The other half of it, by 2030, is going to come from large-scale renewable energy storage.[21]

Access to renewable energy

6.19 A widely expressed theme in the evidence was the fundamental importance of greater deployment of renewable energy to Australia's green energy superpower opportunity.[22] For example, the Department of Foreign Affairs and Trade (DFAT), the Australian Trade and Investment Commission (Austrade) and Export Finance Australia (EFA) explained that:

> Achieving the necessary scale of renewable energy generation capacity will underpin the successful development of potential emerging green export industries, such as renewable electricity exports, clean hydrogen, critical minerals, advanced manufacturing and services exports.[23]

6.20 Stakeholders also noted that greater deployment of renewable energy to support export-oriented green energy industries will be in addition to increases needed to meet existing domestic electricity demand (to replace fossil fuel generation) and to meet increased demand from electrification.[24] Sun Cable observed that even for industries and technologies unsuited to electrification in the foreseeable future, renewable energy is generally the critical input to the most competitive solutions, such as green hydrogen.[25]

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20 Dr Bin Lu, Senior Research Fellow, Zero-Carbon Initiative for Asia Pacific, Australian National University, *Committee Hansard,* Canberra, 31 March 2023, p. 49.

21 Mr Wayne Smith, External Affairs Manager, Smart Energy Council, *Committee Hansard,* Canberra, 31 March 2023, pp. 24–25.

22 See, for example: Australian Aluminium Council, Submission 17, p. 4; Tesla, Submission 24, p. 9; Heavy Industry Low-Carbon Transition CRC, Submission 30, pp. 1–2; Climate Council, Submission 36, p. 6; Australian Hydrogen Council, Submission 39, p. 3; The Next Economy, Submission 51, p. 4; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 2; Sun Cable, Submission 71, p. 3; Australian National University Zero Carbon Energy for the Asia-Pacific Initiative, Submission 98, p. 6.

23 Department of Foreign Affairs and Trade (DFAT), Australian Trade and Investment Commission (Austrade) and Export Finance Australia (EFA), Submission 31, p. 4.

24 DFAT, Austrade and EFA, Submission 31, p. 4; Climate Council Submission 36, p. 6; Clean Energy Council, Submission 38, pp. 1–2; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 3.

25 Sun Cable, Submission 71, p. 6.

6.21 In addition to the need for renewable energy to be widely available, some submitters emphasised the need for it to be available at low-cost.[26] For example, the ZCEAPI stated: 'Very low-cost renewable energy supply is the fundamental requirement for Australia's renewable energy-based export success.'[27]

6.22 Several stakeholders underscored the importance of ensuring that export opportunities do not come at the expense of having low-cost renewable energy available for domestic use.[28] For example, ZCEAPI explained:

> …export industries need to be based on renewable energy capacity that is additional to that which has been installed to support Australia's domestic decarbonisation. In many cases the decarbonisation potential of the renewable energy is higher in domestic uses (particularly when offsetting coal fired electricity generation). Furthermore, it is important that energy-based exports do not raise the cost of the net-zero transition for Australian households.[29]

6.23 Rewiring Australia made a similar point, stating that if domestic clean energy needs are '… overlooked in favour of industrial export of clean energy, the superpower scenario could increase cost of living for households paying for rising prices of fossil fuel powered grids, and significantly delay real emissions reduction in Australia.'[30]

6.24 Associate Professor Emma Aisbett, Associate Director, Research at ZCEAPI, emphasised that '… it's important to not divert existing renewable energy assets that can help decarbonise Australia's grid… towards making hydrogen for export.'[31] Dr Aisbett concluded: 'We need to be aware that there will be some competition as we ramp up our renewable infrastructure between domestic and export-oriented needs, particularly for hydrogen.'[32]

Scale of renewable energy generation capacity

6.25 Many submitters indicated that achieving the deployment of renewable energy at the scale and rate that is required for Australia's transition to a green energy superpower poses a significant challenge.[33]

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26 See, for example: Tesla, Submission 24, p. 10; Climate Council, Submission 36.1, p. 3; Sun Cable, Submission 71, p. 6.

27 Australian National University Zero Carbon Energy for the Asia Pacific Initiative, Submission 98, p. 6.

28 See, for example: Australian Hydrogen Council, Submission 39, p. 3; Australian National University Zero Carbon Energy for the Asia-Pacific Initiative, Submission 98, p. 9; Rewiring Australia, Submission 118, pp. 3–; Associate Professor Emma Aisbett, Associate Director (Research), Zero-Carbon Energy for the Asia-Pacific Initiative, Australian National University, *Committee Hansard*, Canberra 31 March 2023, p. 51.

29 Australian National University Zero Carbon Energy for the Asia-Pacific Initiative, Submission 98, p. 9.

30 Rewiring Australia, Submission 118, p. 3.

31 Associate Professor Emma Aisbett, Associate Director (Research), Zero-Carbon Energy for the Asia-Pacific Initiative, Australian National University, *Committee Hansard*, Canberra, 31 March 2023, p. 51.

32 Associate Professor Emma Aisbett, Associate Director (Research), Zero-Carbon Energy for the Asia-Pacific Initiative, Australian National University, *Committee Hansard*, Canberra, 31 March 2023, p. 51.

33 See, for example: Australian Aluminium Council, Submission 18, p. 4; DFAT, Austrade and EFA, Submission 31, p. 4; Entura, Submission 79, p. 4.

6.26 Various estimates were provided to emphasise the scale of additional renewable energy generation capacity needed to support Australia's green energy superpower ambitions.[34] Many submitters pointed to the Australian Energy Market Operator's (AEMO) *2022 Integrated Systems Plan* which forecast that the size of the NEM would need to almost double by 2050 to meet growing domestic energy demand as a result of increased electrification to replace fossil fuel energy. Further, if Australia pursues large-scale export of green hydrogen, up to eight times current electricity generation capacity would be required.[35]

6.27 DFAT, Austrade and EFA advised '… Australia's total energy exports were 15 times the size of its domestic electricity market' in 2020–21.[36] Mr David Woods, Chief Economist and First Assistant Secretary at DFAT, elaborated on this comparison:

> … transition to being a green energy superpower will require a very significant scale up of our domestic renewable energy generation capacity to underpin the growth of those green energy exports. If I could give you one metric to illustrate that pretty graphically, in 2021 our entire electricity system within Australia – that's not just the NEM, but includes the networks to the west and to the north – generated 956 petajoules of energy. By comparison, our coal and LNG [liquefied natural gas] exports in that same year represented 15,400 petajoules. There's a scale, a magnitude of difference between our domestic electricity system in terms of energy versus that which is represented in our energy exports.[37]

6.28 The CEC suggested that if Australia pursues further processing and manufacturing opportunities utilising renewable electricity and/or or green hydrogen, the scale required would be even greater.[38] Professor Ken Baldwin, Fellow at the Australian Academy of Technological Sciences and Engineering (AATSE), provided an estimate including direct energy exports and a green metals industry:

> We calculated our future scenario based on two very simple business-as-usual assumptions. The first assumption is that we will continue to export the same amount of energy in joules to the world as we do now, not in fossil fuels but in hydrogen or undersea cable HVDC [high-voltage direct current] electricity... The second assumption is we continue to mine the same amount of iron ore and aluminium ore as we do at the moment, but we process it onshore into green

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34 Estimates of the amount of renewable electricity generation capacity required to support Australia's green energy superpower opportunities depend on a wide range of factors including timeframes, technology development and deployment, infrastructure build, the inclusion of off-grid capacity and which industries are included.

35 DFAT, Austrade and EFA, Submission 31.3, p. 2; Clean Energy Council, Submission 38, p. 2; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 3; Australia China Business Council, Submission 102, p. 6; Industry Super Australia, Submission 117, p. 2; Professor Ken Baldwin, Fellow, Australian Academy of Technological Sciences and Engineering, *Committee Hansard*, Canberra, 31 March 2023, p. 13.

36 DFAT, Austrade and EFA, Submission 31, p. 4.

37 Mr David Woods, Chief Economist and First Assistance Secretary, International Economics and Green Economy Division, Department of Foreign Affairs and Trade, *Committee Hansard*, Canberra, 23 November 2022, p. 1.

38 Clean Energy Council, Submission 38, p. 2.

> steel and green aluminium. If you do the numbers on that it will require 27 times the size of the national electricity grid that we have now…[39]

6.29 Others estimated a green energy superpower scenario would require 40- or 50-times the current capacity of the NEM being required from renewable energy sources by 2050.[40]

6.30 The Heavy Industry Low-Carbon Transition Cooperative Research Centre (HILT CRC) advised that for heavy industries to meet commitments to decarbonise their products many gigawatts of new green energy will be required, either as renewable electricity or green hydrogen.[41] To demonstrate scale, HILT CRC estimated decarbonising current alumina production would require additional renewable energy comparable to the average demand of the Victorian electricity grid, while steel production would require double that amount. Further, HILT CRC suggested new export industries in the green steel supply chain could require double the size of the NEM.[42]

6.31 Mr Corbell suggested that some scenario planning may not be achievable:

> At the moment we have a range of scenario planning undertaken by the market bodies in relation to how the National Electricity Market is anticipated to develop. This informs decision-making around access to and development of new transmission infrastructure and a range of other considerations. At the moment, the scenario planning for elements of the NEM is not particularly realistic when it comes to the scenarios we're talking about around green hydrogen manufacture. The hydrogen superpower scenario put forward by AEMO in its most recent integrated system plan assumes a level of green energy build-out of around 22 gigawatts per annum. That is a very high level of clean energy generation development. At the moment, as a point of comparison, we are only achieving around two to three gigawatts per annum. To achieve that very high level is one scenario that, from an investor perspective, our members would say is not credible. Therefore, there is a need for the development of a credible scenario that assumes a higher level of clean energy generation development—but one that is going to be achievable.[43]

6.32 Professor Baldwin noted that a sizable amount of the additional generation capacity required for future industries such as green hydrogen and green metals may not be

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39 Professor Ken Baldwin, Fellow, Australian Academy of Technological Sciences and Engineering, *Committee Hansard*, Canberra, 31 March 2023, p.13.

40 University of Adelaide Institute for Sustainability, Energy and Resources, Submission 18, p. 2, citation omitted; Clean Energy Council, Submission 38, p. 2, citation omitted.

41 Heavy Industry Low-Carbon Transition CRC, Submission 30, pp. 1-2

42 Heavy Industry Low-Carbon Transition CRC, Submission 30, pp. 1-2.

43 Mr Simon Corbell, Chief Executive Officer, Clean Energy Investor Group, *Committee Hansard*, Canberra, 31 March 2023, p. 15.

connected to the electricity grid as these industries may be established in remote areas with on-site renewable electricity generation.[44]

Impact on energy security, reliability and affordability

6.33 Some stakeholders shared their reservations about the implications of the transition to green energy for Australia's energy security, reliability and electricity prices.[45] For example, Mr Thomas Bostock, Chairman at the Australian Environment Foundation (AEF), told the Committee that by transitioning away from traditional forms of energy towards renewable energy:

> … the Western world is seeking to replace the cheapest and most reliable and effective form of energy that is presently provided by coal, gas and nuclear—which has been spurned, and that whole argument is something that has always puzzled us—for totally unreliable, intermittent things that, one way or another, need to be firmed up. That is something that's going to cause trouble because the most reliable way of doing that is with coal and gas. It's a strange thing: all advances in human progress have been through improvements in energy—better energy, more intense energy and cheaper energy—but here we're moving back to much more expensive and unreliable energy.[46]

6.34 Mr Dennis Armstrong, Member, Save Our Surroundings, expressed similar concerns:

> Energy policy is much more than keeping the lights on. It's more about Australia's future prosperity and the future way of life in Australia. Without a truly robust electricity system that is safe, affordable, reliable and secure, Australia cannot attract much-needed manufacturing and value-adding industries, become more self-reliant, become more secure from external threats, provide the services our modern society needs, provide more quality jobs for our growing population and provide very much cheaper electricity to all Australian consumers.[47]

6.35 In their submission the AEF suggested that '… transitioning away from fossil fuels (and nuclear power in other countries) brings about higher prices with consequent direct cost increases to consumers.'[48]

6.36 Another submitter described the introduction of solar and wind technologies in places such as South Australia, Germany, Denmark and parts of the United States (US)

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44 Professor Ken Baldwin, Fellow, Australian Academy of Technological Sciences and Engineering, *Committee Hansard*, Canberra, 31 March 2023, p. 13.

45 See, for example: Dr Geoffrey D Houston, Submission 9, p. 1; Kalapa Wycarbah Local Action Committee, Submission 49, p. 6; Australian Environment Foundation, Submission 68, p. 3; Name withheld, Submission 89, p. 2; Mr Cedric Creed, private capacity, *Committee Hansard,* Gladstone, 17 May 2023, p. 22; Name withheld, Submission 5, p. 14.

46 Mr Thomas Bostock, Chairman, Australian Environment Foundation, *Committee Hansard,* Melbourne, 5 April 2023, p. 31.

47 Mr Dennis Armstrong, Member, Save Our Surroundings, *Committee Hansard,* Macquarie Park, 6 April 2023, p. 1.

48 Australian Environment Foundation, Submission 68, p. 3.

'… has only succeeded in dramatic increase of electricity prices and more importantly, destabilisation electricity grids, and therefore economies and National security.'[49]

Regulatory and planning frameworks

6.37 The Committee heard about challenges associated with the regulatory and planning frameworks for green energy projects. These challenges broadly related to:

- Complexity and duration of approval processes
- Consistency of regulatory and approval processes
- Developing regulations for new and emerging industries.

Complexity and duration of approval processes

6.38 The Committee received evidence suggesting that the complexity and duration of regulatory approval processes can act as a barrier to investment, and that improving regulatory frameworks could assist Australia's green energy superpower transition.[50]

6.39 For example, Westpac Group outlined the types of approvals that renewable energy projects may require. It also observed that Australia has a complicated system of approvals across local, state and federal government, which can impose delays and complexity across renewable energy projects:

> Where these delays or time imposts are greater than those experienced in other jurisdictions, it creates a disincentive for investors when they compare Australia with alternate investment destinations.[51]

6.40 Several submitters referred to the need to reduce the complexity and timeframes for renewable energy projects to connect to the electricity grid.[52] For example, Mr Corbell of the CEIG told the Committee that:

> The other issue that I was referencing were issues around connection to the grid. That's getting the necessary approvals from transmission or distribution network operators as well as planning and environmental approvals from state and federal governments around the development of projects to connect to the grid. At the moment, the time frames around some of those approvals are extremely

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49 Name withheld, Submission 7, p. 2.

50 See, for example: Advanced Materials and Battery Council, Submission 15, p. 2; Copenhagen Infrastructure Partners, Submission 40, p. 1; Woodside Energy, Submission 47, pp. 2, 5; Star of the South, Submission 54, p. 2; Westpac Group, Submission 57, p. 3; Fortescue Future Industries, Submission 93, p. 6, Mr Simon Corbell, Chief Executive Officer, Clean Energy Investor Group, *Committee Hansard*, Canberra, 31 March 2023, pp. 17, 20.

51 Westpac Group, Submission 57, p. 3.

52 See, for example: Copenhagen Infrastructure Partners, Submission 40, p. 1; Entura, Submission 79, p. 3; Mr Simon Corbell, Chief Executive Officer, Clean Energy Investor Group, *Committee Hansard*, Canberra, 31 March 2023, p. 20.

> lengthy. It is one of the key factors that acts as a risk deterrent for investors in terms of how willing they are to invest in projects. So reducing those time frames and improving predictability around the approvals framework is going to be really important.
>
> In the context of your inquiry around green hydrogen manufacture, we're going to need to get these things absolutely right if we're going to get the level of generation needed to deliver the volumes of green hydrogen envisaged in a renewable energy superpower export scenario.[53]

6.41 Similarly, Entura suggested that: 'It is clear that the process needs to be more streamlined to provide investors, developers and owners with greater certainty of the pathway, timeframes and investment required to secure a connection agreement.'[54]

6.42 The Advanced Materials and Battery Council noted the slow process for obtaining permits for green energy developments and called for approval processes to be accelerated.[55]

6.43 Relatedly, Westpac Group drew the Committee's attention to work underway in the European Union to accelerate approval processes by designating areas of land and sea suitable for green energy projects with permits granted in no more than 12 months.[56] Westpac Group said:

> Australia has vast quantities of unused land that may be suitable for renewable energy projects. Adopting statutory deadlines of 12 months for as many approvals and permits as possible would… incentivise further investment. However, we also acknowledge that specific consideration would need to be given to ensuring development did not come at the expense of foundational development approval checks and balances, such as free, prior and informed consent of First Nations Australians… A simpler approval process that simplifies interdependent/multi government body approvals does not need to compromise the standards we should insist on in any development.[57]

6.44 In regard to sites for critical minerals refining, Tesla also suggested identifying and approving '… short and certain permitting for sites…' in advance as a significant advantage.[58]

6.45 Westpac Group explained renewable energy zones (REZ) and suggested they could be expanded. REZ's 'provide a designated area within a state that is suited to renewable energy developments. A logical next step would be to expand the number and size of REZ areas and to allow projects within a REZ access to a nationally

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53 Mr Simon Corbell, Chief Executive Officer, Clean Energy Investor Group, *Committee Hansard*, Canberra, 31 March 2023, p. 20.

54 Entura, Submission 79, p. 3.

55 Advanced Materials and Battery Council, Submission 15, p. 2.

56 Westpac Group, Submission 57, p. 3.

57 Westpac Group, Submission 57, p. 4, citations omitted.

58 Tesla, Submission 24, p. 10.

consistent and even more highly expedited approvals framework, in effect establishing a true 'transit lane' approach for renewable energy projects.'[59]

6.46 Entura said renewable energy zones have '…worked well at the state level (such as in NSW), giving developers some certainty around areas supported for renewable energy development' and suggested these zones could be an opportunity for the Australian Government's consideration.[60] However, some stakeholders criticised the renewable energy zones in for lack of community consultation and social licence[61] and concerns about costs to electricity consumers.[62]

Improving consistency of regulatory and approval processes

6.47 Many aspects in the development of green energy projects (such as land zoning and planning permits) sit with state, territory and local governments.[63] With this considered, some stakeholders argued the Australian Government should play a more central role in regulatory and approval processes relevant to the green energy transition to improve consistency.

6.48 The Law Council of Australia raised the issue of the regulatory roles and responsibilities of state and territories and that planning should recognise these in the development of renewable energy:

> Energy generation from renewable sources is land intensive and Commonwealth measures cannot operate independently from State and Territory approval regimes. For example, supply chains for critical mineral market opportunities rely from the outset on State and Territory approvals to access land to explore for such minerals and develop mining projects in accordance with State and Territory mining, planning and environmental laws.[64]

6.49 Dr Madeline Taylor, Deputy Director at Macquarie University's Centre for Energy and Natural Resources Innovation and Transformation (CENRIT), called for a '… federal approach to the planning, siting and coordinating of renewable energy and renewable hydrogen.'[65]

6.50 Professor Michael Goodsite, Director at the Institute for Sustainability, Energy and Resources (ISER) at the University of Adelaide, recommended that the system of

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59 Westpac Group, Submission 57, p. 4.
60 Entura, Submission 79, p. 4.
61 Responsible Energy Development for New England (RED4NE), Submission 91, p. 1; Mrs Joy Howley, Submission 105, p. 1.
62 Emma Jeffrey, Submission 104, p. 1.
63 See: Mr David Woods, Chief Economist and First Assistant Secretary, International Economics and Green Economy Division, Department of Foreign Affairs and Trade, *Committee Hansard,* Canberra, 23 November 2022, p. 12; Ms Helen Stylianou, First Assistant Secretary, Trade Resilience and Indo-Pacific Economic Cooperation Division, Department of Foreign Affairs and Trade, *Committee Hansard,* Canberra, 23 November 2022, p. 12.
64 Law Council of Australia, Submission 92.1, p. 4.
65 Dr Madeline Taylor, Deputy Director, Centre for Energy and Natural Resources Innovation and Transformation, Macquarie University, *Committee Hansard,* Macquarie Park, 6 April 2023, p. 42.

regulation in Australia needs to be looked at to make it easier to attract investment, adding that investors don't see 'various states; they see Australia':

> The fact is that, in a country like Australia, there are different regulations from state to state and, in principle, when you cross a border with hydrogen transport, you might need to fulfil other requirements.
>
> …
>
> With regulations around safety, around transport and around production, there should be one harmonised set of Australian rules, just as there is for biosecurity and other things, such as energy, that are important to our national security.[66]

6.51 Some submitters and witnesses called for clearer policies and regulatory frameworks, greater policy certainty to build confidence for investors.[67]

6.52 Mr Matthew Stuchbery, Vice President at Copenhagen Infrastructure Partners Australia (CIP Australia), recommended consistent and streamlined permitting frameworks as a measure to attract investment.[68] Mr Stuchbery explained:

> … understanding state by state what the expected planning or permitting time frame is and what steps can be taken to reduce those time frames and align those time frames and those processes as much as possible across states is going to be important, particularly to attract international investors who don't necessarily think on a state basis but think about a country basis. Having consistent and streamlined permitting frameworks is going to be critical. I think setting some targets or at least some visibility around what those typical time frames are and what the end state we want those time frames to be is going to be important.[69]

Developing regulations for new and emerging industries

6.53 A small number of stakeholders identified challenges associated with developing regulations for new and emerging green energy driven industries, particularly in relation to hydrogen.

6.54 The Western Australian Department of Jobs, Tourism, Science and Innovation recommended the Australian Government consider '… ensuring appropriate

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66 Professor Michael Goodsite, Pro Vice-Chancellor, Energy Futures, and Director, Institute for Sustainability, Energy and Resources (ISER), University of Adelaide, *Committee Hansard,* Brisbane, 16 May 2023, p. 24.

67 See, for example: The Next Economy, Submission 51, p. 5; Mr Matthew Stuchbery, Vice President, Copenhagen Infrastructure Partners Australia, *Committee Hansard,* Melbourne, 5 April 2023, pp. 59–60.

68 Mr Matthew Stuchbery, Vice President, Copenhagen Infrastructure Partners Australia, *Committee Hansard,* Melbourne, 5 April 2023, pp. 59–60.

69 Mr Matthew Stuchbery, Vice President, Copenhagen Infrastructure Partners Australia, *Committee Hansard,* Melbourne, 5 April 2023, pp. 59–60. See also: Mr Matthew Stuchbery, Vice President, Copenhagen Infrastructure Partners Australia, *Committee Hansard,* Melbourne, 5 April 2023, p. 62.

standards and regulations are in place to support new and emerging industries, such as the renewable hydrogen industry.'[70]

6.55 For example, Mr Matthew Hingerty, Deputy Chair, Deputy Chief Executive Officer and Head of Business Development at Star Scientific, noted that while regulation for Australia's hydrogen industry is developing, there is currently an absence of regulation for Star Scientific's work with hydrogen:

> For what we do with it, which is not burning it, there is no regulation. We are having to work with regulators and Standards Australia to develop our own regulations. That has slowed down our process, but if you get it right the first time then it is a lot easier than going back to fix it.[71]

6.56 Ms Catherine Zerger, Acting Branch Head, Hydrogen Branch at DCCEEW noted DISR's work on the national hydrogen regulatory frameworks review, which is nearing finalisation and examined opportunities to develop regulatory frameworks needed to support the hydrogen industry, and a national hydrogen infrastructure assessment.[72]

Risks to the environment and land use change

6.57 The Committee received evidence that discussed the implications that the transition to a green energy superpower and the expansion of renewable energy infrastructure will have for land use, including challenges relating to Australia's environment and biodiversity, agriculture and impact on First Nations communities.

6.58 A number of submitters suggested that there are inequitable regulations for different types of land use, and particularly that renewable energy projects are subject to fewer or less onerous regulations than for other land uses.[73] For example Mr Nick Holland, Member, Kalapa and Wycarbah Local Action Committee, explained that:

> Currently, renewable projects aren't subject to environmental impact assessments quite like some other industries, such as mining, industry et cetera. That's probably a big one to start with; they are not subject to those same regulations, I guess, as such, whereas others are. Land clearing is probably a big topic that sits with everyone. Again, I know that probably falls under the state. For this country of remnant vegetation, all valued as high class, there is high value regrowth in those areas… They areas that either farmers or other industries wouldn't be allowed to look at pretty much full stop.[74]

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70 Western Australian Department of Jobs, Tourism, Science and Innovation, Submission 65, p. 7.

71 Mr Matthew Hingerty, Deputy Chair, Deputy Chief Executive Officer and Head of Business Development, Star Scientific, *Committee Hansard,* Brisbane, 16 May 2023, p. 33.

72 Ms Catherine Zerger, Acting Branch Head, Hydrogen Branch, Department of Climate Change, Energy, the Environment and Water, *Committee Hansard,* Canberra, 10 February 2023, p. 7.

73 Kalapa and Wycarbah Local Action Committee, Submission 49, p. 5.

74 Mr Nick Holland, Member, Kalapa and Wycarbah Local Action Committee, *Committee Hansard,* Gladstone, 17 May 2023, p. 8. See also: Kalapa and Wycarbah Local Action Committee, Submission 49, p. 5.

6.59 Mrs Therese Creed, private capacity, told the Committee that solar farms are subject to non-mandatory guidelines and are exempt from regulations that other land uses are subject to: 'We find that… there are very definite sets of rules for renewable energy as opposed to any other industry that changes the land use.'[75]

Biodiversity and conservation

6.60 A considerable number of submitters raised concerns in relation to the impact of renewable energy projects and infrastructure on biodiversity and conservation.[76] For example, the Australian Land Conservation Alliance (ALCA) stated that: 'As large-scale renewable energy expands across Australia – including the production of hydrogen using renewable energy – the tensions over habitat loss from renewable energy are also escalating.'[77]

6.61 Similarly, the South Australian Nature Alliance (SANA) submitted that '… renewable energy generation and its associated needs (for example mining for critical minerals) and infrastructure (such as new transmission lines) has the potential to negatively impact on nature…'[78]

6.62 BirdLife Australia advised that: 'It is essential… that the policy response to climate change is developed and managed in a way that does not have a significant impact on Australia's threatened biodiversity.'[79]

6.63 CIP Australia noted that: 'More attention is required to appropriately navigate the tension between clean energy development and environmental and biodiversity outcomes.'[80]

6.64 ALCA suggested in its submission that biodiversity conservation is increasingly disadvantaged in land tenure reforms aimed at accelerating green energy industries:

> …we are already seeing competing pressures over land use for conservation and renewable energy, and at scale. For example, hydrogen produced using renewable energy…is increasingly driving State-level land tenure reforms. In its diversification lease reforms for Crown land, Western Australia has already demonstrated that conservation is a lower priority in its hierarchy of concerns in accommodating renewable hydrogen's need for land.[81]

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75 Mrs Therese Creed, private capacity, *Committee Hansard*, Gladstone, 17 May 2023, p. 16.
76 See, for example: Queensland Conservation Council, Submission 41, p. 2; The Next Economy, Submission 51, p. 4; South Australian Nature Alliance, Submission 55, p. 2; BirdLife Australia, Submission 58, pp. 1–2; Australian Land Conservation Alliance, Submission 95, pp. 2–3.
77 Australian Land Conservation Alliance, Submission 95, p. 2.
78 South Australian Nature Alliance, Submission 55, p. 6
79 BirdLife Australia, Submission 58, p. 1.
80 Copenhagen Infrastructure Partners, Submission p. 1.
81 Australian Land Conservation Alliance, Submission 95, p. 3, citation omitted.

6.65 SANA also noted that efforts to 'fast track approvals' for renewable energy projects should not result from the 'overriding of current protections for nature…'[82]

6.66 CENRIT highlighted in its submission the importance of effective regulations, noting that energy development and planning regulation are 'fundamentally linked':

> Onshore and offshore renewable energy development and production requires legal consideration and mitigation of environmental, biophysical, and social land use risks and impacts. Australia must effectively regulate renewable energy to mitigate any potential conflicts and create synergetic uses of space.[83]

6.67 Some submitters and witnesses emphasised the need for enhanced land use planning and regulation to minimise adverse impacts on Australia's environment and biodiversity in the green energy transition.[84] For example, BirdLife Australia advised that: 'Valid and strongly-held concerns over renewable energy developments impacting local environments are a product of major shortcomings in environmental and planning laws in Australia at all levels of government.' Further, that: 'A more effective legal regime could potentially also improve certainty and decision-making times for all stakeholder[s], including potential investors.'[85]

6.68 Dr Jody Gunn, Chief Executive Officer at ALCA, told the Committee that in some jurisdictions the regulatory framework '… simply considers the environment to be an inconvenience in securing approvals and does not consider nature to be an investable sector, despite the increasing evidence to the contrary.' Dr Gunn went on to add:

> With increasing awareness of our state of environment and global and national commitments, it is important that those policies, the legislative frameworks and the land use tenure do put it on an even playing field.[86]

6.69 Birdlife Australia told the Committee that 'It is crucial to ensure that our environmental and planning regimes are able to manage and regulate the substantive increase in the number and scale of renewable energy projects in this transition in a way that does not impact adversely on Australia's endangered species and their habitats.'[87] Mr Paul Sullivan, Chief Executive Officer at BirdLife Australia, further explained that:

> From a bird conservation perspective, the key concern is poor planning or uninformed planning. A poorly sited wind farm can present a significant risk to birds and particularly species of conservation concern… Poorly informed

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82 South Australian Nature Alliance, Submission 55, p. 6.

83 Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, p. 8.

84 See, for example: Climate Council, Submission 36, p. 11; Clean Energy Council, Submission 38, p. 2; RE-Alliance, Submission 43, pp. 5, 8; Next Economy, Submission 51, p. 4: Macquarie University Centre for Energy and Natural Resources Innovation and Transformation, Submission 125, pp. 8–9.

85 Birdlife Australia, Submission 58, p. 2.

86 Dr Jody Gunn, Chief Executive Officer, Australian Land Conservation Alliance, *Committee Hansard,* Melbourne, 5 April 2023, p. 12.

87 BirdLife Australia, Submission 58, p. 3.

> planning and decision-making not only impacts on biodiversity; it will put the sector's social licence to operate at risk, in our view.[88]

6.70 Similarly, Dr Gunn suggested the environment be considered as part of planning for projects:

> An integrated and environmentally sensitive approach to renewable energy is achievable through early and good planning. In practice this means that environmental assets must be identified early and incorporated into renewable energy project design, including any associated infrastructure requirements. For example, this means protecting important remnant habitat and the species that call them home and restoring degraded habitat alongside any developments. It also means when state, territory and federal governments identify priority areas for renewable energy projects that they take into account the quality and importance of the habitat and native vegetation and safeguard our natural capital rather than deal with land clearance applications at the end of any development application process.
>
> Importantly, it also means a commitment by governments and the renewable energy and hydrogen industries to provide a net benefit for nature. We should not alleviate the climate crisis by contributing to the nature crisis, two interrelated challenges. We have an obligation to consider these two interrelated crises together and to turn the challenges into opportunities.[89]

6.71 SANA submitted that it is '… critical that plans to transition to a green energy superpower include explicit plans to avoid negative impacts on nature and instead achieve a transition that is nature positive.' Further, '… that nature conservation must be pro-actively planned for as part of our transition to green energy.'[90]

6.72 The Next Economy recommended that the Australian Government recognise that effective land-use planning is a critical enabler of renewable energy development:

> If land use planning is not done well, it can lead to significant opposition from landholders, stakeholders and community members, which causes costly project delays. Land use planning must factor in the amount of land directly required by wind and solar developments and the requirements of associated manufacturing, logistics, energy transmission and storage facilities. Importantly it needs adhere to the standard of 'prior and informed consent' when seeking access and use of First Nations land.[91]

6.73 DCCEEW pointed out in its submission that the Australian Government has announced important environmental reforms in response to the findings of the

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88 Mr Paul Sullivan, Chief Executive Officer, BirdLife Australia, *Committee Hansard,* Melbourne, 5 April 2023, p. 64.

89 Dr Jody Gunn, Chief Executive Officer, Australian Land Conservation Alliance, *Committee Hansard,* Melbourne, 5 April 2023, p. 10.

90 South Australian Nature Alliance, Submission 55, p. 2.

91 The Next Economy, Submission 51, p. 4.

Independent Review of the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) (the Samuel Review):

> Early priorities include improving environmental data, regional planning and new national environmental standards. The Government has also committed to establishing an independent National Environment Protection Agency… which will improve trust and transparency in Australia's national environmental laws.[92]

Improved data and mapping to reduce harm to biodiversity

6.74 BirdLife Australia highlighted the need for risk-based planning and decision support tools to minimise the impact on biodiversity through informed strategic planning. It suggested that 'This simple tool would help grow renewable energy, while managing biodiversity risk.'[93]

6.75 Dr Gunn also outlined need for better data: 'We need to improve data capture and collection around natural capital and understanding around the protection of biodiversity and around understanding the biodiversity assets we have to ensure we can protect the critical assets remaining.'[94]

6.76 RE-Alliance recommended comprehensive land use mapping to avoid land use conflict:

> … to transparently map the best areas for development of renewables projects, having regard to the ideal siting for solar farms and wind farmers near electricity grid infrastructure, but also having regard to prime agricultural land and areas of high environmental value. This will ensure that renewable energy projects can access the best sites for their operations, while avoiding inappropriate zones where conflicts with other important land uses may arise.[95]

6.77 SANA drew attention to the 'Site Renewables Right' initiative undertaken in the US and concluded that:

> A similar exercise should be undertaken for Australia, with maps identifying current and future desirable protected areas, habitat for threatened species, areas of remaining wilderness and areas needed for nature restoration/recovery are overlaid with mapping of preferred locations for renewable energy projects. Layers for cultural heritage should also be included.[96]

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92 Department of Climate Change, Energy, the Environment and Water, Submission 62, pp. 13–14.
93 BirdLife Australia, Submission 58, p. 3.
94 Dr Jody Gunn, Chief Executive Officer, Australian Land Conservation Alliance, *Committee Hansard*, Melbourne, 5 April 2023, p. 13.
95 RE-Alliance, Submission 43, p. 9.
96 South Australian Nature Alliance, Submission 55, p. 6.

Risks to Australia's agriculture and food security

6.78 Some submitters expressed concerns about the implications of the transition to green energy for Australia's agriculture and food security.[97] For example, Mr Bill Stinson, private capacity, told the Committee that:

> … Australia's prime agricultural land is being taken out of production by the rollout of PV solar projects. This must stop. Australia can become a green food superpower by ensuring that our primary agricultural land remains as cropping land to enable food exports to our trading partners.[98]

6.79 Similarly, Mrs Therese Creed, private capacity, suggested that Australia's agriculture and food-producing land must be protected:

> Surely agriculture is one of our massive exports. These sorts of things [solar panels and wind turbines] have the potential to sterilise, not just for a short time but forever, the land that they are situated on, and they have done so. I think food-producing land has to be one of our top assets in this country…

6.80 Ms Rachel Logan, private capacity, submitted that Australia's land must be used responsibly to ensure future food security:

> …projects must reach much higher standards of sustainability (for more than a few years of life, Eg. In turbine blades or solar cells) and must not impact on useful land, when Australia has so little of it for our future food security. The agricultural people and their investments must be protected first, and our role in harnessing renewable energy must be embraced in desert places instead. There is a crucial decision to be made by the government at this juncture as to how our future as a responsible country will eventuate.[99]

6.81 Similarly, Kalapa Wycarbah Local Action Committee called for the Australian Government to assess '… the renewable energy industry and the future plans around energy security.' [100] Kalapa Wycarbah Local Action Committee elaborated:

> We firmly believe that the current plan is not in the best interest of the country due to the impacts on the environment of both Flora, fauna & the reef, the threat to health and safety of our population, the economic cost both having to pay for electricity and cost to construct these projects which are being subsidized. Our food security and impact on our food/ag production should take priority over renewable projects as wind & solar projects cannot truly compliment or work in with existing ag production systems. We urge all levels of government to

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97 See, for example: Name withheld, Submission 4, p. 1; Name withheld, Submission 7, p. 5; Save Our Surroundings, Submission 28, Attachment 1, p. 68; Name withheld, Submission 89, p. 6; Ms Rachel Logan, Submission 107, p. 1.

98 Mr Bill Stinson, private capacity, *Committee Hansard*, Gladstone, 17 May 2023, p. 13.

99 Ms Rachel Logan, Submission 107, p. 1.

100 Kalapa Wycarbah Local Action Committee, Submission 49, p. 6.

> reassess and develop a complete energy plan that will be in the best interest of the country.[101]

6.82 Farmers for Climate Action explained the concept of 'agrivoltaics' as 'combining energy generation with food and fibre production on the same land'[102] and noted that combining '… farming and solar in agrivoltaics presents a powerful path forward, increasing social licence for renewable energy developments and allowing ongoing agricultural use of productive land.'[103]

6.83 In their submission, CENRIT highlighted the potential for agrivoltaics to be reduce land use conflict and improve benefit sharing:

> Agrivoltaics are seen as a technological facilitator of the energy transition while minimising negative social and technical externalities by first, enabling the co-location of food and energy production to dimmish potential land use conflicts; second, agricultural landholder income diversification and increase revenue stability; and third, the opportunity for profitsharing models and co-benefits for agricultural communities.[104]

Waste, contamination and decommissioning of green energy infrastructure

6.84 Some evidence received drew the Committee's attention to the environmental issue of waste and contamination caused by products and infrastructure that enable Australia's transition to a green energy superpower, such as batteries, solar panels and wind turbines.[105]

6.85 Mr Dennis Armstrong, Member, Save Our Surroundings told the Committee that local councils do not have 'the capability' to dispose of the rubbish from the materials that solar panels and wind turbine blades are wrapped in.[106]

6.86 Mrs Therese Creed, private capacity, shared concerns about contamination from wind turbine blades:

> The leading edge of turbine blades shed fine [BPA] dust, and blade edges only have a five-year guarantee. Each blade sheds a minimum of 0.2 to 2.5 grams of bisphenol A dust per year. This dust is spread far and wide by wind… It's going to end up in food that people are going to eat. The stuff that comes out of the panels also leaches out. At Bell solar farm in New South Wales, there was no hail

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101 Kalapa Wycarbah Local Action Committee, Submission 49, p. 6.
102 Farmers for Climate Action, Submission 16.1, p. 5.
103 Farmers for Climate Action, Submission 16.1, p. 51.
104 Macquarie University Centre for Energy and Resources Innovation and Transformation, Submission 125, p. 9.
105 See, for example, Name withheld, Submission 5, p. 3; Dr Geoffrey D Houston, Submission 9, p. 3; Save Our Surroundings, Submission 28 Attachment 1, pp. 19, 43; Kalapa Wycarbah Local Action Committee, Submission 49, p. 5; Name withheld, Submission 61, p. 7; Law Council of Australia, Submission 92.1, p. 9; Name withheld, Submission 124, p. 2.
106 Mr Dennis Armstrong, Member, Save Our Surroundings, *Committee Hansard,* Macquarie Park, 6 April 2023, p. 3.

> damage or anything, but it has leached into the soil. If that gets into our stock water dams or our cattle, they will get condemned at the meatworks. This is also about the viability of agriculture. It's not as if Australia doesn't have land that isn't productive land. We have 2.5 per cent of Queensland on which we can grow food. The rest of it they can put renewable energy on.[107]

6.87 Mrs Creed also shared her concerns with the Committee about contamination from a solar farm approved on land that neighbours her property. Mrs Creed said she sent letters to various government departments seeking information about who would be '… legally and financially accountable for the contamination of water and soil in and around renewable energy sites…' and was advised that she would need to speak to her local council.[108] Mrs Creed elaborated: 'So the buck has been passed back to local council, which does not have the millions of dollars that would be required for the rehabilitation that would be needed.'[109]

6.88 The Law Council of Australia called for measures that would address recycling and waste management issues that will inevitably arise as the use of solar PV and wind turbines increase:

> Policies for investment in storage batteries, including community-owned batteries, should address how these batteries will be disposed of and the costs for the environment. Similarly, solar panels do not have an unlimited lifespan, which means there must be strategic and long term planning to deal with this infrastructure once it has reached the end of its operating life.[110]

6.89 Australia is looking for opportunities to develop its recycling capability so as to reduce waste from products and infrastructure supporting its transition to green energy. For example, Dr Karin Soldenhoff, Manager, Process Development Research, Minerals Business Unit at the Australian Nuclear Science and Technology Organisation (ANSTO), told the Committee about technology to reduce waste from lithium mining:

> One of the good-news stories is that we've actually developed a technology, in conjunction with one of our clients within Australia, that actually takes the waste material and therefore allows the potential for much-increased lithium extraction from the current resources that we have here in Australia. The conventional process needs a certain grade of spodumene, and the rest, which is basically rejected as waste rock, generally is not exported. But this process that ANSTO developed together with Lithium Australia can take that material, so it's basically feed agnostic and has the potential to increase the lithium extraction from the resources that we currently have already.[111]

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107 Mrs Therese Creed, private capacity, *Committee Hansard,* Gladstone, 17 May 2023, p. 22. See also: Dr Geoffrey D Houston, Submission 9, p. 3; Save Our Surroundings, Submission 28, Attachment 1, p. 6.

108 Mrs Therese Creed, private capacity, *Committee Hansard,* Gladstone, 17 May 2023, pp. 16–17.

109 Mrs Therese Creed, private capacity, *Committee Hansard,* Gladstone, 17 May 2023, p. 17.

110 Law Council of Australia, Submission 92.1, p. 9, citations omitted.

111 Dr Karin Soldenhoff, Manager, Process Development Research, Minerals Business Unit, Australian Nuclear Science and Technology Organisation, *Committee Hansard,* Canberra, 10 February 2023, p. 31.

6.90 Mrs Simone Spencer, Deputy Director General, Strategy and International Engagement at the Western Australian Department of Jobs, Tourism, Science and Innovation, discussed work underway to repurpose batteries for other industrial use in other parts of the value chain.[112]

6.91 Some stakeholders expressed concerns regarding the decommissioning and disposal of green energy infrastructure and equipment, such as solar panels and wind turbines, that have reached end of life.[113] For example, one submitter said:

> The fundamental premise for the use of 'green' energy is to generate energy that is not harmful to the environment, however, because natural sources of energy need machines to convert natural energy (wind, solar, etc.) to electrical energy the manufacture, installation, maintenance and disposal of these machines at end of life is environmentally destructive.[114]

6.92 Mr Stinson discussed challenges with solar panel disposal, and told the Committee: 'When you crush the glass, it has polymers and you have to remove those polymers by chemical means, which creates a chemical waste stream.'[115]

6.93 Ms Coldham told the Committee about the life span of offshore wind projects and decommissioning plans:

> …offshore wind is a relatively new industry in that only about two projects around the world have been decommissioned to date. We've seen great advancements in the technology over time. Currently, the industry standard is around a 30-year lifespan for an offshore wind project. Typically, the infrastructure is maintained throughout that period to ensure that it can last. Again, as the industry is quite new, that is an estimated time. It might be later with the newest and greatest turbines. In terms of the end of life, it's certainly something that I think Australia has paid close attention to. It is industry standard both globally and here in the creation of the regulatory framework that decommissioning plans are required from the outset of projects. The Offshore Electricity Infrastructure Act… does have requirements around decommissioning and financial securities at the outset for licence holders to ensure that taxpayers are not left with the burden of any clean-up. We acknowledge that is a good progression for Australia to ensure that there is that level of comfort when projects are being planned to have that full cradle to grave approach.[116]

6.94 Further, Mr Stuchbery of CIP Australia emphasised to the Committee that government, industry and investors must work together to inform the community

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112 Mrs Simone Spencer, Deputy Director General, Strategy and International Engagement, Department of Jobs, Tourism, Science and Innovation, Western Australia, *Committee Hansard,* Perth, 17 March 2023, p. 4.

113 See, for example: Name withheld, Submission 5, p. 8; Save Our Surroundings, Submission 28, Attachment 1, p. 17; Mr Jason Wood, Submission 119, p. 29.

114 Name withheld, Submission 5, p. 2.

115 Mr Bill Stinson, private capacity, *Committee Hansard,* Gladstone, 17 May 2023, p. 14.

116 Ms Erin Coldham, Chief Development Officer, Star of the South Wind Farm Pty Ltd, *Committee Hansard,* Brisbane, 16 May 2023, p. 10.

about the decommissioning of green energy infrastructure. He pointed out that wind turbine blades can now be recycled, and that:

> The impact of decommissioning these things is not as great as putting them up because they can be cut up on site. All sorts of information is valuable for the community to receive to reduce their concerns. As I say, this is an investment that is needed to get that information out to the communities. My main message here is that industry, government and investors need to work together to really get this right. I think, as you alluded to in your question, there's the potential for it to go wrong.[117]

Impact on First Nations communities and their land

6.95 Australia's transition to a green energy superpower will require access to large areas of First Nations land and sea.[118] Mr Brad Riley, Dr Ed Wensing and Dr Lily O'Neill outlined in their joint submission that:

> A fundamental prerequisite for renewable energy generation and storage at the scales required by Australia's transition to a green energy superpower is access to large areas of land and sea. In Australia much of the lands and waters necessary for hosting wind turbines, solar panels, electrolysers and associated infrastructure such as roads, laydown areas, storage and access to coastal shipping and pipelines, will be subject to varying strengths of First Nations rights and interests, through native title and statutory land rights regimes.[119]

6.96 Submitters noted the socio-economic opportunities for First Nations communities in the green energy transition and emphasised the importance of the inclusion of First Nations rights and interests within the policy and regulatory frameworks.[120] For example, Mr Michael Dillon submitted:

> The existence of native title, statutory land rights and other Indigenous rights (such as heritage protection rights) must be seen as an opportunity for inclusion, and not as an obstacle to development. This will increasingly involve negotiation at the conception and implementation stages of green energy projects between proponents and Indigenous interests.[121]

6.97 The First Nations Clean Energy Network (FNCEN) advised that:

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117 Mr Matthew Stuchbery, Vice President, Copenhagen Infrastructure Partners Australia, *Committee Hansard,* Melbourne, 5 April 2023, p. 61.

118 See, for example: Mr Michael Dillon, Submission 22, p. 1; First Nations Clean Energy Network, Submission 45, p. 3; WWF-Australia, the Business Council of Australia, the Australian Council of Trade Unions and the Australian Conservation Foundation, Submission 67, Attachment 1, p. 99, citations omitted; Mr Brad Riley, Dr Ed Wensing and Dr Lily O'Neill, Submission 97, p. 1.

119 Mr Brad Riley, Dr Ed Wensing and Dr Lily O'Neill, Submission 97, p. 1.

120 See, for example: Mr Michael Dillon, Submission 22, p. 1; First Nations Clean Energy Network, Submission 45, pp. 3, 5; Australian National University Zero Carbon for the Asia Pacific Initiative, Submission 98, p. 9.

121 Mr Michael Dillon, Submission 22, p. 1.

> Enabling and empowering First Nations to play a key and central role in Australia's renewable energy transition goes beyond just social licence issues - it presents a unique opportunity for Australia to design a system that is fair and just and which can also positively impact and result in other social and economic benefits for First Nations.[122]

6.98 BZE emphasised the need for First Nations people to be included in planning, execution and management to understand environmental, social and economic impacts.[123]

6.99 Mr Riley, Dr Wensing and Dr O'Neill declared that Australia's green energy transition '… must not further contribute to marginalisation and harm, but rather strengthen opportunities to address socio-economic inequalities between Indigenous and non-Indigenous Australians, through policy aimed at the fair distribution of risk and gain.[124]

6.100 Some submitters emphasised the value of active participation, including the potential for partnership and ownership models to ensure equitable benefit sharing.[125] For example, the Law Council of Australia stated that:

> Not only should new policies consider how those rights and interests are to be protected, but consideration should also be given to the ways in which traditional owners can participate in new renewable energy projects, should they wish to do so, or how the benefits of a project can otherwise be shared equitably with the relevant traditional owners.[126]

6.101 WWF-Australia, the Business Council of Australia, the Australian Council of Trade Unions and the ACF emphasised the importance that First Nations People benefit from the projects on their land:

> This benefit may take the form of agreements for access to energy, financial compensation, or a stake in ownership.
>
> Beyond consent, First Nations people should be engaged in partnerships that involve effective and meaningful participation. The Western Green Energy Hub can be looked towards as an example of a project moving beyond obtaining consent, and entering into a partnership with the Traditional Owners.[127]

6.102 The ANU ZCEAPI reflected on the First Nations experience with the mining boom:

> To date, many Indigenous communities have not received commensurate benefits from Australia's mining boom, despite bearing many of the economic,

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122 First Nations Clean Energy Network, Submission 45, p. 3.
123 Beyond Zero Emissions, Submission 32, p. 6.
124 Mr Brad Riley, Dr Ed Wensing and Dr Lily O'Neill, Submission 97, p. 2, citation omitted.
125 First Nations Clean Energy Network, Submission 45, p. 6; Mr Brad Riley, Dr Ed Wensing and Dr Lily O'Neill, Submission 97, p. 2; Australian National University Zero Carbon for the Asia Pacific Initiative, Submission 98, p. 9.
126 Law Council of Australia, Submission 92.1, p. 8.
127 WWF-Australia, the Business Council of Australia, the Australian Council of Trade Unions and the Australian Conservation Foundation, Submission 67, Attachment 1, p. 99, citations omitted.

> social, cultural and environmental costs. Yet there is a very real opportunity for a more inclusive model to be adopted in the case of utility-scale renewable energy generation and attendant downstream industries.[128]

6.103 Stakeholders emphasised the importance of a model for early and genuine engagement as part of the policy framework for green energy project development, based on the principles contained in the United Nations Declaration of the Rights of Indigenous Peoples including the right to self-determination and free, prior and informed consent.[129] BZE proposed that Australia obtain '… free, prior and informed consent from First Nations Peoples and setting an example for international best-practice for land use partnerships, delivering equitable and long-term benefits to all.'[130]

6.104 Re-Alliance declared that: 'The rights of Aboriginal and Torres Strait Islander people to self-determination, and the principle of Free, Prior and Informed Consent must be front and centre of public policy development around the energy transition.'[131]

6.105 Mr Riley, Dr Wensing and Dr O'Neill explained the significance of free, prior and informed when negotiating with traditional owners, as distinct from the principles of social licence:

> Free, prior and informed consent provides the best framework for negotiating with traditional owners/native title holders in relation to large-scale development on the Indigenous estate because it provides a relatively clear process on governments and developers, which distinguishes it from principles such as social licence to operate (which are less precisely defined and rely on the goodwill of governments and industrial partners).[132]

6.106 The FNCEN drew attention to the development of best practice principles for renewable energy projects published by the organisation in November 2022.[133]

> These Principles place First Nations people and their communities at the centre of the development, design, implementation and opportunities for economic benefit from renewable energy projects.
>
> The First Nations Clean Energy Network has developed the Principles anticipating they will aid governments with the design of policy and regulatory

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128 Australian National University Zero Carbon for the Asia Pacific Initiative, Submission 98, p.9. See also: Mr Brad Riley, Dr Ed Wensing and Dr Lily O'Neill, Submission 97, p. 2.

129 See, for example: Re-Alliance, Submission 45, pp. 2, 7; First Nations Clean Energy Network, Submission 45, pp. 5–6; The Next Economy, Submission 51, p. 4; Westpac Group, Submission 57, p. 4; Law Council of Australia, Submission 92.1, pp. 7–8; Australian National University Zero Carbon for the Asia Pacific Initiative, Submission 98, p. 9.

130 Beyond Zero Emissions, Submission 32.3, p. 12.

131 RE-Alliance, Submission 45, p. 2.

132 Mr Brad Riley, Dr Ed Wensing and Dr Lily O'Neill, Submission 97, p. 3.

133 First Nations Clean Energy Network, Submission 45, p. 4.

> frameworks and also assist industry in its efforts to engage and partner with First Nations in the development of renewable energy projects.[134]

6.107 Some stakeholders described the importance of First Nations engagement to their operations. For example, Mr Stuchbery of CIP Australia told the Committee that partnerships with First Nations people as 'fundamental' to their work and explained that CIP Australia's models are designed to '… encourage engagement with nominated native title holders and enter into Indigenous land use agreements.'[135] Mr Stuchbery also said that regulatory frameworks 'need to bend and stretch and shape themselves accordingly' to support work with First Nations communities.[136]

6.108 Dr Lily O'Neill discussed barriers to understanding First Nations land use agreements as these agreements are generally '… almost entirely commercial in confidence, so research I'm undertaking at the moment is speaking with the lawyers who are negotiating these agreements to find out what the general trends are.'[137] Dr O'Neill told the Committee that trends indicate that people in different parts of the country (such as Western Australia) received greater financial benefits than people in other areas (such as in NSW and Queensland).[138]

6.109 The Committee received evidence highlighting the importance of resourcing and ensuring that First Nations people and communities have the capacity to engage with the green energy transition.[139] For example, Mr Michael Dillon explained that:

> Key Indigenous institutions in facilitating and negotiating third party access to Indigenous land are the Prescribed Bodies Corporate established to hold native title rights. These entities are mandated by legislation, must be incorporated, but are chronically underfunded for the tasks that they are required to address.[140]

6.110 Similarly, in their submission, Mr Riley, Dr Wensing and Dr O'Neill discussed the role of prescribed bodies corporate to hold and manage native title rights, but also pointed to their lack of funding:

> In northern Australia… many native title claims have been finalised and most successful claimant groups have established "prescribed bodies corporate" (PBCs) to manage their native title. These PBCs are the legally required governance arrangements for land that is subject to native title rights and interests and PBCs are required to hold and manage native title in perpetuity - obligations which carry legally mandated compliance requirements. Yet it is

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134 First Nations Clean Energy Network, Submission 45, p. 4.

135 Mr Matthew Stuchbery, Vice President, Copenhagen Instructure Partners Australia, *Committee Hansard,* Melbourne, 5 April 2023, p. 62.

136 Mr Matthew Stuchbery, Vice President, Copenhagen Instructure Partners Australia, *Committee Hansard,* Melbourne, 5 April 2023, p. 62.

137 Dr Lily O'Neill, private capacity, *Committee Hansard,* Canberra, 31 March 2023, pp. 35–36.

138 Dr Lily O'Neill, private capacity, *Committee Hansard,* Canberra, 31 March 2023, pp. 35–36.

139 Mr Michael Dillon, Submission 22, p. 1; First Nations Clean Energy Network, Submission 45, p. 3; Mr Brad Riley, Dr Ed Wensing, and Dr Lily O'Neill, Submission 97, pp. 3–4; Australian National University Zero Carbon for the Asia Pacific Initiative, Submission 98, p. 9.

140 Mr Michael Dillon, Submission 22, p. 1.

widely acknowledged that Australian Government funding for these compliance requirements is inadequate.[141]

6.111 Mr Riley, Dr Wensing and Dr O'Neill further explained that:

> In the context of Australia's transition to a green energy superpower, it must also be considered that the level and pace of change underway has the potential to prohibit effective engagement, co-design and decision-making with First Nations, and that the level of resourcing for PBC's, First Nations communities and their representative organisations must be an urgent area of priority consideration for governments when pursuing expedited timelines for reforms enabling energy transition. Greater levels of resourcing will be immediately advantageous; for the many capable and independent Aboriginal PBCs who rightfully hold the predominant stake in economic development in the regions, as well as for those native title representative bodies… who will play a critical role in securing benefit from distributed renewable energy resources and downstream zero-carbon derivatives.
>
> Without such measures First Nations will be exposed to unreasonable risk, cost and disadvantage from projects progressed by domestic and international proponents for their own commercial benefit, and which initiate processes the costs of which (in time, money, organisational capacity) risk being externalized to native title holders.[142]

6.112 The FNCEN drew attention to the positive experience of First Nations engagement in the renewable energy sector in Canada, noting that the '…outcomes were achieved through actions by Governments acting with foresight, including mandating project ownership targets for the First Nations on whose lands the projects were proposed.'[143]

6.113 Mr Dillion recommended that the scope of the Northern Australia Infrastructure Fund be expanded to proactively address '…the extraordinary infrastructure needs of remote communities, which all have implications for the green energy futures of those communities and in many respects the nation at large.'[144]

6.114 A First Nations Clean Energy Strategy is currently being developed by DCCEEW alongside the National Indigenous Australians Agency, the FNCEN, First Nations communities, and state and territory governments as part of the National Energy Transformation Partnership.[145] DCCEEW explained:

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141 Mr Brad Riley, Dr Ed Wensing, and Dr Lily O'Neill, Submission 97, pp. 3–4.

142 Mr Brad Riley, Dr Ed Wensing, and Dr Lily O'Neill, Submission 97, pp. 3–4. See also: Mr Michael Dillon, Submission 22, p. 1.

143 First Nations Clean Energy Network, Submission 45, p. 6.

144 Mr Michael Dillon, Submission 22, p. 2. See also: Mr Brad Riley, Dr Ed Wensing, and Dr Lily O'Neill, Submission 97, p. 4.

145 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 13; Department of Climate Change, Energy, the Environment and Water, Submission 62.1, p. 1; Mr James White, Branch Head,

> The Strategy, and other initiatives like the First Nations Community Microgrids Program administered by ARENA [Australian Renewable Energy Agency], aims to enable First Nations communities to influence and access the benefits of Australia's renewable energy transformation.[146]

Social licence and community engagement

6.115 The concept of social licence reflects landholder and community support for new developments and projects.[147] Many submitters and witnesses highlighted the importance of building social licence and engaging with communities as central to Australia's transition to a green energy superpower.[148]

6.116 The Australian Energy Infrastructure Commissioner is currently undertaking a 'Review to enhance community support and ensure that electricity transmission and renewable energy developments deliver for communities, landholders and traditional owners' and is due to report to the Minister for Climate Change and Energy by the end of 2023.[149]

6.117 Dr van Ruth told the Committee about Austrade's role, in partnership with state and territory governments, supporting foreign investors to develop and understanding of Australia's regulatory environment and '…their requirements and responsibilities in Australia and the importance of their social licence to operate.'[150]

6.118 Ms Erin Coldham, Chief Development Officer, Star of the South summarised '…social licence takes a long time to build but not a long time to lose.'[151] Ms Coldham explained the approach taken by Star of the South to build social licence as part of their work:

> … we have a constant focus on ensuring that we are always accessible. We have hired a local team based in Yarram in Gippsland. We know that one of the main selling points of a project of this nature is local employment. So having local people in a local office that people can get along and talk to means that we can

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Renewables and Distributed Energy, Department of Climate Change, Energy, the Environment and Water, *Committee Hansard,* Canberra, 10 February 2023, p. 10.

146 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 13.

147 Department of Climate Change, Energy, the Environment and Water, *Improving community engagement and support for energy infrastructure,* www.dcceew.gov.au/energy/renewable/improving-community-engagement-support-energy-infrastructure, viewed 28 July 2023.

148 See, for example, Ms Anthea Long, Head, Minerals and Resources Division, Department of Industry, Science and Resources, *Committee Hansard,* Canberra, 10 February 2023, p. 19; Professor Ian Chubb, Secretary for Science Policy, Australian Academy of Science, *Committee Hansard,* Canberra, 31 March 2023, p. 14.

149 Department of Climate Change, Energy, the Environment and Water, *Improving community engagement and support for energy infrastructure,* www.dcceew.gov.au/energy/renewable/improving-community-engagement-support-energy-infrastructure, viewed 28 July 2023.

150 Dr Frances van Ruth, Head of EMEA Desk, Australian Trade and Investment Commission, *Committee Hansard,* Canberra, 30 November 2022, p. 8.

151 Ms Erin Coldham, Chief Development Officer, Star of the South, *Committee Hansard,* Brisbane, 16 May 2023, p. 9.

> always be accessible, ar any concerns and build that into our project development as we go through.[152]

6.119 BirdLife Australia noted that in regard to decision making for renewable energy projects: 'An informed and consultative approach would ensure that the social licence of projects is maintained, avoiding the undermining of community trust – and reactive advocacy against – the growth of renewable energy infrastructure.'[153]

6.120 Mr Stuchbery of CIP Australia, an investor in the Star of the South project, told the Committee about barriers to understanding where, from the social licence perspective, it is going to be acceptable to build new renewable projects:

> There's a direct overlay in many places in Australia between the value of the resource—so, high wind speeds—and Australia's highest biodiversity value. When you overlay the availability of transmission, we're increasingly developing projects in spaces where it is difficult to navigate the realities of social licence, environmental impacts and all those other matters. So one thing that we put in our own submission was the need and the value of strategic assessment of areas prospective for renewable energy investment, sort of in the same vein that [the Australian Energy Market Operator's] integrated system plan does the transmission can we look at what communities, what areas, we need to unlock and what some of those barriers are that government can work with industry to de-risk, whether that's environmental strategic assessments, whether that's looking at what kind of structural adjustment is needed for areas that have traditionally not had this infrastructure but that will be the new hosts of this infrastructure. So there are a lot of things to think about in that space, and I think that should be considered some of the key enablers to Australia transitioning to a clean energy superpower—just getting that enabling framework right to bring the process of getting approval for projects down from, for example, three years to 18 months.[154]

6.121 The Climate Council emphasised the importance of all aspects of the transition happening in a socially and environmentally responsible way:

> They should seek to reduce existing inequalities and injustices, and leave all Australian communities stronger. Leadership of First Nations and meaningful consultation with local communities, farmers, land owners, and other groups will be fundamental to maximising the benefits and minimising any potential harms.[155]

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152 Ms Erin Coldham, Chief Development Officer, Star of the South, *Committee Hansard,* Brisbane, 16 May 2023, p. 9.

153 BirdLife Australia, Submission 58, p. 2.

154 Mr Matthew Stuchbery, Vice President, Copenhagen Infrastructure Partners Australia, *Committee Hansard,* Melbourne, 5 April 2023, pp. 58–59.

155 Climate Council, Submission 36, p. 8.

6.122 Ms Kylie Walker, Chief Executive Officer at the AATSE, emphasised the role of all levels of government, including local government, to play a role in building social licence.[156] Ms Walker elaborated:

> Helping local governments understand what the benefits and opportunities might be for their people, for their communities, in terms of jobs, in terms of accessible, affordable electricity and in terms of opportunities for careers in the future, as well as having a sustainable environment and sustainable community, is… important. When it comes to building infrastructure as well, we know that some of the biggest barriers at the local level are community fear and misunderstanding. So that education piece, combined with that leadership piece, is vitally important.[157]

6.123 Mrs Joy Howley recommended social licence should form part of the process of obtaining a planning permit:

> Communities require a mechanism to negotiate from the very beginning of the project. Enabling developers to proceed with a Social Licence could ensure by agreement that planning and nuisance issues are worked out well before any contracts are signed and should be a prerequisite for issuing the planning permit.[158]

Workforce skills and capability

6.124 A common theme raised in the evidence was the need to ensure that Australia's workforce is ready to support the deployment of green energy and the development of new industries.[159] DFAT, Austrade and EFA highlighted: 'Transitioning to a green energy superpower will require very high levels of human capital' and 'Obtaining adequate expertise for Australia will be an ongoing challenge for Australia, as other countries seek the same skills and experience…'[160]

6.125 The SEC cautioned that '… without significant intervention and investment the total workforce deficit will cripple our efforts to transform our energy network.'[161]

6.126 The Committee heard that shortfalls of key skilled labour are already emerging, particularly electricians and engineers.[162] The Australian Academy of Science (AAS)

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156 Ms Kylie Walker, Chief Executive Officer, Australian Academy of Technological Sciences and Engineering, *Committee Hansard,* Canberra, 31 March 2023, p. 13.

157 Ms Kylie Walker, Chief Executive Officer, Australian Academy of Technological Sciences and Engineering, *Committee Hansard,* Canberra, 31 March 2023, p. 13.

158 Mrs Joy Howley, Submission 105, p. 1.

159 See, for example: Smart Energy Council, Submission 23, p. 5; Tesla, Submission 24, p. 10; DFAT, Austrade and EFA, Submission 31, p. 5; Grattan Institute, Submission 37, p. 10; Department of Climate Change, Energy, the Environment and Water, Submission 62, pp. 3–4; Transgrid, Submission 52, p. 2; Australian Refrigeration Mechanics Association, Submission 52, p. 1.

160 DFAT, Austrade and EFA, Submission 31, p. 5.

161 Smart Energy Council, Submission 51, p. 5.

162 Smart Energy Council, Submission 23, p. 5; Department of Climate Change, Energy, the Environment and Water, Submission 62, pp. 3–4; Transgrid, Submission 52, p. 2; Australia China Business Council, Submission 102, p. 8.

and AATSE observed Australia's shortages for critical employees and identified the need to '… support the domestic education and training pipelines necessary to supply the transition.'[163] Similarly, Entura noted the impact of skilled labour shortages on project timelines and costs, which in turn risk project viability.[164]

6.127 Submitters emphasised the need for government to ensure the development of a workforce with required skills and capabilities needed to deliver the green energy transition.[165] For example, the Next Economy suggested that to avoid exacerbating labour and skills shortages there is a need to: '… develop appropriate training programs and incentives for workers to move into emerging industries.'[166] Similarly, the Australian Conservation Foundation (ACF) recommended the development of '… a targeted workplace and skills strategy'.[167]

6.128 Several submitters noted the importance of reskilling and upskilling the workforce to transition to green energy industries, particularly as other industries decline.[168] The AAS and AATSE suggested that: 'The government can play an important role in supporting this transition by developing programs to support workers as they move between industries, and by providing skills training where required.'[169]

6.129 BZE and the Australia China Business Council suggested addressing skills gaps through targeted skilled migration.[170] However, Ms Kylie Walker, Chief Executive Officer at the AATSE, noted Australia cannot rely on migration to fill gaps, because other countries are seeking the same skilled labour to support their transitions.[171]

6.130 The Australian Refrigeration Mechanics Association highlighted the need for continued investment in education and training to maintain competencies as standards and technology changes in the green energy transition.[172]

6.131 Transgrid outlined its initiatives aiming to build workforce skills and capability:

> Transgrid is working with regional authorities, training providers, universities and our own Registered Training Organisation to upskill the regional workforce by providing new training opportunities in regional NSW. For example, in August

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163 Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering, Submission 74, p. 2.

164 Entura, Submission 79, p. 3.

165 See, for example: Tesla, Submission 24, p. 10; Queensland Conservation Council, Submission 41, p. 2; Australian Conservation Foundation, Submission 50, pp. 2–3; The Next Economy, Submission 51, p. 5; Entura, Submission 79, p. 3.

166 The Next Economy, Submission 51, p. 7.

167 Australian Conservation Foundation, Submission 50, pp. 2–3.

168 For example: Beyond Zero Emissions, Submission 32, p. 5; Australian Conservation Foundation, Submission 50, pp. 2–3; Transgrid, Submission 52, p. 2; Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering, Submission 74, p. 5; Australia China Business Council, Submission 102, p. 8.

169 Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering, Submission 74, p. 5.

170 Beyond Zero Emissions, Submission 32, p. 5; Australia China Business Council, Submission 102, p. 8.

171 Ms Kylie Walker, Chief Executive Officer, Australian Academy of Technological Sciences and Engineering, *Committee Hansard*, Canberra, 31 March 2023, p. 8.

172 Australian Refrigeration Mechanics Association, Submission 53, p. 1.

> 2022, Transgrid committed to a $2 million Engineering Scholarship Fund with Charles Sturt University. Further support is needed, and we welcome Government initiatives to assist [to] upskill and train local workers.[173]

6.132 The Western Australian Department of Jobs, Tourism, Science and Innovation discussed its focus on reskilling and upskilling, building on its skilled and experienced resource sector workforce:

> A key focus… is ensuring our local workforce is ready to meet the skills and capabilities required by the industries of the future. The Western Australian Government is focussed on upskilling its workforce to ensure it is well-placed to support fast-track industries. Western Australia has invested more than $280 million to upskill and reskill in preparation for future demand.

6.133 DFAT, Austrade and EFA told the Committee that the Australian Government is evaluating ways to address skills shortages through the education and training system and the migration system to ensure current and emerging skills gaps are met.[174] DCCEEW stated that is it working with the Department of Employment and Workplace Relations on a hydrogen skills and mapping exercise.[175]

6.134 Beyond meeting the needs for Australia's transition, the SEC suggested that a highly skilled Australian workforce in green energy industries could lead to high demand for Australian expertise and involvement in overseas projects.[176] Similarly, RE-Alliance indicated that education and training in green energy related industries could be their own export opportunity, building on Australia's significant tertiary education export sector.[177]

Supply chain constraints

6.135 The Committee received evidence that outlined the importance of Australia having secure supply chains, and that supply chain constraints present a significant risk to Australia's decarbonisation and green energy export opportunities.[178] The global trend toward supply chain diversification was discussed in more detail in Chapter 3.

6.136 DCCEEW observed 'Access to secure and reliable supply chains for materials, products and inputs is fundamental to building large-scale renewables and developing new export industries.'[179] Likewise, DFAT, Austrade and EFA explained:

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173 Transgrid, Submission 52, p. 2.
174 DFAT, Austrade and EFA, Submission 31, p. 5.
175 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 11.
176 Smart Energy Council, Submission 23, pp. 8–9.
177 RE-Alliance, Submission 43, p. 3.
178 See, for example: DFAT, Austrade and EFA, Submission 31, p. 5; Smart Energy Council, Submission 23, p. 5; Grattan Institute, Submission 37, p. 10; Transgrid, Submission 52, pp. 2–3; Westpac Group, Submission 57, p. 5; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 3.
179 Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 3.

> … for Australia to remain competitive as a supplier of clean energy and secure a significant market share in emerging and existing markets in clean energy, we will need to… ensure secure and reliable access to inputs required for our clean energy supply chains such as electrolysers, particularly if Australia is to become competitive in value-added processes up the supply chain.[180]

6.137 Submitters indicated availability issues are arising in the market, as the result of both supply issues and increased global demand as other countries also seek materials and equipment for their energy transition.[181] For example, the SEC advised that '… there is a shortfall of currently available input resources that is increasing the global price for renewable energy goods in the solar, storage and wind sector.[182]

6.138 The SEC also suggested that if Australia is to obtain the inputs it needs for the green energy transition, it will need to find new sources of supply or increase domestic production capabilities.[183]

6.139 Similarly, Westpac Group cited that around 90 per cent of Australia's solar panels, an integral part of Australia's energy transition, are imported from a single country.[184] Westpac Group elaborated that as a result '…Australia needs a more resilient and diverse supply chain for solar componentry and, ideally, some form of scale domestic manufacturing capability.'[185]

6.140 Other submitters also drew a link between supply chain constraints and enhanced domestic capabilities.[186] Explaining that most equipment for large-scale renewable energy projects is only available from overseas suppliers, Entura concluded that there is an '… opportunity to support more competitive alternative supply options and invest in facilitating local manufacturing.'[187]

6.141 The Next Economy declared that the government '… needs to facilitate and invest locally in the development of new supply chains and market demand to address supply chain constraints for the products that we will need in Australia that will be made possible through low-cost renewable energy.'[188]

6.142 The Grattan Institute suggested that the government could utilise the trade and investment architecture to secure access to materials and equipment through

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180 DFAT, Austrade and EFA, Submission 31, p. 5.
181 Smart Energy Council, Submission 23, p. 5; Grattan Institute, Submission 37, p.10; Transgrid, Submission 52, p. 2–3.
182 Smart Energy Council, Submission 23, p. 5.
183 Smart Energy Council, Submission 23, p. 5.
184 Westpac Group, Submission 57, p. 4.
185 Westpac Group, Submission 57, p. 4.
186 Australian Electric Vehicle Association, Submission 19, p. 7; The Next Economy, Submission 51, p. 6; Sun Cable, Submission 71, p. 8; Entura, Submission 79, p. 4; Australia China Business Council, Submission 102, p. 7.
187 Entura, Submission 79, p. 4.
188 The Next Economy, Submission 51, p. 7.

'…accelerating tariff removals in free trade agreements, or establishing separate agreements with like-minded countries to secure supply chains.'[189]

6.143 Equipment and materials identified as being subject to supply chain constraints or risk of constraints were solar panels, batteries, electrolysers and high-voltage direct current cables.[190]

Committee comment

6.144 While the Committee does not consider all of these matters to directly relate to trade and investment, they have been included in recognition of their importance to Australia's green energy superpower transition.

6.145 The Committee agrees that the decarbonisation of Australia's electricity grid and greater deployment of renewable energy is fundamental to Australia becoming a green energy superpower. While reaching renewable energy commitments is a challenge, the Committee notes that work is underway to transform of Australia's electricity grid and accelerate the deployment of renewable generation, transmission, and storage through programs such as the Rewiring the Nation and the Powering the Regions Fund.

6.146 The Committee received evidence that Australia will require many magnitudes more renewable energy than the current total NEM to decarbonise its electricity grid and develop export-oriented green energy industries. In the Committee's view, it would be beneficial to have a robust analysis of how much renewable energy can be deployed over certain timeframes to underpin and inform the development of Australia's green energy export opportunities. Such an assessment must be credible, taking into account physical and capital constraints.

6.147 The Committee acknowledges concerns raised during the inquiry in relation to Australia's transition towards green energy and its consequences for future energy security, reliability, and electricity prices. The Committee also agrees that the development of green energy export industries should not be at the expense of reliable and affordable energy for Australians. These issues must continue to be at the forefront of Australia's energy transition.

6.148 The Committee acknowledges that aspects of the current regulatory and approval frameworks for green energy projects can be complex and onerous for project developers and investors. If Australia is to become a green energy superpower, all levels of government must continue to focus on reducing regulatory complexity and the duration of approvals. However, it is important that regulatory rigour be maintained, and that streamlining regulatory frameworks is not achieved by weakening or removing protections.

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189 Grattan Institute, Submission 37, p. 10.

190 Westpac Group, Submission 57, p. 4; Department of Climate Change, Energy, the Environment and Water, Submission 62, p. 5; Sun Cable, Submission 71, pp. 8, 10.

6.149 Certain regulations and approvals necessarily sit with state, territory, and local government, however where appropriate it is important for regulatory frameworks to be consistent across jurisdictions. When new regulations are being developed for emerging green energy industries and technologies, it will be important for regulatory frameworks to be harmonised from the outset.

6.150 Given the scale and national significance of the green energy transition the Australian Government can play a leading and coordinating role. The Committee encourages the Australian Government to continue and deepen engagement with state and territory governments to ensure that regulatory and approval frameworks strike the right balance and are consistent across jurisdictions. In cooperation with states and territories, there may be a greater role for the Australian Government in the identification and development of renewable energy zones and other designated areas identified as suitable for green energy project development, including access to simpler and expedited regulatory and approval processes.

6.151 The Committee acknowledges concerns raised during the inquiry regarding implications of the transition to a green energy superpower for Australia's environment and biodiversity. While there necessarily will be trade-offs, the Committee agrees that green energy developments should not have a detrimental effect on Australia's environment and biodiversity.

6.152 The Committee welcomes the reforms to the *Environment Protection and Biodiversity Conservation Act* 1999 (Cth) to enhance Australia's national environment laws, including the commitment to introduce the National Environment Standards as well as to establish both the independent Environment Protection Australia and Environment Information Australia. A stronger, streamlined and more transparent regulatory framework will improve decision-making and outcomes for all stakeholders.

6.153 The Committee also notes concerns raised regarding the impact of green energy projects on agricultural land and agrees that while there will be trade-offs, prime agricultural land is a vital resource that should be protected where possible.

6.154 The Committee agrees that decision-making for siting of green energy projects must be informed by comprehensive and robust data. As well as optimal locations for green energy projects regarding wind and solar resources, grid infrastructure and transport, the identification of appropriate sites must recognise high-value biodiversity, agricultural, and First Nations locations from the outset. Having widely available high-quality data for project panning could support appropriate siting of projects, reduce land use tensions, improve regulatory processes and provide greater certainty to investors.

6.155 The Committee notes concerns about waste, contamination, and decommissioning relating to renewable energy infrastructure. The disposal of materials and equipment such as solar panels, wind turbines and batteries will be an emerging issue for many countries in the global green energy transition. The Committee believes that Australia should play a leading role in developing and expanding opportunities to reuse and recycle renewable energy equipment and infrastructure.

6.156 The Committee acknowledges that Australia's green energy transition will impact First Nations land, water and communities. While there are challenges, there are enormous economic and social opportunities for First Nations people in Australia's green energy superpower transition.

6.157 The Committee agrees that First Nations people must enabled to have a say in, directly participate in and share in the benefits of green energy projects. Particularly, there is greater potential for First Nations people, communities, and businesses to have an ownership role in green energy projects. This could be encouraged by dedicated investment support, for example through existing special investment vehicles.

6.158 The Committee notes that Prescribed Bodies Corporate may face resourcing challenges that prohibit adequate engagement in the development of green energy projects. This scenario risks forgone benefits for First Nations communities as well as potentially impacting on project timeframes and viability.

6.159 The Committee welcomes the important step of the development of the First Nations Clean Energy Strategy, co-designed with First Nations people. The Committee looks forward to the strategy being finalised and implemented.

6.160 The Committee agrees that renewable energy projects should be supported by communities in which they are located. The Committee believes that keeping communities informed and engaged with planning processes is a central part of building social licence.

6.161 The Committee notes the Australian Energy Infrastructure Commissioner recently commenced a review of community engagement practices related to the deployment of renewable energy infrastructure in July 2023. The Committee looks forward to reading the outcome of the review.

6.162 The Committee agrees that a skilled, capable workforce is crucial to Australia's transition to a green energy superpower. While some measures are in place, Australia must do more to align education and skills to Australia's most probable green energy economy opportunities. Further, while skilled migration will play a role, the focus should be on developing a domestic workforce to mitigate exposure to global skills shortages. An enhanced response should include measures for re-skilling and targeting the development of new skills through Australia's education and training system.

6.163 The Committee notes that supply chain constraints may present a significant challenge to Australia's domestic decarbonisation and pursuit of green energy export opportunities. Further, the Committee believes that enhancing Australia's sovereign manufacturing capability could assist with managing supply chain risks. It would be prudent to prioritise support for sovereign manufacturing for equipment such as solar panels and battery materials that are vital for Australia's decarbonisation, where Australia has potential strengths in manufacturing, and that may be subject to supply chain risks.

Recommendations

Recommendation 9

6.164 The Committee recommends that the Australian Government undertake detailed analysis to identify the scale of renewable energy that can credibly be deployed, to underpin and inform the development of Australia's export-oriented green energy industries.

Recommendation 10

6.165 The Committee recommends that efforts by Commonwealth, state and territory, and local governments to develop streamlined and more transparent regulatory and approval frameworks be consistent and equitable across land uses, including in relation to community engagement and consultation.

Recommendation 11

6.166 The Committee recommends that the Australian Government, in consultation with stakeholders, develop robust and comprehensive national data and mapping to inform land use planning decisions and identify appropriate sites for green energy projects.

Recommendation 12

6.167 The Committee recommends that the Australian Government allocate funding to support research and commercial opportunities to reuse and recycle products, equipment, and infrastructure in Australia's transition to a green energy superpower.

Recommendation 13

6.168 The Committee recommends that the Australian Government examine whether Prescribed Body Corporates are adequately supported to ensure the capacity of First Nations people and communities to engage in and benefit from Australia's green energy transition.

Recommendation 14

6.169 The Committee recommends that the Australian Government, through the First Nations Clean Energy Strategy, consider how First Nations people, communities, and businesses can be supported to increase direct participation and ownership in green energy projects.

Recommendation 15

6.170 The Committee recommends that the Australian Government, in consultation with states and territories, accelerate development of targeted green energy skills and capabilities to ensure that the workforce can support Australia's green energy superpower transition.

Recommendation 16

6.171 The Committee recommends that the National Reconstruction Fund prioritise support for projects that enhance sovereign manufacturing capability in sectors subject to current and potential future global supply chain constraints.

Mr Steve Georganas MP
Chair
6 October 2023

Additional comments – Australian Greens

Recommendation

1.1 To truly become a green energy superpower, no new coal, oil, or gas projects can proceed.

1.2 This Government has continued to approve the opening and expansion of fossil fuel projects, despite clear evidence that no such projects are to be approved if we wish to reach net zero by 2050.[1]

Recommendation

1.3 The Australian Government should lift national targets to 75 per cent by 2030 and net zero by 2035 to align with 1.5 degrees of warming.

Senator Dorinda Cox

[1] International Energy Agency, Net Zero by 2050: A Roadmap for the Global Energy Sector, May 2021, pp. 18–19.

Additional comments – Senator the Hon Matthew Canavan

1.1 The Chair's report begins from an incorrect premise, which begins by stating that:

> Global efforts to reduce greenhouse gas emissions and commitments to achieving net-zero emissions are transforming world trade. As a result, demand for Australia's traditionally emissions-intensive export industries is changing as many countries, including Australia's major trading partners, seek to replace their imports with 'green' alternatives to assist them to reach their decarbonisation goals.[1]

1.2 The International Energy Agency recently reported that global coal demand had hit record levels:

> As projected in the Coal 2022 report last December, global coal demand reached a new all-time high in 2022, rising above 8.3 billion tonnes (bt).[2]

1.3 Coal demand is up 8 per cent in India, 4.6 per cent in China and a whopping 36 per cent in Indonesia. Even Europe recorded increases in coal demand of 1 per cent as it adjusts to the fallout from Russia's invasion of Ukraine. The "net-zero transformation" of world trade is an invisible one.

1.4 China's total coal imports have soared since the lifting of its unofficial ban on Australian imports. Customs data released on 8 August 2023 showed July imports at 39.26 million metric tons, level with June's 39.87 million but up almost 67% from the same month last year. For the first seven months of this year, the world's biggest coal importer saw arrivals of 261.18 million metric tons, up 88.6% from the same period in 2022.[3]

1.5 According to the World Bank, without China successfully transitioning to a low-carbon economy, achieving global climate goals will be impossible. China emits 27 percent of global carbon dioxide and a third of the world's greenhouse gases.[4]

1.6 China has the greatest number of coal-fired power stations of any country or territory in the world. As of July 2022, there were 1,118 operational coal power plants on the Chinese Mainland. This was nearly four times the number of such power stations in

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1 Committee Report, page 1.
2 https://www.iea.org/reports/coal-market-update-july-2023/demand (accessed 26 September 2023).
3 https://www.afr.com/ 3 July 2023 (accessed 26 September 2023).
4 https://www.worldbank.org/en/news/press-release/2022/10/12/china-s-transition-to-a-low-carbon-economy-and-climate-resilience-needs-shifts-in-resources-and-technologies (accessed 26 September 2023).

India, which ranked second. China accounts for over 50 percent of total global coal electricity generation.[5]In the first half of 2023, China saw 52 gigawatts (GW) of new coal power permitted, maintaining the previous rhythm of permitting two coal power plants per week. Coal power plant commissioning also doubled year-on-year, with 17.1 GW added to the grid in the first half of 2023.[6]

1.7 In India, three new coal plant expansions (3.9 gigawatts, or GW) received permits in the first five months of 2023 alone, up from zero the year before, as well as seven other coal plant proposals (7.6 GW) also moving forward into the permission process, and two additional coal plants (2.9 GW) appeared under consideration for the first time this year.[7]

1.8 The report focusses on and significantly overstates, the capacity of new technologies not yet proven or tested at scale. Take for example, hydrogen.

1.9 Green Hydrogen is produced by renewables with an electric current breaking down water into hydrogen and oxygen (electrolysis). Hydrogen advocates focus on the source and cost of electricity for the electrolysis – without stating the real fact – electrolysis needs water. Nine tonnes of water are needed to produce one tonne of hydrogen with electrolysis. The water also needs to be purified first. The energy-hungry desalination plant is coming back in vogue. Water purification typically requires two tonnes of impure water to produce one ton of purified water. So, one tonne of hydrogen actually needs 18 tonnes of water. Accounting for losses, the ratio is closer to 20 tonnes of water for every one ton of hydrogen.[8]

1.10 It takes 20 tonnes of water to make one ton of hydrogen fuel. A dam or river can't supply that quantity of water. The source of water doesn't get a mention. Where do you suppose that will be?

1.11 Hydrogen production requires secure, long-term access to water, which may prove challenging in a country known for variable rainfall and frequent droughts, particularly as the impacts of climate change intensify. While the Australian hydrogen industry looks set to take off, a level of uncertainty remains as to whether Australia's domestic water resources can support long-term, commercial-scale hydrogen production.

1.12 Water access regimes and trading schemes in Australia are complex, with different rules applying in each of the states and territories. Water pricing, availability and use restrictions also differ between states, and between water sources within states. These factors should be considered when project planning and budgeting.

1.13 Desalination, recycled wastewater and stormwater are being explored as alternatives to relying on fresh water and the traditional water entitlements model for hydrogen

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5 Global operational coal-fired power stations by country 2022, published by Statista Research Department, 25 August 2023 (accessed 26 September 2023).

6 https://globalenergymonitor.org/press-release/chinas-coal-power-spree-could-see-over-300-coal-plants-added-before-emissions-peak/ 28 August 2023 (accessed 26 September 2023).

7 Ibid.

8 https://rmi.org/hydrogen-reality-check-distilling-green-hydrogens-water-consumption (accessed 26 September 2023).

production and other industrial applications. Project developers should consider exploring alternative water sources for hydrogen production, and factor potential changes in water supply into project planning and costs.[9]

1.14 Submitters highlighted Australia's considerable natural strengths that underpin the opportunity to become a green energy superpower. These include abundant renewable energy resources (solar and wind) a large land mass with low population density, extensive marine jurisdiction, significant critical minerals reserves and geographical proximity to key export markets.[10]

1.15 Australia might have the highest solar radiation per square metre of any continent in the world – but you can't generate solar energy when the sun doesn't shine – so it is at most available and generating energy for 12 hours a day – when the power needs of households and business require reliable power 24 hours a day. The vast tracts of land required to capture this energy is destroying natural landscapes, agricultural lands and regional communities. Not to mention the thousands of kilometres of transmission lines required to bring this energy into the grid. If we can't generate enough renewable energy for domestic use, how and when will we be realistically in a position to export this energy?

1.16 Australia's landscape also provides an abundance of wind[11] – but you can't predict the wind and you can't generate wind energy when the wind doesn't blow at a sufficient rate. Tops of mountain ranges are being flattened, vast tracts of land (including pristine vegetation) is being destroyed in an effort to secure the optimal position to catch the wind. And there is further need for thousands more kilometres of transmission lines required to bring this energy into the grid.

1.17 Furthermore, the degradation and clearing of these landscapes increases the risk of polluted run off into our precious water ways, rivers and oceans.

1.18 Australia's marine jurisdiction is approximately double the size of Australia's land mass, and accounts for four per cent of the world's oceans.[12] But we want to spoil, disturb and destroy this marine environment with offshore wind developments – and yet more kilometres of transmission lines back into the onshore grid.

1.19 There are increasing concerns about the impact of large-scale wind and solar energy on our pristine landscape.

1.20 Wind energy also has severe environmental effects. Most significantly its land footprint. On average wind requires 421x more land than nuclear, with estimates comparing it to the Rolls Royce SMR stipulating 10,000x more land is needed for wind to produce the same output of electricity (Bryce, 2022). In most cases this land is unsuitable for further use with exclusion zones needed to avoid negative health

9 Ibid.
10 Committee Report, Pages 15-16.
11 Committee Report, page 17.
12 Committee Report, page 18.

impacts derived from wind turbines (Metzger, 2011). Moreover, wind has a detrimental impact on wildlife particularly birds.[13]

1.21 In its submission to the recent Inquiry into removing nuclear energy prohibitions, Voice for Walcha's stated that:

1.22 The proposed wind farm consists of up to 119 wind turbine generators (WTGs) with a maximum tip height of 230m and ancillary infrastructure, including substations, a battery energy storage system (BESS), new and upgraded roads, overhead cabling and underground cabling. Temporary construction facilities, including batching and crushing facilities will also operate during the construction period. This Wind Farm and others planned in the vicinity will cause considerable environmental damage, cause significant visual impact, may impact property values, will cause health issues associated with audible noise and inaudible low frequency noise, will cause considerable traffic disruption during construction and most importantly has already caused community discord.[14]

1.23 Similarly, Responsible Energy Development for New England raised concerns about the impact on their community of renewable energy projects in its submission: "Our Community is experiencing the "rollout" of some 14 GW of Renewable Energy Projects which will result in some 2000 Wind Towers and many millions of Solar panels along with new Transmission Lines, new Substations Battery Storage and Pumped Hydro. If constructed it will result in massive overdevelopment and Cumulative Impact on Prime Agricultural Land, a delicate Ecosystem and a relatively closely settled rural environment. This has resulted in mental stress on neighbours and division amongst small Rural Communities. This area simply has not got the resources to host such massive overdevelopment.[15]

1.24 And in testimony to that Inquiry, Mr Irwin made the following comments about the impact of transmission lines: "The big advantage of repowering existing coal-fired power stations is that the transmission system is already there. The problem with solar is that you need such a vast area of land. Darlington Point is 1,000 hectares. You have to put it out remotely. That means that you've got to put in a lot of extra transmission to connect it to where you want it. The other problem is that, with the win not blowing all the time and the sun not shining all the time, the way you try to get around that is moving it around the country, so we're going to need a lot more big transmission links. This is a really big expense. We're seeing this in the AEMO estimates. They're going to need a huge amount of extra interstate transmission as well. It's hardly used; it's not used up to its capacity a lot of the time, so it's not the best investment."[16]

1.25 Australia is also endowed with vast geological reserves and mineral resources, including critical minerals. Australia is one of the world's leading producers of bauxite

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13 Coalition Dissenting Report, *Inquiry into Environment and Other Legislation Amendment (Removing Nuclear Energy Prohibitions) Bill 2022*.

14 Ibid, page 85.

15 Ibid, page 86.

16 Ibid.

(aluminium ore), iron ore, lithium, gold, lead, diamond, rare earth elements, uranium, and zinc. Australia also has large mineral sand deposits of ilmenite, zircon and rutile. In addition, Australia produces large quantities of black coal, manganese, antimony, nickel, silver, cobalt, copper and tin.[17]

1.26 Another aspect of this report is the significant overstatement of the current production of the many raw materials that are essential inputs to the production of low emissions technologies that are vital for the world to achieve its decarbonisation goals. Some of these raw minerals are defined as 'critical minerals' on the basis that they are both essential for modern technologies, economies or national security and that there is a risk of supply chain disruption or limited availability.[18]

1.27 As pointed out by the Minerals Council of Australia in its submission to the critical mineral's strategy:

> The world must undergo an extraordinary deployment of clean energy technologies to achieve global net zero emissions by 2050, along with a massive increase in global production of the material inputs required to manufacture the necessary technologies and infrastructure.

1.28 With faster and more streamlined approvals and cheaper energy, the economic opportunity critical minerals present for Australia is significant. Global mining investment is expected to increase by US$100 billion annually from current levels to produce the mineral commodities required for the world to achieve net-zero emissions by 2050. This equates to about A$4 trillion of investment required between now and 2050.

1.29 Australia is fortunate to have the mineral resources, stable political system, world leading exploration geoscience and environmental management systems needed to meet the growing global demand for critical minerals, including mineral fertilisers and minerals at risk of longer-term supply disruptions. However, unless the Australian Government puts business growth and investment at the centre of its policy making these attributes are not enough to seize the opportunity before us.

1.30 Mining investment cannot be taken for granted in the face of strong and growing competition from other countries. And yet, without investment in mining and early stage processing there will be no opportunity for mid-stage and end stage manufacturing in Australia.

1.31 The Australian Government has a clear role in providing policy settings that improve investment conditions for mining in general – and critical minerals in particular – if Australia is to successfully attract the capital and technology needed to capture this opportunity and support long-term industry growth and job creation.

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17 https://www.ga.gov.au/education/classroom-resources/minerals-energy/australian-mineral-facts (accessed 26 September 2023).

18 https://www.ga.gov.au/scientific-topics/minerals/critical-minerals (accessed 26 September 2023).

1.32 That will require a sophisticated and integrated approach to national and international economic policy. It will require the development of more strategic and economic partnerships that go well beyond free trade agreements and establish mutually supportive domestic policy settings between Australia and its key partners – policy settings that integrate the supply chains for the minerals and manufactures needed by our separate economies.

1.33 However, to successfully establish our mining and manufacturing future we must also look at our domestic policy and regulatory settings. We also need to be competitive as a destination for capital. Our ability to attract the necessary capital and become the lead global supplier of processed critical minerals and metals and their manufacture means we need to find ways to remove our economic and policy friction points and infrastructure inefficiencies that drag on our economic objectives. We need to drive a domestic economic policy realignment that delivers reliable and affordable energy, skills, technology and infrastructure.

1.34 Australia is an expensive place to do business. We have a high-cost business environment relative to our competitors in the minerals sector: with a high cost energy and transport infrastructure, chemicals and other inputs, skilled labour, land, transport, tax rates and high costs associated with regulatory processes and approval delays.

1.35 Domestic policy settings and policy stability are also of critical importance to Australia's capacity to attract multi-billion dollar capital investments into mining, processing and manufacturing projects. Currently there are significant policy and regulatory disconnects and differences between federal, state and territory governments that create frictions and inconsistencies, driving up costs, adding delays or worse, driving onshore processing offshore.[19]

1.36 One of the most limiting features of this 200-page report is the absence of any consideration of the world's most reliable, low emission energy source – that is nuclear energy.

1.37 Of the 20 richest nations in the world only three do not have nuclear power: Australia, Saudi Arabia and Italy. Saudi Arabia is building a nuclear power station and Italy gets much of its imported electricity from France, where over 60 per cent of the electricity is produced by nuclear.

1.38 Australia's status as a nuclear outcast is more remarkable given that our country has the largest reserves of uranium in the world. Australia is the world's fourth largest producer of uranium and is home to one of the world's leading nuclear medical facilities just 30 kilometres from the centre of Sydney.[20]

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19 https://minerals.org.au/resources/submission-to-australias-critical-minerals-strategy-discussion-paper/ (accessed 26 September 2023).

20 Coalition Dissenting Report, *Inquiry into Environment and Other Legislation Amendment (Removing Nuclear Energy Prohibitions) Bill 2022*.

1.39 Given that Australia's coal fired power fleet is now old, and governments have not supported constructing new ones because of concerns over climate change, there has never been a greater justification for overturing the ban on nuclear energy.

1.40 Nuclear energy delivers electricity by harnessing the heat produced in the fission, or splitting, of radioactive isotopes of uranium or plutonium in a reactor. Nuclear energy is also widely used in submarines for power and propulsion, but also other shipping, including aircraft carriers and icebreakers. Australia has just approved the use of nuclear-powered submarines in our waters.

1.41 Nuclear plants are generally characterised by large capacity and output, high capital cost, and long construction times, but relatively low operating costs and almost zero carbon dioxide emissions from their operation.[21]

1.42 Nuclear energy is used to produce electricity in 31 countries from some 450 nuclear reactors, providing around 10 per cent of global electricity. Many nations are building new nuclear power plants because they provide reliable, emission free power. There are 54 nuclear power stations under construction.[22]

1.43 There is a strong case that nuclear energy can provide a competitive energy option especially against the alternative of relying on a firmed renewable energy solution.

1.44 The key question for Australia's future is whether nuclear is comparable to other options under consideration in this inquiry and presented in this report.

1.45 In a major report in 2020 comparing the costs of different energy technologies, the International Energy Agency (IEA) concluded that: "The cost of electricity from new nuclear power plants remains stable, yet electricity from the long-term operation of nuclear power plants constitutes the least cost option for low-carbon generation."[23]

1.46 Given the IEA's findings on the competitiveness of existing nuclear technologies it is strange that this Inquiry has not bothered to even consider this as an option, or even attempt to incorporate any information in this its report.

1.47 Given the cost blowouts that are occurring on major projects like Snowy Hydro 2.0 and the Battery of the Nation, it is not clear that these projects will, or have to, proceed. If Australia instead chose to build nuclear plants, there would be reduced need for large storage or transmission projects like these. Therefore, excluding their costs to compare the relative costs of nuclear and renewables produces a misleading comparison.

1.48 Putting aside the estimated costs of different energy options, the actual costs of electricity in countries that have adopted a high penetration of wind and solar energy have been much higher than those that have predominantly relied on nuclear energy. For example, those high-income OECD countries with a higher share of nuclear

21 Ibid.
22 Ibid.
23 Ibid.

energy have an average electricity price 25 per cent lower, than those countries with an above average share of solar and wind electricity.[24]

1.49 A comparison between two countries like Australia highlights the higher cost of solar and wind electricity in the real world. Germany has adopted aggressive investments in solar and wind electricity. Germany has also been phasing out its nuclear power plants. Solar and wind electricity now generate a third of Germany's electricity and its electricity price for households is 54 cents per kWh. In comparison, France has a long history of investing in nuclear electricity and 63 per cent of France's electricity is generated by nuclear. (Only 12 per cent of France's electricity is generated by solar and wind energy.) France's household electricity price is 33 cents per kWh, almost 40 per cent lower than Germany's electricity prices.[25]

1.50 Nuclear power, like wind and solar, generates only a small amount of carbon dioxide emissions. In addition, longer lifetime requires less replacement. The design lifetime for nuclear power plants is around 60 years, solar lasts for about 25 years and wind for about 20 years.

1.51 Carbon emissions are generated through the construction of new nuclear, solar and wind facilities. However, given that a nuclear plant must be replaced much less frequently these emissions will be lower as well.

1.52 The broader environmental impacts of nuclear power are less than those of wind and solar because nuclear energy uses less land for the same amount of power generation. Nuclear energy's high energy density requires fewer materials and less land area per unit of electricity generated.

1.53 Nuclear energy also has a much lower environmental cost than large scale wind and solar energy. Given that nuclear energy has a smaller environmental footprint than other energy types, it is ironic that nuclear remains prohibited in Australia's primary laws to protect the environment. This is just another reason for why Australia's ban on nuclear is illogical.

Conclusion

1.54 If we are serious about the reduction of emissions to meet targets, and the Government's target is for 82 per cent of Australia's electricity to come from renewable sources by 2030, then we should explore all low-carbon options—and it is a bonus that nuclear is also a fantastic source of reliable baseload power.

1.55 Why are we limiting ourselves to renewables and hedging our bets unless there is a political or financial agenda with the renewable industry?

1.56 Nuclear is fit-for-purpose from the moment it is brought online. We are spending billions to Rewire the Nation and pave our agricultural land with transmission lines, because it doesn't work with existing infrastructure. Nuclear does, and not only is it

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24 Ibid.

25 Ibid.

fit-for-purpose, but when we move to the next generation of energy technology it will be a direct exchange, rather than the billions likely to be required to again change the energy infrastructure to future technologies.

1.57 Yet the focus of this report rests squarely on the role Australia would play in global decarbonisation well beyond the size of its emissions and economy. A push to make Australia a green energy superpower will only harm our economy, our environment, and our future.

Recommendations

1.58 **Recommendation 1**: That the Australian Government add uranium to its list of critical (or green) minerals.

1.59 **Recommendation 2:** That the Australian Government remove the ban on nuclear power.

1.60 **Recommendation 3:** That the Australian Government impose a moratorium on large scale renewable energy projects until a better regulatory approval process is put in place to assess the cumulative impacts of these projects on Australia's land and water resources.

1.61 **Recommendation 4:** That the Australian Government ban the use of freshwater for the creation of hydrogen for export. As the driest continent on Earth, Australia should not export its scarce water resources to other countries.

Hon Matthew Canavan

LNP Senator for Queensland

Committee Member

A. Submissions

1 Mr Rohan Byrnes

2 Mr Robert Beatty

3 Mr Len Neale

4 *Name Withheld*

5 *Name Withheld*

6 Mr Peter Feros

- 6.1 Supplementary to submission 6
- 6.2 Supplementary to submission 6

7 *Name Withheld*

8 *Name Withheld*

9 Dr Geoffrey D Houston

10 Clean Energy Investor Group

11 Malcolm Ritter

12 Mr Rodney Hutcheon

13 Colin Stevenson

14 Electric Vehicle Council

15 Advanced Materials and Battery Council

16 Farmers for Climate Action

- Attachment 1

17 Australian Aluminium Council

18 University of Adelaide Institute for Sustainability, Energy and Resources

19 Australian Electric Vehicle Association Ltd

- 19.1 Supplementary to submission 19

20 Mr Stephen Akers

21 Low Emission Technology Australia

22 Mr Michael Dillon

23 Smart Energy Council

24 Tesla

25 Star Scientific Ltd

26 The University of Queensland

27 Alpha HPA Limited

28 Save Our Surroundings

- 28.1 Supplementary to submission 28
- Attachment 1

29 Tasmanian Government

30 Heavy Industry Low-carbon Transition Cooperative Research Centre (HILT CRC)

31 Department of Foreign Affairs and Trade (DFAT), Australian Trade and Investment Commission (Austrade) and Export Finance Australia (EFA)

- 31.1 Supplementary to submission 31
- 31.2 Supplementary to submission 31
- 31.3 Supplementary to submission 31
- 31.4 Supplementary to submission 31
- 31.5 Supplementary to submission 31

32 Beyond Zero Emissions

- 32.1 Supplementary to submission 32
- 32.2 Supplementary to submission 32
- 32.3 Supplementary to submission 32
- 32.4 Supplementary to submission 32

33 Centre for Energy Technology

34 Australian Nuclear Science and Technology Organisation (ANSTO)

- 34.1 Supplementary to submission 34

35 Ammonia Energy Association (Australia) Ltd

36 Climate Council of Australia

- 36.1 Supplementary to submission 36

37 Grattan Institute

38 Clean Energy Council

39 Australian Hydrogen Council

- 39.1 Supplementary to submission 39

40 Copenhagen Infrastructure Partners

41 Queensland Conservation Council

42 Australian Pipelines and Gas Association

43 RE-Alliance

44 Everledger Pty Ltd

45 First Nations Clean Energy Network

46 Future Battery Industries CRC

- 46.1 Supplementary to submission 46

47 Woodside Energy

48 Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH)

49 Kalapa Wycarbah Local Action Committee

50 Australian Conservation Foundation

51 The Next Economy

- Attachment 1
- Attachment 2

52 Transgrid

53 Australian Refrigeration Mechanics Association (ARMA)

54 Star of the South Wind Farm Pty Ltd

55 The South Australian Nature Alliance

56 The Northern Territory Government

57 Westpac Group

58 BirdLife Australia

59 *Name Withheld*

60 Dr Cherie Gooding

61 *Name Withheld*

62 Department of Climate Change, Energy, the Environment and Water

- 62.1 Supplementary to submission 62

63 Department of Industry, Science and Resources

- 63.1 Supplementary to submission 63
- 63.2 Supplementary to submission 63
- 63.3 Supplementary to submission 63
- 63.4 Supplementary to submission 63
- 63.5 Supplementary to submission 63

64 Geoscience Australia

- 64.1 Supplementary to submission 64

65 Western Australian Department of Jobs, Tourism, Science and Innovation

66 Commonwealth Scientific and Industrial Research Organisation (CSIRO)

- 66.1 Supplementary to submission 66

67 WWF-Australia, the Business Council of Australia, the Australian Council of Trade Unions and the Australian Conservation Foundation

- Attachment 1

68 Australian Environment Foundation

69 Embassy of the United Arab Emirates

70 Dr Llewelyn Hughes and Dr Thomas Longden

71 Sun Cable

72 Export Council of Australia

73 *Name Withheld*

74 Australian Academy of Technological Science and Engineering & The Australian Academy of Science

- 74.1 Supplementary to submission 74

- 74.2 Supplementary to submission 74
- 74.3 Supplementary to submission 74

75 Coalition for Conservation

76 Boundless Earth

77 Ms Kay Wilson

78 Australian Geothermal Association

79 Entura

80 Mr Peter Cunningham

81 Mr David Archibald

82 *Name Withheld*

83 Mr Anthony Cox

84 Mr Benjamin Cronshaw

85 Mr Rafe Champion

86 Mrs Pamela Jones

87 Mr Daniel Sullivan

88 *Name Withheld*

89 *Name Withheld*

90 Mr Justin Gard

91 Responsible Energy Development for New England (RED4NE)

92 Law Council of Australia

- Attachment 1

93 Fortescue Future Industries

94 APA Group

95 Australian Land Conservation Alliance

96 Beth White

97 Mr Brad Riley, Dr Ed Wensing and Dr Lily O'Neill

- 97.1 Supplementary to submission 97

98 ANU Zero-Carbon Energy for the Asia-Pacific Initiative

99 Ian McDonald

100 Ms Jocelyn Guy

101 *Name Withheld*

102 Australia China Business Council

103 Mr Ray Barbero

104 Emma Jeffrey

105 Mrs Joy Howley

106 *Name Withheld*

107 Ms Rachel Logan

108 Val Spencer

109 Mr Cameron Way

110 Peter & Annette Hanna

111 Brendan Godwin

112 *Name Withheld*

113 Dennis Workman

114 Andrew Chapman

115 James Bowen

- Attachment 1

116 Hon Matthew Kean MP

117 Industry Super Australia

118 Rewiring Australia

- 118.1 Supplementary to submission 118

119 Mr Jason Wood

120 nGeni Australia Pty Ltd

121 Confidential

122 *Name Withheld*

123 *Name Withheld*

124 *Name Withheld*

125 Macquarie University Centre for Energy and Natural Resources Innovation and Transformation (CENTRIT)

126 Mr Mark Clarkson

B. Hearings and witnesses

Wednesday, 23 November 2022 – Canberra

Department of Foreign Affairs and Trade

- Mr Michael Growder, Acting First Assistant Secretary, Climate Diplomacy and Development Finance Division
- Ms Juliana Nam, Assistant Secretary, Free Trade Agreements Policy and Economic Cooperation Branch, Free Trade Agreements and Stakeholder Engagement Division
- Ms Helen Stylianou, First Assistant Secretary, Trade Resilience and Indo-Pacific Economic Cooperation Division
- Mr David Woods, Chief Economist and First Assistant Secretary, International Economics and Green Economy Division

Wednesday, 30 November 2022 – Canberra

Export Finance Australia (via videoconference)

- Ms Amanda Copping, Chief Customer Officer, Project and Structured Finance
- Mr John Hopkins, Managing Director and Chief Executive Officer
- Mr John Pacey, Chief Credit Officer

Australian Trade and Investment Commission

- Mr Alvin D'Almaida, Manager, Trade and Investment
- Mr Sam Guthrie, General Manager, Government and Policy Division
- Mr Andrew Morris, Manager, Trade and Investment
- Mr Xavier Simonet, Chief Executive Officer
- Mr Dan Tebbutt, Head, Expanding Exporters
- Dr Frances van Ruth, Head of EMEA Desk

Friday, 10 February 2023 – Canberra

Department of Climate Change, Energy, the Environment and Water

- Ms Rachael de Hosson, Branch Head, Net Zero Innovations and Partnerships Branch
- Mrs Jo Evans, Deputy Secretary, Climate Group
- Ms Edwina Johnson, Branch Head, Safeguard Mechanism Taskforce
- Mr Matthew Ryan, Branch Head, Transport and Regions
- Mr James White, Branch Head, Renewables and Distributed Energy
- Ms Amanda Wormald, Principal Adviser on the Inflation Reduction Act
- Ms Catherine Zerger, Acting Branch Head, Hydrogen Branch

Department of Industry, Science and Resources

- Ms Deborah Anton, Head, Industry Growth Division
- Mr Andrew Hutchinson, General Manager, Critical Minerals Office, Minerals and Resources Division
- Mr David Lawrence, Head, Oil and Gas Division
- Ms Anthea Long, Head, Minerals and Resources Division
- Ms Rebecca Manen, General Manager, NRF Strategy, Manufacturing and National Reconstruction Fund Division
- Mr William Tan, Acting General Manager, National Reconstruction Fund Priorities Branch, Manufacturing and National Reconstruction Fund Division
- Mr Mark Weaver, General Manager, Industrial Competitiveness and Strategies Branch, Industry Growth Division

Commonwealth Scientific and Industrial Research Organisation

- Dr Alexander Cooke, General Manager, Missions Program Office
- Dr Peter Mayfield, Executive Director, Environment, Energy and Resources
- Dr Dietmar Tourbier, Director, Energy Business Unit

Australian Nuclear Science and Technology Organisation (by teleconference)

- Dr Robert Acres, Commercial Technical Consultant, Nuclear Science and Technology Division
- Mr Alan Brindell, Director of Corporate Affairs
- Dr Karin Soldenhoff, Manager, Process Development Research, Minerals Business Unit

Geoscience Australia

- Ms Allison Britt, Director, Mineral Resources Advice and Promotion
- Dr Andrew Feitz, Director, Low Carbon Geoscience and Advice
- Dr Andrew Heap, Chief of Minerals, Energy and Groundwater Division
- Dr Steve Hill, Chief Scientist, Office of the Chief Scientist
- Dr Jodie Smith, Branch Head, Oceans, Reefs, Coasts and the Antarctic Branch

Friday, 17 March 2023 – Perth

Western Australian Department of Jobs, Tourism, Science and Innovation

- Ms Rebecca Brown, Director General
- Mrs Simone Spencer, Deputy Director General, Strategy and International Engagement

Fortescue Future Industries Pty Ltd

- Dr Mark Hutchinson, Chief Executive Officer
- Dr Maia Schweizer, Director, Western States

Future Battery Industries CRC (by videoconference)

- Mr Shannon O'Rourke, Chief Executive Officer

Perth USAsia Centre

- Mr James Bowen, Policy Fellow

Friday, 31 March 2023 – Canberra

Australian Aluminium Council (by teleconference)

- Marghanita Johnson, Chief Executive Officer

Australian Academy of Technological Science and Engineering and the Australian Academy of Science

- Professor Ken Baldwin, Fellow, Australian Academy of Technological Sciences and Engineering
- Professor Ian Chubb, Secretary for Science Policy, Australian Academy of Science
- Ms Kylie Walker, Chief Executive Officer, Australian Academy of Technological Sciences and Engineering

Clean Energy Investor Group

- Mr Simon Corbell, Chief Executive Officer

Smart Energy Council

- Mr Leigh Heaney, Government Relations Manager
- Mr Wayne Smith, External Affairs Manager

Mr Bradley Riley, Dr Edward Wensing and Dr Lily O'Neill and Mr Michael Dillon

Australian Electric Vehicle Association

- Ms Jude Burger, Vice-President
- Dr Warwick Cathro, National Secretary

Professor Llewelyn Hughes, Private capacity

- Professor Frank Jotzo, Director, Zero-Carbon Energy for the Asia-Pacific, Australian National University
- Dr Thomas Longden, Fellow, Crawford School of Public Policy, Australian National University

Australian National University Zero-Carbon Initiative for Asia Pacific

- Associate Professor Emma Aisbett, Associate Director (Research) (by teleconference)
- Professor Paul Burke, Project Convenor
- Dr Bin Lu, Senior Research Fellow
- Dr Lee White, School of Regulation and Global Governance

Australian Pipelines and Gas Association

- Mr Steven Davies, Chief Executive Officer

Export Council of Australia

- Mr Arnold Jorge, Chief Executive Officer

Wednesday, 5 April 2023 – Melbourne

Grattan Institute

- Mr Anthony (Tony) Wood, Program Director, Energy and Climate Change

Australian Land Conservation Alliance

- Dr Jody Gunn, Chief Executive Officer

Boundless Earth

- Ms Nicola Ison, Head of Direct Advocacy

- Mr Eytan Lenko, Chief Executive Officer

Beyond Zero Emissions

- Ms Sanaya Khisty, Chief Strategy Officer
- Mr Rohan Moorey, Senior Researcher

Australian Environment Foundation

- Mr Thomas (Tom) Bostock, Chairman
- Mr Alan Moran, Director

Australian Hydrogen Council

- Dr Fiona Simon, Chief Executive Officer

Heavy Industry Low-carbon Transition (HILT) CRC

- Ms Susan Jeanes, Chair
- Professor Graham (Gus) Nathan, Research Director

Clean Energy Council

- Ms Anna Freeman, Policy Director, Decarbonisation

Copenhagen Infrastructure Partners (by teleconference)

- Mr Matthew Stuchbery, Vice President

Birdlife Australia

- Mr Sean Dooley, National Public Affairs Manager
- Mr Paul Sullivan, Chief Executive Officer

Thursday, 6 April 2023 – Macquarie Park

Save Our Surroundings

- Mr Dennis Armstrong, Member
- Mrs Margaret Armstrong, Member
- Mrs Kathryn Reynolds, Member

Climate Council

- Dr Simon Bradshaw, Research Director, Projects

Rewiring Australia

- Dr Saul Griffith, Co-founder and Chief Scientist

Electric Vehicle Council

- Mr Behyad Jafari, Chief Executive Officer

- Ms Natalie Thompson, Senior Policy Officer

Australia China Business Council (by teleconference)

- Mr Anthony Coles, Chair, Net Zero Working Group
- Mr David Olsson, National President and Chair

Transgrid

- Mr David Feeney, Head of Policy and Energy Market Reform
- Mr Craig Stallan, Executive General Manager, Delivery

Macquarie University Centre for Energy and Natural Resources Innovation and Transformation

- Mr Jordie Pettit, Research Assistant
- Dr Madeline Taylor, Deputy Director

Tuesday, 16 May 2023 – Brisbane

Advanced Materials and Battery Council

- Dr Lynette Molyneaux, Director
- Mr Craig Nicol, Chair, Advanced Materials and Battery Council and Founder, Managing Director and Chief Executive Officer, Graphene Manufacturing Group

Star of the South Wind Farm Pty Ltd (by videoconference)

- Ms Erin Coldham, Chief Development Officer

Low Emission Technology Australia

- Mr Damian Dwyer, Director, Policy and International Relations
- Mr Mark McCallum, Chief Executive Officer

University of Adelaide Institute for Sustainability, Energy and Resources

- Professor Michael Evan Goodsite, Pro Vice-Chancellor, Energy Futures and Director, Institute for Sustainability, Energy and Resources

Ammonia Energy Association (Australia) (by videoconference)

- Mr John Mott, Director

Star Scientific Ltd

- Mr Matthew Hingerty, Deputy Chair, Deputy Chief Executive Officer and Head of Business Development

Wednesday, 17 May 2023 – Gladstone

Alpha HPA

- Mr Rimas Kairaitis, Managing Director
- Mr Robert (Rob) Williamson, Director and Chief Operating Officer

Kalapa Wycarbah Local Action Committee

- Mr Stephen Akers, Member
- Mr Nick Holland, Member
- Mr Glen Kelly, Chairman

Mr Bill Stinson, Private capacity (by videoconference)

Mr Cedric Creed, Private capacity

Mrs Therese Creed, Private capacity

Friday, 23 June 2023 – Canberra

Department of Climate Change, Energy, the Environment and Water

- Ms Jo Evans, Deputy Secretary
- Mr Sam Lowe, Principal Adviser on the Inflation Reduction Act
- Mr James White, Branch Head, Renewables and Distributed Energy, Electricity Division
- Ms Catherine Zerger, Branch Head, Hydrogen, Adaptation and New industries Division

Commonwealth Scientific and Industrial Research Organisation

- Dr Peter Mayfield, Executive Director, Environment, Energy and Resources
- Dr Dietmar Tourbier, Director Energy Business Unit

Department of Foreign Affairs and Trade (DFAT) and Australian Trade and Investment Commission (Austrade)

- Mr Gary Cowan, First Assistant Secretary, North and South Asia Division, DFAT
- Mr Alvin D'Almaida, Manager, Resources and Energy, Austrade
- Mr Matthew Fox, First Assistant Secretary, Climate Diplomacy and Development Finance Division, DFAT
- Mr Sam Guthrie, General Manager Government and Net Zero Lead, Austrade
- Mr Warren Hauck, Acting First Assistant Secretary, Trade Resilience and Indo-Pacific Economic Cooperation Division, DFAT
- Mr Peter Horn, General Manager Investment and Net Zero Lead, Austrade

- Mr Ravi Kewalram, First Assistant Secretary and Chief Negotiator, Free Trade Agreements and Stakeholder Engagement Division, DFAT
- Mr Peter Sawczak, First Assistant Secretary, United States and Indo-Pacific Strategy Division, DFAT
- Mr David Woods, First Assistant Secretary, Chief Economist, International Economics and Green Economy Division, DFAT

C. Australian list of critical minerals

Table C.1 Australian list of critical minerals

Critical mineral		On US list[1]	On EU list[2]	On Japan list[3]	On India list[4]	Australia's geological potential[5]	Australia's economic demonstrated resource[6]	Australian production	Global production (2020)[7]
1	High purity alumina	Yes[8]	Yes[9]	No	No	Moderate	No data	No data	No data
2	Antimony	Yes	Yes	Yes	Yes	Moderate	125.2 kt	3.9 kt	155 kt
3	Beryllium	Yes	Yes	Yes	Yes	Moderate	No data	No data	240
4	Bismuth	Yes	Yes	Yes	Yes	Moderate	No data	No data	17 kt

1 J Burton, *U.S. Geological Survey Releases 2022 List of Critical Minerals*, United States Geological Survey (USGS), U.S. Department of the Interior, Federal Government of the United States, 2022, accessed 3 March 2022.
2 Joint Research Centre, *The Fourth List of Critical Raw Materials for the EU*, European Commission, 2020, accessed 3 March 2022.
3 J Nakano, translation of a Ministry of Economy, Trade and Industry (METI) publication as presented in *The Geopolitics of Critical Minerals Supply Chains*, Centre for Strategic & International Studies (CSIS), 2021, p 22, accessed 3 March 2022.
4 V Gupta, T Biswas and K Ganesan, Critical Non-Fuel Mineral Resources for India's Manufacturing Sector—A Vision for 2030, Council on Energy, Environment and Water (CEEW) and Department of Science & Technology, Government of India, 2016, pp. 73–74, accessed 3 March 2022.
5 Geoscience Australia, *Australia's Identified Mineral Resources 2021*, Geoscience Australia, Australian Government, unpublished, accessed 3 March 2022.
6 Geoscience Australia, *Australia's Identified Mineral Resources 2021*, [dataset], Geoscience Australia, Australian Government, accessed 3 March 2022.
7 Geoscience Australia, using estimated world production from *USGS Mineral Commodity Summaries 2021*, adjusted with reported Australian production in the dataset of Australia's Identified Mineral Resources 2021, accessed 17 January 2022.
8 The United States identifies aluminium as a critical mineral.
9 The European Union identifies bauxite (an ore of aluminium) as critical.

5	Chromium	Yes	No	Yes	Yes	Moderate	0	0	40 000 kt
6	Cobalt	Yes	Yes	Yes	Yes	High	1495 kt	5.6 kt	135 kt
7	Gallium	Yes	Yes	Yes	Yes	High	No data	No data	300 t
8	Germanium	Yes	Yes	Yes	Yes	High	No data	No data	130 t
9	Graphite	Yes	Yes	Yes[10]	Yes	Moderate	7970 kt	0	1100 kt
10	Hafnium	Yes	Yes	Yes	No	High	14.5 kt	No data	No data
11	Helium	No	No	No	No	Moderate	No data	4 hm^3	140 hm^3
12	Indium	Yes	Yes	Yes	Yes	Moderate	No data	No data	900 t
13	Lithium	Yes	Yes	Yes	Yes	High	6174 kt	40 kt	82 kt
14	Magnesium	Yes	Yes	Yes	No	High	Magnesite: 286 000 kt	Magnesite: 799 kt	Magnesite: 26 000 kt
15	Manganese	Yes	No	Yes	No	High	Manganese ore: 276 000 kt	Manganese ore: 4800 kt	17 200 kt
16	Niobium	Yes	Yes	Yes	Yes	High	216 kt	No data	78 kt
17	Platinum-group elements	Yes	Yes	Yes	Yes	Moderate	107 t	0.522 t	380 t
18	Rare-earth elements	Yes	Yes	Yes	Yes	High	4200 kt	20 kt	240 kt
19	Rhenium	No	No	Yes	Yes	Moderate	No data	No data	53 t
20	Scandium	Yes	Yes	No	No	High	30.34 kt	No data	No data
21	Silicon	No	Yes[11]	Yes	Yes	High	No data	No data	8 kt

[10] Japan identifies carbon (which forms graphite) as a critical mineral.
[11] The European Union identifies silicon metal as a critical mineral.

22	Tantalum	Yes	Yes	Yes	Yes	High	99.4 kt	0.1 kt	1.8 kt
23	Titanium	Yes	Yes	Yes	No	High	Ilmenite: 274 000 kt Rutile: 35 300 kt	Ilmenite: 1100 kt Rutile: 200 kt	Ilmenite: 12 000 kt Rutile: 1000 kt
24	Tungsten	Yes	Yes	Yes	No	High	577 kt	Less than 1 kt	84 kt
25	Vanadium	Yes	Yes	Yes	Yes	High	7408 kt	0	86 kt
26	Zirconium	Yes	No	Yes	Yes	High	Zircon: 79 300 kt	Zircon: 400 kt	Zircon: 2000 kt

Source: Department of Industry, Sciences and Resources, *Australia's Critical Minerals List,* www.industry.gov.au/publications/australias-critical-minerals-list, viewed 29 June 2023.