



All systems go: Powering ahead

Australia's economic
opportunity from trading
in global decarbonisation

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Deloitte
Access Economics

This report has been commissioned by National Australia Bank Limited to quantify the structural changes and economic opportunities over the next 30 years to position Australia's economy for growth in a low-emissions world. The report has been prepared by Deloitte. All findings and views expressed in the report are those of Deloitte.

Foreword

A great deal has changed in the 12 months since the first *All Systems Go* report, which found that Australia's economy needs to be structurally different and requires a significant reallocation of capital investment to transition to net-zero by 2050.

Legislation of national emissions reduction targets has motivated Australian governments, industry and businesses to take greater action on climate change. This includes expanding the Safeguard Mechanism, commitment to develop sectoral decarbonisation plans, federal and state government renewable energy investments and more businesses having set net-zero goals.

Beyond our shores, advanced economies have kicked-off ambitious decarbonisation plans propelled by compelling government policy settings, funding, and investment mandates.

At the same time, we're seeing the signs of accelerating climate change around the world, unleashing devastating human, environmental and social harm.

The product of these changes is manifesting in a global sense of urgency to transition economies faster, effectively starting a global race to attract the resources needed: talent, technology, and capital.

This new report commissioned by NAB, *All Systems Go: Powering Ahead*, considers Australia's economy within the context of a global market that is thirsty for renewable energy resources, which Australia has in abundance: sun, wind and critical minerals.

It recognises that these natural endowments, alongside other low-emissions products and services, present huge export potential for Australia and will become the bedrock of Australia's future economic prosperity, as traditional exports decline.

But to lower the economic cost of transition and set up our economy to capitalise on the opportunity before us, what we achieve from now to 2030 is critically important.

If all Australia does is what's necessary to hit our targets, by 2050 Australia risks becoming a materially poorer country than we are today.

Avoiding this calls for significant coordination of public and private planning and investment to transform and replace industries that have been at the centre of our historic economic growth and to create a new green industrial base for export to seize Australia's share of global demand for low emissions energy and minerals as economies become net zero.

The task ahead is immense, but crucial. Australia will need to build fast to export decarbonisation to the world and these opportunities can only be realised through necessary local changes.

We need to bring down lead-times for renewables production, storage and transmission projects. We also need to ensure we have the labour to build them, as well as improved consultation and a consistent national framework for decision-making that delivers major green infrastructure projects that have widespread community support.

NAB has a critical role to play in funding and supporting Australia's transition to net-zero and will keep backing our customers to realise the opportunity.

This report highlights not only the scale of the challenge and opportunity for Australia in the climate transition, but also what we stand to lose if we don't leverage our natural advantages to go further and establish a compelling green industrial base for export to the rest of the world.

How Australia transitions matters, and we need to get it right.



A handwritten signature in black ink, which appears to read 'Philip Chronican'. The signature is fluid and cursive, with a small dot at the end.

NAB Chair Philip Chronican

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Insights

There is a \$435 billion opportunity for Australia's economy from competitively trading in global decarbonisation^a.

Australia's path to net zero requires investment and a shift in where capital investment flows. As outlined in the first *All Systems Go* report in 2022, the reallocation of capital away from emissions-intensive assets towards low-emissions technology represents both a necessary cost and a new area of opportunity for Australia.

In the past year, increased policy certainty offered by Australia's emissions reduction and renewable energy targets has started to drive the needed investment shift. At the same time, businesses, particularly in emission-intensive sectors, are working hard to achieve their decarbonisation targets as the impacts of climate change hit. And with the world likely to reach 1.5°C of warming earlier than expected, the costs of a protracted transition are rising fast.¹

As the climate heats up, so too does the competition for investment, talent and technologies that will deliver global decarbonisation. Assets that depend on fossil fuels must increasingly be replaced to meet global climate targets.

As economies race to do this at home, they are also chasing a share of new global green industries^b to drive innovation and growth. How this plays out across supply chains and impacts trade will determine the economic cost and opportunity from transition for Australia.

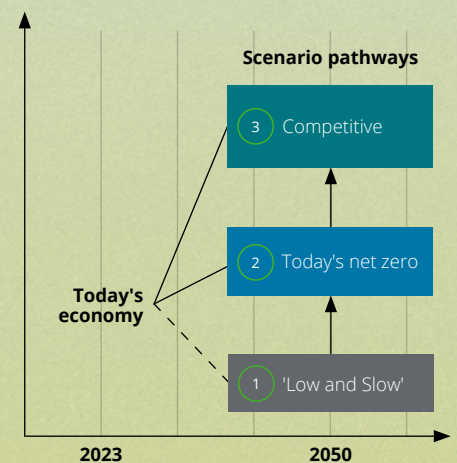
This report identifies how Australia can lower transition costs and boost the competitiveness of green industries to realise export opportunities offered by a net zero world. Australian green industrial activity can power ahead to create a \$435 billion economic opportunity.

^a \$435 billion is the net present value to 2050 of the incremental change in Gross Domestic Product (GDP) of "Competitive Decarbonisation" compared to "Today's net zero".

^b Referring to the supply chains and industry capabilities of renewable energy, green hydrogen, critical minerals, and metals manufacturing in this report.

Modelling the economic impacts of Australia trading in global decarbonisation

Figure 1 – Economic scenario framework used in this report



1

'Low and slow' baseline

The baseline economic outlook represents no further policy action to meet net zero. Lower emissions reduction and slower technology change characterise the economy. Average global warming exceeds 2°C as Australia and the world is not net zero by 2050. ➔

Trade in goods that reduce emissions is an important feature of achieving global net zero. Australia will need to diversify exports and increase industrial competitiveness to lower the cost of transition.

The setting of net zero targets will not, by itself, increase Australia's competitiveness in green technologies and related industrial exports. To get the full opportunity of net zero, Australia will need to overcome some hard economic truths to level the global playing field on which we compete.

Australia's prosperity has materially relied on global demand for emissions-intensive natural resources. The scale of transformation needed to restructure the economy for growth in a decarbonised world will be relatively expensive because of this. Australia's high-risk exposure to climate change impacts also increases mitigation and adaptation costs. With these structural challenges, Australia's current industrial base, as an enabler of decarbonisation efforts and a basis to grow exports in a net zero world, isn't very competitive.

If this dynamic plays out, Deloitte Access Economics' estimates that Australia may not reach its economic potential under today's net zero policies and exports could decline by \$270 billion (relative to the low and slow baseline, Figure 1).^c This means Australia's economy will not have transformed enough to meet surging global demand for low-emission goods which must look elsewhere to be satisfied.

Importantly, this is not a simple story of coal export decline. Export decline is also driven by a lack of competitiveness in renewable energy manufacturing and slower growth in alternative exports beyond traditional mining. Australia needs to quickly replace high-emissions activities with low-emissions ones.

To do this, Australia first needs to look inward and get its domestic policy and demand settings right. This can see Australia expand activity across new green industrial supply chains. By both replacing and expanding green industrial activity,

^c The scenario framework for this modelling is summarised in Figure 1 and detailed in the Appendix. This figure provides the net present value to 2050 of the incremental difference between 'Today's net zero' in reference to the 'Low and slow' baseline.

2

Today's net zero

Australia's economy meets current targets to reduce emissions by 43% in 2030 and is net zero by 2050. Scenario represents achieving 'today's net zero policies' that are announced to deliver future decarbonisation. Global average warming is limited to 'well below 2°C' as the world is net zero by 2050.

3

Competitive decarbonisation

Most scenario variables are the same as 'Today's net zero'. But Australia competitively decarbonises via increased investment and productivity in energy, green hydrogen and critical minerals and related metals manufacturing. Australia creates new export opportunities with expanded supply chains.



Australia can increase total exports and achieve a wider distribution of economic opportunity. Deloitte Access Economics estimates that, by doing this, Australia can turn an otherwise declining export outlook into an increase in economy-wide export opportunities of \$255 billion for Australia.^d

The economic opportunity in transitioning Australia to net zero emissions is immense. But global competition means Australia must step up

Backed by \$120 billion in capital investment, Australia's energy and raw materials manufacturing systems^e expand their economic output and productivity in the modelled scenario to generate economic growth.^f

As Australia steps up to meet its 2030 renewable energy target, the energy system and its infrastructure transforms substantially in the modelled scenario. Industrial processes and manufacturers that draw from this increased supply of renewable energy are better positioned to further adopt low-emissions technology across supply chains for productivity improvements.

From 2030, Australia can take advantage of this transformation and surging global demand created by the need to rapidly replace emissions-intensive assets. Productivity and innovation across connected supply chains and emergent technological processes in Australia's green industrial sectors grows export opportunities by \$420 billion by 2050. Green industrial exports are what drive a net increase in Australia's total exports – they not only replace lost economic output from emissions intensive activity but create new growth.

Achieving net zero emissions at a lower cost, via innovation and productivity from green industries, also grows the services economy. Services are crucial in enabling decarbonisation and driving economic benefits – with services growing by \$215 billion from Australia's stronger trade position by 2050.

Australia has many elements of what the world needs to meet global climate commitments. The challenge is to ensure the world can buy it from us

From developing critical mineral supply chains to a scaled green hydrogen industry, additional policy mechanisms and ramped-up private investment is needed for Australian green industrial activity to power ahead.

An unprecedented shift is needed to build out competitive elements of green industrial value chains for export opportunities and to keep up with the sophisticated green industrial bases of Europe, China, and the United States.

This report explores strategic measures Australia can adopt to enhance its position and grow exports by 2050. Such actions include increased investment into the commercialisation of low emissions technology research, expanding and establishing interconnected public incentives^h for renewable energy and green manufacturing, providing robust support to green manufacturing startups, and streamlining the regulatory processes related to energy transmission investment.

^d Net present value of additional total exports (net both growing and declining exports) in 'Competitive Decarbonisation' compared to 'Today's net zero'.

^e Economic systems share common elements, like supply chains, and these overlaps create interdependencies important to decarbonisation. For example, decarbonising the energy system will significantly decarbonise the manufacturing system.

^f Net present value of additional investment in 'Competitive Decarbonisation' compared to 'Today's net zero' by 2050.

^g Net present value of additional green industry exports in 'Competitive Decarbonisation' compared to 'Today's net zero' by 2050.

^h For example, manufacturing firms can access incentives to implement renewable energy, and this directly links to other incentives to adopt supplementary low-emissions technology for other production processes not reliant on electricity.



\$435 billion

total economic opportunity

from trading in global decarbonisation

2023

2050

Note: \$435 billion is the net present value to 2050 of the incremental change in Gross Domestic Product (GDP) of 'Competitive Decarbonisation' compared to 'Today's net zero'.

Australia lowers the transition cost

Renewable energy, green hydrogen, critical minerals and metals manufacturing define Australia's green industrial potential



Note: All figures represent the net present value of the incremental change of 'Competitive Decarbonisation' compared to 'Today's net zero' by 2050. The \$255 billion export figure represents all industry exports for Australia. This total export figure is a 'net' figure, capturing both declining exports (e.g. coal) and growing exports (e.g. critical minerals).

A new dynamic for Australia in the global race to net zero

Lowering the economic cost

Australian business and governments are focussed on the implementation of net zero policies to reduce emissions while maximising economic benefits and minimising transition costs. Seven years remain for Australia to meet its target of 82% renewable energy share in the National Electricity Market (NEM) and be on track to reduce emissions 43% below 2005 levels by 2030.

With that goal comes the realities of reducing emissions, driving renewables in the network, keeping the lights on, while at the same time driving down transition and economic costs. Within this dynamic, Australia now confronts a global acceleration towards net zero with increasing global competition for financial, physical and human capital to drive the domestic transition.

This challenge can only be met by driving the economy harder and faster to net zero in a way that also establishes the conditions for an economy at the forefront of a global demand for less emission-intensive goods and services. Just as Australia's economy has historically prospered from mining and producing what the global economy needs, this can also be the position the Australian economy takes to meet global market conditions for a net zero future.

Competitive global landscape

Australia's economic success story is defined by the mining, agriculture and tourism industries creating great wealth during the past three decades. These industries underpin Australia's geographically dispersed population, exports and labour market, as well as other industries such as construction, manufacturing and retail trade.

The world has wanted what Australia has to offer and China's push for development has created an unrelenting demand for Australia's natural resources. While Australia has benefited from its natural advantages, economically this has meant Australia has been too dependent on a few activities rather than developing diverse and sophisticated global supply links.² With a lower level of economic sophistication, Australia has limited networks for the competitive production of new goods and services demanded by the world. This economic starting point impacts Australia's position in the global race to net zero.

Assets and activities that depends on fossil fuels must be replaced to meet global climate targets. As economies race to do this at home, they are also chasing a share of new global green industries to drive innovation and growth. This increasing competition will ultimately determine which economies have a lower cost of transition because they have come out on top.

In response to rising competitiveness, the United States Congress, for example, has passed significant and ambitious climate legislation. The Inflation Reduction Act of 2022 (IRA) and investments to bolster semiconductor capacity and establish high-tech hubs via the CHIPS and Science Act of 2022 reflect a new reindustrialisation movement in the US. These policies, as well as the industrial policy landscape in Europe and China, are rippling through the global economy and give bold first movers a distinct advantage in attracting the right economic mix to deliver domestic and global decarbonisation (via exports).

Why does the IRA matter?

The IRA contains over US\$369 billion (AU\$520 billion) worth of programs and funding. The collective investment will have three broad effects. First, it incentivises deployment of clean energy for a step change in industrial decarbonisation. Second, it creates a system of cascading incentives that transform the economics of clean energy manufacturing. The US is likely to become a major player across key clean energy value chains from renewables to batteries and green hydrogen as a result. Finally, scaled investment into technologies will dramatically reduce clean energy and green finance costs. This creates an easier path to net zero and other countries can benefit from US-led green innovation.



All Systems Go

Previous analysis for NAB in [All Systems Go](#) (2022) highlighted that a significant flow of new capital investment is needed to realise the economic opportunities of net zero, but that sufficient capital will not be mobilised through isolated transactions.

A systems approach recognises the interdependencies of actions to reach net zero at least cost. Interconnected systems made up of existing and new industries are now being reset through the rapid adoption of new technologies and shifts in operating processes. New and old industries can form a series of complex, interconnected and emissions-free systems – energy, mobility, raw materials manufacturing and food and land use systems.

The economic system construct is used in this analysis with a specific focus on the energy and material manufacturing systems and their role in generating green industrial activity.

Figure 2 – Four key economic systems for Australia's path to net zero



The **energy system** is critical to how everything in the economy functions. The system's core industries relate to energy generation, but the system also includes upstream industries such as resource exploration and extraction, related manufacturing (e.g. solar panels) and construction (e.g. new generation assets) and downstream industries such as electricity distribution.



The **mobility system** encompasses all transport functions and the inputs required (i.e. fuels, car manufacturing). The transformation of the mobility system will require the near-complete replacement of the vehicle fleet with the systems approach factoring in the emissions of inputs and processes required to achieve this.



The **materials manufacturing system** provides vital inputs to all aspects of the economy. The system includes hard-to-abate operations, which currently have few viable low-carbon alternatives. Cement, steel, aluminium, and other hard-to-abate heavy industries could see much wider use of green hydrogen and electrification, with on-site carbon-capture technology playing an important role.



The **food and land use system** feeds the world. The system contributes significantly to emissions through livestock husbandry, crop burning, and deforestation. The transformation of the food and land use system is expected to see the system go from being a significant contributor to emissions to a net carbon sink.

Source: Deloitte Access Economics



Trading up for a green industrial revolution

With the right mix of innovation and policies in place, the world can achieve a green industrial revolution by 2050—giving rise globally to new growth industries, more and new jobs, and new technologies as the worst impacts of climate change are avoided. This offers a win-win for the climate, the global economy and Australia's growth outlook.

But a new economic growth dynamic is needed for Australia to fully benefit from this global shift. Significant transformation is required to restructure the economy away from high-emitting, extractive industries and processes. This change will be costly to the economy. Such transition costs are exacerbated by Australia's high exposure to climate change, bringing with it increasing disruption to business continuity, in addition to adaptation costs. Adding to these structural challenges, Australia's current industrial base isn't competitive enough to support decarbonisation at home or abroad.

A failure to overcome these challenges will hold Australia back from the growth opportunities of transition to net zero. Deloitte Access Economics estimates that, if Australia does not overcome these challenges, under today's net zero policies, exports could decline by \$270 billion by 2050.¹

To avoid this outcome, Australia must go beyond merely replacing emissions-intensive activities and position the economy to meet global market conditions for a net zero future. A dual focus in transitioning away from emissions-intensive activity while fostering increased export activity in green industries can achieve a greater distribution of economic prosperity from decarbonisation. In this report, green industrial activity refers to the supply chains and industry capabilities of renewable energy, green hydrogen, critical minerals, and metals manufacturing in this report.

The analysis in this report uses economic scenario modelling and identifies how Australia can lower the cost of transition and boost green industrial competitiveness to realise the export opportunities in a net zero world

¹ The scenario framework for this modelling is summarised in Figure 3. This figure provides the net present value over the period to 2050 of the incremental difference between 'Today's net zero' in reference to the 'Low and slow' baseline.

Economic modelling in this report

Understanding the results

Previous Deloitte Access Economics analysis for the Business Council of Australia concluded inaction on climate change could cost Australia's economy \$3.4 trillion in lost GDP over the next 50 years. Compared to this path of inaction, the economic dividend of reaching net zero is a gain of \$890 billion to Australia's economy by 2070.

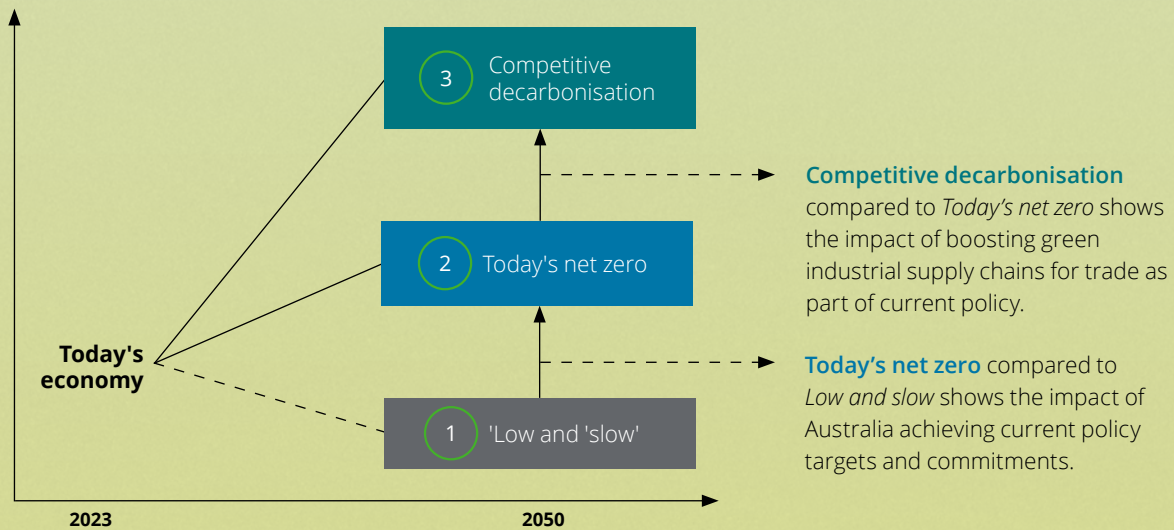
This analysis established that the advantages of addressing climate change far exceed the costs of doing nothing. Today, there is a growing focus on optimising the implementation of net zero policies to maximise economic benefits and minimise transition costs. This shifts the scenario framework adopted for economic modelling to analyse net zero policy impacts.

In establishing an economic framework, Deloitte Access Economics no longer considers an "inaction" path a viable baseline. There is global momentum in lower emissions technologies which will continue regardless of policy action and renewable energy will continue to increase.

Scenario analysis should now examine the potential for achieving a lower cost transition for Australia against a new baseline – a 'low and slow' path to net zero, which considers no further action beyond what is in place today (Figure 3). This framing demonstrates the relative economic costs and benefits of specific policy actions to meet net zero emissions (e.g., today's net zero policies), and what additional economic settings can maximise economic opportunity for Australia (e.g., competitive decarbonisation policies).

Figure 3 – Economic scenario framework

Scenario pathways



1 'Low and slow' emission reduction baseline

The baseline economic outlook represents no further policy action from today to meet net zero. Lower emissions reduction and slower technology change characterise the economy. Average global warming exceeds 2°C as Australia and the world is not net zero by 2050.

2 This report's baseline: Today's net zero

Australia's economy meets current targets to reduce emissions by 43% in 2030 and is net zero by 2050. Scenario represents achieving 'today's net zero policies' that are announced to deliver future decarbonisation. Global average warming is limited to 'well below 2°C' as the world is net zero by 2050.

3 This report's scenario: Competitive decarbonisation

Most scenario variables are the same as 'Today's net zero'. But Australia competitively decarbonises via increased investment and productivity in energy, green hydrogen and critical minerals and related metals manufacturing. Australia creates new export opportunities with expanded supply chains.

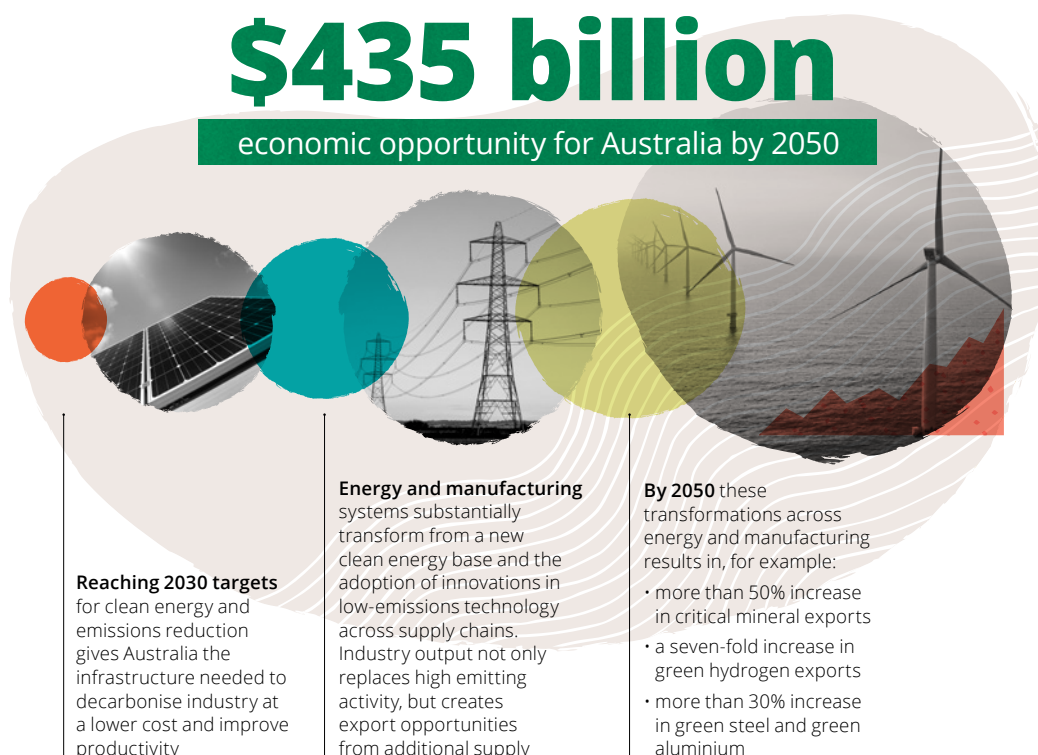
Australia's economic opportunity from trading competitively

Deloitte Access Economics estimates a \$435 billion opportunity for Australia's economy from competitively trading in global decarbonisation by 2050.

This result is driven by additional policy mechanisms and private investments, which ensure Australian green industrial activity powers ahead and creates competitive trade advantages.

Figure 4 represents a summary of the phased step up in investment, productivity and export activity from 2030 that results in Australia establishing a more globally competitive green industrial base. This ramp up secures Australia's \$435 billion opportunity by replacing high emitting activity (which historically drives growth) across the economy such that Australia can meet surging global demand for low-emissions goods.

Figure 4 – Step change from 2030 drives Australia's economic growth opportunity

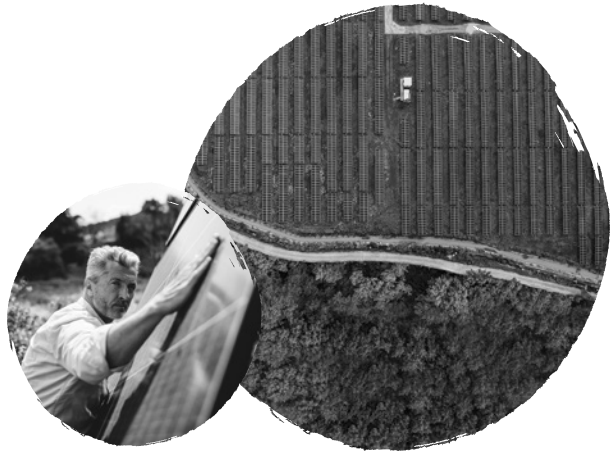


Note: Green hydrogen expands from a base of no current production. Further discussion on the limitations, opportunities and policy actions needed to create green hydrogen can be found in Deloitte's 2023 global green hydrogen outlook, [link available](#).

Source: Deloitte Access Economics

ⁱ \$435 billion is the net present value to 2050 of the incremental change in Gross Domestic Product (GDP) of 'Competitive Decarbonisation' compared to 'Today's net zero'. All figures presented in this section are a net present value of 'Competitive Decarbonisation' scenario outputs compared to 'Today's net zero' scenario. Refer to Appendix A for details of scenarios modelled.

More than half of the economic opportunity for Australia is realised via the increase in green industry output (gross value added) from 2030, comprised of renewable electricity, green hydrogen, critical minerals, and metal manufacturing sectors. By 2050 these industries and their supply chains are integrated efficiently to form low-emissions energy and manufacturing systems. Improved productivity and sophistication in supply chains drives cost competitiveness and grows green industry output by an additional \$280 billion by 2050.



Australian green industry dividend



Notes: Figures are a net present value, assuming a discount rate of 2%. Green industrial activity refers to the supply chains and industry capabilities of renewable energy, green hydrogen, critical minerals, and metals manufacturing. For more details on the modelling methodology, please refer to Appendix A

Source: Deloitte Access Economics

This expanded economic capacity in green industries supports an increase to Australia's exports of about \$420 billion by 2050. This export growth turns an otherwise declining trade outlook into a net increase in overall export opportunities of \$255 billion for Australia's economy, demonstrating the importance of green industrial exports to replace declining emissions-intensive activity and catalyse new market opportunities for Australian products.

The success of global decarbonisation, whether partial or complete, will lead to a transformative shift in the structure of the world's economic landscape. For

Australia's economic prosperity, it is crucial businesses and supply chains adapt and capitalise on the emerging opportunities in this new global economy.

Given that Australia relies heavily on its export market to drive significant revenue for businesses and the overall economy, prioritising decarbonisation and industrial renewal efforts is vital.

Increasing Australia's share of global green industrial trade

By aligning Australia's decarbonisation objectives with its export markets, the nation can position itself as an indispensable partner in meeting the demands of the evolving global economy. This strategic approach will not only bolster Australia's long-term economic resilience but foster innovation within its industries.

There are several strategic measures Australia can adopt to enhance its position and grow exports in this context.

Table 1 – Summary of strategic actions Australia can take to trade competitively as the world decarbonises

Strategic actions	Accelerate to 2030	Compete in the race to global net zero by 2050
Tipping points: Activating the opportunity	<ul style="list-style-type: none"> • Crossing "deployment thresholds" will drive acceleration in the uptake of renewable energy and low-emissions tech 	<ul style="list-style-type: none"> • Harnessing the "four D's" – decarbonisation, digitisation, decentralisation and democratisation • Electrifying all households
Value carbon: Driving incentives to switch	<ul style="list-style-type: none"> • Delivering and expanding existing carbon market arrangements (e.g., Safeguard Mechanism, offsets) • Company reporting • Sectoral decarbonisation plans and targets 	<ul style="list-style-type: none"> • Aligning cross-border carbon valuation approaches • Finance facilitating capital reallocation • Capturing alternative revenue streams to reinvest in emerging industry development
Build: and build and build...	<ul style="list-style-type: none"> • Hitting Australia's 82% renewable energy target and expand the number of transmission lines built • Targeted common user, logistics and transport infrastructure to facilitate new exports 	<ul style="list-style-type: none"> • Demand for Australia's renewable electricity could increase 6x today's levels • Scaling up export supply chain systems
Connections: Australia's links to rest of the world	<ul style="list-style-type: none"> • Fostering a stable and high-yielding investment environment • Diversifying and strengthening trading networks 	<ul style="list-style-type: none"> • Attracting global capital to green industry expansion • Integrating with emerging supply chains in new markets • Lowering non-tariff barriers to trade via domestic demand
Capabilities: Putting Australia's talent to work	<ul style="list-style-type: none"> • Investing in skills and assets to actively drive change 	<ul style="list-style-type: none"> • Developing transferable experience in building out green industrial base to the rest of world, particularly the Asia Pacific region
Innovation: Commercialising at the cutting edge	<ul style="list-style-type: none"> • Focusing on the tech needed for hard-to-abate sectors • Financing approaches that bridge the aspiration-commercial gap 	<ul style="list-style-type: none"> • Deep decarbonisation of non-energy systems • Maturing negative emissions technologies to support 'beyond net zero'

Catalysing opportunity for Australia

On the path to net zero, Australia needs first to look inward and get its domestic policy and demand settings right.

Tipping points

Technology deployment of low-emissions systems is accelerating around the world. In many cases, deploying and scaling technologies is pushing renewable technology down cost curves.³ This is not a linear process. In many cases, crossing a '5% of market share deployment' triggers a virtuous cycle for renewable energy technology deployment.⁴

The Australian household is already a lot further along in its decarbonisation journey, compared with other regions, by rapidly installing rooftop solar. However, this varies between northern and southern regions. While there is significant further work in electrifying households and improving energy efficiency, this represents a key domestic demand signal in transforming other systems.

More broadly, economic systems will need to move in a coordinated way and to harness the trends of decarbonisation, digitisation, decentralisation and democratisation to take full advantage of this transition.⁵ This framework – the four D's – relies on the important roles that technology, system flexibility and the social dimensions play in an optimal net zero pathway for Australia. Digitisation can help to manage supply and demand across systems, while decentralised, "small machines" at the household or business level can increase flexibility and lower costs. Democratised decision making further underpins the need for coordination, and generates the social licence for tipping points to be crossed.

Value carbon

In many cases, the 'green premium' for emissions-reducing technology is too high for many parts of the Australian economy to switch. Actions to value carbon, both within companies, industries and driven by policy, are essential to align incentives more closely with the ongoing emissions reductions. Australia's current policy landscape currently focuses on implicitly valuing carbon through the Safeguard Mechanism.

Out to 2050, there will be an ongoing need to align these approaches across borders, to ensure Australia remains competitive in trade. Important early work this decade will ensure we are able to meet the standards and expectations of our trading partners.

Build

If one thing is clear, Australia will need to build fast to export decarbonisation to the rest of the world.

Renewables needs to be built at roughly 7GW per year to meet current levels of demand, up from a historical rate of 6GW during the past five years.⁶

But Australia can't just build renewable energy for domestic consumption. Sufficient renewable energy needs to be produced, using the right technologies in the right locations, to be able to export additional capacity, either directly through transmission lines or through energy-carrying commodities like hydrogen. This outcome requires a need to build more energy capacity, both at utility and decentralised scale, faster. This would see not just the share of renewable energy meet the 82% 2030 target, but also a *larger total volume* of renewable energy.

To accelerate the pace of systems transformation, there is a key role for all levels of government in streamlining regulatory approaches and accelerating approval processes while ensuring appropriate levels of environmental protection, conservation, community consultation and consideration of cultural heritage. Getting out of our own way will mean ensuring the reasonable removal of barriers that slow down the transition to a zero emissions economy, particularly in Australia's phase out of fossil fuels.

Connections

For the full activation of this opportunity, renewable energy supply chains, including critical materials and components, will need to be secured globally – Australia's export potential will only be realised when it can access the inputs needed to build the low-emissions systems described in this report. Further cooperation in lowering barriers to trade can make it attractive for countries to import Australia's green industrial products.

Attract global investment and accelerate access to capital

Global capital is mobilising behind decarbonisation. Global annual clean energy investment is expected to rise by 24% between 2021 and 2023, driven by renewables and electric vehicles.⁷ *All Systems Go* highlighted the capital requirements of Australia's transition to net zero. If Australia is to export decarbonisation, it will need to attract a lot more of this clean investment and much of it will be sourced from overseas.⁸

Some of Australia's largest trading partners have introduced climate policies that make them more attractive destinations for investor capital. The IRA has already had an effect, particularly on the economics of green hydrogen production. Much like what the IRA

has done for the US, Australia can place its bets and spur the domestic demand that will facilitate global competitiveness.

Despite this, and over the longer term, many large multi-nationals still look to Australia, particularly to develop experience they know will be applied in the rest of the region.⁹

Australia should coordinate the attraction of this capital alongside trading partners, to achieve mutually beneficial outcomes, where possible.

Capabilities: put Australia's talent to work

Around four of every five dollars in Australia's economy is produced in the services sector.¹⁰ Achieving net zero emissions in a more efficient and productive way will support jobs in the wider services economy. This is a truly inclusive transition, where a prosperity-focused transition enables well-paying jobs in the wider economy.¹¹

Three enabling sectors – **financial services, government and the technology sector** – are critical in facilitating and capitalising on an export-oriented transition:

- **Financial services** will likely fund much of the shift to a low-carbon economy. Australia can leverage its strong financial sector to mobilise resources and enable capital to flow to our natural advantages. It will need to finance flows across borders to rapidly buildout mature low-emission technologies and infrastructure. Accelerating the deployment of emerging technologies will also heavily rely on finance. Players across the financial services industry have a tremendous opportunity to support a variety of sectors that are poised for rapid growth in the coming decade.¹² ➔

- **Governments** at all levels will play an instrumental role, setting clean energy standards, emissions targets, carbon prices, and other regulatory and policy mechanisms. They will also act as a catalyst for rapid change through procurement (for example, electrifying vehicle fleets) and as an ecosystem architect, proactively building and nurturing the cross-cutting networks of public sector agencies, businesses, academics, NGOs, and citizens needed to collaboratively develop and rapidly scale innovative climate change solutions. At the same time, the public sector can signal leadership and commitment to decarbonisation by shifting their own operations to a more sustainable footing.
- **The technology sector** has a critical role to play in providing the digital infrastructure and solutions to enable a decarbonised economy. Additional investment into the commercialisation of low-emissions technology research, expanding and establishing public incentives for renewable energy and green manufacturing, and providing robust support to green manufacturing startups are important mechanisms to catalyse green industry output. With further technological advances and innovation, the relative cost to businesses of adopting these technologies decreases. Building on and continuing to support Australia's history of cutting-edge renewable energy technology development will be important for global decarbonisation as well as our own.¹³

Services will be crucial both in enabling decarbonisation across systems and in directly driving economic benefits – worth \$215 billion to the services sector by 2050. More broadly, the experience Australians develop in decarbonising the domestic economy will enable the decarbonisation of the economy at-large through these skills and service offerings.



Systems powering ahead

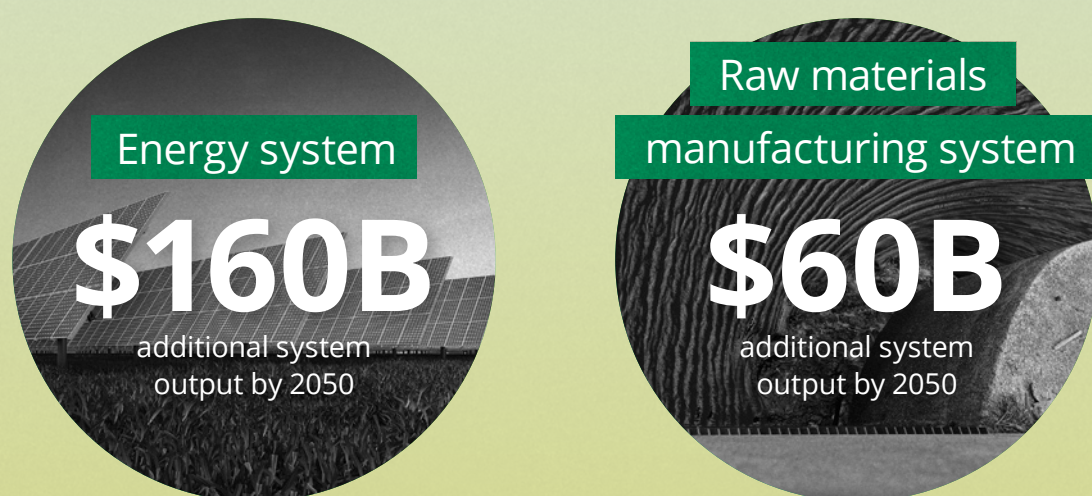
Australia has many elements of what the world needs to meet global climate commitments. The challenge is to ensure the world can buy it from us.

For Australia to seize the external opportunities offered by surging demand for low-emissions goods, all economic systems must decarbonise and position themselves to best capture growing global demand. This is especially true in staying competitive with the sophisticated green industrial bases of Europe, China, and the US, which now increasingly compete for global market share.

Australia's energy and raw materials manufacturing systems are core to domestic decarbonisation and net-zero targets. But external opportunities from Australia exporting green industrial goods are also linked to the performance of the energy and raw material manufacturing systems.

How these systems integrate to form low-emission supply chains and extend innovation spillovers, for example, increase the likelihood of Australia achieving a more competitive trade position. With a systems lens applied, green industry activity spread across energy and manufacturing result in an additional \$220 billion of output by 2050 (Figure 5).

Figure 5 – System opportunities from positioning Australia to best capture external advantages



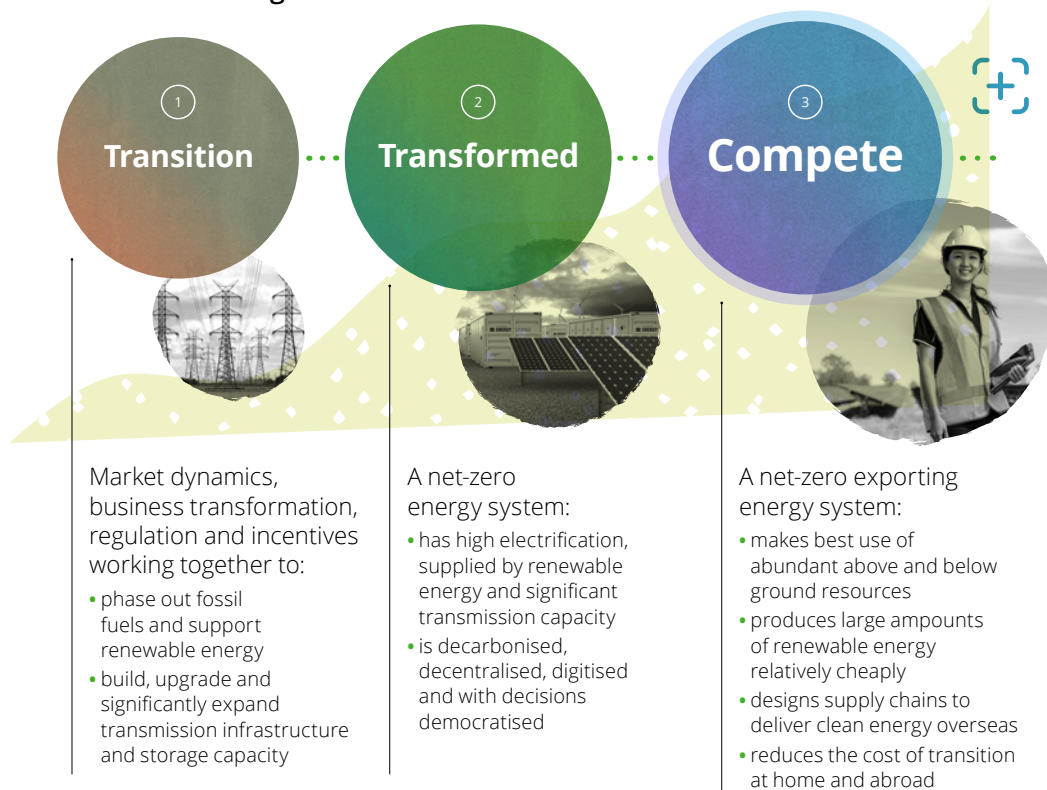
Note: All figures presented in this section are a net present value of 'Competitive Decarbonisation' scenario outputs compared to 'Today's net zero' scenario.

Source: Deloitte Access Economics

Energy system is the foundation of trade competitiveness

Australia has unique above and below ground resources that can help Australia’s energy system decarbonise and boost trade opportunities. From abundant wind, water, sun, critical minerals and green transition metals (such as copper, iron, aluminium), the country has a comparative advantage in producing renewable energy, which can help decarbonise energy sources relatively more cheaply.

Figure 6 – Energy system transformation to net zero under ‘Competitive decarbonisation’ advantages



Source: Deloitte Access Economics

More broadly, the ability to produce renewable energy relatively cheaply can also facilitate broader fuel switching across the economy – within households, businesses, commercial spaces and industrial and agricultural production.

Australia has made some progress to decarbonising its energy sources, with the share of renewables in the electricity generation increasing from 11% in 2011 to 32% in 2022.¹⁴ This increase has been largely driven by a rapid expansion of solar and wind energy, which have, at times, provided over 100% of the energy needs of states like South Australia.¹⁵ Nonetheless, the fossil fuel phase out remains an ongoing challenge, focused on electricity generation, but extending into all economic systems. As the economic and social cost of using fossil fuels becomes more apparent and increases over time, so too will the need to accelerate the pace of transition.

The task over the next decade is immense, but crucial. An export-oriented electricity system could require an additional 20% of transmission line capacity to be built

by 2030.¹⁶ Hard-to-abate sectors requiring renewable fuels, like hydrogen, may require even greater renewable electricity generation to meet the demand from green hydrogen. To accelerate the deployment of green hydrogen, industry, governments and researchers need to continue to work collaboratively to accelerate its development. Expanding hydrogen hubs, where various producers, users and potential exporters across numerous sectors are co-located in a specific region, can help scale green hydrogen capabilities and associated technologies such as electrolyzers.^{17, 18}

Transforming the energy system to reduce emissions will require a broader set of supporting infrastructure, such as charging points, batteries and additional roads and other transport infrastructure. Some of this investment would occur regardless in the baseline, but it possible that an export-focused transition may bolster development in regional Australia.



Transmitting the transition

The nation's future as a leading renewable energy provider is more attainable than an idle dream: few countries enjoy our natural endowments of vast solar and wind resources, a huge land mass to exploit them, an abundance of rare earth and other minerals, and proximity to Asian markets.

The clean energy transition, however, relies on the timely completion of critical transmission projects, enabling renewables to progressively replace emissions-heavy coal in the energy mix.

You can't connect new renewables to the grid without modernising Australia's ageing transmission network. It's that simple.

Transgrid chief executive Brett Redman is a firm believer in the nation's potential as a source of clean energy in the region.

"Right now, we're seeing first-hand the greatest transformation of our lifetimes as coal is replaced by renewables," Mr Redman said.

"If Australia wants to become a global leader in this space, we need to build the energy superhighways that will move clean energy from where it's generated to the areas where it's needed."

As the transport, industry and building sectors electrify to reduce emissions, Mr Redman says energy demand will surge, growing up to 70% by 2050 from business-as-usual electrification alone.

More optimistically, if Australia were to become a leading clean energy provider by producing and exporting green hydrogen and metals, he says demand for electricity could increase six times over the same period.

This is why the nation needs an "expanded and strengthened transmission backbone", which is essential to connecting geographically spread-out renewable generators and Renewable Energy Zones, and to supporting energy sharing between states.

"Over the next decade, Transgrid plans to invest \$16.5 billion to build new transmission infrastructure including the \$7bn, 1,600km Southern Superhighway made up of our three major projects – EnergyConnect, HumeLink and VNI West," Mr Redman says.

"Transmission enables cheap, renewable electricity to flow to consumers, and more supply will help lower high wholesale energy prices.

"A deep decarbonisation of our economy would see Australia harnessing our abundant renewable energy resources, large landmass, significant mineral ores and access to Asian markets to revitalise our industries, grow our economy and create thousands of new jobs.

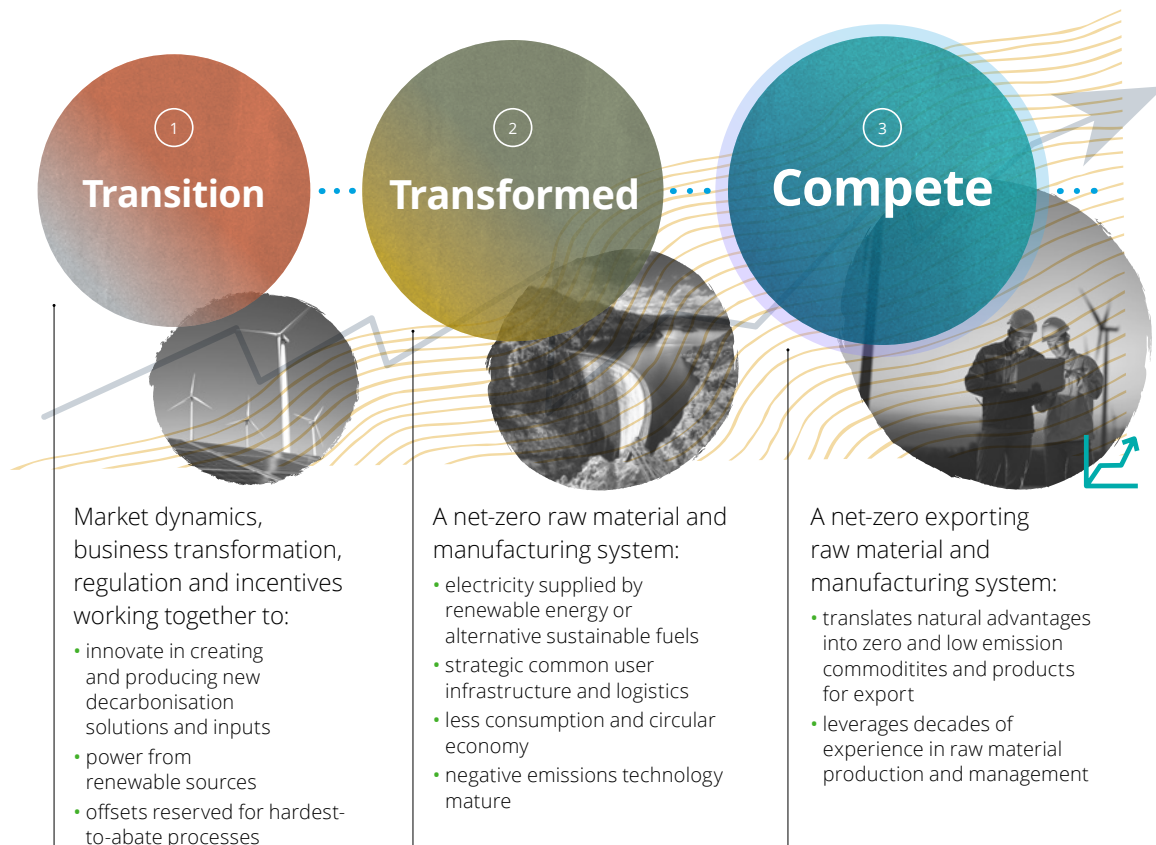
"Transmission projects are at the centre of making that all possible."

Source: National Australia Bank case study

Raw materials manufacturing system core to export opportunity

There is a strong link between Australia's raw materials manufacturing and energy systems. Drawing upon Australia's ability to produce a large amount of renewable energy at a lower cost than other regions can help drive the domestic transformation of the raw material manufacturing system.

Figure 7 – Manufacturing system transformation to net zero under 'Competitive decarbonisation'



Source: Deloitte Access Economics

Renewable energy can be used to electrify many emissions-intensive industrial processes to decarbonise fuel inputs. In other cases, such as in aviation and chemical manufacturing, alternative sustainable fuels, like biofuels and gases, may be required to decarbonise manufacturing that is not suitable for electrification.¹⁹ In the longer term, green hydrogen is expected to play a more prominent role as a substitute fuel in high temperature processes and heavy-duty transport. Policies to reduce the cost of using green hydrogen as an input into the raw material manufacturing system could also have wider benefits, such as increasing the competitiveness of green steel.²⁰

One group of commodities that will play a significant role helping the world reach net zero is critical minerals. Critical minerals (which includes cobalt, graphite, lithium and rare earths, among others) are key inputs in the production of batteries and rooftop solar panels, technologies that are essential to helping the world decarbonise. Australia is fortunate enough to have abundance of critical mineral reserves. Today, Australia is the largest lithium exporter in the world, responsible for 53% of global production in 2022.²¹ This presents opportunities for the traditionally emissions-intensive mining sector in a future net zero world by transitioning to extracting the metals and minerals required for decarbonisation.



More broadly, the race to net zero can provide the catalyst for systems to collaborate and design new decarbonisation solutions and industrial processes, particularly for hard-to-abate sectors. This could be reinforced by an ambitious trade and industry policy strategy and the right regulatory settings to attract the over \$90 billion of additional capital investment required to support the decarbonisation of this system. In turn, this could result in the creation of new goods, and associated supply chains, that can be fit-for-purpose in a net zero world. If local decarbonisation is executed effectively, this can support the raw material manufacturing system to service a share of the increased domestic and external demand for decarbonisation inputs, thereby ensuring that Australia can unlock a lower emissions pathway and realise a significant advantage.

Australia will need to replace emissions-intensive activity and expand low-emissions activities across new green industrial supply chains. A dual focus in transitioning away from emissions-intensive activity while fostering increased export activity in green industries can achieve a greater distribution of economic prosperity from decarbonisation.

Australia has the natural, economic, institutional and community endowments to become a globally competitive green industrial powerhouse.

Appendix A

Modelling detail

What makes the numbers?

This analysis in this report relies on several core economic concepts and is supported by economic scenario modelling. Deloitte Access Economics' scenario modelling uses an in-house integrated climate-economy model called 'D.Climate'.

D.Climate model

Traditionally, most macroeconomic models and economic policy analyses are considered against a "baseline" that assumes economic growth will occur unhindered by rising concentrations of greenhouse gases (GHGs) in the world's atmosphere. This viewpoint does not hold true in practice – particularly in the long run – as determined by climate science. Therefore, such economic analysis is not suitable.

Climate change impacts should not be considered as a scenario relative to a baseline of unconstrained emissions-intensive growth, because, absent fundamental societal and economic shifts, the impacts of unmitigated climate change are the baseline. By excluding the economic impacts of climate change from economic baselines, decision-making is not well supported.

Deloitte Access Economics has developed an extension of an in-house regional general equilibrium model, DAE-RGEM, giving it the functionality of a full-fledged integrated assessment model (IAM). This functionality is achieved by linking DAE-RGEM to a climate module, which represents local and global abatement, emissions and damages caused by climate change. This model is referred to as D.Climate and has been used to develop the analysis in this report.

D.Climate incorporates multiple economic damages that vary by sector and region and has full integration with the global economy through the Global Trade Analysis Project (GTAP) database and a complete set of emissions accounts covering CO₂ and non-CO₂ gases.²²

Deloitte Access Economics' development of D.Climate draws on and contributes to three key streams of research:

- The primary stream is that of advances in CGE models, allowing for modelling of complex and dynamic policies like those required to affect a transition to a low-carbon environment.²³
- Another stream is advances in IAMs.²⁴ The IAM stream, in its initial phases, used a more aggregate representation of the economy that allowed for a stylised climate module.²⁵ These models sought to incorporate potential damages associated with climate change into a model of the economic system to form an integrated (but simplified) framework for assessing the decisions facing policymakers when it came to emissions reduction targets.²⁶
- The third and most recent stream seeks to combine the two described above and provide richer sectoral and policy detail of modern CGE models coupled with a climate feedback mechanism that allow for integrated assessment.²⁷

A detailed technical description of D.Climate functionality [is available online](#) for a 2022 study of climate change impacts on the United States.²⁸ D.Climate has since been updated to reflect revised climate science from the IPCC AR6 analysis and additional academic literature on damage functions, for example.²⁹

Economic scenarios in this report

Previous Deloitte Access Economics analysis using D.Climate modelling has established the significant cost of climate change on Australia's economic growth outlook. Compared to the compounding costs of climate change damages to economic growth from inaction, decarbonisation globally and domestically offers the best economic outlook for Australia.

Today, there is a growing focus on optimising the implementation of net zero policies to maximise economic benefits and minimise transition costs. This shifts the scenario framework adopted for economic modelling to analyse net zero policy impacts.

Deloitte Access Economics no longer considers an 'inaction' path a viable baseline – there is global momentum in lower emissions technologies which will continue regardless of policy action and renewable energy will continue to increase. Scenario analysis should now examine the potential for achieving a lower cost transition for Australia against a new baseline – a 'low and slow' path to net zero, which considers no further action beyond what is in place today.

As such, Australia's current policy settings and decarbonisation targets are best compared to a 'low and slow' baseline, that does not meet current climate targets. This framing demonstrates the relative economic costs and benefits of specific policy actions, and what additional economic settings can maximise economic opportunity for Australia (Figure 8).

'Low and slow' emissions reduction baseline

The baseline economic outlook represents no further policy action from today to meet net zero. Lower emissions reduction and slower technology change characterise the economy. Average global warming exceeds 2°C as Australia and the world is not net zero by 2050.

This report's baseline: Today's net zero

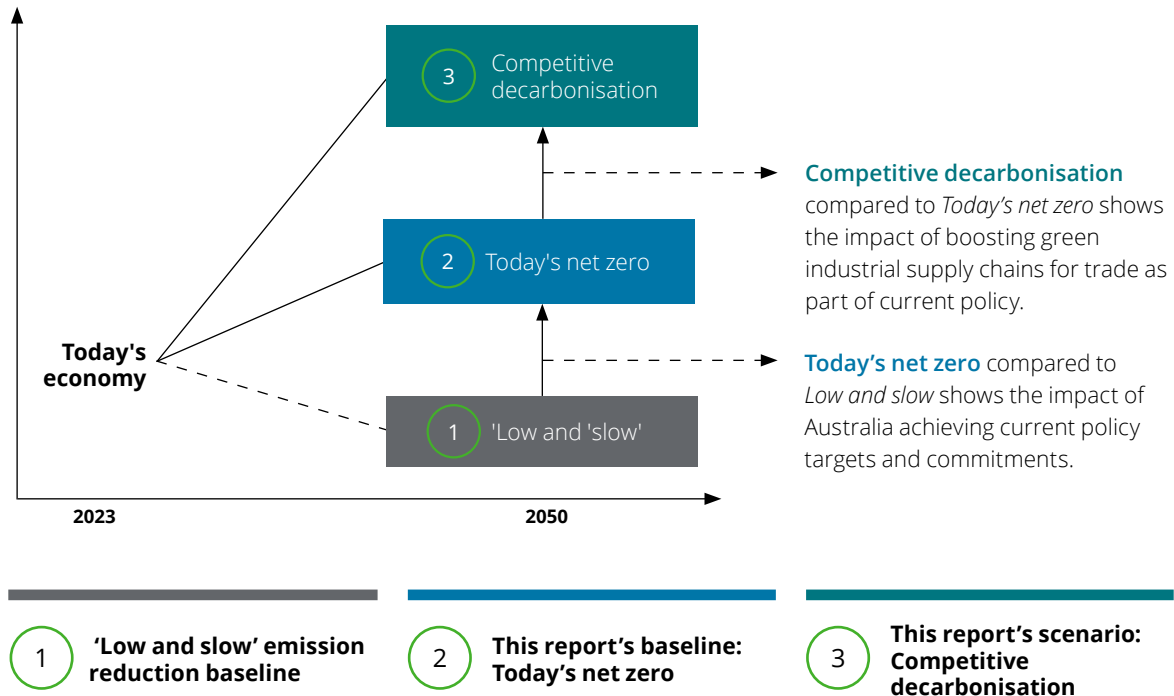
Australia's economy meets current targets to reduce emissions by 43% in 2030 and is net zero by 2050. Scenario represents achieving "today's net zero policies" that are announced to deliver future decarbonisation. Global average warming is limited to "well below 2°C" as the world is net zero by 2050.

This report's scenario: Competitive decarbonisation

Most scenario variables are the same as 'Today's net zero'. But Australia competitively decarbonises via increased investment and productivity in energy, green hydrogen and critical minerals and related metals manufacturing. Australia creates new export opportunities with expanded supply chains.

Figure 8 – Economic modelling scenario framework supporting D.Climate results

Scenario pathways



Source: Deloitte Access Economics

Table 1 provides further detail to the specific technical inclusions in D.Climate under each scenario in this report.

Table 1 – Economic scenario modelling summary

Baseline “Today’s Net Zero” scenario	“Competitive decarbonisation” scenario
National parameters	
<p>Reflecting the impact of legislating an interim target of reducing emissions by 43% below 2005 levels by 2030, and meeting net zero by 2050:</p> <ul style="list-style-type: none"> • Increased share of renewables in Australia’s energy mix • Annual change in energy efficiency in Australia • Additional government expenditure and private investment needed to realise the increased climate change commitments 	<p>Building on the new baseline:</p> <ul style="list-style-type: none"> • Australia can produce large quantities of renewable energy relatively quickly to 2030 with additional public and private capital investment. This results in an increase in Australia’s capital productivity of the renewable electricity sector relative to the baseline scenario, and carries through to expanded economic activity post 2030. • The increase in global demand for inputs into decarbonisation via trade is assumed to benefit Australia as it has established comparative advantage in producing and manufacturing these inputs. This is reflected in an increase in Australian exports of renewable electricity, hydrogen, critical minerals and green metal manufacturing to the rest of the world relative to the baseline scenario
Global parameters	
<p>Global emissions policy settings in line with updated policy scenarios:</p> <ul style="list-style-type: none"> • Emissions reduction to limit global warming to below 2°C • Global emissions policy settings as outlined in IEA’s World Energy Outlook and Net Zero by 2050 scenarios (i.e., global share of renewables in energy mix, renewable energy capacity mix, technology learning mix, and demand for hydrogen and critical minerals)³⁰ 	<p>Global assumptions are held constant with the baseline scenario, to capture the relativity of the shifting pace of Australia’s decarbonisation trajectory.</p>

Source: Deloitte Access Economics

The magnitude and trajectory of the changes applied in the competitive decarbonisation scenario was informed based on a wide variety of publicly available reports and datasets:

- Increases in Australia’s capital productivity in the renewable electricity sector were benchmarked against Australia’s National Energy Productivity Plan.
- The total amount of electricity generated using renewable energy were benchmarked against estimates from AEMO’s 2022 Integrated Systems Plan and various scenarios outlined in Net Zero Australia.³¹
- The expected revenue from Australia’s exports of renewable electricity, green hydrogen, critical minerals and green metal manufacturing was benchmarked against estimates from Beyond Zero Emissions’ “Slow Starter” and “Go for Gold” scenarios.³²

The modelling also assumes that the impact of these outcomes will only take effect from 2030, to account for renewable energy expansion and the time needed for the effects of decarbonisation and productivity-enhancing initiatives to filter throughout the economy.

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