accenture

Sunshot: Australia's opportunity to create 395,000 clean export jobs

SUMMARY REPORT

October 2021

Commissioned by

ACF WWF BCA Business Council of Australia ACTU australian council of trade unions

Acknowledgement of country

Accenture and the commissioning organisations respectfully acknowledge Australia's Aboriginal and Torres Strait Islander people as the Traditional Owners of Australia and pay respect to their Elders past, present and emerging.

Acknowledgements

We are grateful to the following experts that have been consulted in the development of this report:

- Gabrielle Kuiper, Institute for Energy Economics and Financial Analysis contributor, Churchill fellow
- Ivor Frischknecht, Non-executive director, former CEO of ARENA
- Rebecca Burdon, Melbourne Climate Futures at the University of Melbourne, and Climate Resource
- Simon Smart, University of Queensland
- Tim Buckley, Institute for Energy Economics and Financial Analysis

About Accenture

Accenture is a leading global professional services company, providing a broad range of services and solutions in strategy, consulting, digital, technology and operations. Combining unmatched experience and specialised skills across more than 40 industries and all business functions — underpinned by the world's largest delivery network — Accenture works at the intersection of business and technology to help clients improve their performance and create sustainable value for their stakeholders. Visit us at www.accenture.com

About ACF

The Australian Conservation Foundation is Australia's national environment organisation. We are 700,000 people who speak out for the air we breathe, the water we drink, and the places and wildlife we love. We are proudly independent, non-partisan and funded by donations from our community.

About ACTU

The Australian Council of Trade Unions is the peak body for Australian unions, made up of 38 affiliated unions who together represent about 1.8 million workers and their families.

About BCA

The Business Council of Australia represents Australia's largest employers, advocating for good policy on behalf of the business community and the Australians they employ.

About WWF

WWF-Australia is part of the world's leading conservation network and has been working to create a world where people live in harmony with nature since 1978. WWF's mission is to stop the degradation of the earth's natural environment and to build a future in which humans live in harmony with nature. At every level, we collaborate with people around the world to develop and deliver innovative solutions that protect communities, wildlife, and the places in which they live. Since 2019, WWF has been advocating for Australia to become a world leading renewable energy export nation through its Renewables Nation program.

Australia's opportunity to create 395,000 clean export jobs

Australia's exports are dominated by fossil fuels and high embodied carbon products. Among Australia's top 10 exported goods, which together represent 60% of total export value, 97% are either fossil fuels, products with high embodied emissions, or inputs into high-emissions processes. Australia's exports are also significantly more emissions intensive than those of other countries: Australia ranks in the top 3 for exported fossil fuel emissions behind Russia and Saudi Arabia.

These exports are now at risk due to the increased global focus on combating climate change. Demand for thermal coal—which represents 6% of Australia's current exports—is expected to decline 80% globally by 2050 in the IEA's net zero by 2050 scenario. Many countries including our major export destinations (e.g. China, Japan, Korea) have adopted net zero carbon targets. Demand for Australia's high carbon embodied products is also at risk due to regulations that tax carbon-intensive imports such as the European Union's planned carbon border adjustment mechanism.

While the energy transition puts some of our exports at risk, it also opens a path to new clean export opportunities. Australia has a natural clean energy advantage: an abundance of solar and wind energy and the metals and minerals required for the energy transition. Australia has the highest average solar radiation per square metre of any continent in the world and is already the world's largest miner of lithium, a key input into batteries. Australia is the largest producer of some of the most important materials for industrial development and decarbonisation (including iron ore, copper and bauxite) which we are well placed to process with renewable energy. Our combination of high-quality renewable energy resources and abundant metals and minerals means that Australia could be positioned to prosper in the global energy transition.

This report explores six clean export opportunities in clean energy, technologies and services that can fuel Australia's growth in the low emissions economy.[1] There are two sets of opportunities: energy and minerals; and technology and services.

In energy and minerals, three opportunities stand out:

1. Exporting hydrogen or ammonia produced with renewable energy
2. Processing and exporting higher value metals (e.g. steel and aluminium) using renewable energy
3. Exporting minerals critical for production of clean energy technology

In technology and services, there are three leading opportunities:

4. Exporting batteries manufactured in Australia
5. Exporting education and training services built on our strong clean energy economy
6. Providing clean energy services

Note: 1. The report does not explore all clean energy export opportunities and focuses only on those where Australia has a distinct advantage

Australia's opportunity to create 395,000 clean export jobs

In total, Australia's six clean export opportunities are enormous. By conservative estimates, they have the potential to generate $89 billion of gross value added (GVA) and 395,000 jobs for Australia in 2040. To give some sense of the size of the opportunity, this is larger than the GVA of our fossil fuel industry today and with many more jobs. Each of these opportunities represent a substantial new industry and together they would form a formidable new set of exports for Australia.

These industries would not just bring export revenue – they could also produce a range of jobs, many in regional areas. A range of jobs accessible by workers across qualification levels would be created; more than half of jobs would be in mining, manufacturing, and professional services. A high proportion of new jobs could be in regions with existing high-carbon activities.

But fully exploiting these new opportunities will not be easy and will require concerted effort across a range of actors. While governments are taking steps to support new clean sectors especially through renewable energy zones and support for new technology, greater scale of effort will be required to fully develop these opportunities. Unlocking clean exports at this scale would require 6 times the current national electricity output and a commitment to commercialise new industries such as renewable hydrogen and green steel.

For this reason, the four partners of this report believe significant new policies and actions are required to realise this opportunity.

Australia will need to act quickly as we face significant competition from other countries. Five policies and actions are required:

1. Coordinated investment in clean export industrial precincts
2. Co-investment in new industries
3. Support for workers and regions to diversify
4. Low-carbon material procurement
5. Interim target for renewable hydrogen and green metals production

Investment will be required to underwrite new renewable energy supply as technology costs decline and global demand strengthens. There will also need to be significant investment in new renewable energy industrial clusters to co-locate renewable energy generation and energy storage with manufacturing and clean exports production. Targets will be important to galvanise industry and signal our ambition to investors. Critically, there is a role for government to help local economies diversify by providing leadership, coordination and support to workers moving from the carbon economy to the clean economy. These policies could have a catalytic effect on Australia's clean export industries, supporting new investment, growth and jobs.

With these commitments, Australia can become a clean exports powerhouse, realise a $89 billion opportunity and create 395,000 new jobs.

Australia's exports are dominated by fossil fuels, high-embodied emissions goods and inputs into such goods

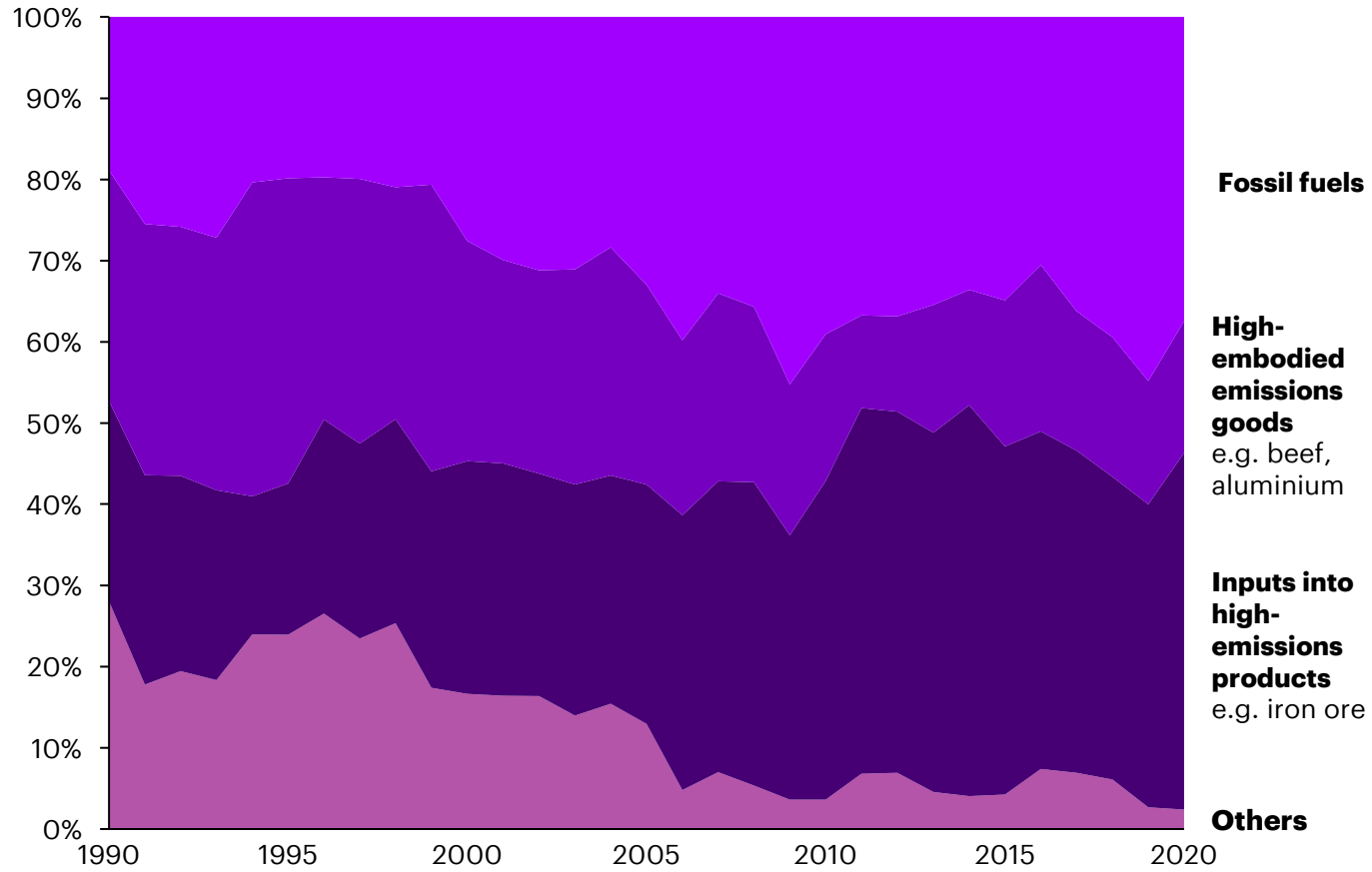
Australia's exports have become increasingly dominated by fossil fuels, high embodied emission goods and inputs into high embodied emission goods. **The top 10 goods represent 60% of total export value and 16% of GDP, of which 97% are fossil fuels or have high embodied emissions**. Hence, 16% of Australia's GDP is at risk as the world transitions to carbon neutral based on our current composition. Australia will need to restructure the composition of its exports to respond both to the decrease in global fossil fuel demand and the increase in emissions reduction ambition. This will require an unprecedented scale of change for Australia.

Australia has consistently been a commodities and resources based export economy, with resources representing as much as 60% of exports since 2017. Further, fossil fuels have represented over 25% of exports on average over the last 10 years. As countries phase out fossil fuel use, there will be increasing volatility in fossil fuel markets as the number of markets reduce.

The graph highlights the high proportion of exports that are at risk through either direct fossil fuel import reduction or an increase in emission reduction ambition. This risk is most prominent for goods exports, which represent 80% of total export value.

Figure 1: Share of energy intensive and fossil fuel exports in Australia's top ten goods exports[1]

%, share of total top ten goods exports value



Source: 1. DFAT TRIEC pivot tables Notes: Fossil fuels include coal anthracite and bituminous, crude petroleum, and petroleum gases and other gaseous hydrocarbons processed. High-embodied emissions goods include non-monetary gold, meat and meat preparations, metallic minerals processed, road motor vehicles and parts, and machinery for specialised industries. Inputs into high-emissions processes include iron ore and concentrates, other metalliferous ores and concentrates and non-ferrous metals simply transformed.

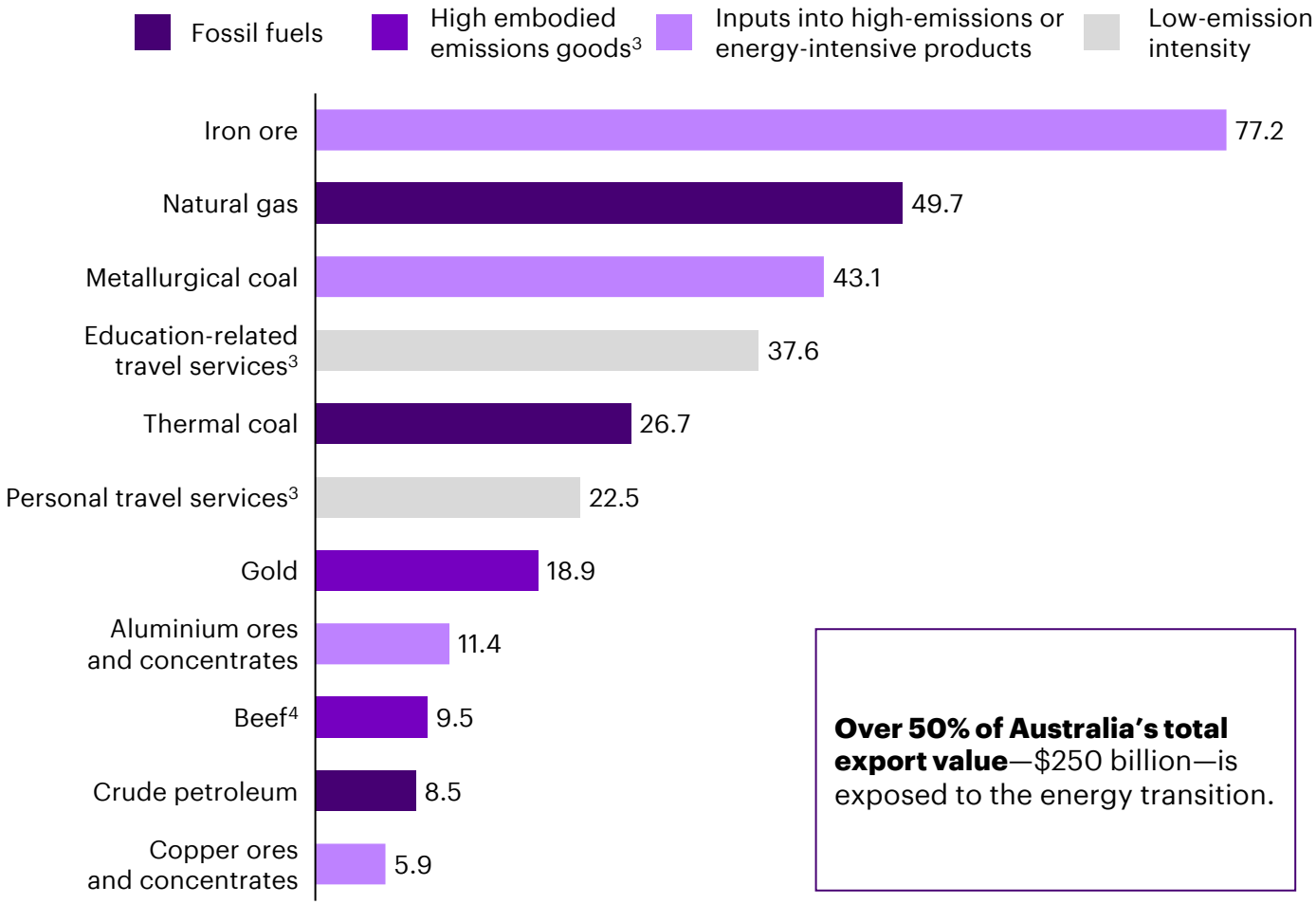
Currently, 8 out of 10 of Australia's largest exports are exposed to risks from the energy transition

Over 50% of Australia's existing export value is generated from fossil fuels or other exports at risk from the global energy transition. Fossil fuels alone represent almost 20%, or $76 billion, of Australia's exports by value.

Exports are a significant contributor to Australia's GDP. Trade is equivalent to 45% of GDP and directly responsible for 1 in 5 Australian jobs. Australia's exports are at risk from the global energy transition represent a considerable portion of Australia's economy**. This risk must be managed through rapid action to coordinate the transition as international demand moves away from emissions intensive exports.**

Figure 2: Australia's top ten exports by balance of payment basis[1,2]

Billion dollars, 2018-19



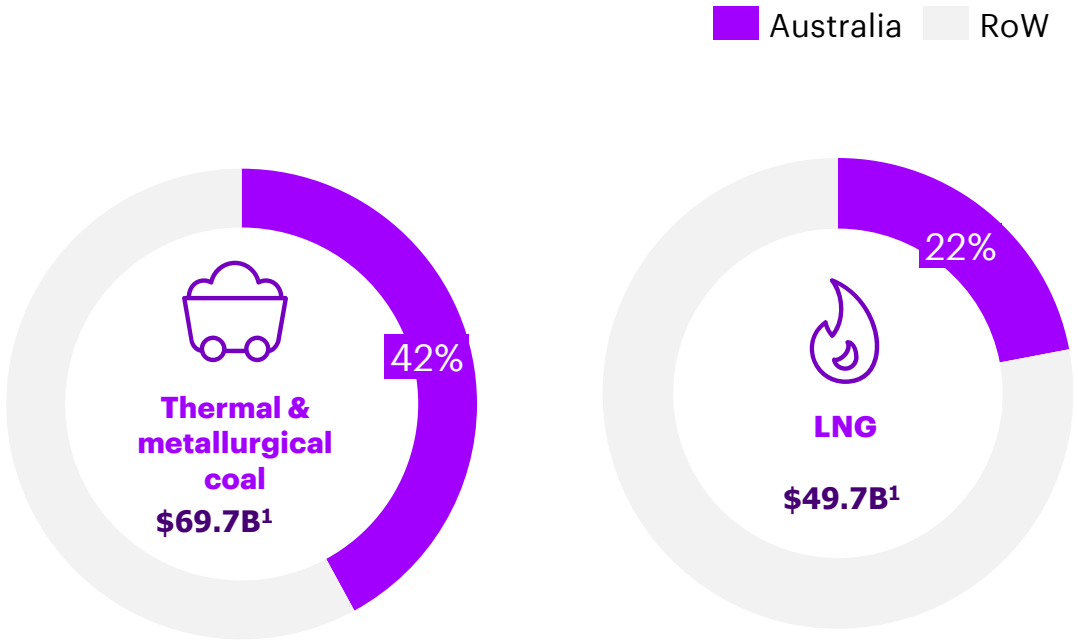
Over 50% of Australia's total export value—$250 billion—is exposed to the energy transition.

Source: 1. DFAT (2020), *Trade and Investment at a Glance* 2. DIIS-OCE (2019), *Resources and Energy Quarterly*
Notes: Coal is considered a singular export by DFAT however the Department of Industry reports on thermal and metallurgical coal separately and given their distinct uses they have been presented separately here. 3. Education-related and personal travel services have experienced a significant decline in 2019-20 data. 4. Beef and other high embodied emission goods were not within the scope of this report.

Australia is a major global supplier of fossil fuels and ranks among the highest countries for CO_2 emissions from fossil fuel exports

Figure 3: Share of global coal and natural gas exports[2,3]

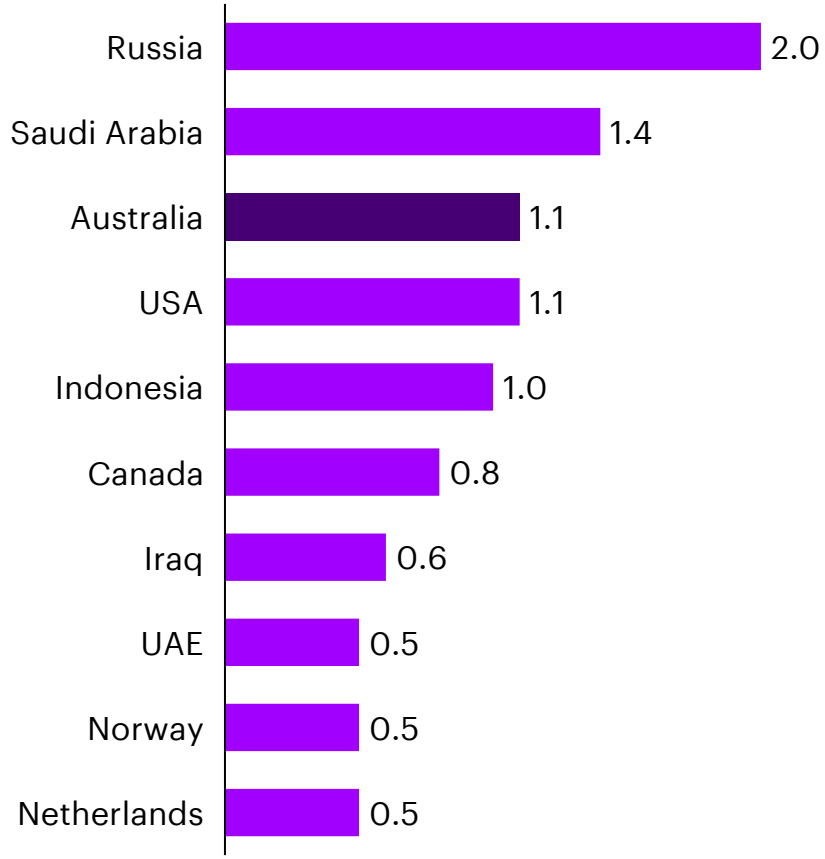
% of global exports, 2019-20



Australia is the world's top exporter of thermal and metallurgical coal[2], and the world's largest liquefied natural gas (LNG) exporter[3]

Figure 4: Global ranking of CO_2 emissions due to fossil fuel exports[4]

billion tonnes



Note: 1. Current value of Australian exports
Sources: 2. Office of the Chief Economist (2021), *Resources and Energy Quarterly June 2021* 3. Government of Western Australia (2021), *Western Australia LNG profile – April 2021* 4. Australia Institute (2020), *High Carbon from a Land Down Under*

Australia's largest export markets have set ambitious renewable energy and net-zero targets

The majority of Australia's export markets have committed to increasing their share of renewables by 2030 and a net-zero target by 2050. These commitments and targets from Australia's largest export markets indicate a shifting demand for fossil fuel and energy intensive exports. An increase in global emission reduction ambition will create risk to exports as countries shift away from fossil fuel based energy production and as countries, businesses and customers demand lower consumption emissions.

Given the countries with net-zero targets represent a 66% share of Australia's export market share, it is imperative that Australia adjusts its future exports to align with these shifting markets. **If Australia does not adjust accordingly, it risks losing export revenue without supplementing historic exports with new opportunities.**

Figure 5: Australia's top 10 export markets and their renewable energy and net-zero targets

Export markets	% share of Aus exports	Renewable energy target	Net-zero target	
China	32.6	40% by 2030	✓	2060
Japan	13.1	36-38% by 2030	✓	2050
Republic of Korea	5.9	42% by 2034	✓	2050
United States	5.3	100% by 2035	✓	2050
India	4.9	60% by 2030		
New Zealand	3.4	97% by 2030	✓	2050
Singapore	3.4	2GW solar energy by 2030		
Taiwan	2.9	20% by 2030	✓	2050
United Kingdom	2.9	38-40% by 2030	✓	2050
Malaysia	2.5	20% by 2025		

Over 65% of Australia's export market share have an 100% net-zero target emission by 2060

Sources: Energy and Climate Intelligence Unit (2021), *Net Zero Tracker*.

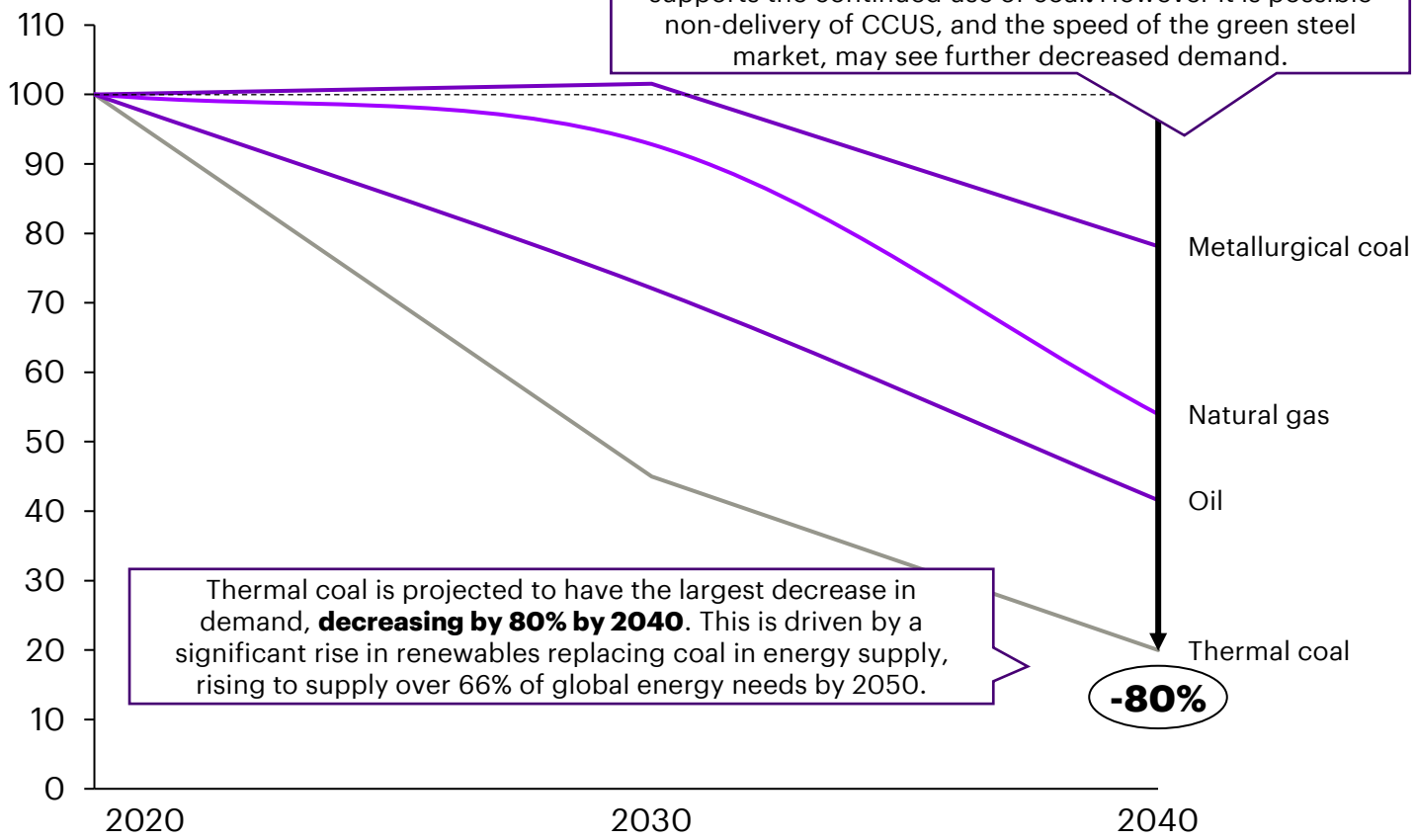
These exports are now at great risk due to the increased focus on mitigating climate change

The IEA's Net Zero by 2050 scenario lays out the necessary steps to achieve net zero energy-related and industrial process greenhouse gas emissions globally by 2050. **This target is consistent with limiting the global average temperature rise to 1.5°C** without overshoot (with 50% probability).

The IEA projects significant declines in demand for thermal coal, oil and natural gas by 2040, with further reductions expected to achieve net zero emissions by 2050. Given Australia's high exposure to fossil fuels, this reduction will have a significant impact on the market for Australian exports.

Figure 6: Change in global fossil fuel demand, 2020-2040, according to IEA Net Zero by 2050 scenario[1]

Index; 100 = fossil fuel supply in 2019



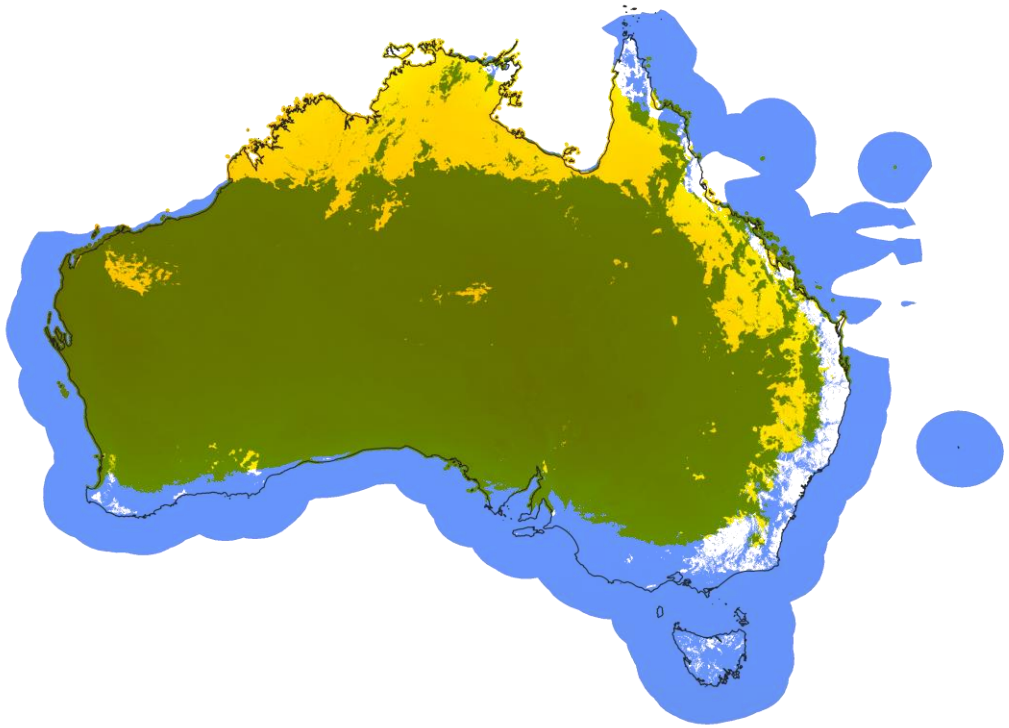
Notes: 1. **The index shown here for thermal coal, natural gas and oil are taken directly from the IEA NZE projections for 2040.** The reduction in metallurgical coal was inferred from the reduction in steel production since metallurgical coal is used almost exclusively for steel production. The share of primary steel production by method is provided for 2019, 2030 and 2050. Further the total production of steel for 2019, 2030, 2040 and 2050 are provided. By summing the proportion of steel made via methods using metallurgical steel, the percentage decrease in steel manufactured using metallurgical steel can be calculated.

Source: IEA 2021, *Net Zero by 2050*

Australia has a natural advantage with an abundance of solar and wind energy, and the metals and minerals required for the energy transition

Figure 7: High solar and wind power potential across Australia[1,2]

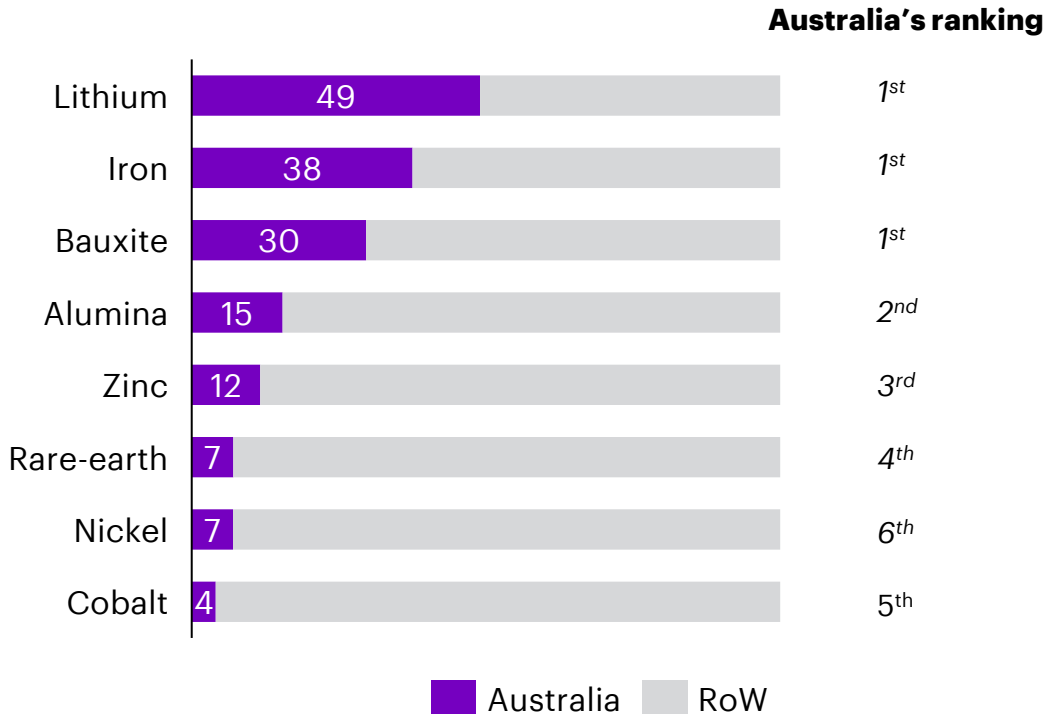
kWH/kWp, W/m^2



- Average daily solar PV potential ≥ 4.5 kWh/kWp
- Average daily solar PV potential ≥ 4.5 kWh/kWp and wind power density ≥ 450 W/m^2
- Average wind power density ≥ 450 W/m^2

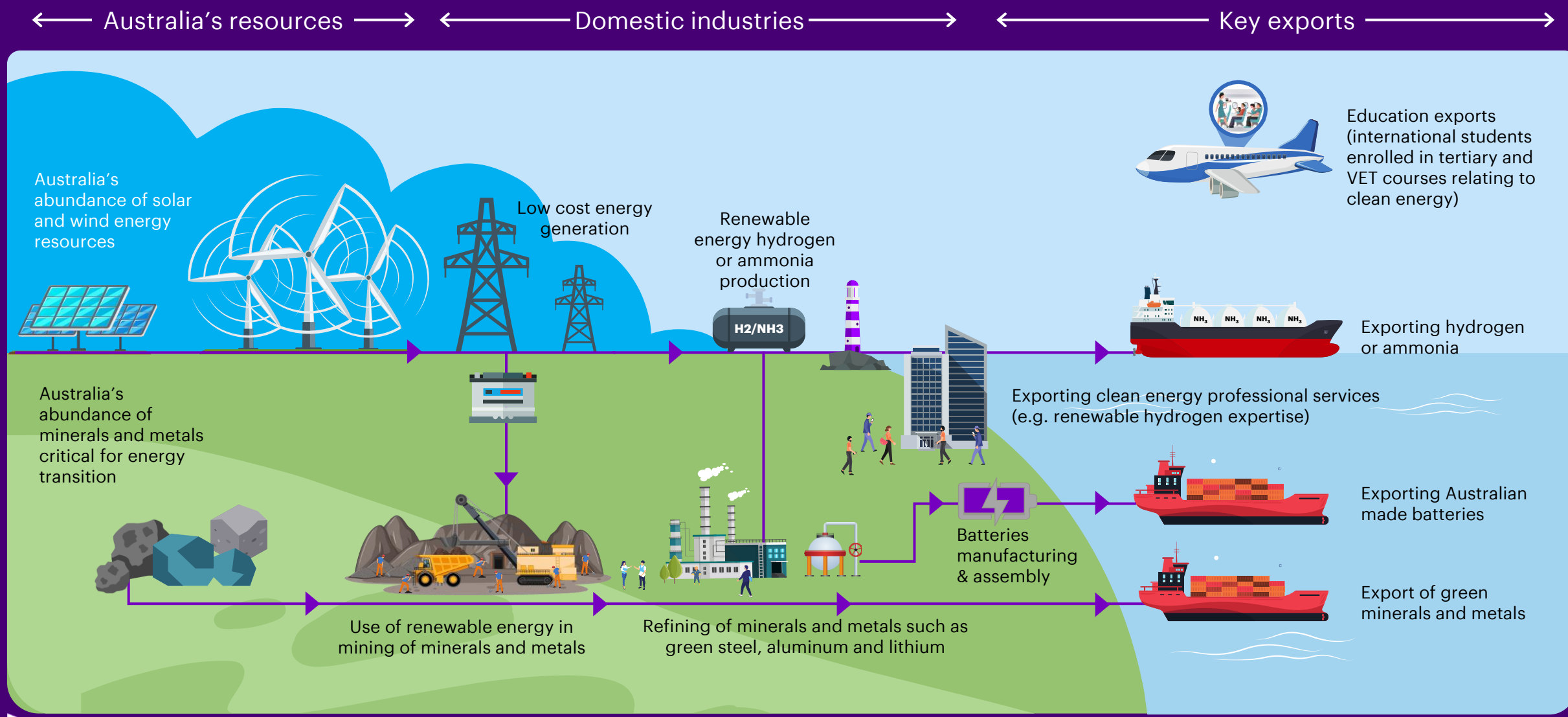
Figure 8: Australia's production of select metals and minerals essential for the energy transition[3]

% of global production



Source: 1. Global Wind Atlas 2. Global Solar Atlas 3. US Geological Survey (2021)

As the world transitions to a low emissions economy, Australia is well placed to pivot to lead the global energy transition



This report explores six export opportunities in clean energy and technologies that can fuel Australia's growth in the low emissions economy

Energy & materials

Technology & services

Renewable hydrogen and ammonia

Export of hydrogen, likely in the form of ammonia as a carrier, produced with renewable energy. This may take the form of electrolysers connected to a grid serviced by renewable energy or an off-grid renewable energy development.

Green metals

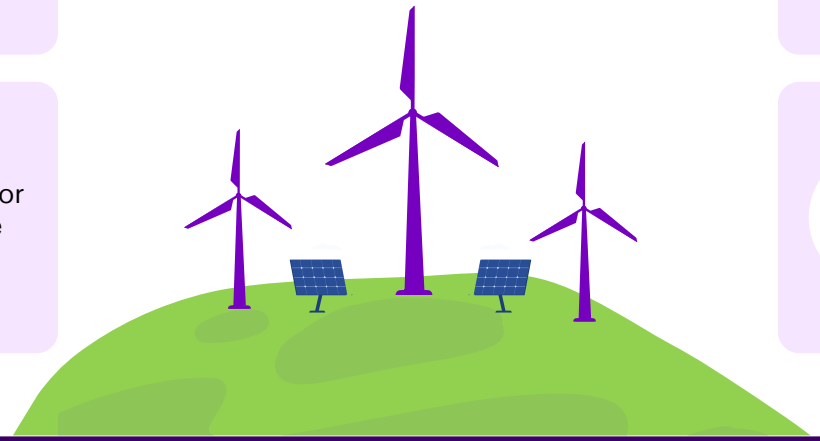
Processing & export of high-value metals such as aluminium and steel produced using renewable energy

Critical minerals

Export of critical minerals that are required for clean energy technologies. This includes the export of raw minerals and the refinement in Australia and export of the metals.[1]

2040

Australia's clean energy export opportunities [1]



Batteries

Export of batteries manufactured in Australia

Education & training

International student enrolments in clean energy and environment related fields of study at Australian Universities and VET institutions, driven by growing demand for skills in clean energy sector

Engineering, ICT & consulting services

Export of services required to scale clean energy projects globally , including engineering and project management, construction, research and technology, systems integration, and much more.

Notes: A long list of potential export opportunities including others such as direct electricity transfer, heating & cooling technologies, electric vehicles, solar and wind turbine components and many more were identified. The following six were selected for further exploration based on market attractiveness and Australia's comparative advantage. 1. This opportunity includes only the expected demand for clean energy technologies and not total critical mineral demand.

Our methodology considers supply and demand conditions in 'business as usual' and policy scenarios to estimate size of each opportunity; the policy scenario has been sized based on conservative estimates of demand- and supply-side drivers

Methodology to estimate economic value creation for each opportunity

Opportunity drivers

Demand-side drivers	1	Global market demand by 2040	What is the global market demand for this opportunity?
	2	Demand for Australian exports	Is there an export market for Australian goods? Which markets are key?
Supply-side drivers	3	Australia's current production	What is our current production?
	4	Technology	Is it technologically feasible? Or when do we predict technology would be feasible and commercially scalable?
	5	Supply capabilities	Do we have the raw materials and the expertise?
	6	Investment/ infrastructure	Does this require significant infrastructure investment?

Scenario

PATH 1:
Australia's projected 2040 export revenue in a 'Business as usual' (BAU) scenario

PATH 2:
Australia's projected 2040 export revenue in a policy scenario

Outputs

Gross value added
Measures the marginal economic value that is added by an industry (or business) to the costs of inputs. E.g. if a business spent $55 on inputs for its $100 revenue, then it has created $45 of value-added. This is defined as direct gross GVA.

From this direct expansion in the economy, flow-on supply-chain effects in terms of local purchases of goods and services are anticipated, and it is estimated that these indirect impacts would result in a further increase to value-added. This is defined as indirect GVA.

Job creation
Measures the total number of new jobs created (full time, part-time and casual) due to additional industry output (revenue). Direct jobs refers to jobs created in the specific industry due to additional revenue. Indirect jobs refer to jobs created due to flow-on supply-chain effects.

Based on conservative estimates, clean energy opportunities have the potential to generate $89B in gross value added for Australia and create 395,000 jobs in 2040

Energy & materials

Renewable hydrogen/ammonia

$28.9 B	$22.3 B	33k
Revenue	Direct and Indirect GVA	Direct and Indirect Jobs

Green metals*

$35.3 B	$20.1 B	111k
Revenue	Direct and Indirect GVA	Direct and Indirect Jobs

Critical minerals mining & refining**

$38.4 B	$24.1 B	110k
Revenue	Direct and Indirect GVA	Direct and Indirect Jobs

2040

Australia's clean energy export opportunities [1]

Technology & services

Batteries

$27.6 B	$6.9 B	45k
Revenue	Direct and Indirect GVA	Direct and Indirect Jobs

Education & training

$11.9B	$10.5 B	66k
Revenue	Direct and Indirect GVA	Direct and Indirect Jobs

Engineering, ICT & consulting services

$5.9 B	$5.0 B	30k
Revenue	Direct and Indirect GVA	Direct and Indirect Jobs

Source: Accenture analysis
*Only estimated for green alumina, green aluminium, green steel and direct reduced iron (DRI)
**Only estimated for copper, nickel, lithium, cobalt, and rare-earth minerals required for the clean energy transition
Note: 1. The numbers represent the policy scenario for all opportunities. Gross value add and jobs are based on estimated export revenue for opportunities in 2040. Conservative estimates have been taken for each of the opportunities. These values should be considered only a baseline value and not the maximum possible value available to be captured.

While the largest opportunities are in new energy and metals, services will be a significant beneficiary of these developments

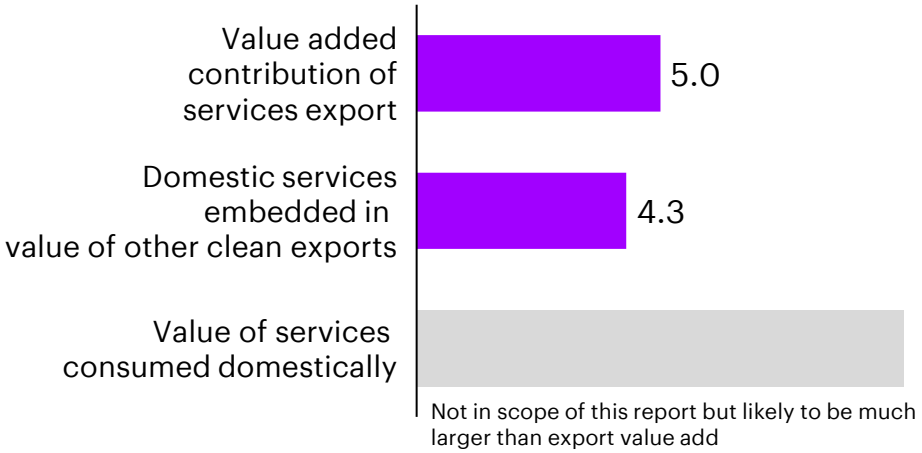
Seizing these export opportunities will unlock a range of new capabilities such as:

- Renewable energy building and operations
- Grid build, management and maintenance
- Energy systems design and operations
- Smart technologies and ICT services
- Clean energy legal, advisory and financial services for large infrastructure projects

The services sector is an important enabler of global value chains. The sector plays a role not only directly through the services export but additionally through indirect contribution within each of the export opportunities. While some services are exported directly, others are used as inputs to the production of goods exports – for example, engineering services embodied in manufacturing exports. Services embedded in other clean energy export opportunities could add a further $4.3B to the economy. In addition to this contribution, there will be further consumption of services domestic that have not included in the calculations below.

Figure 9: Many of which will provide the backbone for domestic and export services

2040 Gross Value Add ($B)

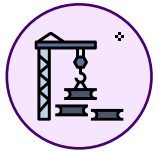


Source: Accenture analysis

Australia will need to act quickly as it faces significant competition from other countries

We must act fast in order to capture the full potential of these opportunities.

There is substantial international competition for many of the clean energy exports evaluated in this report. Many countries also have high potential renewables resources and have outlined strategies and funding for export opportunities so Australia's place as a leader is not assured. Hence, it is imperative that Australia acts fast if it is to capture a substantial share of the global market over countries with similar aspirations and renewable resources. Australia's competitors have existing targets that are ambitious and fast-moving, some as early as 2025. Further, countries such as China have an existing advantage in the refining of critical minerals, which further emphasizes the need for Australia to act quickly and at scale to capture these markets.

Opportunity	Example countries that are making significant investments in clean energy exports
 **Renewable hydrogen / ammonia**	 Chile has announced an ambitious National Green Hydrogen Strategy that outlines plans to produce green hydrogen at scale. The Government of Chile has committed $50 million in financing for pilot projects to reach three main goals: 1) to reach 5 GW of electrolysis capacity under development by 2025, 2) produce the most cost-efficient green hydrogen by 2030, and 3) be within the top 3 exporters by 2040.[1,2] Chile has similar renewable energy resources to Australia and hence a similar competitive advantage to producing hydrogen.
 **Green metals**	 Germany has committed to the ambitious national target of carbon neutral by 2045. To decarbonize their industries, Germany has committed €8, or $12.9, billion to fund large-scale hydrogen projects to support chemical, steel and transport industries. The government has committed over $8 billion to clean up steel production specifically. In 2020, Germany was the 8th largest producer of steel globally[3] and could capture a similarly significant share of green steel through significant funding for decarbonization.
 **Critical minerals mining & refining**	 China currently has the majority global share of processing all of the critical minerals of interest; copper, nickel, cobalt, lithium and rare earth elements. In 2019, China was responsible for processing a 65% share of Cobalt, 58% share of Lithium and 87% share of rare earths.[4] China's has developed an expertise and infrastructure of processing that has led to the cornering of the market.

Sources: 1. International Climate Initiative (IKI) (2021), *Chiles National Green Hydrogen Strategy* 2. Government of Chile-Department of Energy (2020), *National Green Hydrogen Strategy* 3. World Steel Association (2021), *World Steel in Figures* 4. IEA (2021), *The Role of Critical Minerals in Clean Energy Transitions*

These new export opportunities are greater in scale than current fossil fuels exports and could be an important avenue of diversification for regional economies

These six clean energy export opportunities[1] could create 19% greater revenue, 11% greater value add and over 83k more direct jobs in 2040 than the current fossil fuel[2] industry generated in 2020. In addition to the greater economic contribution, the six opportunities identified in this report will improve Australia's economic complexity and encourage a diversity of industries. This comparison highlights the scale of the new opportunities which could exist in conjunction to existing traditional industries.

Figure 10: Revenue of clean energy exports (2040) and fossil fuel exports (2020)[3]

2020 $ billion

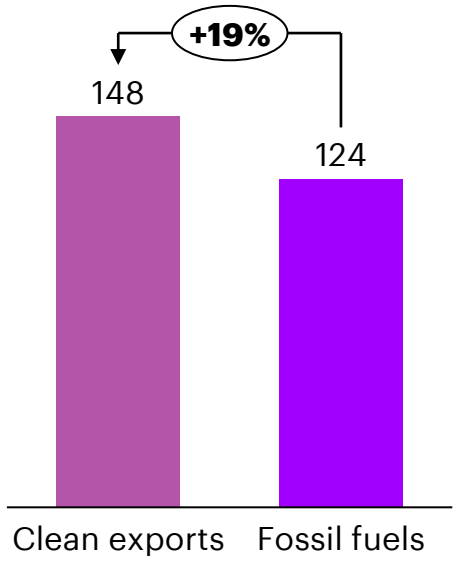


Figure 11: GVA of clean energy exports (2040) and fossil fuel exports (2020)[4]

2020 $ billion

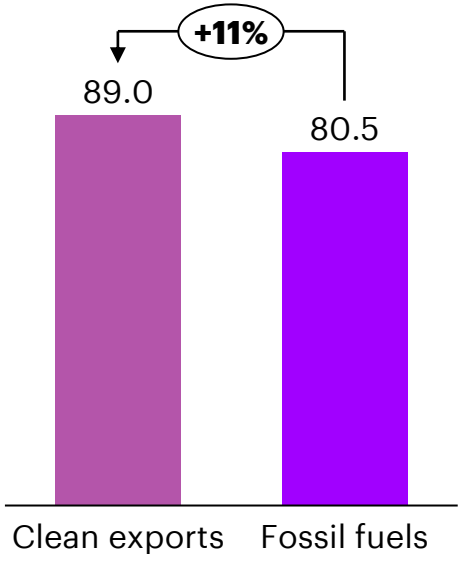
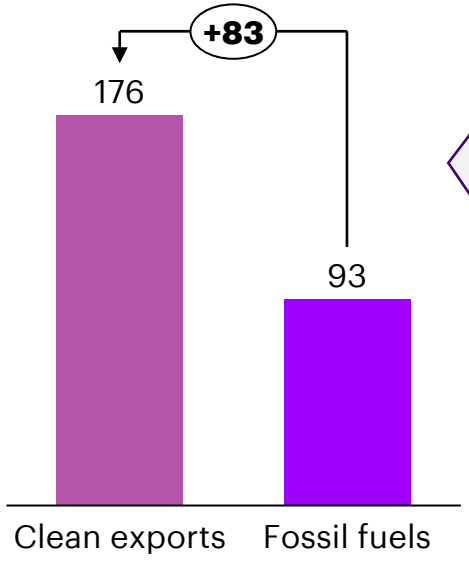


Figure 12: Direct jobs from clean energy exports (2040) and fossil fuel industry (2020)[5]

Direct jobs, `000



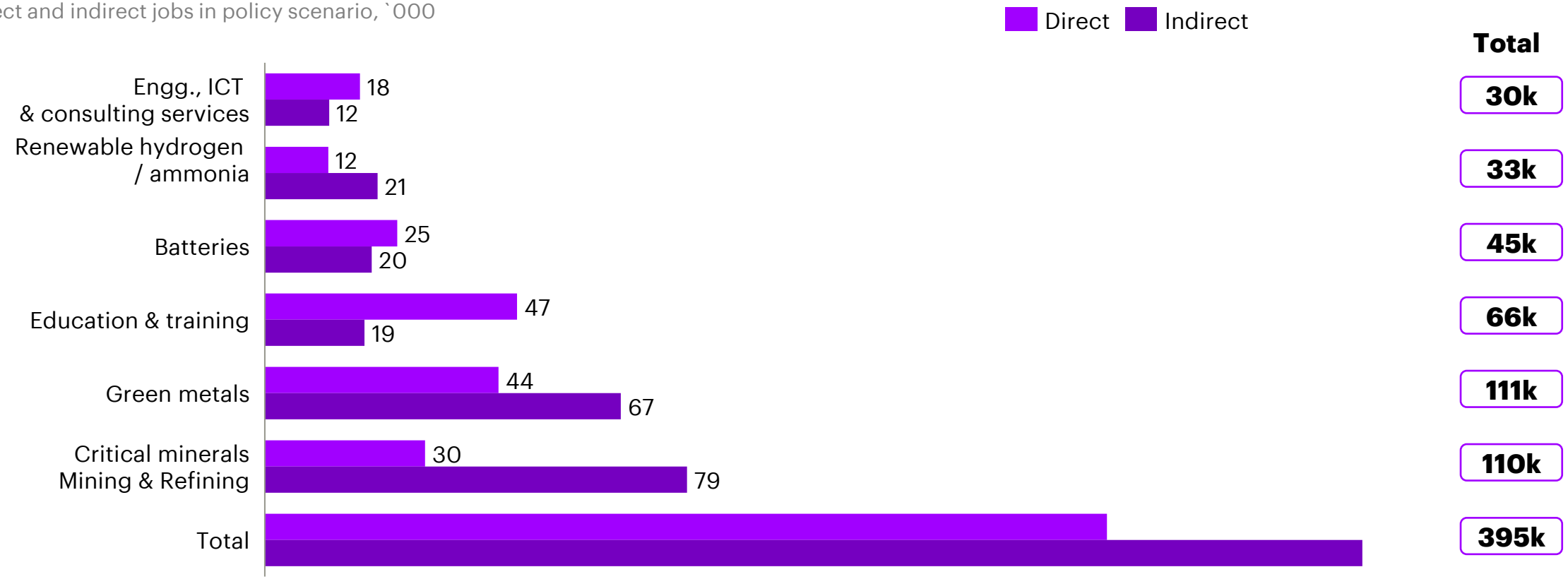
Clean exports include industries that employ more people per dollar of revenue than the current fossil fuel industry.

Notes: 1. There are additional possible opportunities that have not been modelled in this report. 2. Fossil fuels include metallurgical and thermal coal mining, and oil and gas extraction. Sources: 3. DISER OCE (2021), *Resources and Energy Quarterly* 4. ABS (2020), *Gross Value Added (GVA) by Industry*, 5. ABS (2020), *Labour Force (November)*

The clean energy opportunities will create 176,000 direct jobs and 219,000 indirect jobs due to the flow-on supply chain

Figure 13: Jobs enabled by Australia's clean energy export opportunities

Direct and indirect jobs in policy scenario, `000

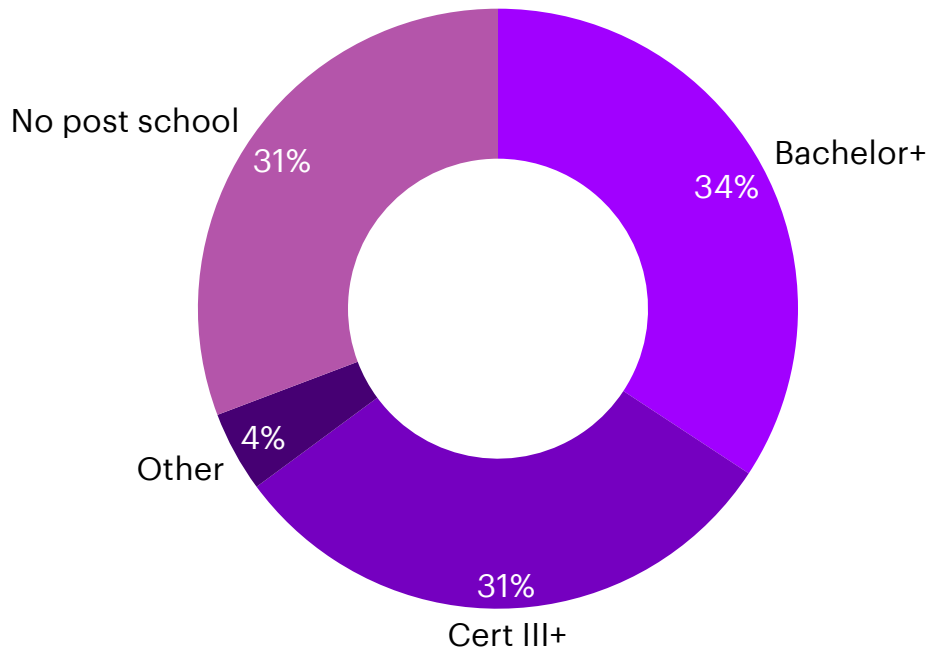


Note: Represents the total number of new jobs created (permanent and casual) due to additional industry output (revenue) Direct jobs refers to jobs created in the specific industry due to additional output. Indirect jobs refer to jobs created due to flow-on supply-chain effects. Indirect jobs will include some but not all potential new renewable energy jobs created in the economy.
Source: Accenture analysis

Clean exports will create opportunities for workers across qualification levels; more than half of jobs would be in mining, manufacturing, and professional services

Figure 14: Breakdown of jobs by qualification required

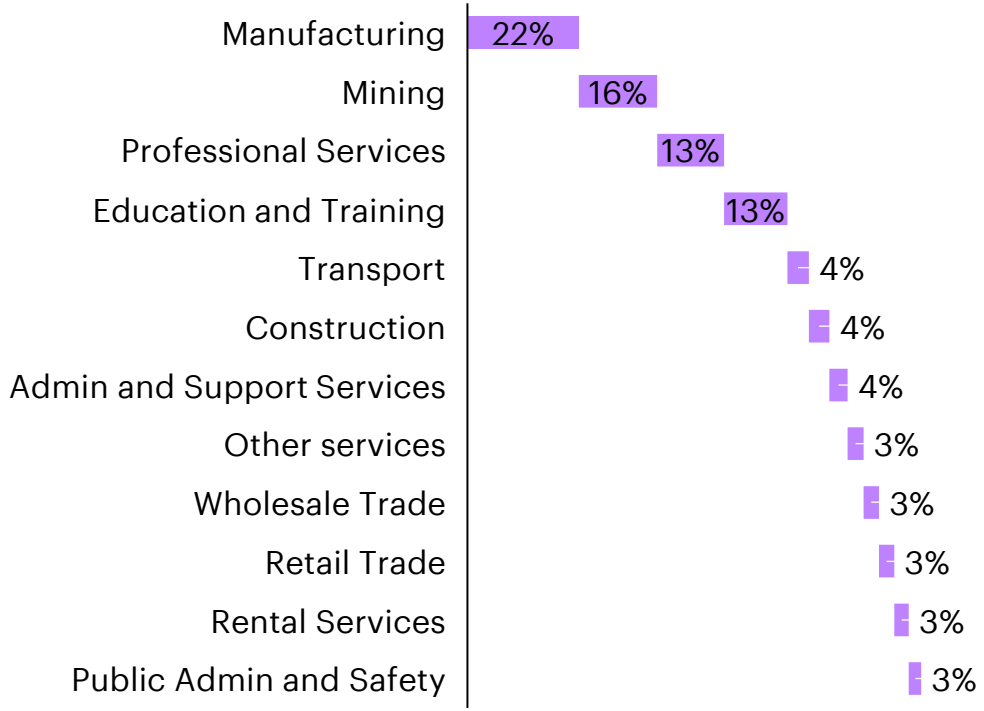
% of total direct and indirect jobs



Clean exports will create equal opportunities for workers across qualification levels, with approximately an equal division of jobs requiring bachelor and above, certification III and above, and no post school qualifications

Figure 15: Breakdown of jobs by industries

% of total direct and indirect jobs



More than half of new jobs would be in mining, manufacturing, and professional services industries. ~80% of jobs will offer permanent full-time or part-time employment, with remaining ~20% offering casual employment[1]

Note: Remaining 9% of jobs are in other sectors with <2.5% of total

Source: Accenture analysis

Note: 1. According to ABS, casual workers are defined as employees without access to paid leave entitlements. Estimated based on ABS's estimates of casual workers and applying a similar ratio to the new jobs created in each industry. ABS estimates of casual workers in some industries is conservative as some casual workers who found their job through a labour hire firm/employment agency can be categorised as permanent employees within 'Admin and support services' industry

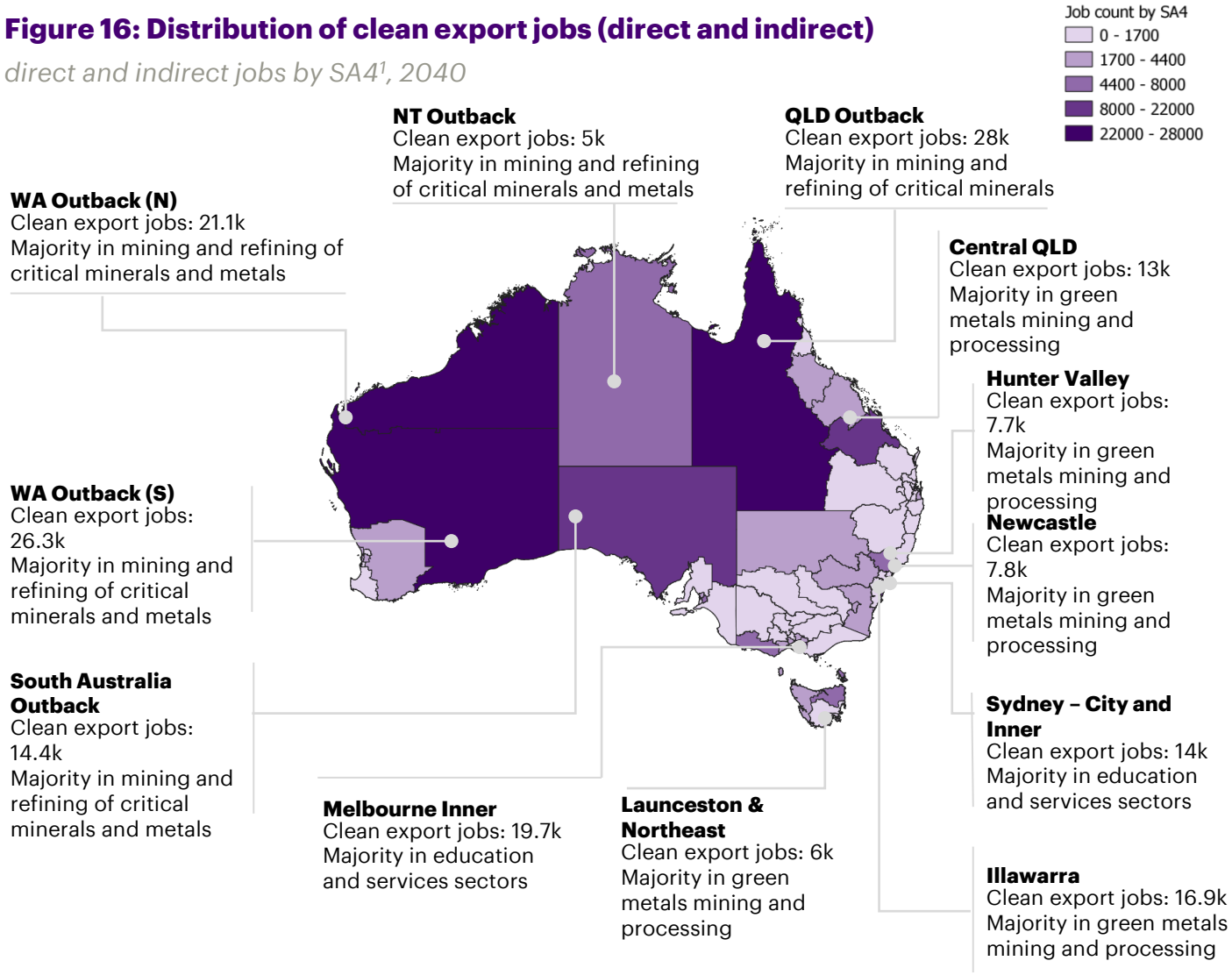
New jobs could be supported in several regions across Australia

Regional Western Australia, Central and Outback Queensland, Outback South Australia and Illawarra region in New South Wales are the major regions that could see a significant growth in employment, primarily driven by mining, value added refining and processing of critical minerals and metals. Both Central QLD and WA Outback have a rich endowment of several critical minerals such as lithium, bauxite, and rare-earths. The Illawarra region is currently a steel producing hub and may well transition to producing green steel. However, if Australia moves to green steel, steel plants could also be located closer to the ore and source of renewable energy in WA and SA Outback.

Clean export opportunities will also create employment in major cities and surrounding regions such as Melbourne Inner (19.7K) and South East, Sydney City and Inner South (14K), and Brisbane Inner City (5.3K). The majority of these jobs will be enabled due to growth in education services sector as well as growth in domestic ICT and other professional services supporting clean energy opportunities.

Figure 16: Distribution of clean export jobs (direct and indirect)

direct and indirect jobs by SA4[1], 2040



Note: 1. Statistical Area Level 4 (SA4s) are the largest sub-state regions in the main structure of the Australian Statistical Geography Standard.
Source: Accenture analysis

Many jobs could be in regions that currently employ high numbers of coal mining and LNG workers

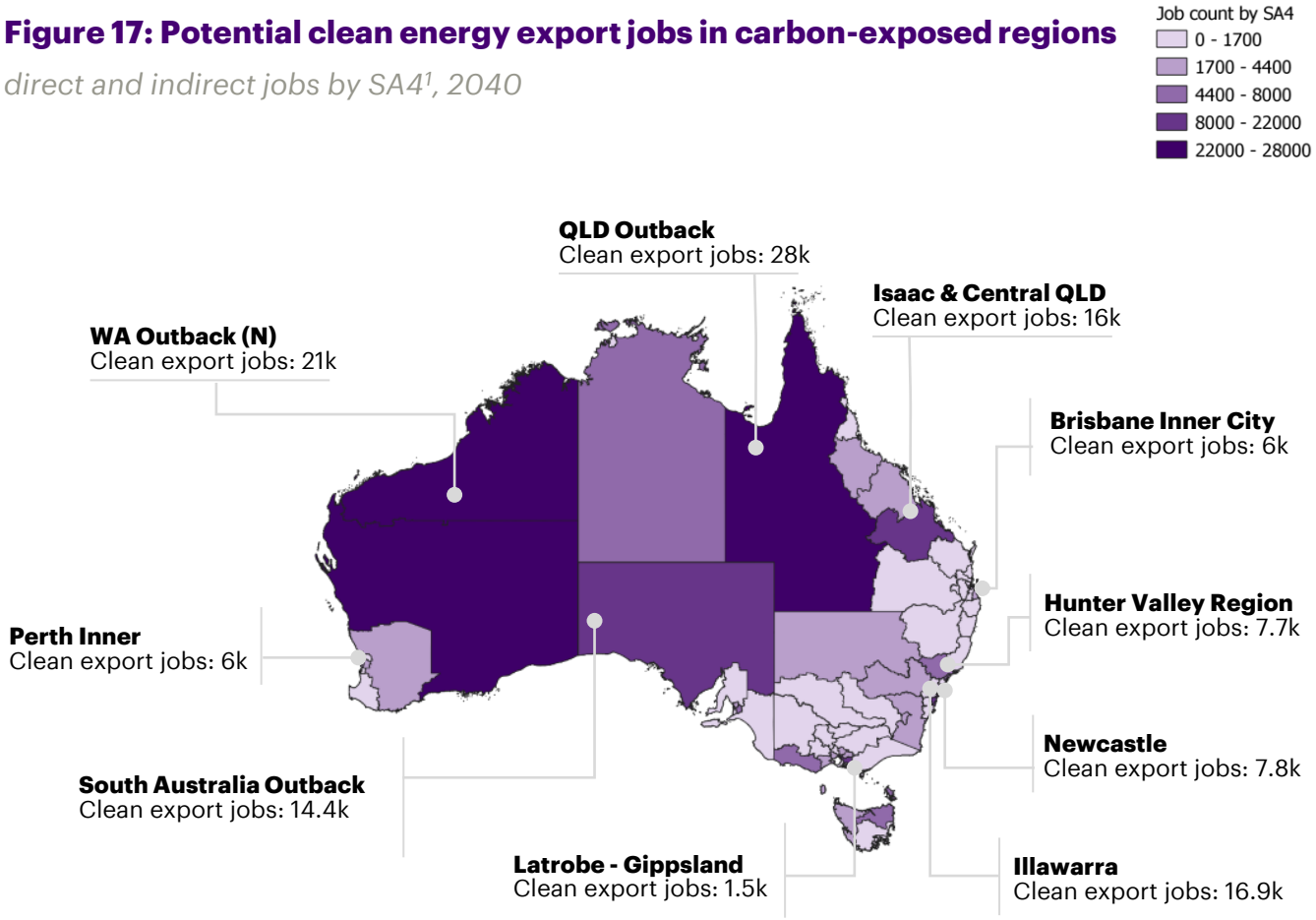
There are ~120,000 workers currently employed directly in carbon-intensive industries.[1] These industries include coal mining, oil and gas extraction, iron and steel forging, electricity generation, and metals and metals products manufacturing. There are 36,000 carbon workers in coal mining regions such as Central QLD and Hunter Valley region in NSW. An additional 7,700 are in Newcastle and Illawarra regions in NSW. Areas surrounding Brisbane and Perth are home to ~5,000 and ~4,000 workers. The remaining are scattered across the country.

The top seven regions in Australia with highest number of direct carbon workers account for 60,000 jobs (50%). Clean energy export opportunities could create as many as 38,400 direct jobs and 43,700 indirect jobs in those regions.

Producing these jobs will not be easy. Strong policy action, as outlined in this report, will be required to drive clean energy opportunities and create new employment. In addition, a transition authority with appropriate budget would be required to support a just transition for regions, workers and families currently supported by employment in carbon-intensive industries (refer to Section 5 of the detailed report for further discussion).

Figure 17: Potential clean energy export jobs in carbon-exposed regions

direct and indirect jobs by SA4[1], 2040



Note: 1. Statistical Area Level 4 (SA4s) are the largest sub-state regions in the main structure of the Australian Statistical Geography Standard
Source: ABS Census (2016), Accenture analysis

Unlocking clean exports at this scale would require 6x Australia's current electricity output by 2040

A dramatic increase in renewable electricity generation would be required to take advantage of the opportunities identified in this report. To meet additional demand for new clean exports at the same time as electrifying other energy demand, renewable electricity in the order of 6x the current total electricity generation across Australia would be required.

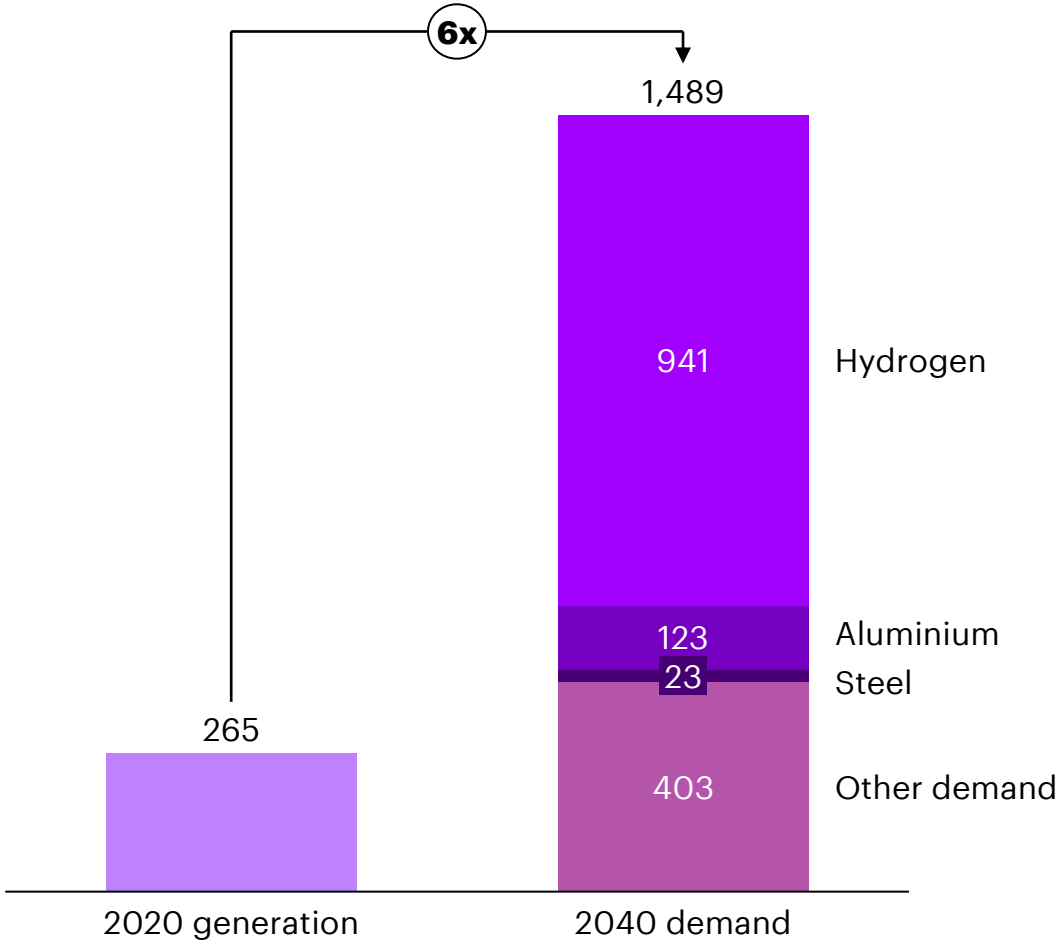
In the past 3 years, Australia has seen average growth of 8.4 TWh of renewable electricity each year. **To reach the 2040 renewable energy demand in the policy scenario, the annual rate of additional renewable electricity would have to jump to around 75 TWh every year until 2040 – a 9x increase on recent growth.**

Delivering clean energy at this scale around the country will require connecting diverse renewable energy resources with investment in new and strengthened transmission networks supported by intraday and long-duration energy storage.

To meet the scale of renewable energy expansion required, vast areas of land will be needed. Genuine free prior and informed consent of First Nations people must be obtained. FPIC is explicitly recognised by the UN declaration on the Rights of Indigenous Peoples which was endorsed by Australia in 2009. Beyond this, First Nations people should be engaged in partnerships that involve effective and meaningful participation including the option to hold equity stakes in renewable export projects.

Figure 18: A 6x increase in electricity generation would be required by 2040[1]

Australian electricity 2020 generation, 2040 demand, TWh



Sources: 1. DISER (2021), *Australian Energy Statistics, Table O* 2. AEMO (2021) *Inputs, Assumptions and Scenarios Report*, Accenture analysis
Note: 2040 demand incorporates AEMO's estimate of NEM underlying demand and Accenture estimates of the additional Australia-wide electricity demand including the green steel, aluminium and hydrogen opportunities identified in this report

Clean energy exports depend on low-cost, firm renewable electricity

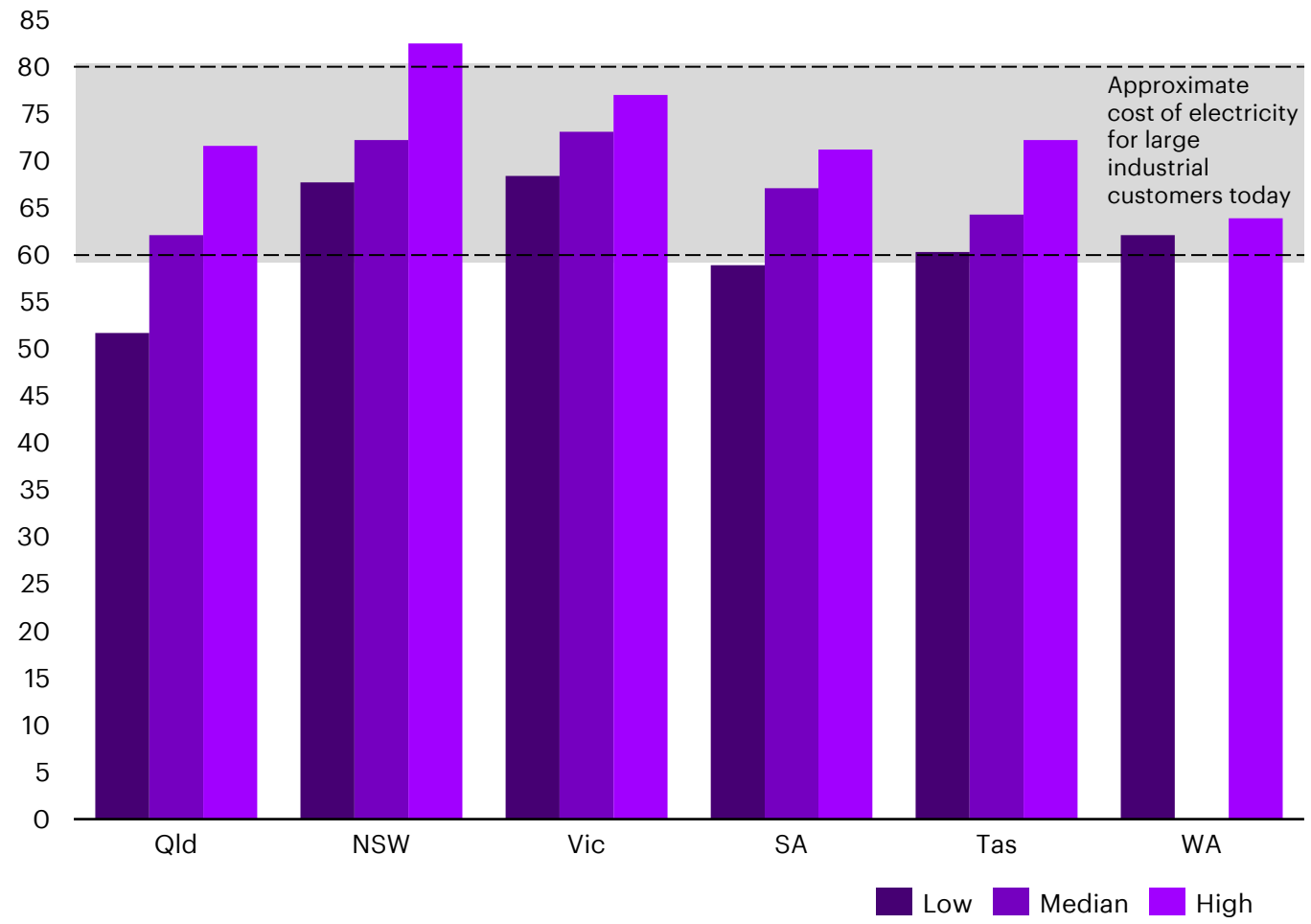
Recent CSIRO analysis indicates that the long-term levelised cost of firm renewable electricity is potentially in the range of $53-83/MWh by 2040, bringing firmed renewables into line with electricity prices paid by the largest industrial customers today.

CSIRO has also flagged opportunities to develop the electricity system in ways that would push costs even lower:

- Using batteries in electric vehicles to balance the grid ('vehicle-to-grid') would see lower overall system costs.
- Flexible hydrogen production connected to the National Electricity Network could lower the overall storage needs of the system, resulting in even lower overall long-term electricity costs.

Figure 19: Australian locations are expected to provide firmed renewable energy at competitive costs

Levelised cost of firmed renewables, 2040, by state and zone (A$/MWh)[1]



Source: 1. Energy Transition Initiative / CSIRO (2021), Accenture analysis

Australia's renewable energy growth is slowing

Renewable electricity is critical for attracting investment into clean export production in Australia, but the rate of new large-scale renewables connecting to the grid appears to be slowing.

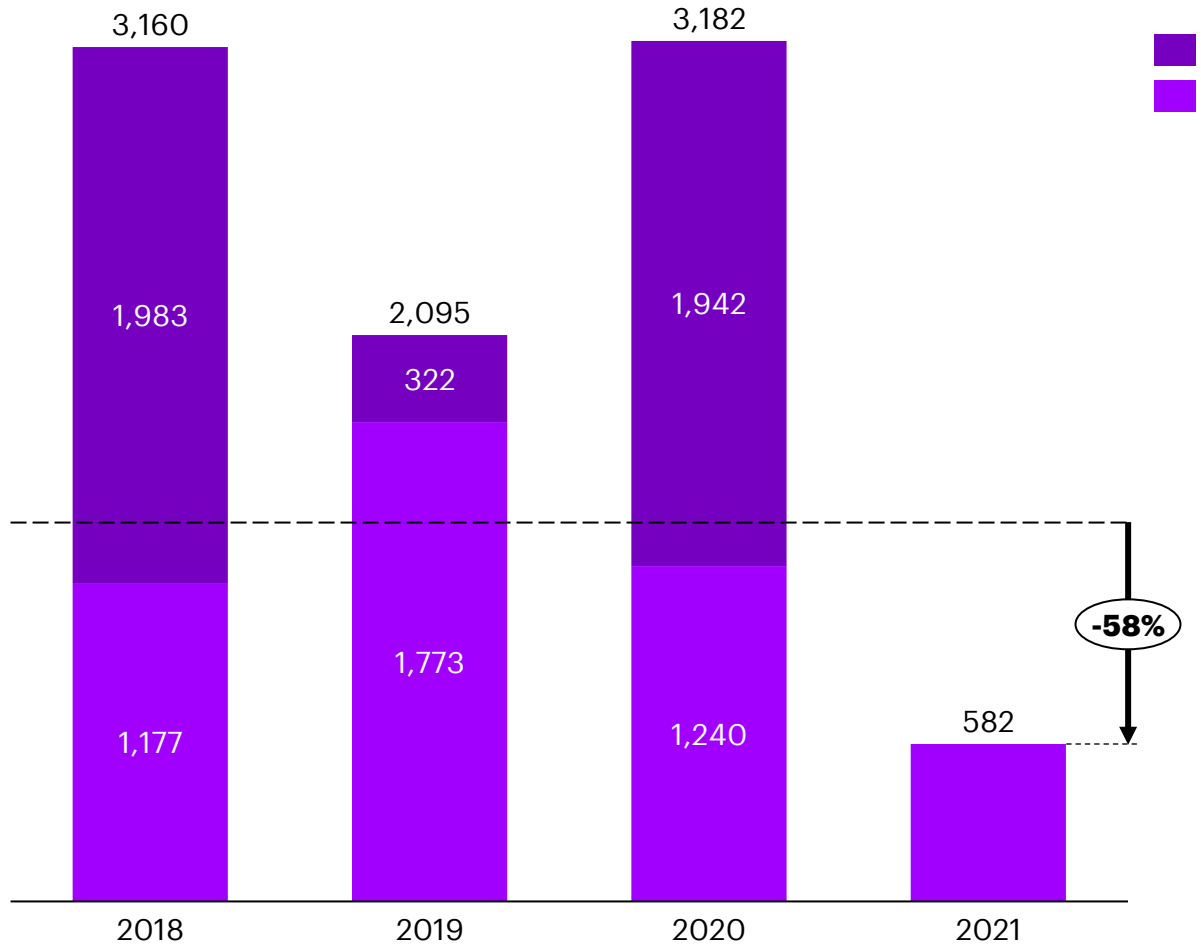
New renewables connecting to the National Electricity Market in the first half of this year fell to their lowest level in recent years.

Investment data tells a similar story. The Clean Energy Council reports that investment in large-scale renewable energy projects slowed from 51 projects worth $10.7B in 2018 to 28 projects worth $4.5B in 2019.[2]

Lack of a clear policy framework and recent challenges with grid connections and network constraints have contributed to this slowdown.

Figure 20: New renewable energy capacity connected to the National Electricity Market[1]

MW



Source: 1. AEMO (2021), *Quarterly Energy Dynamics (2018-2021)*, Accenture analysis 2. Clean Energy Council (2020), *Clean Energy Investment collapses as risks and uncertainty mount*

A cost gap remains between traditional and clean technologies today

Hydrogen from renewables is nearly twice as expensive as fossil fuel derived hydrogen today.

In Australia, it costs $2.20 per kg to produce hydrogen from natural gas. In comparison, producing hydrogen from renewables costs around $5.20 per kg today.

Achieving lower costs for renewable hydrogen will be driven by three factors: declining costs for renewables, higher deployment of electrolysers, and technical improvements in electrolyser efficiency.

Producing green steel using hydrogen is around 20% more expensive than the typical market price for steel.

In steel production, hydrogen is used for process heat but can also act as a reductant. At an electricity cost of $50/MWh, hydrogen DRI is around 20% more expensive than the typical market price of steel. Where electricity costs are close to $20/MWh or less, green steel can be cost competitive. Using hydrogen in steel production requires an uptake of lower emissions manufacturing, a premium for green metals, or lower electricity costs from hydrogen.

Figure 21: Cost gap for renewables-based hydrogen in Australia[1]

2020, A$/kg

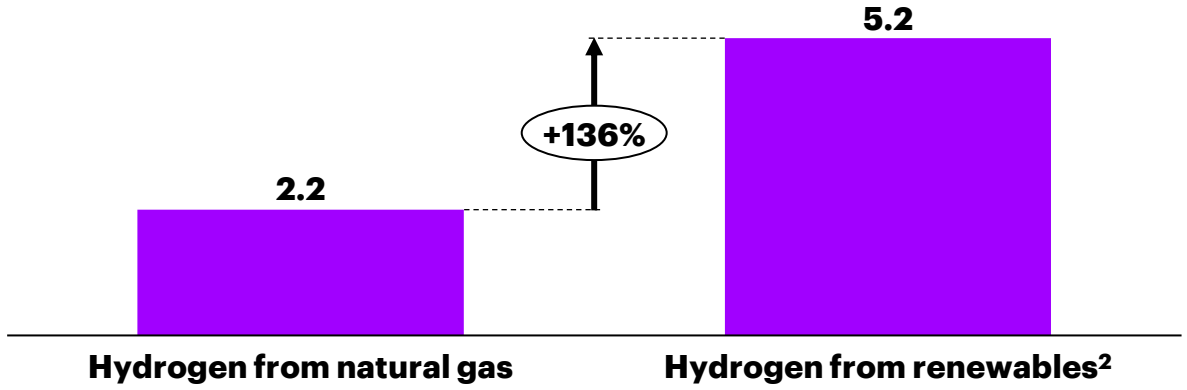
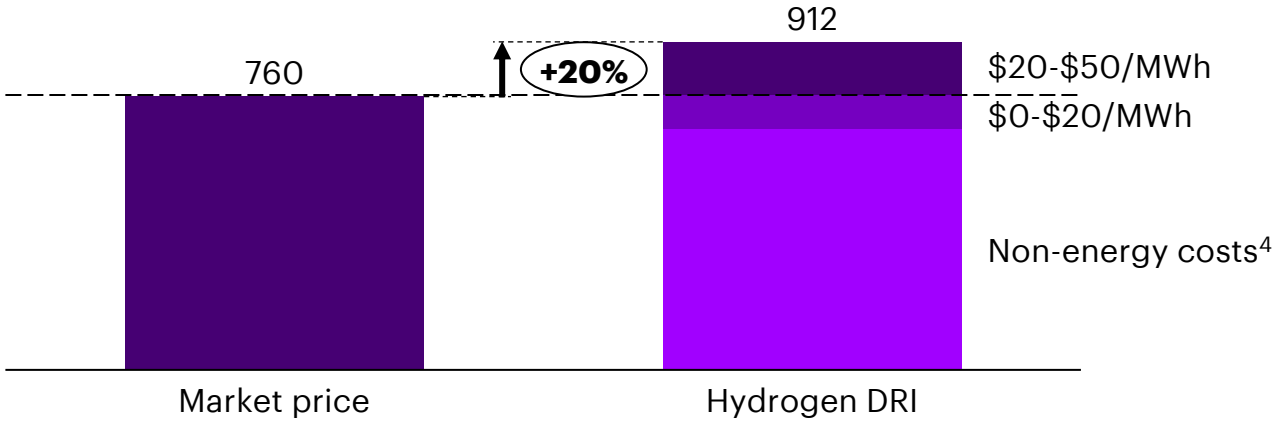


Figure 22: Cost gap for steel produced with hydrogen[3]

2020, A$/tonne



Sources: 1. Energy Transitions Initiative (2021), *Phase 1 Technical Report* 3. Rocky Mountain Institute (2019), *The disruptive potential of green steel*
Notes: 2. Assumes PEM electrolysis using renewables PPA 4. Non-energy costs include the cost of iron ore and labour.

There is some policy support for clean energy exports, but no comprehensive strategy and few measurable targets

Australia has a range of policies to support clean energy exports, though there are gaps.

Hydrogen has the most comprehensive policy support, underpinned by the National Hydrogen Strategy and state strategies in NSW, WA and VIC. The Commonwealth has set a target of "H2 under $2" and ARENA's new Investment Plan targets support for hydrogen.

Batteries is the least progressed opportunity area. The main initiative by the Commonwealth is the creation of the FBICRC. WA is the only state with a battery industry strategy.

Green steel is included in the Low Emissions Technology Roadmap with cost targets for production (less than $900 per tonne). The federal government has provided some funding for feasibility studies and ARENA's latest Investment Plan includes support for green metals.

Critical minerals has a strategy at the national level, focused on attracting investment into Australia. Various forms of financial support have been provided, but there are no specific targets.

None of the policies are at the level required to unlock the potential discussed in this report. Existing policies have been factored into the BAU scenario.

Figure 23: Current policy landscape in Australia

In clean export sectors covered by this report

Opportunity	Government	Strategy	Measurable targets	Financial support: Targeted[1]	Financial support: Volume[2]	Example policies and actions[3]
Renewable energy hydrogen & ammonia	Federal	✓	✓	✓	$$	• National Hydrogen Strategy, CEFC Advancing Hydrogen fund, ARENA Investment Plan
	NSW	✓	✗	✓	$$	• Net Zero Industry and Innovation Program
	VIC	✓	✓	✓	$	• Renewable Hydrogen Industry Development Plan
	WA	✓	✓	✓	$	• Renewable Hydrogen Strategy
	QLD	✓	✗	✓	$	• Queensland Hydrogen Industry Strategy
Green steel	Federal	✓	✓	✓	$$	• Low Emissions Technology Roadmap, ARENA Investment Plan
Batteries	Federal	✗	✗	✗	$	• Establishment of FBICRC
	QLD	✗	✗	✗	-	• N/A
	VIC	✗	✗	✗	-	• N/A
	WA	✓	✗	✓	$	• Future Battery Industry Strategy
Critical minerals	Federal	✓	✗	✗	$	• Critical Minerals Strategy
	NSW	✓	✓	✓	$	• Minerals Strategy
Services	Federal, state and territories	✗	✗	✗	-	• There are few strategies, targets or financial incentives to support services or education and training exports
Education & training	Federal, state and territories	✗	✗	✗	-	

Notes: 1. Targeted evaluates whether the financial support is specific to the export opportunity. 2. Level of available funding where '$$$' indicated funding is level aligned to policy case and '-' indicates no or minimal funding. 3. See appendix for more details.
Source: Accenture analysis

A national clean exports strategy with clear targets backed up by credible policies is required

Given the **cost gaps** today between clean and fossil fuel technologies and the **scale** of the required renewable energy build, we need a **package** of policies and actions.

A national strategy with clear targets would put in place the fundamentals for the clean exports sector to develop.

A national strategy would:

- catalyse investment in renewables and the full range of export opportunities
- put in place the necessary infrastructure
- support research and development
- develop the long-term skills required

to take advantage of growing global demand for clean energy commodities, goods and services.

The vision: a national strategy

A **national clean exports strategy**

A cooperative, unifying national approach bringing together governments, industry, unions, First Nations people, R&D and the education sector

with **clear targets**

Growth targets to galvanise the industry and signal our national ambition to the world

backed up by **credible policies**

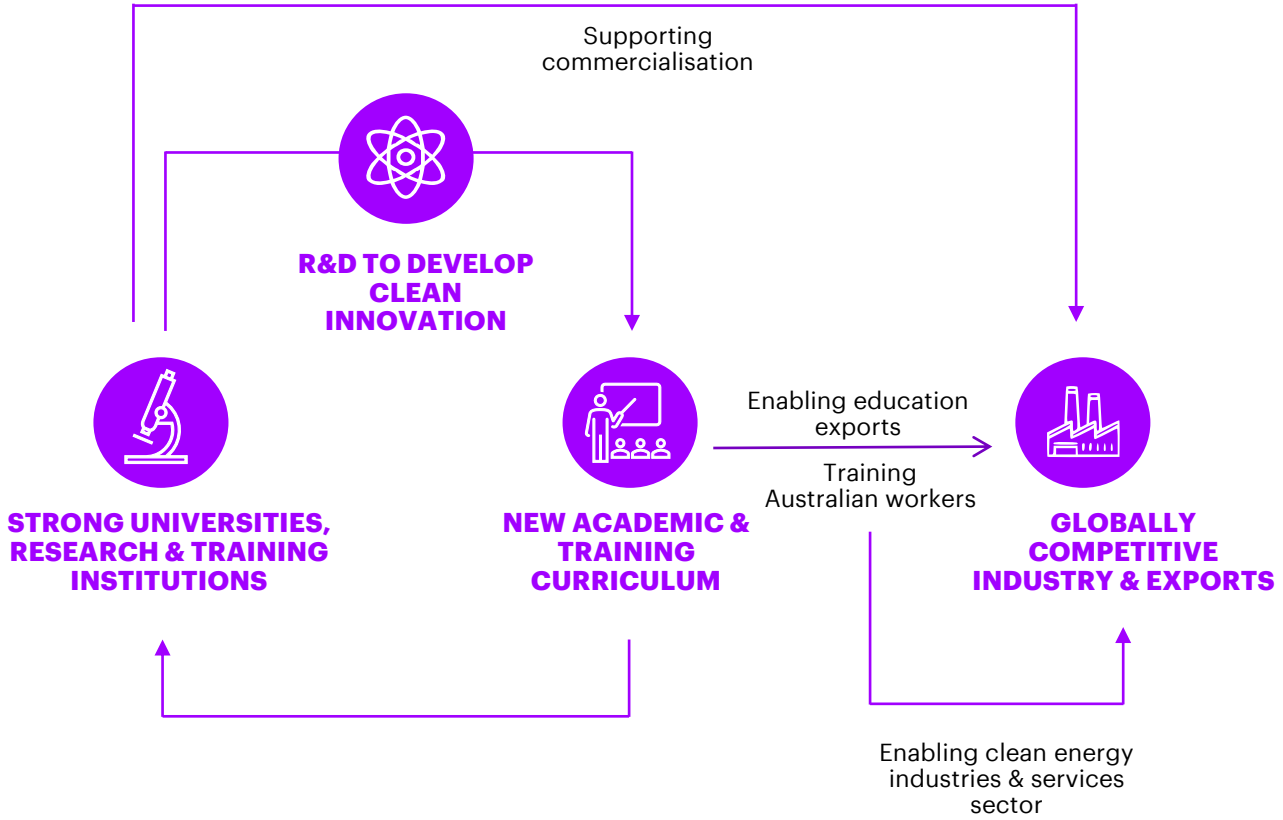
Co-investment, financial incentives and innovative policy solutions to catalyse investment in clean exports at scale

Strong research and education institutions will be essential to delivering the national clean exports strategy

Universities and research institutions have a critical role to play as key clean energy stakeholders. Universities enable new capacity through new research and insights and can provide effective solutions to complex clean energy problems.[1] Australian universities have a strong legacy in leading renewable energy research, with the establishment of the University of New South Wales' Solar Photovoltaics Group and beginning of solar energy research at Australian National University in the 1970s. In addition, Australian universities provide a regular supply of highly skilled people who develop and implement solutions to clean energy barriers.

A holistic approach to scaling new clean industries must include strong investment and coordination with Australian universities and key research institutions such as CSIRO to promote cutting-edge research and innovation, develop new academic and training curriculum, and enable a skilled clean energy workforce.

Role of Australian Universities, training and research institutions



Source: 1. European Universities Association (2017), Energy Transition and the Future of Energy Research, Innovation, and Education

Five significant policies and actions are required for Australia to capture the clean exports opportunity

01

Coordinated investment in 7 clean export precincts

By coordinating investment in clean energy and export industries, governments can link Australia's low-cost renewable energy resources to clean exports at precincts around the country.

02

$10 billion co-investment in new industries

By co-investing using grants, debt, equity or carbon contracts for difference (CCfDs), governments can directly support flagship projects to accelerate the scale-up of Australia's clean export industries.

03

$5 billion fund for workers and regions delivered by a new energy transition authority

A new fund overseen by a dedicated authority with representatives from government, industry and unions will help manage the disruptive impacts of the transition on workers and regions with carbon-intensive industries.

04

Support for low-carbon materials in major infrastructure projects

An immediate new program to support the use of low-carbon materials in buildings and major infrastructure projects would boost domestic demand, supporting new manufacturing capacity and laying the foundation for exports.

05

An interim target of 6 GW of hydrogen capacity and 3 green metals plants by 2027

Setting an ambitious target as part of a national strategy will galvanise collaboration between governments, industry, unions and the research and education sector to grow Australia's clean export industry.