Australian Government

Australia's Net Zero Plan

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Updates

On the 17 March 2026 and 25 November 2025 minor updates have been made to the Net Zero Plan to correct mislabelled figures and minor grammatical errors.

Note on data

Unless otherwise specified, throughout the Net Zero Plan financial years (e.g. 2023-24) are presented as calendar years (e.g. 2024).

Acknowledgements

The Australian Government acknowledges the advice of Climate Change Authority which has informed the Net Zero Plan and six sector plans.

The Australian Government thanks all stakeholders and community members that participated in consultation.

Acknowledgement of Country

The Australian Government acknowledges the Traditional Owners of Country throughout Australia and their continuing connection to land, skies, waters and community. We pay our respects to their cultures and their Elders past and present.

First Nations knowledge is critical to living sustainably in Australia. The knowledge that Aboriginal and Torres Strait Islander peoples hold as Custodians of Australia's land and natural resources can and should underpin a fair and equitable net zero transition.

Contents

Foreword

The Australian Government is acting on climate change because it is the right thing to do for our environment, and the smart thing to do for our economy.

Climate change is real and is having a real impact on our farmers, our regions, our communities and our economy.

Working together, we can create the good jobs our people and communities need, while making sure we pass on the healthier environment our children deserve.

The global shift to clean energy is already well underway, and represents one of the biggest economic transformations since the Industrial Revolution. It presents Australia with an enormous economic opportunity.

If we move now and get it right, we can set Australia up for a new era of growth and prosperity.

For Australia, the best way to preserve our way of life and protect our natural environment is to build on our national advantages.

We are home to the resources and minerals needed for batteries, solar and electric vehicles.

We are the sunniest continent on earth and we lead the world in solar research and technology.

We can use these advantages to deliver affordable and reliable energy for our country, hundreds of thousands of new jobs in our regions and suburbs and secure billions of dollars in global investment.

This is all about making the most of our strengths, making our economy more competitive, dynamic and resilient. And making more things here in Australia.

In the last three years, the private sector has grasped the economic opportunity, driving total investment above $97 billion since 2022.

Government has set Australia's ambition and committed over $70 billion for decarbonising Australia's economy over the coming decades – supporting new industries, investing in renewables, building transmission and helping households electrify.

Households and small businesses are playing their part too.

Australia now leads the world on rooftop solar. More than 1 in 3 households have installed solar panels.

Our Cheaper Home Batteries program is helping households and businesses boost storage.

Millions of Australians are taking practical steps to permanently reduce their power bills, reduce pressure on the national grid and do the right thing by the environment at the same time.

Together, we are cutting emissions, creating new jobs and securing Australia's place in a changing global economy.

The Climate Change Authority has provided their independent, expert advice to Government on setting a target for 2035.

A target of 62-70% emissions reductions, they advise:

> 'is in Australia's national and economic interest. Committing to an ambitious target is necessary to maximise the chances of Australia capturing the full potential benefits of the global clean energy transition.'

> 'is ambitious, achievable, in Australia's national interest, and is based on robust analysis of the best available evidence. It anchors Australia's commitment to the global goal of pursuing efforts to limit warming to 1.5°C, the threshold beyond which multiple climate systems risk irreversible breakdown.'

We have accepted their advice and Australia's 2035 target is 62-70% below 2005 levels by 2035.

This is a responsible target, backed by a real plan and proven technology.

It is ambitious, because it accelerates progress towards net zero, and it is achievable, because we can meet it by continuing what is working and building on the strong foundations we have laid over the past three years.

Alongside our plan, we are establishing a new $5 billion Net Zero Fund within the National Reconstruction Fund (NRF). Drawing from and refocusing existing NRF capital, it will support major investments by large industrial facilities in decarbonisation and energy efficiency, and scale up manufacturing low emissions technologies.

We are also setting aside more than $1 billion to make clean fuels here.

And we are putting more than $170 million towards initiatives to help households and communities decarbonise, improve energy efficiency and accelerate the roll out of kerbside and fast electric vehicle charging options.

We are updating the CEFC's investment mandate to include a new focus on the rapid roll out of renewable projects to drive down electricity prices, and committing up to $2 billion more to the CEFC General Account, to be drawn down in line with these changes.

Treasury modelling published alongside this Net Zero Plan is clear.

A credible plan to achieve net zero will give businesses the confidence they need to seize the opportunity and invest in Australian jobs.

By contrast, delay and drift will only drive investment away, drive power prices higher and add to pressures on the cost of living and put Australian jobs at risk. Doing nothing is simply not an option.

Acting on climate change strengthens Australia's place in the global economy as well.

Over 84% of global GDP is covered by net zero commitments including our major trading partners China, Japan and South Korea.

Australians can be proud of the contribution we have already made.

In 2015 the world was on track to heat up 4 degrees Celsius above pre industrial levels.

By 2024, global efforts had shifted this trajectory down to just less than 3 degrees.

Put simply, global action is making a difference and Australia is playing its part.

Every fraction of a degree of global temperature change will matter.

Working together, we can continue to reduce our emissions, grow our economy and strengthen our nation.

The Hon Anthony Albanese MP
Prime Minister of Australia

The Hon Chris Bowen MP
Minister for Climate Change and Energy

Executive summary

Australia has already made real progress in reducing emissions.

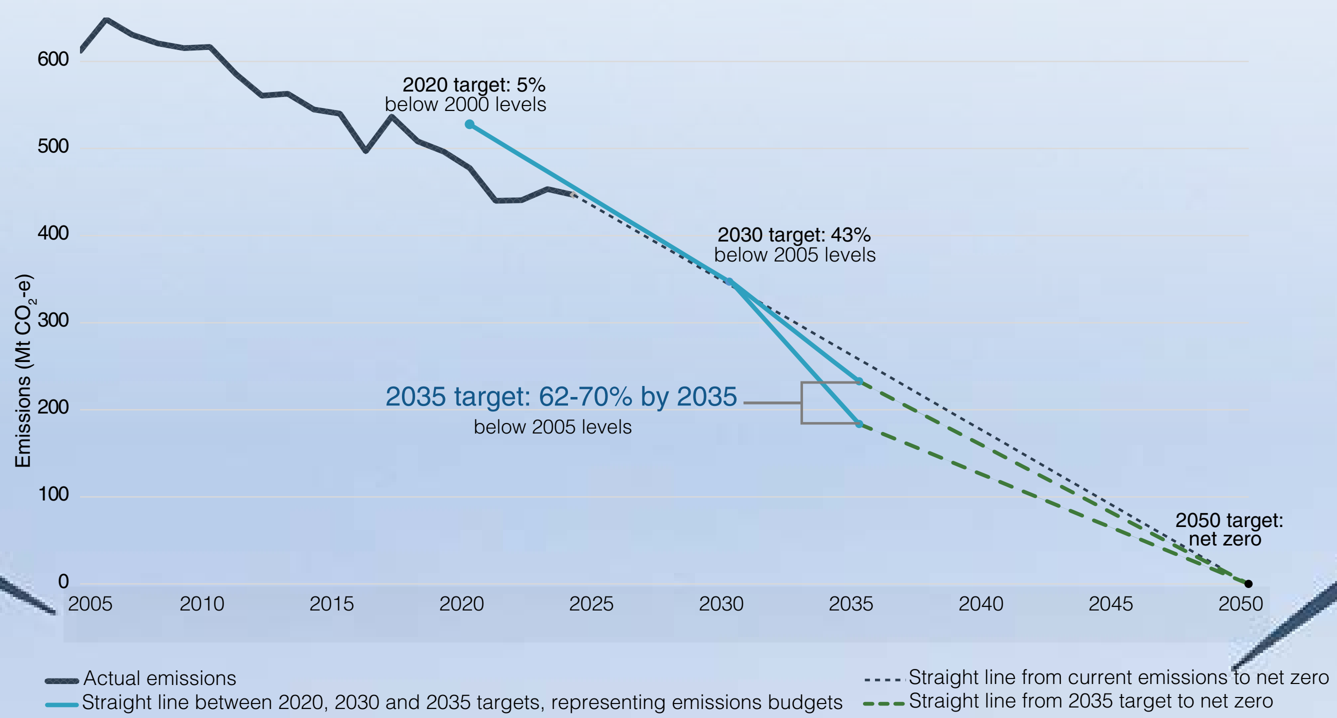
So far, the actions taken by government, businesses and households reduced Australia's emissions in 2024 by 27% on 2005 levels. Our most recent data for 2025 indicates emissions are now down 29%.

That's equivalent to taking the entire Australian vehicle fleet off the road - twice.

The Government has adopted the Climate Change Authority's recommendation and set Australia's 2035 target.

Australia will reduce emissions by 62-70% on 2005 levels by 2035 as the next step on our path to net zero.

Figure 1: Australia's emission reduction targets



Five decarbonisation priorities

To reach our 2035 target, and net zero by 2050, government will focus effort on five decarbonisation priorities:

- **Clean electricity across the economy**
- **Lowering emissions by electrification and efficiency**
- **Expanding clean fuel use**
- **Accelerating new technologies**
- **Net carbon removals scaled up**

Priority one: Clean electricity across the economy

Decarbonising and expanding the electricity network

Our electricity network needs modernisation. Australia's ageing coal fired power stations are too expensive and unreliable to support our growing energy needs.

After a period of underinvestment and uncertainty, rebuilding our energy system is a large, complex and capital-intensive task, but one that needs to be done and we are getting on with it.

In Australia, harnessing our abundant renewable energy resources, firmed by gas, hydro and batteries, is the cheapest way to replace retiring generation assets and meet growing energy demand.

What we have done:

- In three years, we have added over 18 GW of renewable energy – wind and solar – to the grid. Already, over 40% of Australia's two major grids are renewable
- Wind and solar capacity is up 45% - more than 4 times the capacity of the Snowy Hydro Scheme and enough to power over 6 million households
- Australia leads the world in rooftop solar. More than 1 in 3 households have installed solar panels. There's now more household solar capacity than all remaining coal fired power stations in Australia
- Australian households and businesses with solar are installing home batteries at speed through our Cheaper Home Batteries scheme. In just over two months since launch, more than 55,000 home batteries with total storage capacity of over 1 GWh have been installed around Australia – a pace that could see Australia hit its 1 million batteries target before 2030.

We have:

- **Committed over $20 billion in Rewiring the Nation**, making clean energy more accessible and affordable for Australian consumers. Through Rewiring the Nation, we are investing in new network infrastructure at the lowest possible cost to consumers
- **Supported nation building projects, such as Marinus Link**, that will unlock economic development in Tasmania's north, secure greater cleaner energy including hydro, and deliver better energy security for the mainland
- **Launched the Capacity Investment Scheme**, providing a long-term revenue safety net for investors by underwriting contracts to support new renewable generation and dispatchable projects. The Scheme ensures more renewable energy projects get built sooner
- **Recapitalised the Clean Energy Finance Corporation**, with $2 billion added to its special account earlier in 2025 to finance the deployment of clean energy technologies
- **Enabled offshore wind generation development**, with six declared priority offshore renewable energy zones
- **Created the National Renewable Energy Priority List**, supporting accelerated planning and approvals processes for priority renewable energy infrastructure
- **Accelerated households generating and storing their own electricity**, through our $1 billion Home Energy Upgrades Fund, Solar Banks program for apartments and our Cheaper Home Batteries Program
- **Invested in TAFE Centres of Excellence and improved community benefit** ensuring energy regions see the full benefit of the transition with good, lasting jobs and higher standards for developers.

As we work towards our 2035 target, we will:

- **Update the CEFC's investment mandate** to include a new focus on the rapid roll out of renewable projects to drive down electricity prices, and commit up to $2 billion more to the CEFC General Account, to be drawn down in line with these changes
- **Unlock long term investment in large scale firmed, renewable generation and storage capacity**, informed by the review of National Electricity Market (NEM) wholesale market settings
- **Streamline approvals for renewable energy projects**, particularly through reforms to the *Environment Protection and Biodiversity Conservation Act 1999*
- **Continue to drive investment in consumer energy resources** to reduce pressure on the grid, including through uptake of solar and batteries and virtual power plants (including in community, commercial and industrial properties)
- **Explore ways to further unlock investment in renewable energy** to accelerate emissions reduction in the electricity sector while maintaining energy security.

Priority two: Lowering emissions by electrification and efficiency

Electrifying wherever possible and improving energy performance and materials efficiency

We have the technology now to electrify many parts of our economy and we are working to make sure the incentives, support and regulations are in place to accelerate this.

In 2022, electric vehicles were 1.8% of new light vehicle sales across Australia. In just three years that has climbed to 10%. This is being driven by consumer demand – as more affordable, cheaper to run cars enter our market.

Electric buses are now on our roads in almost every state and territory of Australia and transport companies are investing in electric trucks for back-to-base delivery.

Industry are taking steps to electrify where they can, and Government is providing support to reduce upfront capital costs and support companies to make the investments needed for a low emissions future.

Households are electrifying rapidly – switching to induction stoves and heat pumps, replacing gas heaters with reverse cycle air conditioners.

There have already been over 4 million solar installations under the Small-Scale Renewable Energy Scheme, supporting households to upgrade energy systems including heat pumps and water heaters.

Treasury modelling shows that investing in electrifying your household will bring benefits over the long term with lower bills (Figure 6.2).

Swimming pools, sports clubs and community centres are doing their bit too, upgrading and improving facilities around Australia.

We have:

- **Introduced the New Vehicle Efficiency Standard**, which will reduce emissions intensity from new passenger vehicles by 60% by 2030, and help Australians choose cleaner, cheaper to run vehicles, including electric vehicles
- **Committed $1 billion in Household Energy Upgrades**, helping Australians upgrade their homes and install things like hot water heat pumps, insulation, air conditioning, batteries and double glazing
- **Expanded the Social Housing Energy Performance Initiative to $1.1 billion** (including $800 million from the Commonwealth) to support energy upgrades to over 100,000 social and affordable housing properties by 2028-29
- **Created the $475 million Driving the Nation Fund**, supporting innovation in cleaner transport and the rollout of electric vehicle (EV) charging infrastructure on key highway routes and at car dealerships and repairers
- **Allocated $1 billion through Powering the Regions** Safeguard Transformation Stream and Industrial Transformation Stream to help heavy industry and other large regional facilities reduce emissions from gas processes, electrify industrial processes and invest in energy storage.

As we work towards our 2035 target, we will:

- **Expand energy performance programs**, including those that help households and business better understand the energy performance of appliances and commercial buildings like the National Australian Built Environment Rating System (NABERS), the Greenhouse and Energy Minimum Standards (GEMS) Scheme and Commercial Buildings Disclosure program
- **Expand the Nationwide House Energy Rating Scheme** to rate existing homes across Australia, helping home buyers, renters and owners make informed choices about energy upgrades
- **Accelerate the rollout of EV kerbside and fast charging with a $40 million program,** using existing power poles around the country to deliver more EV charging options faster, at lower cost, giving flexibility to owners without off-street parking
- **Work with community sporting facilities to improve lighting and install solar and batteries with a $50 million program**, reducing emissions, energy costs and allowing clubs to put more money back into grassroots sports
- **Develop a Demand-side Statement of Opportunity** (DSOO) to inform the market where there are opportunities to use energy more efficiently, helping to make our demand growth more manageable
- **Review the New Vehicle Efficiency Standard** in 2026 to assess the policy's effectiveness, refine regulatory systems and mechanisms, and consider the framework in light of the 2035 target
- **Implement the Circular Economy Framework** to double circularity by 2035.

We will also explore:

- Options for reducing barriers to electrifying small to medium facilities and industrial processes
- How to ensure business, industry and communities have the best signals, opportunities and frameworks to improve energy performance
- Ways to drive down emissions across Australia's transport fleet faster, including across different modes of transport, working with states and territories
- Ways to improve solar and battery recycling, recovering key components so we can continue to reuse materials in support of the transition
- Working with states and territories to maximise the benefits new buildings can achieve by harnessing the efficiency and cost effectiveness of electrification.

Electric car charging, Australia.

Priority three: Expanding clean fuel use

Switching activities that can't be electrified to low carbon alternative fuels

Some areas of the economy can't electrify because the right technologies don't exist yet, or they're currently too expensive.

High heat manufacturing, like making steel and cement, and long-distance transport by road, air and sea, are hard to electrify right now.

This is where alternative fuels have a big role to play over the decades to come – low carbon liquid fuels, biomethane, renewable hydrogen and renewable ammonia.

For sectors that rely on coal, like iron and steel making, natural gas is an immediate option to reduce emissions until lower carbon fuels become available.

Australia is already a significant supplier and exporter of biomass for refining into low carbon fuels overseas.

By building a low emissions fuels industry in Australia, we can lower our emissions, boost our fuel security and seize new export opportunities.

If Australia is successful in realising its renewable export potential, the global emissions displaced by Australian low-emission exports in 2050 could be greater than Australia's net emissions in 2024.

We have:

- **Created a $250 million Innovation Fund** for low emissions fuels, including sustainable aviation fuel and renewable diesel, helping reduce costs for first-mover LCLF producers
- **As part of our Future Made in Australia agenda, committed $8 billion over 10 years to accelerate renewable hydrogen investment** through the Hydrogen Production Tax Incentive and Hydrogen Headstart
- **Created new fuel quality standards** for renewable diesel, unlocking supply in Australia
- **Amended the National Greenhouse and Energy Reporting Scheme** to enable reporting of specific low emissions fuels delivered through shared infrastructure.

As we work towards our 2035 target, we will:

- **Invest $1.1 billion in new low carbon liquid fuel production here in Australia**, providing drop-in fuel alternatives to support farmers, truck drivers, airlines and industry with options to reduce emissions
- **Explore ways to incentivise take-up** of low carbon fuels in support of building domestic production
- Work with states and territories to redirect waste streams as feedstocks for production of low carbon liquid fuels.

Priority four: Accelerating new technologies

Innovating to expand emissions reduction options

Australia leads the world in solar research and technology.

Researchers are pioneering breakthroughs in new battery production, solar recycling, feed supplements and carbon capture and storage.

Across Government, over $2.2 billion has been invested in research and development directed at energy outcomes since 2022-23, with agencies like Australia's Renewable Energy Agency deploying millions each year to support early stage research and commercialisation in renewable technologies.

Historically, technology costs have fallen for key renewable technologies faster than expected. For example, back in 2011, Treasury projected solar photovoltaics (PV) would contribute 3% of electricity generation in 2024. However, the cost of PV fell 75% in the 5 years to 2014 – and in 2024, PV contributed 17%.

The innovative solutions we invest in today could drive significant abatement towards the end of the coming decade.

We have:

- **Set the Australian Renewable Energy Agency (ARENA) on a sustainable footing** to support decarbonisation over the decade to come
- **Established the $1.5 billion Future Made in Australia Innovation Fund**, supporting development and deployment of new technologies in everything from green metals production, clean energy technology manufacturing and low emissions fuels
- **Enabled the Clean Energy Finance Corporation (CEFC)** to invest in critical R&D opportunities in clean energy, including through the $500 million Powering Australia Technology Fund and $200 million Clean Energy Innovation Fund
- **Established an Expert Panel led by Australia's Chief Scientist** to evaluate new approaches to measuring fugitive methane emissions
- Invested $87 million over 10 years to establish the **Zero Net Emissions Agriculture Cooperative Research Centre.**

As we work towards our 2035 target, and as part of decarbonising our industrial facilities, we will:

- **Review Safeguard Mechanism policy settings** in the financial year 2026-27, to ensure the scheme's design is appropriately calibrated and effectively delivering emissions reductions in line with Australia's targets, informed by Climate Change Authority advice about the extent to which on-site abatement is being driven by the reforms
- **Establish a new $5 billion Net Zero Fund as a sub-fund of the National Reconstruction Fund (NRF)**, drawing from and refocusing existing capital to support major investments by large industrial facilities in decarbonisation and energy efficiency, and scale up manufacturing low emissions technologies
- Informed by the Government's Strategic Examination of R&D, look for ways to streamline and scale up research collaborations that power the transition
- Undertake a landmark study with the UN Environment Program to improve understanding of methane emissions, important for steel and energy supply chains.

We will also explore:

- Strengthening strategic partnerships with governments, industry and international partners to progress important climate technologies with the potential to drive down emissions beyond 2035
- How we can ensure Australian industry remains globally competitive by delivering a level playing field for our biggest emitters like cement and steel in a decarbonised economy.

Priority five: Net carbon removals scaled up

Scaling up carbon removals to balance residual emissions

Regardless of how effectively we reduce emissions, all available analysis indicates our economy will still be emitting greenhouse gases in 2050 – carbon removals are a critical part of reaching net zero.

Land based abatement, particularly reforestation, is the most cost-effective carbon removal option to help reach net zero emissions in 2050. There are great economic opportunities for land holders to diversify their incomes through earning Australian Carbon Credit Units (ACCUs).

Methodologies like savanna burning also allow First Nations land managers to use their knowledge of managing country to sequester more carbon and earn revenue from ACCUs.

But we need to invest in a range of options for future carbon removals. New carbon removal technologies will be increasingly important as 2050 approaches, but most need further development before they will be ready to be deployed at scale.

Already, carbon capture and storage projects are being implemented around Australia.

We have:

- **Strengthened the ACCU scheme** enabling land managers to earn money for eligible carbon storage on their land, which has already abated 169 million tonnes of emissions to date
- **Invested $73.8 million in a Support Plantation Establishment Program**, increasing future plantation forest resources available for processing
- **Invested $65 million in projects** that will use emerging technologies like direct air capture and mineral carbonisation to offset hard-to-abate industrial processes

As we work towards our 2035 target, we will:

- Improve data collection and analytical capabilities to better understand land-use changes and opportunities for integration of carbon removal projects within agricultural production systems
- Examine the carbon, biodiversity and agricultural productivity co-benefits that expanded landscape restoration efforts could deliver, strengthening the climate resilience of regional Australia
- Open a second round of the **Carbon Capture Technologies Program** for $52 million to continue to accelerate the development of new carbon management technologies, critical to reaching net zero by 2050
- Deliver a Carbon Dioxide Removal (CDR) Roadmap with the CSIRO

Canberra, ACT, Australia.

Stable institutions create policy certainty and crowd in investment

Achieving our 2035 target, and then net zero emissions by 2050, will require sustained effort and investment over decades – backed by strong, stable institutions.

The Australian Renewable Energy Agency and Clean Energy Finance Corporation were created in 2012 and between them incubate new technologies through development, to commercial scale deployment.

The Australian Government has expanded on this through the establishment of the National Reconstruction Fund Corporation to drive investment in high-value industry transformation.

Through the *Climate Change Act 2022* we have legislated targets and accountability measures to provide policy certainty and make sure Australia's progress is transparent. The Minister for Climate Change and Energy makes an annual statement to Parliament.

The Climate Change Authority is empowered to provide independent advice, informed by science, tracking progress towards targets and advising Government on new targets.

We legislated the Net Zero Economy Authority, ensuring communities and workers, particularly in regions with transitioning industries can, access the opportunities of net zero.

We have legislated our Future Made in Australia ambition; an agenda to seize the economic opportunities from the global shift towards net zero and low emissions exports, providing long term assurance to industry that our commitments are resolute.

These institutions create a stable operating environment, where the forward pathway is clear, there are long term legislated mechanisms to support the transition and accountability to make sure we stay on track.

Government will continue to work to remove barriers to investment. In September 2025 we launched Australia's Investor Front Door, making it easier to develop major, transformational projects across Australia.

We are reforming environmental approvals to protect our environment and unlock more efficient assessments for clean energy projects.

Cooperation with all levels of government will be critical, for investments and delivery of our national targets. They are key delivery partners – with many already leading the way.

Six sector plans: reducing emissions in every sector

There are many different pathways to achieve emissions reductions across key sectors of the economy – electricity and energy; industry and waste; resources; built environment; agriculture and land; and transport.

We know from experience, the opportunities for emissions reduction will vary across sectors. Our emissions to date have come from changes to land use and the growth of renewables in the electricity sector. But to reach our 2035 target, and net zero by 2050, every sector will need to play a stronger role.

For some, the decarbonisation pathway will be more rapid because technologies are mature, cost effective and ready to scale (e.g. electricity and energy).

Others face a slower and more gradual route because technologies are at an earlier stage of development or more barriers stand in the way (e.g. agriculture).

Many sectors are dependent on the progress of others, particularly those reliant on the supply of renewable energy from the electricity and energy sector (e.g. transport, built environment).

Over the next decade, immediate gains will be felt quickest in electricity and energy sectors, largely through electrification. This supports transport and built environment emissions reductions.

As we progress towards net zero, reducing emissions in hard to abate sectors like industry and resources, and agriculture, will become more important.

Sector plans accompanying this Plan set out immediate opportunities to drive abatement and longer term goals and barriers to achieving abatement goals.

Electricity & Energy

Energy performance; and the supply of electricity, liquid fuels, and gas

Industry

Alumina and aluminium, cement and concrete, chemicals and plastics, food and beverages, iron and steel, manufacturing and additional industries, other metals refining and smelting, pulp, paper and paperboard, waste and resource recovery

Resources

Oil and gas extraction, processing, liquefaction, coal mining and processing, mining and processing of metallic and non-metallic minerals, resource exploration and support services

Built Environment

Residential, commercial and public buildings as well as urban open spaces and water infrastructure

Agriculture and Land

Livestock, cropping, on-farm energy use, fisheries, forestry and land use

Transport

Light and heavy road transport, rail, maritime, aviation, including transport infrastructure's embodied emissions

Navigating the Plan

The Net Zero Plan is divided into four parts:

Figure 2: Structure of the Net Zero Plan

Part 1 Climate Change in Australia (Chapters 1-3)

sets out the opportunities and challenges of the net zero transition and how the Plan provides a stable and predictable framework to help all Australians navigate the transition. It highlights how the Net Zero Plan, complemented by 6 sector plans provides a clear roadmap to support a fair and orderly transition, through Australia's 2035 target. It sets out Australia's current emissions profile and how existing climate policies have set us on the path to net zero.

Part 2 Australia's Net Zero Pathway (Chapters 4-7)

sets out Australia's 2035 target and the pathway through which Australia can transform its economy to capitalise on opportunities from the global transition and reach net zero emissions by 2050. This is based on analysis by the Treasury, the CCA and CSIRO, alongside insights from extensive engagement with stakeholders. This Part sets out the Australian Government's 5 decarbonisation priorities to drive action to achieve net zero by 2050.

Part 3 Enabling the Transition (Chapters 8-11)

describes how the transition to net zero will require coordinated action across the economy. Getting these settings right will help share benefits across the country and build confidence, allowing the transition to accelerate. It sets out the groundwork that government has laid to streamline approvals, finance the transition, and build the jobs and skills required to realise new economic opportunities.

Part 4 Working Together (Chapters 12-14)

discusses the different roles of governments, the private sector, academia and research institutions, communities, First Nations peoples and our international partners. It showcases how First Nations people's connection to Country and culture is fundamental to climate action in Australia, and how strong First Nations' leadership is creating opportunities to reduce emissions and ensure the benefits of the transition flow to their communities. It also discusses the importance of working with local communities to build social licence for the transition and deliver tangible benefits for all Australians.

1

Climate change in Australia

Playing a strong and active role in global climate action is indisputably in Australia's national interest.

A credible pathway and policy stability will ensure Australia attracts investment, remains globally competitive and reduces emissions.

This Plan represents the next step in our pathway and articulates how we will build on progress to date in collaboration with industry, investors, First Nations peoples, communities and international partners.

Chapter 1

Sets out the opportunities and challenges of the net zero transition

Chapter 2

Sets out how the Net Zero Plan, complemented by 6 sector plans, provides a clear pathway to support a fair and orderly transition

Chapter 3

Sets out Australia's emissions outlook, detailing our current emissions profile and suite of climate policies and measures

1. Climate change risk and opportunity for Australia

Key messages

- While we can no longer avoid climate impacts, every action we take today towards our climate goals will help avoid the worst impacts on Australian communities and businesses.
- We are working alongside communities to respond and adapt to the impacts we can no longer avoid.
- Record investment in clean energy is driving global emissions reductions, and creating opportunities for new industry development and growth in Australia.

1.1 The climate is already changing, with major implications for Australia

Australia is experiencing the profound and accelerating impacts of climate change. Australia's average land temperature has increased by approximately 1.5°C since 1910.[1] Australians are already living with increasing impacts from climate change, and are witnessing more frequent and severe events, such as droughts, floods, bushfires and heatwaves.[2]

Many communities have experienced recent hazards and disasters, such as ex-tropical cyclone Alfred in New South Wales and Queensland, Tasmanian West Coast bushfires in 2025, and drought conditions affecting large areas of Australia's southern states. Climate change is also contributing to the emergence of new types of adverse events, such as South Australia's ongoing algal bloom, which is partly driven by extended periods of warm ocean temperatures.[3] Events like this underscore that new impacts will emerge as climate change intensifies.

Australia's National Climate Risk Assessment (NCRA) provides the first comprehensive government-led assessment of the risks Australia faces as a result of climate change. It presents a sobering future, underscoring that climate-fuelled extreme weather events are increasing pressure on our natural ecosystems and the livelihoods and communities that rely on them. Climate disasters are impacting our infrastructure, including our transport networks, hospitals, schools and homes, and these costs are escalating over time. This is affecting our economic productivity and imposing significant costs on regional and national economies, from recovery and rebuilding efforts (Box 1.1). For example, the 2022 NSW floods caused $6.4 billion in insured losses alone.[4]

The Insurance Council of Australia estimates natural disasters are costing Australian homeowners around $4 billion each year, and are increasing insurance premiums.[5] Changes to seasonal conditions over the period 2001–2020 have reduced annual average agricultural profits by an average of 23% relative to the previous 50 years. Reductions in rainfall in southern Australia could exacerbate these losses.[6]

Climate risks are connected, and impacts in one sector will compound and amplify others.

Slow-onset climate change impacts may also threaten our net zero transition if not well understood and managed. Rising temperatures, extreme heat and heatwaves increase health risks, and heat-related mortality and make it harder to work outdoors.

Individuals and households already disadvantaged are the most vulnerable to such impacts of a changing climate.

The risk of vector-borne diseases (e.g. malaria and dengue fever) will rise with increased temperature, rainfall and floods in some areas, putting pressure on the healthcare system. Crop yields will decrease with declining rainfall (e.g. in southwest Western Australia). Many ecosystems, which support clean water and air, food security and regulate the local climate, will be impacted or lost.[7]

Aboriginal and Torres Strait Islanders (First Nations peoples) will also continue to experience unique and increasing impacts from climate change, which threatens the health of and access to Country, with flow-on detriments to social and physical health and wellbeing.

Disruptions to supply chains and telecommunications can also lead to enhanced security risks both in Australia and the region.

Every fraction of a degree increase in temperature escalates the risks and impacts of climate change.

Stabilising global temperatures through mitigation efforts will reduce some, but not all, climate impacts. Adaptation is needed regardless of how successful our emissions reduction policies are, with impacts such as sea level rise locked in for centuries to come. Australia's National Adaptation Plan (NAP) establishes a framework for adapting to the risks identified within the NCRA.

The NAP sets the foundation for the Australian Government to work collaboratively with state, territory and local governments, communities, First Nations peoples, businesses, and non-government organisations to build their adaptive capacity. It recognises the important roles a resilient environment and community play in supporting climate adaptation and sets out key priorities to build our capacity to manage climate extremes.

Adapting effectively to climate change and enhancing resilience will support Australia's transition to net zero by improving infrastructure resilience, reducing costs and boosting productivity.

1.2 Climate change is an urgent global challenge

Australia cannot – and is not – tackling climate change alone.

Australia, as one of 195 signatories of the Paris Agreement, is committed to holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels.[8] This commitment requires global emissions to fall rapidly and be at or below net zero in the second half of this century.[9]

Box 1.1 The cascading impacts of intense storms in Broken Hill

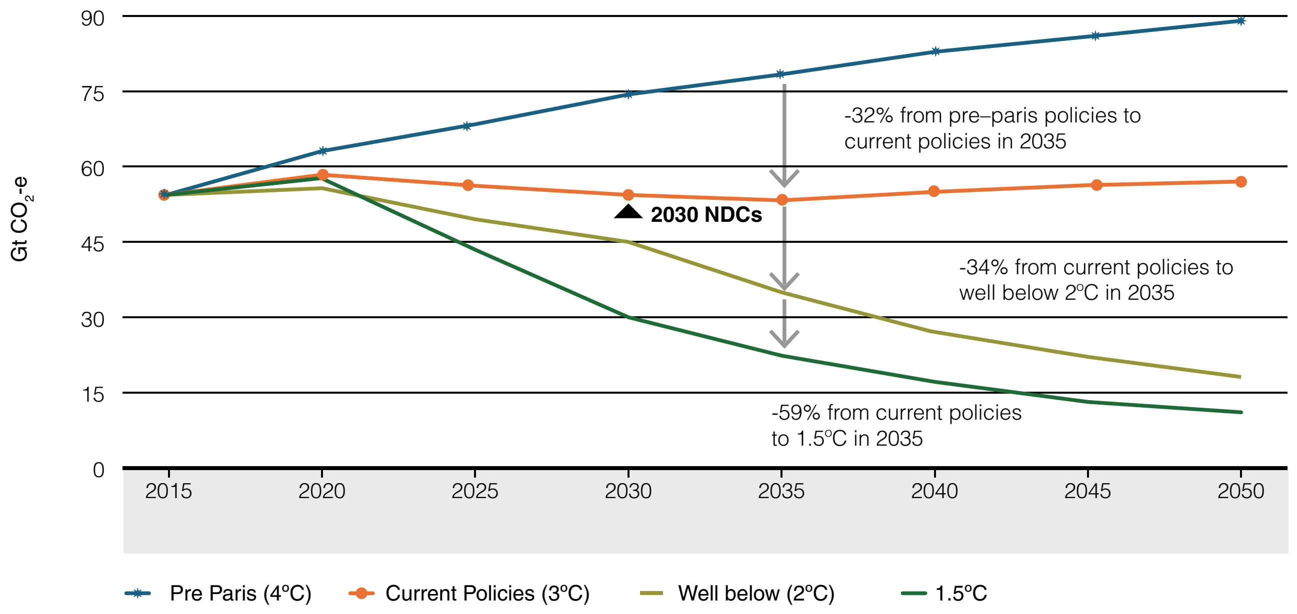
On 17 October 2024, a short but intense storm destroyed 7, and damaged 2, transmission towers supplying power to the greater Broken Hill area in NSW. Over the following 2 weeks 12,700 properties experienced intermittent power outages as transmission infrastructure was repaired, and backup gas turbines experienced faults and underwent maintenance. These disruptions also caused telecommunication network outages that affected 3,930 fixed-line and NBN services.

An inquiry by the NSW Parliament Committee on Environment and Planning found that, in addition to significant economic losses, these outages led to:

- widespread health impacts – residents with chronic health conditions were at risk of being unable to operate required electronic medical devices
- unstable power supply, voltage fluctuations and power spikes – which caused lasting damage to essential appliances like refrigerators and spoilage of food and medications
- sewerage and water pump failures – causing a backup of untreated sewerage, and water sources running low
- limited fuel availability – with some stations closed due to their reliance on telecommunications to operate their pumps and an increased demand for fuel to operate generators. This led to extensive queues to obtain fuel.

Source: Parliament of NSW, Legislative Assembly Committee on Environment and Planning, The electricity outages affecting Far West NSW in October 2024, Report 2/58 – June 2025.

Figure 1.1 Global emissions trajectories.ǂ



Collective international efforts are showing significant progress. In 2015, prior to the Paris Agreement, global policies had the world on track to warm by 4°C above pre-industrial levels by 2100 (Figure 1.1).[10] Current policies are on track to cut global emissions by 32% compared to pre-Paris levels by 2035 and lead to just less than 3°C of warming above pre-industrial levels by 2100.[11] There is still work to do, to align with a 2°C or 1.5°C trajectory.[12]

Despite a shifting global environment, countries across the world continue to affirm their commitment to the Paris Agreement and net zero goals. The Climate Change Authority (CCA) considered recent challenges to multilateral cooperation, including the implications of the United States' planned withdrawal from the Paris Agreement, and they concluded it is unlikely to materially hinder Australia's decarbonisation efforts. Around 80% of global GDP is covered by national net zero commitments, including Australia's major trading partners such as China, Japan and the Republic of Korea.[13] This share rises to over 84% when subnational commitments are included.*

The Climate Change Authority advised:

> 'The global transition is inevitable, already occurring, and accelerating—driven by rising global incomes and energy demand, falling clean energy costs and expanding low-emissions technology options, and rising concerns about the risks and impacts of climate change.'

2035 Targets Advice, page 4

Global energy intensity (energy use per unit of GDP) declined by an average of 2% per year between 2010 and 2019 and 1.2% per year from 2020 to 2023.[14] Similarly, carbon intensity (carbon dioxide emissions per unit of energy) fell on average by 0.3% annually from 2010 to 2019.[15] These trends reflect structural changes in the global energy system, including improved energy efficiency, a shift away from coal and the growing role of renewable energy.

ǂ *Treasury analysis of: Intergovernmental Panel on Climate Change (IPCC), Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report, Cambridge University Press, Cambridge, UK and New York, NY, USA, April 2022; International Institute for Applied Systems Analysis (IIASA), AR6 Scenario Explorer and Database, Laxenburg, Austria, 2022.*

* *Including sub-national commitments from US states would raise coverage to at least 84%. Source: Net Zero Tracker, Energy and Climate Intelligence Unit, Data-Driven EnviroLab, NewClimate Institute, Oxford Net Zero, 2025 (Net Zero Tracker).*

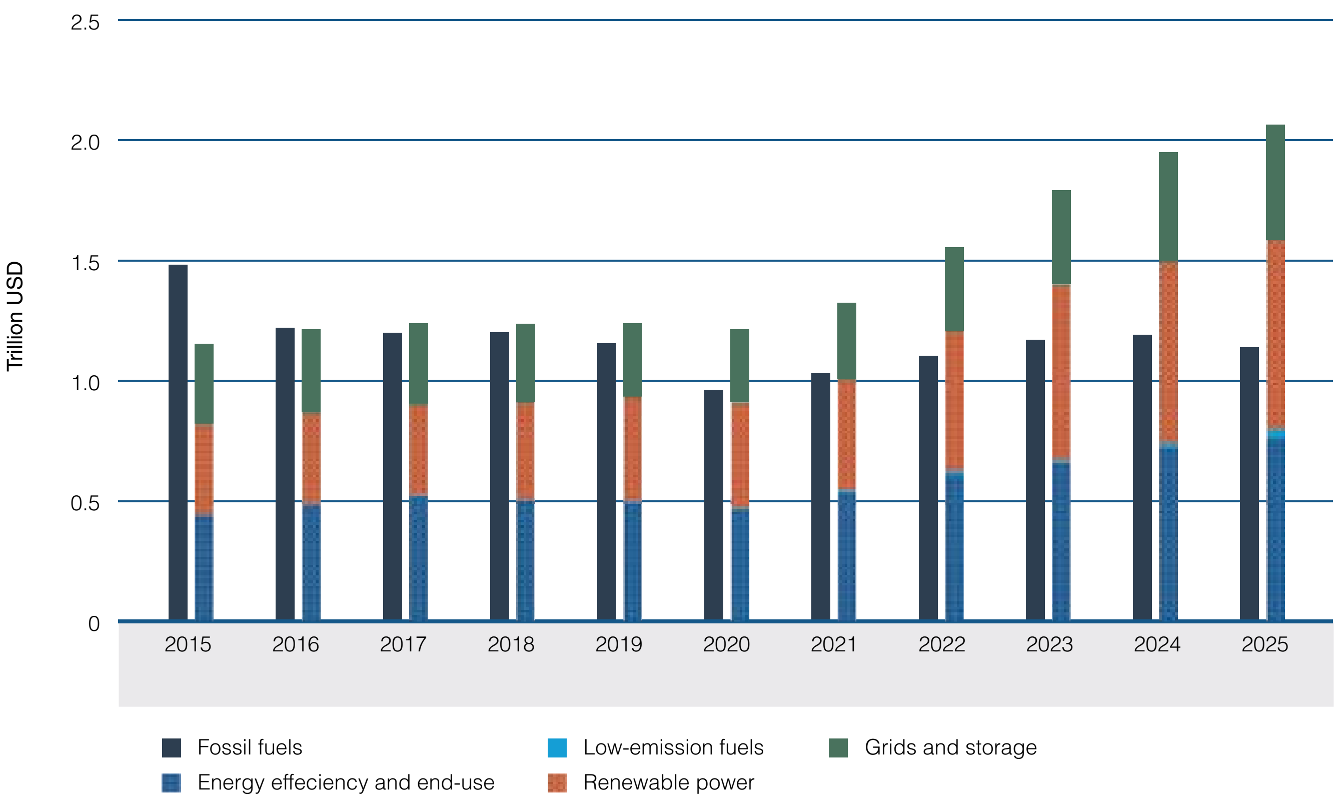
The plummeting costs of wind and solar have seen them become the fastest growing sources of electricity,[16] and clean energy investment and jobs now outnumber those in the fossil fuel industry.[17] The IEA reports that global investment in clean energy infrastructure, efficiency and electrification are set to rise to USD2.2 trillion in 2025, double the investment in oil, coal and natural gas (Figure 1.2).[18] They project that renewables are set to meet around 90% of global electricity demand growth out to 2027,[19] and that demand for, and investment in, fossil fuels is set to decline over the next 10 years.[20]

The IEA attributes the clean energy investment surge to a combination of emissions reduction goals, technological gains, energy security imperatives, and countries seeking to establish stronger positions in emerging global markets.

In Australia, investors continue to prioritise climate action to protect long-term returns, strengthening net zero commitments, establishing interim targets and developing climate investment strategies in recognition of the clear economic case for the global transition.[21]

Regardless of geopolitical challenges, these economic fundamentals suggest the transition to net zero will accelerate. Australia stands to gain from shaping global efforts, building our influence and access to emerging markets, while diversifying to better manage external shocks.

Figure 1.2 International investment in energy 2015–2025[22]



1.3 Australia's opportunity in the net zero transition

Australia's fossil fuel resources have contributed to our economy, regional employment and trade relationships for decades. Resources and energy account for around 11.4% of Australia's GDP, with Australia being the world's largest exporter of iron ore and alumina. Coal and natural gas were our second and third largest exports by value respectively (after iron ore) in 2024.[23] Over two-thirds of the total energy produced in Australia is now exported as some form of raw or refined fossil fuel energy.

As global energy systems shift toward lower-emissions sources, including renewables, Australia must adapt to secure our ongoing prosperity and stability.

Australia has world-leading renewable resources, rich metal and mineral deposits, a skilled workforce, strong trade partnerships and a stable investment environment. These advantages will enable Australia to sustain economic growth and remain competitive as the world transitions away from fossil fuels towards lower emissions goods and services.

Capital is flowing most readily into jurisdictions with clear transition plans, frameworks that support sustainable finance, business and industry growth, and stable and consistent policy that enables long-term decision-making.[24]

Pursuing our comparative advantages and incentivising efficient investment will also enhance productivity outcomes for Australia. This can be achieved by accelerating energy performance, increasing investor certainty, encouraging innovation, enhancing market designs, and addressing barriers to infrastructure deployment such as slow planning and approval processes. The Government is focused on reforms that will enhance productivity and competitiveness across the economy, providing flow-on benefits for the transition.

A lithium mine processing plant Western Australia, Australia.

1.4 A clear pathway will help communities, industry and government successfully navigate the transition

How exactly the transition unfolds from here is uncertain, with both challenges and opportunities ahead for Australia. Technology costs are hard to predict, community support for solutions can accelerate or delay the deployment of infrastructure, and international developments or new breakthroughs can drive new market dynamics. Coupled with unexpected economic and climate shocks, this means there are upside and downside risks for Australia's transition.

The transition will need to be navigated in a way that ensures fair and equitable outcomes for all Australians. This means working with regional and remote communities, including First Nations, to ensure everybody has a clear understanding of what the transition means for their local area and are supported to participate in key decision-making processes.

A long-term pathway to net zero builds confidence in the transition and helps to navigate through uncertainty. Strong and stable policy drives investment, and predictable systems of review and improvement bring flexibility to adjust policies and approaches as things change.

Swan Valley, Western Australia, Australia.

Over the last 3 years, significant progress has been made in building a stable policy framework to enable climate action, track progress and refine our efforts over time.

This includes passing Australia's *Climate Change Act 2022* in September 2022, which:

- legislated our 2030 target to reduce emissions by 43% on 2005 levels, and our long-term goal of net zero by 2050
- expanded the role of Australia's independent CCA to provide independent advice on targets and progress
- enhanced accountability and transparency by requiring the Minister for Climate Change and Energy to table an Annual Climate Change Statement in parliament, reporting on progress in our emissions reductions commitments.

This provides a robust cycle to review and refine our policies and measures over time to ensure Australia remains on track to net zero (Figure 1.3).

The Climate Change Authority advised:

> 'Australia's existing policies – anchored by national emissions reduction legislation, sectoral initiatives and funding programs – provide a strong platform for progress… There are opportunities either to expand their reach or introduce select initiatives to address gaps and barriers to implementation.'

2035 Targets Advice, page 57

The Net Zero Plan builds on this framework, providing a long-term pathway for Australia's transition and priorities for further action.

Figure 1.3 Set-do-review-refine framework

2. The Net Zero Plan and sector plans

Key messages

- The Net Zero Plan and the 6 sector plans set out a clear pathway and actions to ensure a fair and orderly transition for Australians and provide the private sector with greater confidence to continue investing.
- The plans are informed by extensive community and industry engagement as well as independent expert advice.

2.1 Guiding Australia to net zero emissions by 2050

The Net Zero Plan sets out how Australia can transition to net zero emissions by 2050, and the steps the Australian Government is taking to achieve this. It sets out Australia's 2035 target, the next big milestone in our net zero journey.

The Plan responds to calls from investors, business, industry, unions, farmers, community, First Nations peoples and conservation groups, who have all stressed the need for clear guidance on Australia's pathway to net zero.

A fair and orderly transition will:

- **Deliver affordable, clean and reliable energy for all Australians**, minimising cost of living and household pressures by leveraging Australia's vast renewable energy potential.
- **Revitalise Australia's industrial competitiveness** capitalising on our natural advantages in resources and clean energy.
- **Ensure opportunities and benefits flow equitably** to communities, providing the supports needed for transitioning regions.
- **Enable early, consistent action** for an orderly and efficient transition to net zero.
- **Accelerate investment, innovation and knowledge-sharing** by leveraging Australia's strategic partnerships.

The 6 sector emissions reductions plans cover all major sources of emissions across the economy. They outline how each sector can contribute to Australia's transition and provide detail on the emissions reduction opportunities and transition pathways for each sector.

Solar farm, South Australia, Australia.

2.2 The plans and 2035 target are grounded in independent, expert advice

The 2035 target and plans draw on independent expert advice from the CCA and Commonwealth Scientific and Industrial Research Organisation (CSIRO), and analysis from across government.

Economic modelling by the Australian Treasury explores 3 scenarios for potential net zero pathways and their economic impacts in the context of the global net zero transformation. This work, set out in the companion document 'Australia's Net Zero Transformation: Treasury Modelling and Analysis', provides insights into how Australia can efficiently achieve emissions reductions over time, and how to maximise opportunities.

> The government's comprehensive approach ensures the pathways outlined in the plans are robust, credible and underpinned by the best available evidence.

As required under the *Climate Change Act 2022*, the Minister for Climate Change and Energy requested the CCA provide advice on a national 2035 emissions reduction target. This advice was received on 12 September 2025.

In addition, parliament requested the CCA provide advice on sectoral pathways, as a Special Review under the *Climate Change Authority Act 2011*. The CCA's advice has directly informed the Australian Government's decision and this Net Zero Plan, and is referenced throughout.

2.3 The plans and 2035 target have drawn on extensive consultation with the community and industry

The Net Zero Plan, 2035 target and sector plans were informed by extensive community and stakeholder consultation. This included the CCA's public consultations in 2023 and 2024 across 3 reports, which cumulatively received 565 submissions. The CCA also conducted industry roundtables, meetings with unions and workforce representatives, regional community workshops, First Nations engagement, ministerial and senior official council meetings with state and territory governments, and engagement with local government organisations.

The Australian Government also drew on a wealth of engagement, input and insights from industry and communities, collected through related policy work. This included submissions and information provided during development of the Future Gas Strategy, National Hydrogen Strategy, Capacity Investment Scheme, the National Electric Vehicle Strategy, the National Health and Climate Strategy and others. This engagement has reinforced that all sectors and stakeholders play a role in the transition, and the importance of enabling and encouraging broad participation (Figure 2.1).

Figure 2.1: Key messages by stakeholder cohort

Communities and regions:

- Communities are leading work underway to chart the energy transition locally. They are eager to be involved, but are looking for assistance from governments and collaboration with business.
- Upfront costs and access to information remain challenges to taking action and will require government assistance to overcome.
- Regional communities already face specific place-based challenges, including access to health and social services, housing, and the right training. Developing place-based solutions, which fulfill these community needs is key to accelerating the pace of the energy transition.
- Communities support the mainstreaming of climate considerations across all areas of government policy and adopting approaches that recognise the interlinkages between government policy decisions in different areas (e.g. the health and wellbeing implications of increased active transport).
- Coordination is needed between levels of government, communities and business to deliver an orderly transition.

Workers and unions:

- Many workers are interested in the opportunities of new industries and want to have the skills to take part. This training must be targeted at the right time and the right place.
- A fair and orderly transition will deliver high-wage and secure jobs in safe and inclusive environments.

Business and investors:

- Businesses are ready to invest in the net zero transition. A stable and navigable investment environment is essential for facilitating capital flow to the transition.
- Australia is competing globally for investment. An ambitious target will help to signal the appetite for investment, and underpinning policies will make the target achievable by accelerating capital attraction.

First Nations communities:

- Net zero project proponents must seek free, prior and informed consent from Traditional Owners when operating on Country.
- Indigenous businesses are eager to join the supply chains of renewable projects, helping to unlock prosperity for First Nations communities.
- Climate change is a threat to Country and the linked cultural practices of First Nations peoples. Disruption of Country and culture takes a significant toll on social and emotional wellbeing. Government should work in partnership with Traditional Owners to understand how best to act to protect Country and empower Traditional Owners to look after Country.

Youth:

- The best climate action will also protect the environment for future generations.
- Support must be offered to the most disadvantaged through the transition, to deliver climate justice.
- Young people want to see resilient communities that can withstand climate impacts, and where they can support local action.
- Communities want a say in co-designing climate actions to ensure they work for people, especially regional and First Nations communities, and people with disabilities.

3. Australia's emissions and outlook

Muswellbrook, New South Wales, Australia.

Key messages

- Australia's emissions are coming down. Our current policies and measures put us on track to achieve our 2030 target of 43% if we stay the course.
- National emissions were 27% below 2005 levels in 2024. Our most recent data for 2025 indicates emissions are now down 29%.
- These are real reductions supported by strong policies, including the 82% renewable electricity target and Safeguard Mechanism.

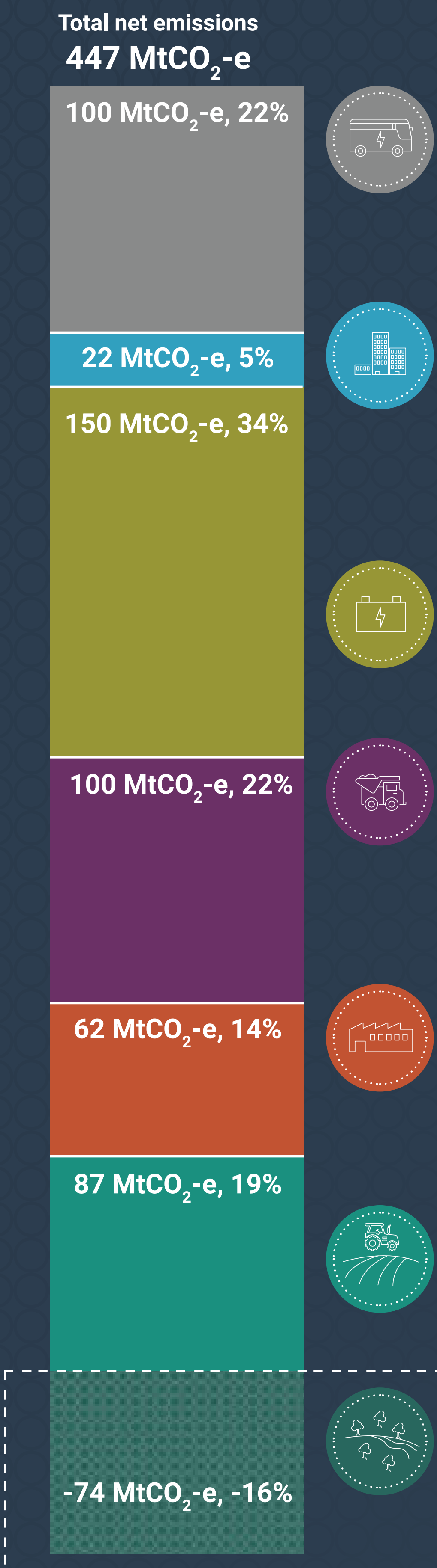
3.1 Australia's current emissions profile

Australia has a world-class system to track its greenhouse gas emissions. This allows Australia to understand emissions sources, drivers and trends, monitor and evaluate the effectiveness our policies, and implement measures to reduce them. Our system enables transparency and accountability – Australia publishes comprehensive annual reports and data to fulfil Australia's international reporting obligations under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. Australia also publishes quarterly emissions updates to ensure governments, industry and investors have the latest information to support their decisions. This information is used to inform the Australian parliament and the public on progress toward national emissions targets.

Emissions come from a range of economic activities. Australia's emissions reduction targets and reporting framework cover carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and synthetic greenhouse gases such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).[25] Australia's largest source of greenhouse gas emissions is the burning of fossil fuels to generate electricity, followed by the combustion of fossil fuels to drive our transport and resources sectors.

The Net Zero Plan considers emissions across 6 major emissions sources, representing key sectors of Australia's economy (Figure 3.1).

Figure 3.1 Australia's emissions by sector, 2024 (note: totals may not sum due to rounding)[26]



Transport

The transport sector covers light and heavy road transport, rail, maritime vessels, aviation, and the construction of transport infrastructure and support services. The sector directly contributes 22% of Australia's annual emissions; the largest single source of emissions is light vehicle road transport. Indirectly, the transport sector accounts for emissions through the materials used for manufacture of vehicles and infrastructure such as roads.

Built Environment

The built environment sector covers residential, commercial, and public buildings as well as urban open spaces and water infrastructure. The sector directly accounts for around 5% of Australia's emissions, mainly through combustion of fuels for space and water heating, cooking and construction, and leakage from refrigerants. Indirectly, it accounts for further emissions through the energy and materials used in construction and operation. For example, the built environment sector is indirectly responsible for almost half of the emissions from electricity use.

Electricity and Energy

The electricity and energy sector covers the generation of electricity, manufacture of petroleum products, the supply of gas, and other related services. These functions underpin Australia's economy and are currently the largest source – approximately 34% – of Australia's annual emissions.

Resources

The resources sector covers the exploration and production of minerals, oil and gas, and coal resources. Production includes resource extraction and, depending on the commodity, any additional on-site processing as well as limited minerals processing. The sector also covers mine closure, decommissioning and rehabilitation. The sector contributes significantly to Australia's economy, especially through exports. It also contributes about 22% of Australia's annual emissions.

Industry

The industry sector covers the manufacturing and processing of goods, for domestic use and as exports. It spans 9 priority subsectors including waste and resource recovery, manufacturing, iron and steel, cement and concrete, metals refining and smelting, and waste and resource recovery. The sector contributes significantly to Australia's economy and employment and accounts for 14% of annual emissions.

Agriculture

The agriculture and land sector covers farming, land management, forestry, and fisheries. Agriculture emissions, primarily in the form of methane from livestock (particularly cattle and sheep) and manure, nitrous oxide from agricultural soils, and on-farm fuel use, contribute 19% of Australia's annual greenhouse gas emissions.

Land

The land sector contains vegetation and soils that can both emit and sequester carbon dioxide; it is currently a net carbon sink (that is, it sequesters more than it emits) equivalent to 16% of Australia's annual emissions

3.2 Australia has already made progress in reducing emissions

Since 2005, domestic policy settings, technology advancements and the effects of global events have had a major impact on Australia's emissions. While emissions from transport and some energy subsectors (such as LNG production) have grown since 2005, others, such as agriculture and electricity, have reduced.[27]

Australia's national emissions were 447 million tonnes of carbon dioxide equivalent (Mt CO_2-e) in 2024, 27% below 2005 emissions. The latest preliminary data for 2025 shows a further reduction to 436 Mt CO_2-e, which is 29% below 2005 emissions (Figure 3.2).

Australia has seen emissions reductions due to:

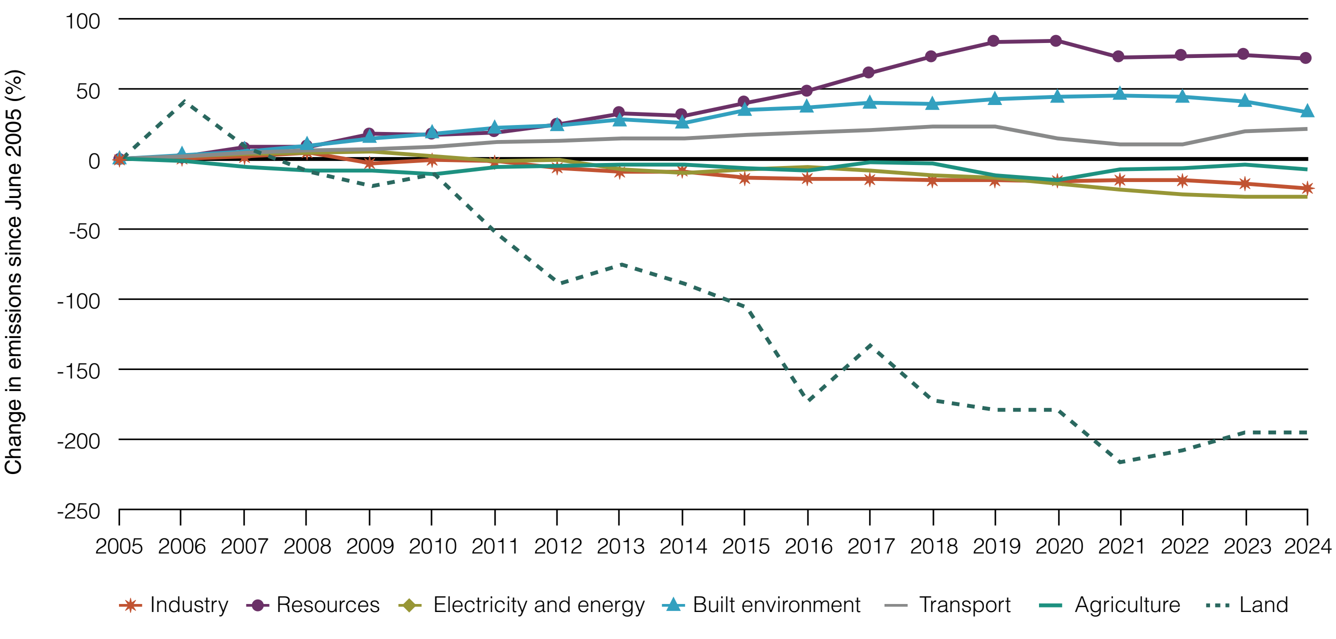
Land sector becoming and remaining a net sink. The sector contributed 13% of national emissions in 2005, but now is a net sink equivalent to over 16% of national emissions in 2024.[28] This is due to several factors including state and territory policies to reduce land-clearing, declines in harvesting of native forests and expansion of forest cover including through plantation establishment.

Reduced electricity sector emissions resulting from the rapid growth in solar and wind deployment across the country, replacing coal-fired generators as they retire. This growth reflects the combined impact of national, state and territory renewable energy policies and a significant reduction in renewable technology costs. In 2024, a record 7.5 GW of new renewable electricity capacity was added, of which over 3 GW was rooftop solar.[29]

Strengthening of the Safeguard Mechanism and Australian Carbon Credit Unit (ACCU) Scheme which provide clear, long-term policy signals and options to support emissions reductions across the economy. Some of the more recent emissions reductions observed can be attributed to these policies. Further details on these policies can be found in Box 3.2 – Safeguard Mechanism and Chapter 9 – Carbon Markets.

Australia's climate action has resulted in a gradual decoupling of ongoing economic growth from national emissions. The emissions intensity of the Australian economy reduced by more than 55% between 2005 and 2024, and emissions per capita fell by more than 46%.[30]

Figure 3.2 Percentage change in emissions by sector since June 2005

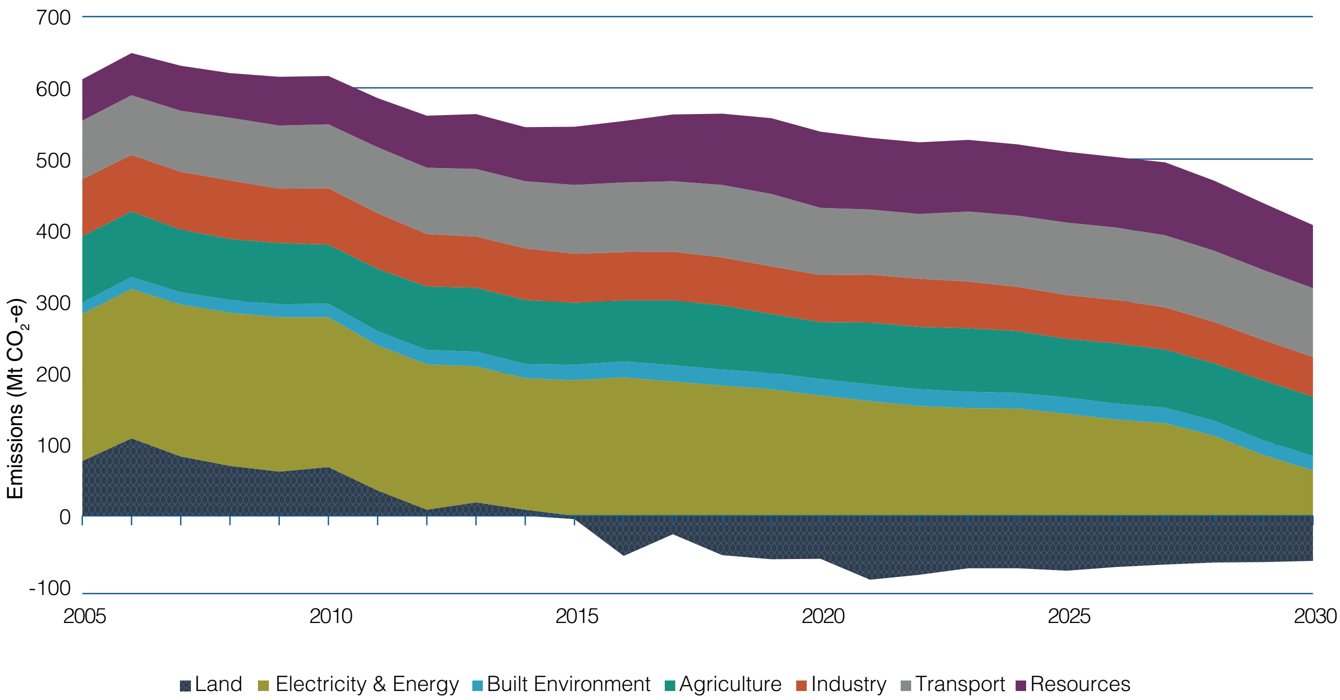


3.3 Major policies since 2022 provide a strong foundation for further emissions reductions

Over the past 3 years, Australia's emissions outlook has improved substantially with the implementation of a robust set of national emissions reduction policies.

The latest emissions projections show that with current policies, Australia is on track to meet the 2030 target on an emissions budget basis and is just shy of meeting the point-in-time target, reaching 42.6% below 2005 levels in 2030.

Figure 3.3 Emissions projections by sector, 2005 to 2030 (Note: Inventory data used up to 2024, 2024 Emissions Projections data used from 2024–2030)



Box 3.1 Uncertainty in emissions projections

Australia's emissions reporting provides a basis for governments and industry to calibrate policy and investment over the long-term to achieve Australia's emissions targets.

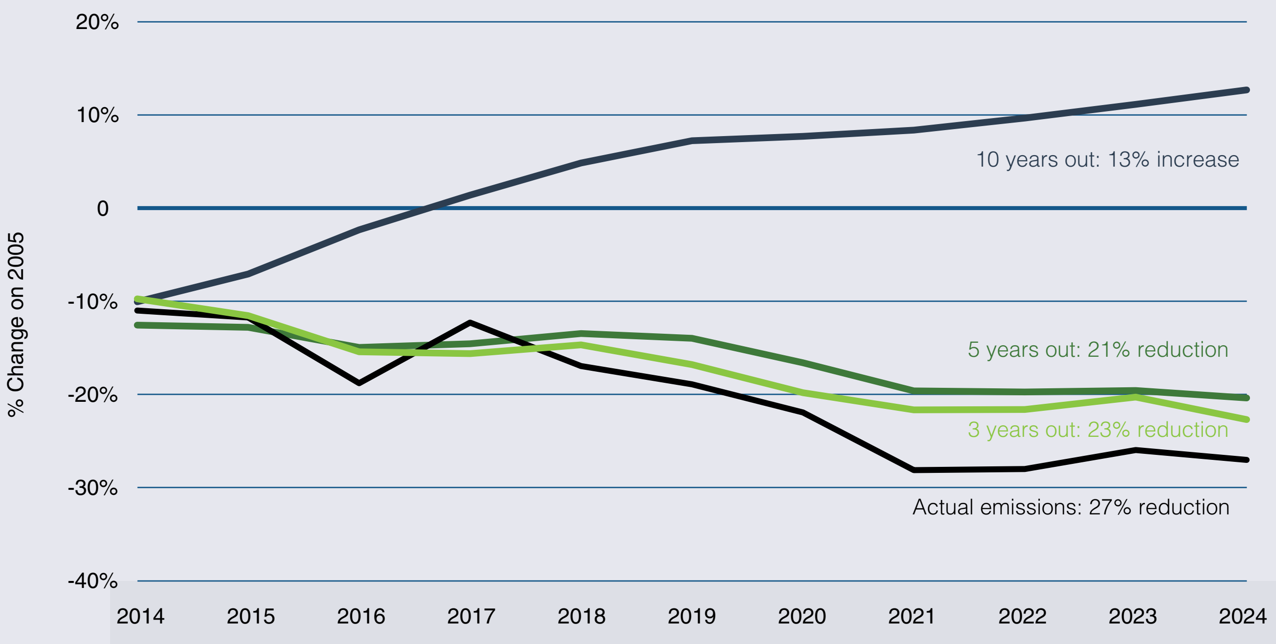
Emissions projections use the best available data on production and activity levels, commodity prices and macroeconomic trends to help determine how Australia is progressing towards its targets.

Emissions estimates are influenced by domestic policy settings, technology advancements, global markets and the continuous improvement of emissions data and methods. They are also impacted by events such as bushfires, drought, La Niña and El Niño weather events, and the COVID-19 pandemic.

For these and other reasons, projections are inherently uncertain. They involve judgements about the future growth path of domestic and overseas economies, policies and measures, technology and human behaviour. This uncertainty increases the further into the future emissions are projected. Historically, Australia's actual emissions have been substantially lower than projected.

As new policies have been introduced, clean technology costs have fallen, public and consumer sentiment has shifted, and global action on climate change has strengthened, Australia has significantly out-performed projections made in previous years (Figure 3.4).

Figure 3.4 Differences between emissions projections 10, 5, and 3 years in advance, compared to actuals for 2014-2024



Since 2022, the Australian Government's policy reforms have established legally binding policies calibrated to our national targets for well over half of Australia's emissions (Figure 3.5).

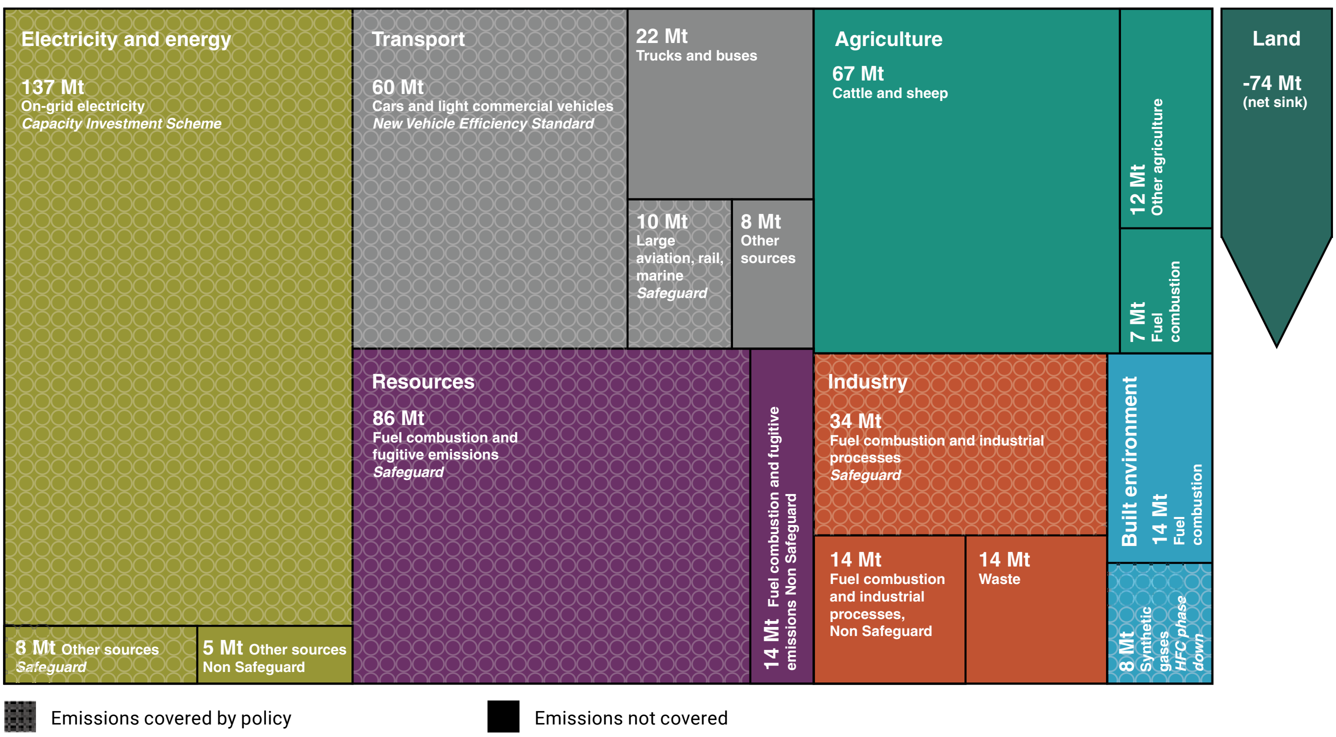
The Capacity Investment Scheme (CIS) supports the expansion and decarbonisation of Australia's electricity grids with firmed renewables, to help achieve Australia's target of 82% renewable generation on-grid by 2030. It provides long-term revenue underwriting for projects, which decreases financial risk for investors. The CIS will support a total of 40 GW of projects with up to 26 GW of renewable generation capacity, and up to 14 GW of clean dispatchable capacity.[31] Achieving 82% renewable electricity generation is estimated to deliver 44 Mt* of cumulative abatement from 2024 to 2030.

The New Vehicle Efficiency Standard (NVES) improves access to low- and zero-emissions vehicles for Australian motorists by setting emissions targets for new passenger cars and light commercial vehicles – like utes and vans – sold in Australia. Car manufacturers and suppliers must meet these targets for all new vehicles, on average, that they bring into Australia. Over time, the emissions target is lowered. The NVES is expected to reduce the emissions intensity of new passenger vehicles by around 60% by 2030, and the emissions intensity of new light commercial vehicles by half over the same period. The NVES is expected to achieve 20 Mt† of cumulative abatement by 2030.

The ACCU Scheme incentivises carbon abatement activities through projects ranging from reforestation to energy efficiency. Proponents carry out registered projects to reduce emissions or sequester carbon and are issued with one ACCU for each tonne of carbon dioxide equivalent sequestered or avoided. ACCU crediting is subject to strict eligibility criteria based on the Offset Integrity Standards to ensure abatement is additional, measurable and evidence-based (see Chapter 9 for full description). Since 2011, the ACCU Scheme has delivered over 169 Mt of abatement across Australia.[32]

Figure 3.5 illustrates the broad coverage of the **CIS**, the **Safeguard Mechanism** (Box 3.2) and the **NVES**.

Figure 3.5 Emission sources in 2024 covered by legally binding policy measures (Note: units refer to $MtCO_2$-e, totals may not sum due to rounding).



* *Estimate is based on internal analysis.*

† *The Department of Infrastructure, Transport, Regional Development, Communications, Sport and the Arts (March 2024) Cleaner, Cheaper to Run Cars: The Australian New Vehicle Efficiency Standard Impact Analysis*

Rio Tinto Yarwun Alumina Refinery, Gladstone, Queensland, Australia. Credit: Rio Tinto.

Box 3.2 The Safeguard Mechanism and its role in national emissions reductions

The Safeguard Mechanism legislates an emissions reduction trajectory to net zero in 2050 for over 200 of Australia's largest industrial facilities. Safeguard baselines decline annually in line with Australia's emission reduction targets of 43% below 2005 levels by 2030 and net zero by 2050. This will deliver around 200 $MtCO_2$-e of cumulative emissions reductions by 2030, with covered facilities collectively reducing their net emissions from 136 $MtCO_2$-e in 2024 to less than 100 $MtCO_2$-e in 2030, and continuing on a trajectory to net zero by 2050.[33]

The Safeguard Mechanism covers emissions across 4 of the 6 sectors:[34]

- Resources – 87% of sector emissions or 87 $MtCO_2$-e
- Industry– 56% of sector emissions or 35 $MtCO_2$-e
- Transport – 11% of sector emissions or 11 $MtCO_2$-e
- Electricity and energy – 3% of sector emissions or 4 $MtCO_2$-e

The Safeguard Mechanism is market-based and technology-neutral. It specifies the emissions outcome to be achieved, while leaving businesses to decide where their best opportunities for efficiency and transformation lie. This allows the cheapest emissions reductions to be accessed first, lowering the cost of compliance for facilities, and lowering the overall cost of reducing Australia's emissions.

- If a facility emits less greenhouse gas than allowed by their baseline it generates tradable credits (Safeguard Mechanism Credits or 'SMCs') for the difference between its emissions and baseline.
- If a facility emits more greenhouse gas than allowed by their baseline it must take action to reduce them, or purchase credits from others. Facilities can surrender SMCs or ACCUs to complement on-site reductions.

The Safeguard Mechanism is flexible and scalable. Its settings can be calibrated to align with any target. The decline rate of 4.9% annually to 2030 has been set so that Safeguard facilities deliver a proportional share of Australia's 2030 target. The decline rate for the period to 2035 will be considered in the 2026-27 Review and ensure the scheme's design is appropriately calibrated and effectively delivering emissions reductions in line with Australia's targets (see further in Chapter 9 Carbon Markets).

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2

Australia's net zero pathway

An orderly transition to net zero emissions will support economic growth, create jobs in new industries, and provide broad-based support for households, communities and industries.

Part 2 of the Net Zero Plan sets out Australia's pathway through its 2035 target of 62 - 70% to net zero by 2050. This is informed by analysis from the Treasury, the Climate Change Authority, and extensive engagement with stakeholders.

4. Australia's 2035 target

Key messages

- Australia's 2035 emissions reduction target is 62-70% below 2005 levels.
- The target represents Australia's highest possible ambition. It is a credible contribution to global action to keep 1.5˚C within reach, and positions Australia to seize the opportunities from the global transition to net zero.
- The target can be met while the economy continues to grow, with technologies and practices we have today.
- The target and emissions budget provide flexibility for Australia to navigate uncertainty, risk, and seize opportunities over the next 10 years.
- In setting this target, the Government has considered and adopted the recommendation of the Climate Change Authority.

Australia's interim emissions reduction targets are important waypoints on the path to net zero emissions by 2050. They help keep our economy on a steady, predictable pathway and provide confidence for investors to support Australia's clean industries. In 2022, the Government increased Australia's 2030 target to 43% below 2005 levels and legislated that commitment. In line with the Paris Agreement, Australia is now determining its ambition for 2035.

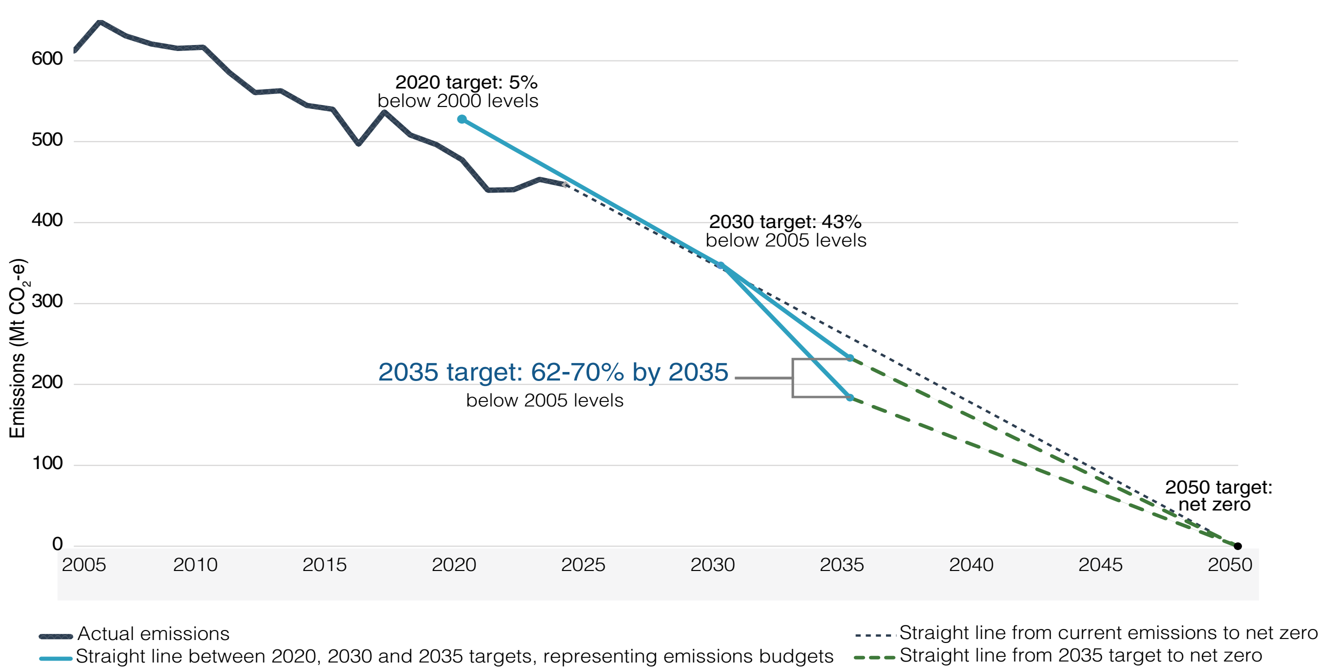
Australia's 2035 target is 62-70% below 2005 emissions levels, covering all sectors of the economy and all greenhouse gases (GHGs) (Figure 4.1).

This is an ambitious and achievable target for Australia. It demonstrates Australia's commitment to transform our economy by attracting investment in new, clean industries that help deliver on Future Made in Australia priorities. It is also a responsible contribution to global efforts to address climate change.

The Climate Change Authority advised:

> 'Adopting a 2035 target that is, and is seen to be, ambitious is crucial for unlocking national economic benefits, for creating good jobs in regions that have underpinned Australia's economy for generations, and for delivering new opportunities for Australian farmers and First Nations communities.'
>
> 2035 Targets Advice, page 5

Figure 4.1 Australia's emissions reduction targets and progress[1]



4.1 Independent advice informed Australia's target

The *Climate Change Act 2022* enshrines a world-leading process for developing emissions reduction targets, requiring the government to consider the independent advice of the Climate Change Authority (CCA) before setting a new target.

On 21 July 2023, the Minister for Climate Change and Energy wrote to the CCA to request this advice for Australia's 2035 target.

The CCA's advice is the culmination of two years' work, informed by modelling from CSIRO, extensive scientific and policy analysis, and public consultation. The CCA's 2035 Targets Advice was also informed by its Sector Pathways Review.[2] This advice was provided on 12 September 2025 and recommended a target of 62-70%.

The Climate Change Authority advised:

> 'The Authority finds that an emissions reduction target of 62–70% from 2005 levels represents Australia's highest possible ambition taking account of the matters set out under the relevant legislation, is achievable, and is in Australia's national and economic interest.'

2035 Targets Advice, page 4

The Government has adopted the CCA's target recommendation.

The Government considered the CCA's advice alongside other important inputs, such as consultation on the Net Zero Plan and sector plans, and Treasury's modelling and analysis. These inputs informed the government's understanding of:

- The economic benefits, costs, and opportunities for Australia and how these may be shared across households, industries and regions
- Achieving the global temperature goals of the Paris Agreement
- Australia's position and role in the international community and in global markets
- The policies and technologies required to achieve the target.

4.2 62-70% is ambitious

The Climate Change Authority advised:

> 'Our comprehensive analysis has led us to conclude that 62-70% is an ambitious target for Australia to achieve by 2035. … It aligns with what the science demands: strong and urgent action.'

2035 Targets Advice, page 7

A target of 62-70% by 2035 represents a substantial step-up in ambition for Australia, halving current emission levels and accelerating progress toward net zero by 2050. Over the next 10 years, Australia aims to reduce emissions by more than it has over the past 20 years. The average rate of emissions reductions will need to accelerate from 16 $MtCO_2$-e per year from now to 2030, to at least 23 $MtCO_2$-e per year from 2031 to 2035.

The global response to climate change is driving an irreversible transformation of energy systems and the global economy; one of the largest structural changes since the Industrial Revolution. Our world-class access to renewable energy, critical mineral resources, skilled workforces, geographic position, and our reputation as a reliable trading partner positions us well to benefit and prosper from the global transition as a major renewable energy and green commodity exporter. As the CCA notes "an ambitious target should position Australia for prosperity, realising opportunities to navigate the transition from an emissions-intensive economy to a prosperous future as a major exporter of low-emissions products" (2035 Targets Advice, page 14).

The Australian Government has set the target with this international context in mind, recognising that despite geopolitical challenges and volatility, the economic fundamentals remain and will continue to accelerate the transition to net zero. Australia's target enhances our competitiveness as global investors are looking for stable markets for renewable technologies and clean energy industries.

The Climate Change Authority advised:

> 'This continued momentum of global action reinforces the imperative for Australia to sustain strong action on climate change.'

2035 Targets Advice, page 92

This target is an important, but not our only, contribution to global mitigation efforts to meet the Paris Agreement goals. Our investment in developing clean energy technologies and industries will support other nations in their decarbonisation pathways.

A target of 62-70%, along with our international contributions, will help achieve the overarching goal of the Paris Agreement to keep global average warming well below 2°C and pursue efforts to limit warming to 1.5°C. The CCA found that 'a target of 62-70% … anchors Australia's commitment to the global goal of pursuing efforts to limit warming to 1.5°C, the threshold beyond which multiple climate systems risk irreversible breakdown' (2035 Targets Advice, page 15). The science shows us that every fraction of a degree matters, including for Australia, where the National Climate Risk Assessment shows the significantly increased impacts for higher global warming levels.[3]

The UN's Global Stocktake of progress under the Paris Agreement recognises that global emissions must reduce by 60% from 2019 levels to keep 1.5°C within reach, as found by the IPCC Sixth Assessment Report.[4] While this does not determine what national contributions should be, it provides a useful point of comparison. This is well within Australia's target range of 62-70% - for Australia a 60% reduction on 2019 levels is equal to a 68% reduction on 2005 levels.

The Climate Change Authority advised:

> 'Continuing to strive for 1.5 °C matters because the difference in risks and impacts between a 1.5 °C and 2 °C outcome is stark.'
>
> 2035 Targets Advice, page 22

4.3 62-70% is achievable

The purpose of the 2035 target is to drive stronger action over time. This is what is required nationally and globally if we are to achieve the Paris temperature goals and avoid the worst impacts of climate change.

As the economic case for the net zero transition strengthens, targets play a crucial role in signalling our national economic intentions, highlighting opportunities and building investor confidence. The CCA advise that an ambitious target increases the likelihood of Australia capturing the benefits of the global transition and the potential size of these benefits.

The CSIRO's modelling, which informed the CCA advice, shows that a 62-70% target can be achieved while the economy grows at an average rate of 2.7% each year. All major sectors increase the volumes and value of their output.[5]

The Climate Change Authority advised:

> 'The projected reductions in net emissions are all achieved against a projected background of economic growth and rising national income. Much of the so-called 'cost' of achieving a target is actually investment to replace ageing assets like old coal plants, vehicles, appliances and industrial gear with cheaper-to-run technology – it's investment that has to happen regardless of the emissions reduction imperative.'
>
> 2035 Targets Advice, page 12

These findings are reinforced by modelling undertaken by Treasury which shows that an orderly transition to net zero would support continued economic growth, higher living standards and employment. A disorderly transition will cost investment, jobs and the economy. This is further discussed in Chapter 5.

The CCA concluded that a target of 62-70% below 2005 levels can be achieved with existing technologies and practices – achievement does not rely on new, unproven technology.[6] This includes continuing to expand renewable energy generation, electrifying and improving the efficiency of transport and buildings, improving the efficiency and emissions intensity of industry, mining and agriculture and increasing land-sector carbon removals.

Similarly, findings from the Treasury modelling show there are cost-effective pathways that deploy current technologies to achieve the required emissions reductions.

Past experience shows that clean energy technologies and capabilities often improve faster than projected, giving us confidence that even the upper end of the target range could be achieved if technology and market innovation continues to surpass today's expectations. Technology pathways are described in more detail in Chapter 5.

The Climate Change Authority advised:

> 'Right now, the priorities are to rapidly deploy and scale known technologies, and to set the foundations and mobilise capital for the technologies needed after 2035.'

2035 Targets Advice, page 11

CCA and Treasury analysis shows Australia has extensive abatement opportunities, and our track record shows we have the means – and the commitment – to act.

The policies and reforms introduced by the Government since 2022 provide strong foundations and are making progress towards the target. Australia's emissions are now 29% below 2005, and with today's policy settings and market and global trends, we are projected to be 51% below 2005 by 2035. Compared to now, that is two thirds of the way to 62%, and more than half of the way to 70%. Further policy effort will build on these foundations, including through scheduled reviews to recalibrate existing measures.

The Climate Change Authority advised:

> 'The foundational climate change policies for achieving this target are also now in place. These must be refined, extended and expanded to ensure the target is reached in a timely, efficient, and effective manner.'

2035 Targets Advice, page 42

Australia's emissions outlook has consistently improved faster than projected due to the combination of policy, global, technological, market and other developments, (Box 3.1). Global projections have similarly improved – in part because modelling of the energy transition consistently tends to overestimate costs and underestimate deployment rates for clean technologies.[7]

The Australian Government is not alone in addressing climate change. As the CCA notes, the target 'represents the total collective effort required across the economy; it is not the target for any individual sector, business, jurisdiction or household.' (2035 Targets Advice, page 32). The Australian Government plays a leadership role in providing the right policies, regulatory settings, supports and standards. It also works with state, territory and local governments, as well as industry and communities, as everyone invests in the transition and the social and environmental benefits it brings (discussed further in Part 4).

The Climate Change Authority advised:

> 'Everyone has a role to play in reducing emissions, and the sum of those roles is greater than the parts. When governments, major corporations, investors, small businesses, community groups and households each commit to action, their efforts reinforce one another. Strong targets or action enables and encourages others to do the same, building momentum across the economy.'

2035 Targets Advice, page 43

4.4 Setting an achievable target, robust to uncertainty

Achievement of any emissions reduction level within the target range would be a strong contribution to global climate action; as the CCA states, ‘the future is always going to be uncertain but that is no cause to pause – the stakes are too high and stalling creates other risks and costs.’ (2035 Targets Advice, page 10).

Setting the target as a range allows Australia to manage risks and uncertainty while pursuing an ambitious target. The global landscape is volatile. Shifts in global markets will affect demand for our energy commodity exports. Technology costs are often lower than predicted. Climatic and weather patterns affect emissions from our land sector, such as elevated sequestration during La Niña periods and elevated emissions during droughts. For example, over the past 20 years, Australia’s land sector emissions have seen year-to-year variations of around 10 $MtCO_2$-e, and in a few instances shifts of up to 30 $MtCO_2$-e. These could lead to point-in-time variations in our emissions of a few percent of national emissions.

The Climate Change Authority advised:

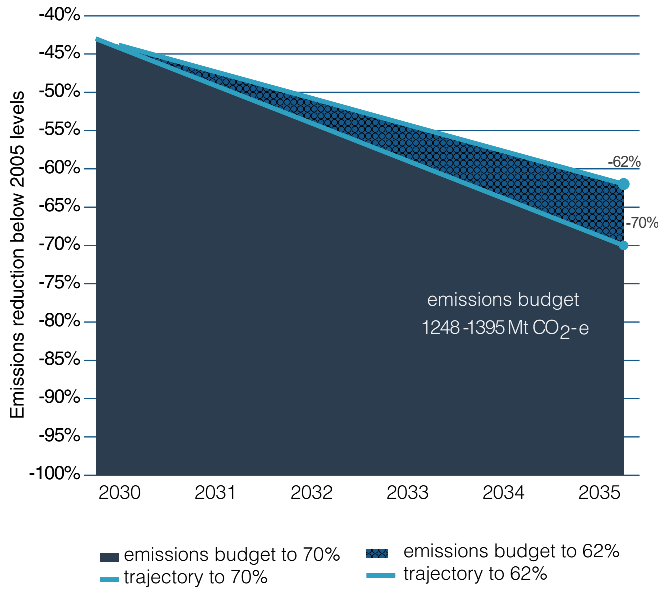
> ‘The Authority considers there are good reasons for the Australian Government to adopt a target range, rather than a single point target…. A target range signals intent, while recognising a variety of uncertainties and delivery risks.’
>
> 2035 Targets Advice, page 14

A target range factors in these risks and provides a more stable policy basis for planning against variable weather patterns and global market fluctuations. Target ranges are commonly used internationally by other countries to manage similar risks and factors.

Australia’s target will be implemented as a multi-year budget – that is, a limit on total net emissions from 2031 to 2035. The emissions budget corresponding to the target is estimated to be 1248-1395 $MtCO_2$-e. This is Australia’s official Nationally Determined Contribution (NDC) under the Paris Agreement.

This budget approach helps to moderate the impacts of year-to-year variability. It also aligns with the science of climate change, as the extent of warming and other impacts depends on cumulative greenhouse gas emissions over time, not on emissions in a single year.

Figure 4.2 2035 target straight line trajectory and corresponding emissions budget



5. Australia's pathway to net zero

Key messages

- Australia's pathway to net zero emissions involves rapid deployment of renewable energy, accelerating electrification and energy performance, switching to low-carbon fuels and other solutions, and carbon removals to address residual emissions.
- An orderly transition to net zero will support continued economic growth, higher living standards, jobs and investment. Using our natural advantages to scale clean energy industries and exports means these benefits can be greater, and our exports larger.
- Delay will cost investment, jobs and the economy

This Chapter presents a consolidated picture of Australia's transition to net zero at a whole-of-economy and sectoral level. It uses the best available information to chart an orderly and efficient pathway to meet Australia's targets. It outlines the potential pattern and timing of abatement in Australia over three phases – to 2030, 2035 and 2050.

5.1 A pathway informed by robust analysis

Independent analyses have consistently found that an orderly net zero pathway will maximise benefits for Australia.[8] Common features of an orderly and efficient transition include rapid deployment of mature renewable technologies to reduce electricity emissions; energy efficiency improvements and electrification; investment in alternative fuels and new technologies to reduce costs and scale their adoption; and maintaining and expanding carbon removals, including land-based abatement, to balance residual emissions. While all sectors contribute to reducing emissions to 2050, the role of each sector changes over time, driven by the availability and relative cost-effectiveness of abatement options.

The CCA's Sector Pathways Review confirms these features and highlights that:[9]

- Working to reduce emissions now using mature technologies, while developing and commercialising emerging technologies, is the most efficient pathway. Delay increases risk, cost and sees Australia miss opportunities.
- There is a need for a clear, stable policy environment underpinned by strong engagement and collaboration between policymakers, businesses, communities and households.
- More opportunities to decarbonise will emerge over time. Technologies that are still experimental could be 'game changers' in coming decades, reducing the cost and increasing the pace of decarbonisation.

5.2 Modelling provides insights on abatement opportunities

The Treasury undertook modelling and analysis to provide insights into the potential economic opportunities from different pathways to net zero.*

Using scenario analysis, Treasury has drawn on the best available evidence to provide insights into how Australia can efficiently achieve emissions reductions over time.

- Treasury modelled two scenarios that broadly reflect this Plan – a 'Baseline Scenario' and a 'Renewable Exports Upside Scenario'. These see Australia reach 43% emissions reductions by 2030, 65% reductions by 2035 (which is consistent with the target range), and net zero by 2050. They assume orderly and efficient emissions reduction pathways reflecting the expected availability of technology, in the context of global climate action to keep warming well below 2°C.
- Treasury also modelled a 'Disorderly Transition Scenario', in which Australia delays climate action, does not set a credible 2035 target and does not undertake further climate policy action until 2040, before rapidly reducing emissions to achieve net zero by 2050.

**Note: Treasury's modelling differs from the analysis in Australia's annual emissions projections (discussed in Chapter 3). The projections are prepared in accordance with international reporting requirements. They focus on the national emissions outlook to 2040, under current policy settings, and in the context of current global action (which falls short of the global temperature goals).*

Treasury's modelling provides insights into how Australia can efficiently achieve emissions reduction over time and the impact of different pathways to net zero on investment, economic growth, living standards, jobs and the structure of the economy. The actual mix of activity will be determined by the combination of abatement technology, market, policy and other drivers over the period to 2050.

Kardinia Energy's Printed Solar technology uses carbon-based semi-conducting polymers printed on recyclable PET plastics.

Box 5.1 CSIRO modelling of sectoral pathways and 2035 targets for CCA

The CCA commissioned the CSIRO to undertake modelling as one input to inform its advice on the 2035 target and Sector Pathways Review.[10] The CSIRO modelled six net zero scenarios for Australia, in the context of two levels of global climate ambition (aligned with limiting warming to below 2°C and 1.5°C). The domestic emission pathways reach net zero between 2035 to 2050.

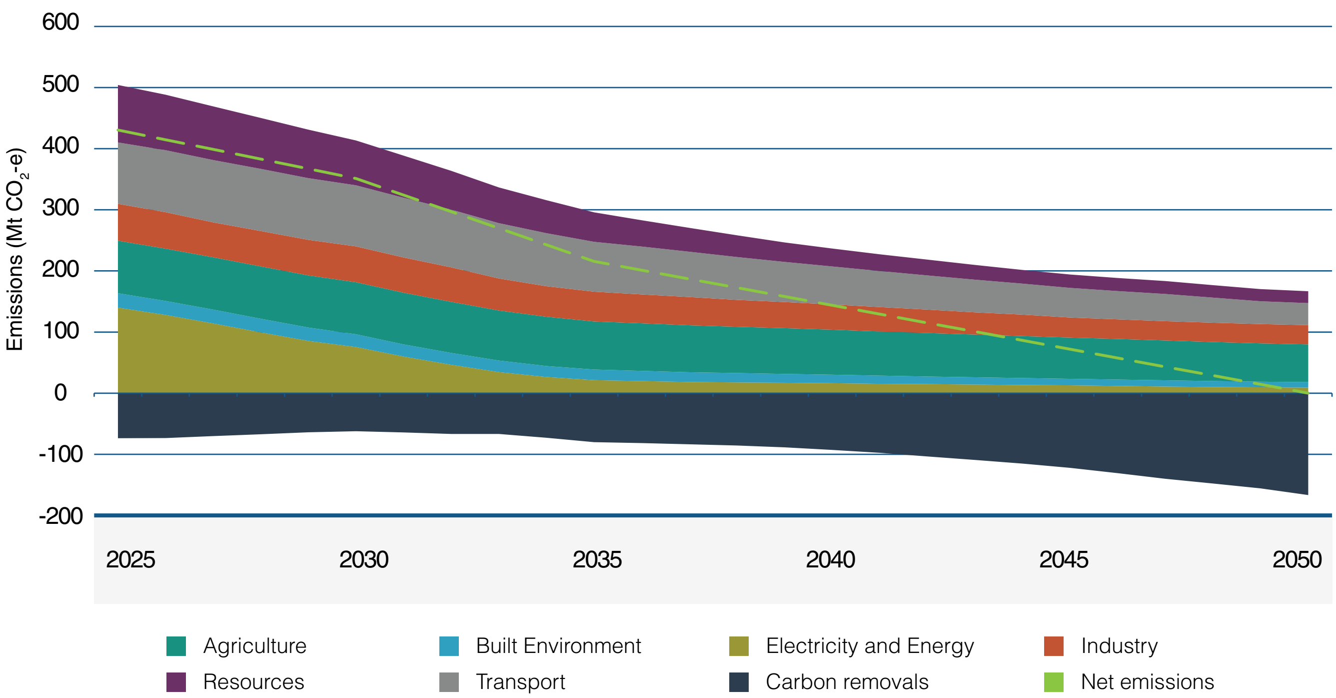
CSIRO's analysis explores different questions and uses different assumptions to Treasury, however, findings on the key abatement opportunities and sequencing of these to net zero emissions are largely aligned.

Differences in the assumptions and results reflect that the future is uncertain, and remind us that the ultimate mix of abatement will only be known as the transition unfolds. This underscores the importance of flexible policies focused on emissions outcomes, and support for a diverse mix of technologies and other solutions.

5.3 Australia's pathway to 2050

Treasury's Baseline Scenario illustrates an efficient pathway consistent with existing policies, the expected availability of abatement technology, and a global economy that achieves emissions reductions consistent with keeping global average temperature increases to well below 2°C. The key opportunities for Australia – to 2030, 2035 and net zero in 2050 – are outlined on the following pages.

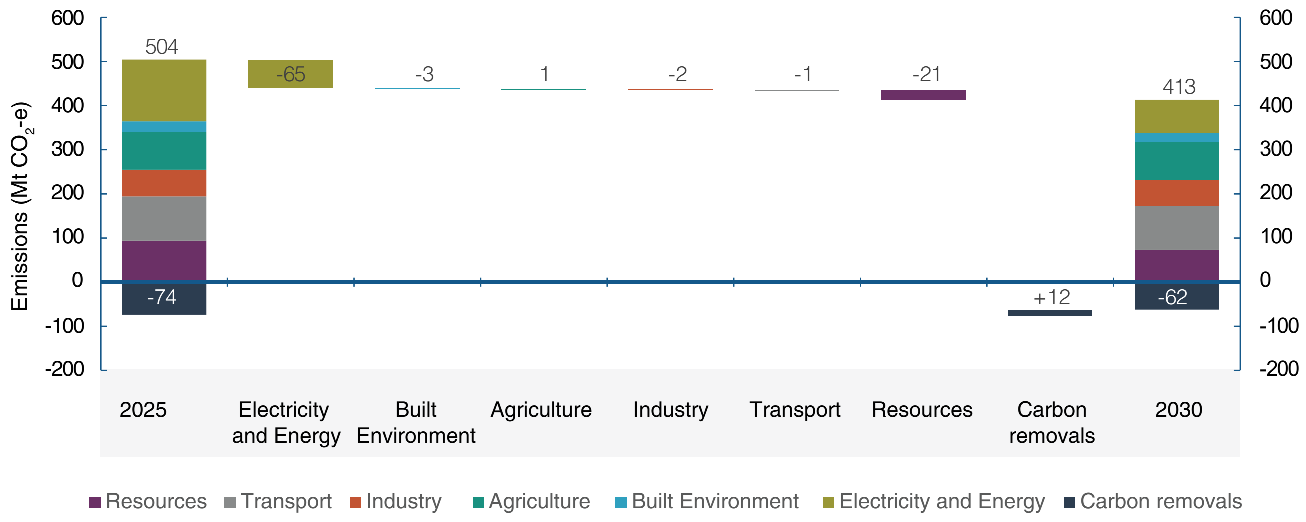
Figure 5.1 Projected emissions under Treasury Baseline Scenario, by sector



5.3.1 From now to 2030

Australia is well-positioned to meet its 2030 target with existing policies and measures.

Figure 5.2 Indicative abatement and composition by sector, Treasury Baseline Scenario, 2025 to 2030



To 2030, most abatement comes from accelerated deployment of firmed renewable **electricity** displacing fossil fuel generation in the electricity and energy sector. Treasury's modelling indicates firmed renewable capacity meets growing electricity demand from transport, the built environment and some manufacturing processes. CSIRO's modelling similarly shows electricity decarbonisation is the largest source of near-term abatement through increased deployment of renewable sources. Energy efficiency improvements support achievement of the 82% renewable target and the associated emission reductions. (Box 5.2).

The **resources** sector has the second largest contribution to emissions reductions by 2030 in this scenario. This reflects investment in cost-effective electrification, on-site renewable electricity generation, and a gradual decline in domestic and global demand for fossil fuels (particularly thermal coal). Liquified natural gas (LNG) and gas facilities implement carbon capture and storage (CCS) technology where it is cost effective.

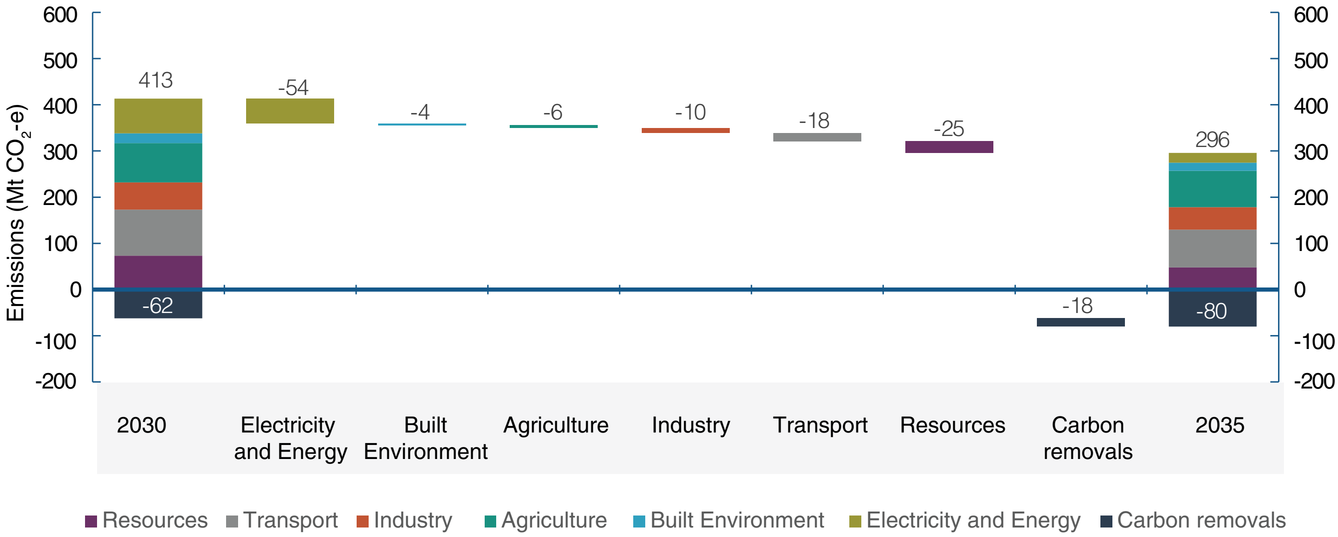
Electrification arrests emissions growth in the **transport** sector – which peaks then starts to trend down – and continues emissions reductions within the **built environment** and **industry** sectors.

The **land** sector sink moderates slightly after the elevated levels of sequestration during the extended La Niña weather event from 2020 to 2023.

In the next five years, it will be important to continue building the foundations to enable future emissions reductions across other sectors (see Chapter 7). This includes infrastructure and enabling systems like certification for low carbon liquid fuels and hydrogen, and investing in innovation in agriculture.

5.3.2 From 2030 to 2035

Figure 5.3 Indicative abatement and composition by sector, Treasury Baseline Scenario, 2030 to 2035



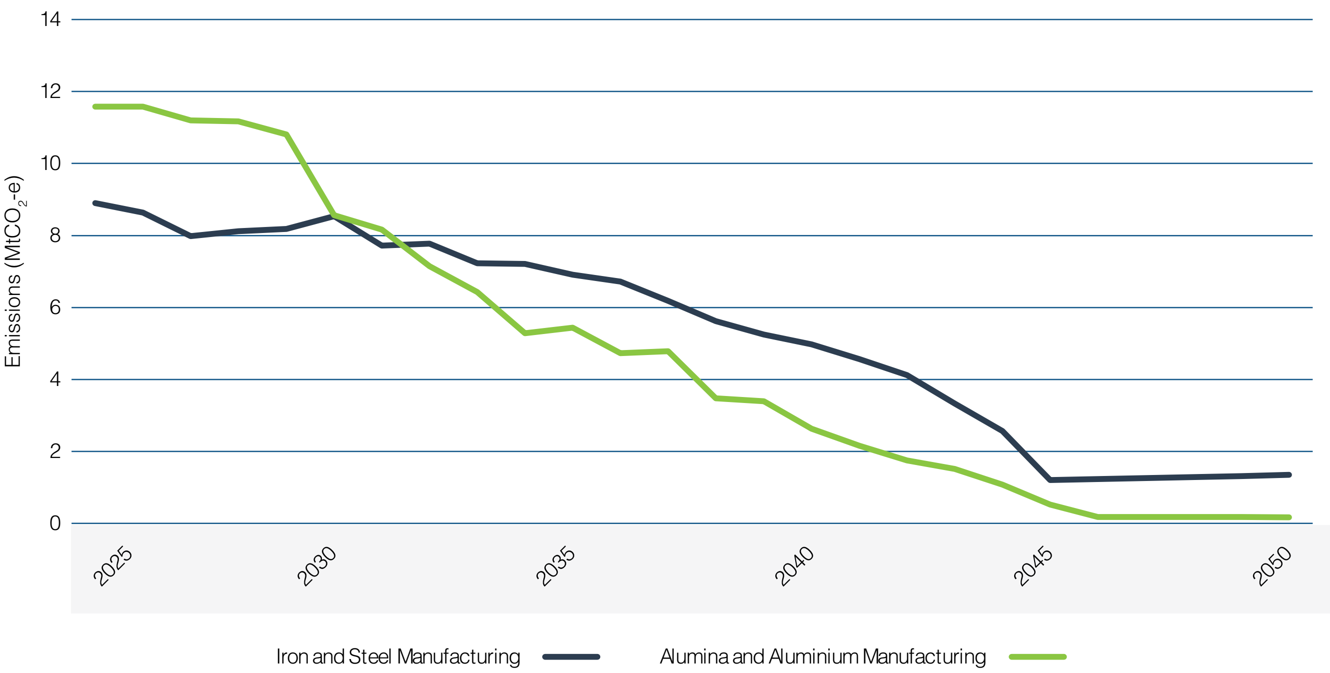
From 2030 to 2035 there is further decarbonisation of the energy system, growing contributions from other sectors as electrification accelerates, and clean fuels begin to be deployed where electrification is not viable.

In the **electricity and energy sector**, electricity is mostly decarbonised, with most coal exiting the electricity system and electricity generation emissions falling by over 90% below 2005 levels. Sustained rollout of firmed renewable electricity generation and transmission, alongside installation of well-integrated consumer energy resources (small-scale solar and batteries that are integrated to allow consumers to manage their on-grid demand) replaces coal capacity. Liquid fossil fuel use declines as other sectors take up electrification opportunities (Box 5.2).

Energy efficiency continues to support the energy transition, with improvements in buildings, appliances and equipment helping balance increased electricity demand from accelerated electrification of vehicles and industry.

Under this scenario, emission reductions accelerate across both the **resources** sector, where emissions reduce by over a third, and the **industry** sector where emissions reduce by over 15%. Declining global fossil fuel demand contributes to lower fossil fuel mining activity and related emissions. Technologies to reduce fugitive emissions - such as from ventilation air methane within coal mining - begin to be scaled up, and LNG facilities electrify. Mining and other industrial facilities continue to take up feasible and cost-effective electrification for applications like transport and low temperature heat processes, in addition to on-site renewable electricity generation. Industrial facilities such as iron, steel, and alumina manufacturing begin to reduce emissions through fuel switching to less emissions-intensive fuels (Figure 5.4). Emissions from these manufacturing sectors reduce by around 30% between 2030 and 2035, from 17 MtCO_2-e in 2030 to 12 MtCO_2-e in 2035.

Figure 5.4 Projected emissions reduction for industrial sectors, Treasury Baseline Scenario, 2025 to 2050



Broad-based electrification also drives emissions reduction across other sectors.

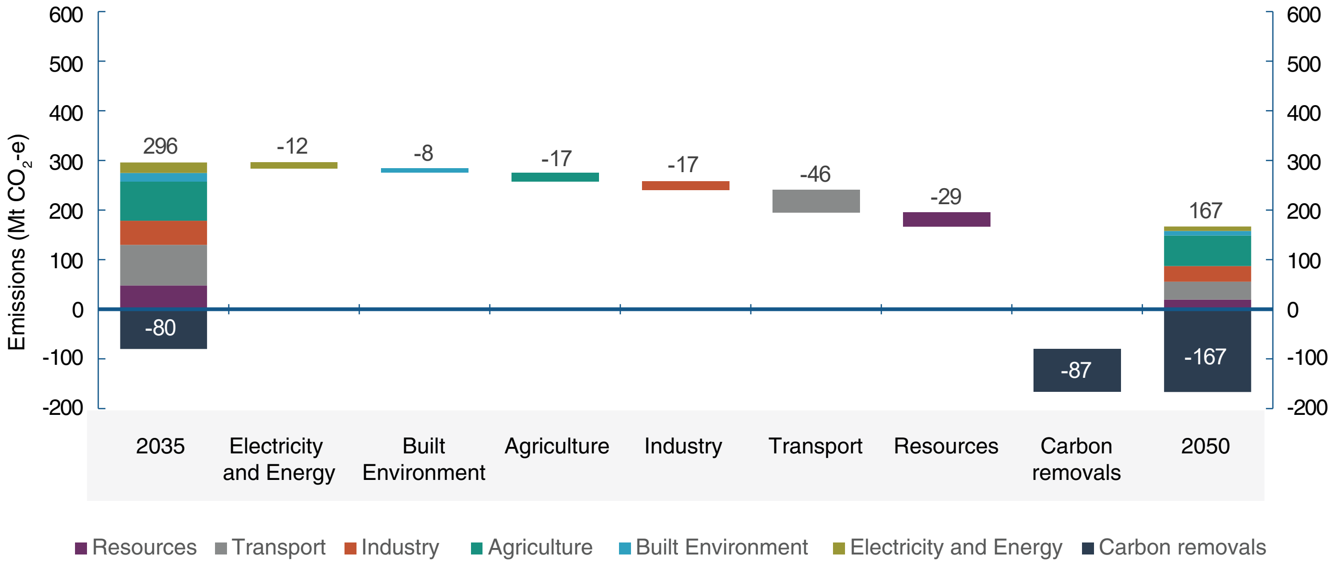
Emissions in the **built environment** sector fall as the shift from gas use to electricity gains momentum in residential buildings and commercial activity. Electrification also drives material reductions in the **transport** sector under this scenario, with emissions falling around 20% between 2030 and 2035. More drivers switch to electric vehicles, and less-efficient internal combustion engine (ICE) vehicles are retired and replaced with newer higher-efficiency models. Electrification of heavy vehicles is limited, but initial deployment of low carbon liquid fuels such as renewable diesel and sustainable aviation fuel begins in freight and aviation.

Some electrification and fuel switching, and initial uptake of nitrification inhibitors and methane-reducing feed additives, begin to reduce **agriculture** sector emissions.

Net removals in the **land** sector increase over the period, returning to the levels seen in the early 2020s. This is partially driven by increased demand for offsets from Safeguard facilities. Reforestation, regeneration and improved fire management of savanna ecosystems offer the most cost-effective opportunities.

5.3.3 To net zero in 2050

Figure 5.5 Indicative abatement and composition by sector, Treasury Baseline Scenario, 2035 to 2050



With the **electricity and energy sector** already largely decarbonised, abatement scales up in other sectors beyond 2035. Technology options, market trends and other factors are more uncertain over the longer term, however current analysis suggests significant further reductions in emissions from transport, resources and industry are possible, with land-based carbon removals scaling up over time to balance remaining emissions.

In Treasury's Baseline Scenario renewable generation reaches 97% in the National Electricity Market in 2050, consistent with AEMO's Integrated System Plan Step Change scenario. Consequently, **electricity** emissions get to near zero. Off-grid renewable electricity generation expands to support renewable hydrogen production, to produce green metals and other commodity exports as well as some domestic decarbonisation.

The **transport sector** sees the largest absolute emissions reductions over this period, falling by more than half. Transition of the passenger vehicle fleet from ICE vehicles to EVs accounts for most of this change. Abatement scales up for heavy vehicles, maritime and aviation through a steady increase in uptake of LCLFs across the period.

Box 5.2 Australia's fuel and energy mix is expected to change over time

Electricity currently comprises approximately a quarter of Australia's total final energy consumption+. Fossil fuels such as petrol, diesel, natural gas and aviation fuel comprise over half of Australia's energy consumption and the emissions associated with their use contribute about a third of annual emissions.

DCCEEW analysis of Treasury's Baseline Scenario illustrates how the mix of energy supplied in Australia could change over time; and its impacts on associated emissions.

Figure 5.6 Australia's energy supply mix, 2025 to 2050, DCCEEW analysis of Treasury Baseline Scenario*

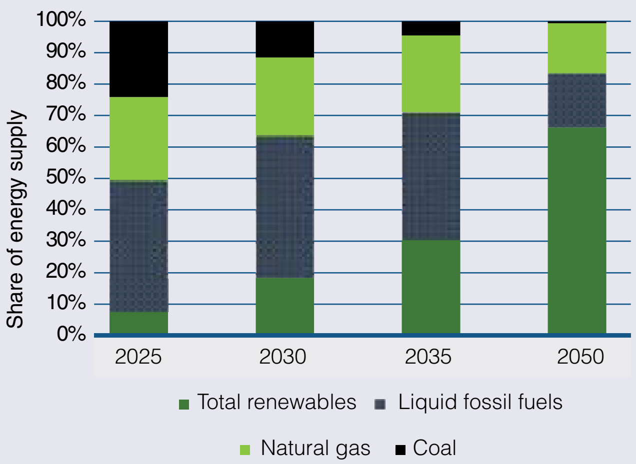
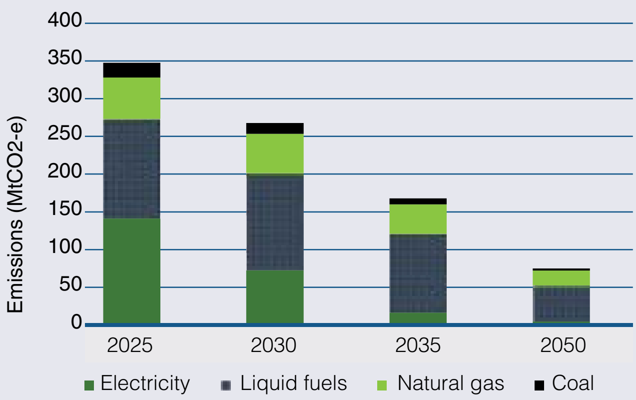


Figure 5.7 Australia's emissions by fuel type, 2025 to 2050, DCCEEW analysis of Treasury Baseline Scenario



+Note: Energy consumption is the total energy consumed by end-users. It excludes fossil fuels used in electricity generation and electricity used in hydrogen production. Gas used as a chemical feedstock and coal used in iron and steelmaking is included.

**Note: Total renewables refers to renewable electricity generation and low carbon liquid fuels*

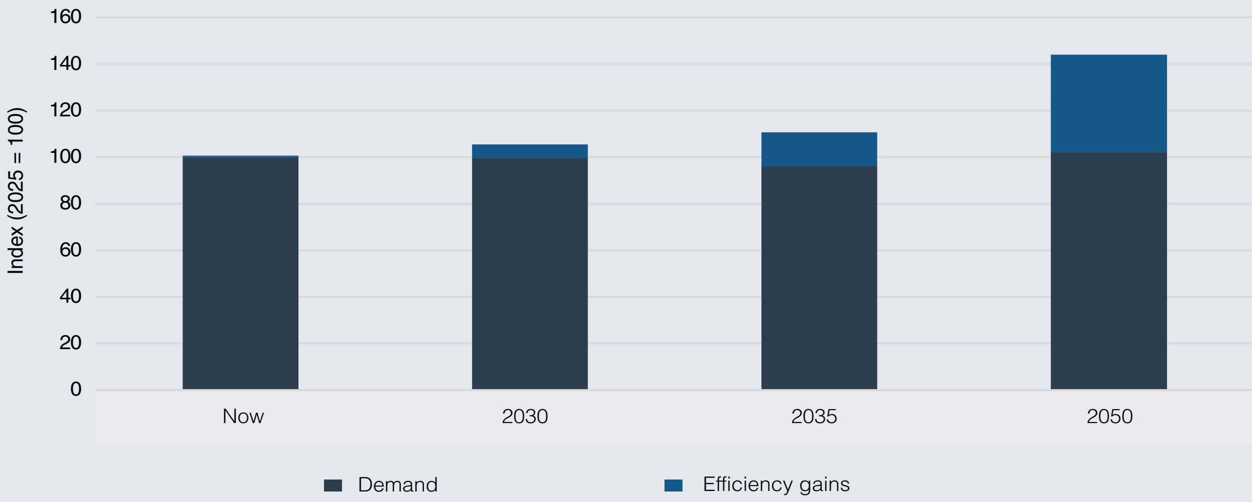
Liquid fossil fuel supply sees an overall reduction of about one-third by 2050. This is driven in the early stages by declining demand for petrol (used mostly in passenger vehicles) as vehicle efficiency improves and electric vehicle uptake accelerates. From 2035 onwards, scaled up production of renewable hydrogen and low carbon liquid fuels displaces diesel and aviation fuel. Liquid fossil fuels emissions reduce by over two-thirds from 2025 to 2050.

Gaseous fuels also see a transformation. Natural gas supply in 2050 reduces by about half compared to supply in 2025, and emissions fall by around 70% from 2025 to 2050 (Figure 5.10).

Electrification across sectors sees electricity make up an increasing share of energy consumption, with demand doubling; but emissions declines to near zero by 2050.

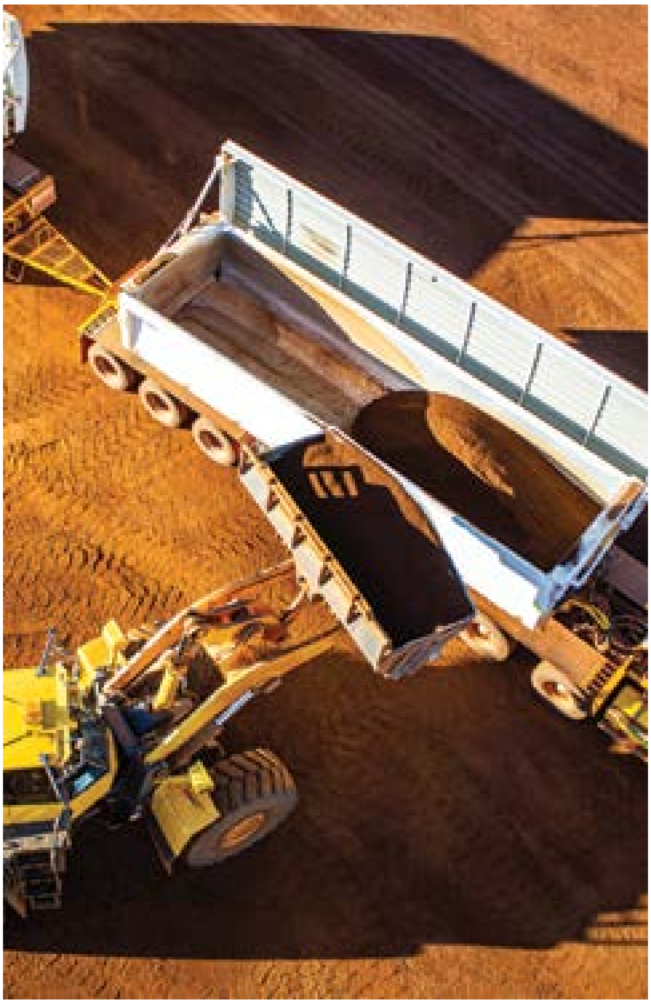
Energy demand growth at point of use is moderated by energy performance improvements over the transition. This allows Australia to get more out of our energy inputs and existing energy infrastructure. DCCEEW analysis shows efficiency gains deliver energy savings at point of use of around 30% in 2050.

Figure 5.8 Estimated energy demand savings from energy efficiency, DCCEEW analysis of Treasury Baseline Scenario, 2024 to 2050*



**Note: Energy demand estimated by DCCEEW based on Treasury's Baseline Scenario. Efficiency gains estimated by DCCEEW.*

Decarbonisation of the **resources** and **industry** sectors continues at pace beyond 2035, with resource emissions falling by more than half and industry emissions by around a third by 2050. Global fossil fuel demand continues to fall, leading to lower fugitive and energy-related emissions from coal and gas production. Electrification at mining, and remaining LNG and gas facilities, supported by onsite renewable electricity generation, scales up. Alumina and aluminium, and iron and steel manufacturing facilities continue to reduce their emissions, including by transitioning from fossil fuels to use electricity or hydrogen in production processes (Figure 5.4).



Iron ore mining, Australia.

Box 5.3 Australia's industrial transition

Clean energy industries are increasingly shaping the global economy. Australia will secure substantial economic returns by positioning itself as an integral part of those industries and supply chains.

As Australia pursues the Future Made in Australia agenda and seeks to grow its manufacturing base, we are addressing existing pressures on our industries to ensure our long-term energy security, industrial competitiveness, and economic resilience.

The Australian Government is working in partnership with Australian industry as the world transitions to net zero. The Industry Sector Plan highlights action over the near term to improve energy efficiency, deploy existing technologies and transition to alternative fuels in as many businesses as possible. Ensuring there is sufficient supply of appropriately priced renewable energy is also a priority.

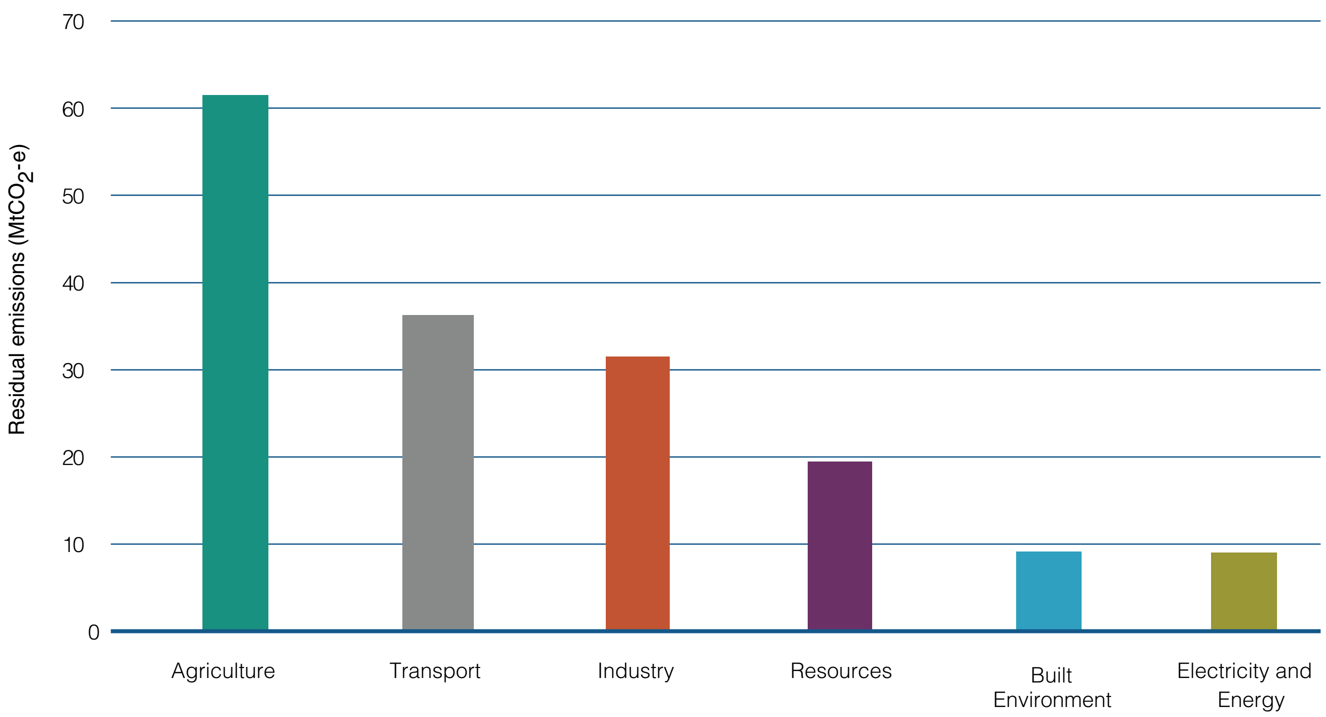
In the medium term, new technologies are expected to be commercialised alongside widespread adoption of existing technologies. This paves the way for significant decarbonisation across the harder to abate industrial sectors in the longer term, such as iron, steel, alumina and aluminium.

Annual emissions in the **agriculture sector** decline modestly, with emissions in 2050 around a quarter lower than in 2035. This reflects a gradual uptake of abatement technologies including feed additives that reduce methane emissions from livestock. Uptake of slow-release and nitrification-inhibiting fertilisers lead to fewer nitrous oxide emissions from crop production.

Emissions in the **built environment sector** continue to decrease, supported by the decarbonisation of the electricity grid. Continued household switching from gas to electricity, and the associated increase in energy efficiency, drives most of this reduction. The rate of fuel-switching away from gas, particularly at the individual household level, will be impacted by a range of factors, including social and behavioural preferences which mean some households will continue to use gas even after it becomes economic to electrify.

Land-based carbon removals roughly double over this period to balance residual emissions (Figure 5.9). Treasury analysis suggests removals are likely to be primarily driven by reforestation activities, as engineered carbon removal technologies are not assumed to be cost-competitive over this timeframe. Technological breakthroughs may change this outlook. For example, engineered carbon removal technologies like direct air capture (DAC) may become cheaper over time and innovations, such as livestock methane reduction solutions, could drive faster declines in residual emissions. CSIRO modelling suggests DAC could augment land-based sequestration from 2035 onwards. However, the path for such technologies remains highly uncertain given current costs and lack of projects at scale.

Figure 5:9 Projected residual emissions in 2050, Treasury Baseline Scenario



Using natural gas for its highest value uses supports efficient decarbonisation

Natural gas remains an important contributor to Australia's economy and energy security throughout the transition to net zero, but its role changes and overall use declines.

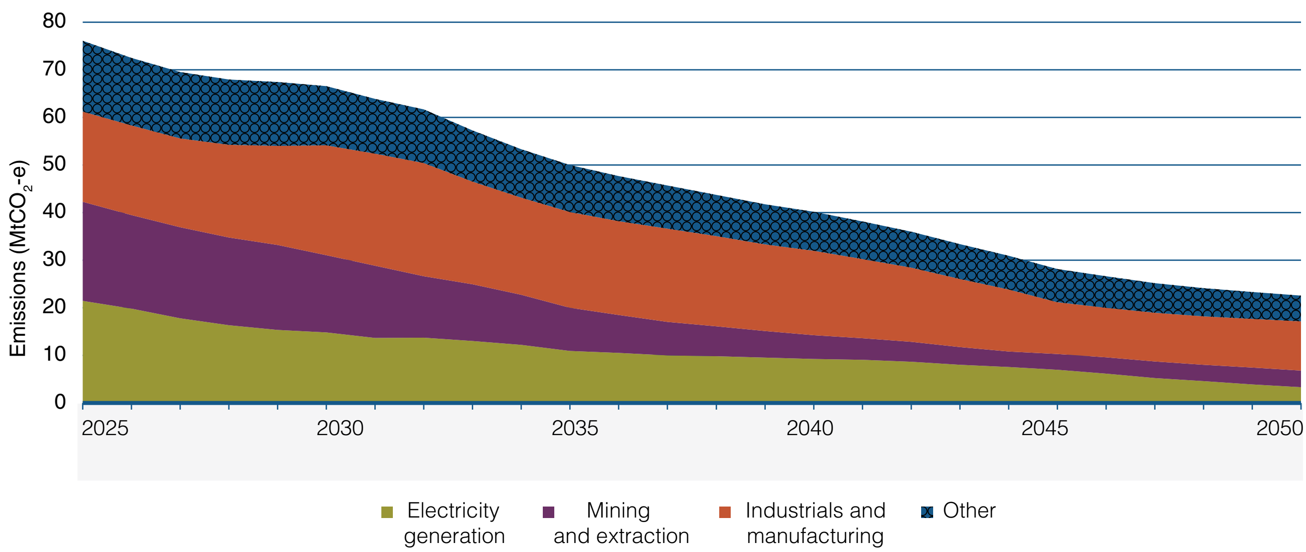
Natural gas users will transition at different times due to the relative cost of natural gas and electricity, the availability and affordability of alternative technologies and fuels, and the timing of asset turnover. Treasury's Baseline Scenario shows emissions from economy-wide natural gas use declining by 70% to 2050 (Figure 5.10) driven by:

- **Residential and commercial applications**: Steady declines in natural gas use out to 2050 as the cost advantages of electrification grow.
- **Electricity:** Natural gas plays an enduring and critical role to firm renewable generation, however, total gas-fired generation falls over time. Off-grid electricity generation, particularly in the mining sector, shifts from gas to renewables.
- **Industry:** Natural gas plays a variety of roles. Low temperature heat industrial applications are expected to electrify, whereas high heat applications may rely on gas for longer. Natural gas continues to be used as a feedstock for industrial products, such as fertilisers and chemicals, until technically and commercially viable alternatives are available. Out to 2035, natural gas consumption in industrial sub-sectors such as steel and alumina manufacturers could grow, as they switch from coal to gas to reduce their emissions-intensity. Beyond 2035, some industrial users begin to transition to renewable electricity and hydrogen.
- **Resources sector:** Emissions from natural gas use decline as electrification increases in mining, and as demand for fossil fuels declines.

Action to reduce natural gas demand will support decarbonisation over the long-term. However, the next few years is a critical period in which additional natural gas supply, transport capacity and storage will be needed to support domestic energy affordability, emissions reductions and industrial capability – and to ensure Australia continues to meet export commitments.

The Australian Government is currently undertaking a Gas Market Review to ensure sufficient affordable natural gas supply in the longer term. The Future Gas Strategy maps the government's plan for managing these challenges, and the Electricity and Energy Sector Plan provides more detail on the role of natural gas through the transition.

Figure 5:10 Emissions from domestic gas use by industry grouping, Treasury Baseline Scenario, 2025 to 2050. Note: 'Other' includes agriculture, built environment, and transport industries.



5.4 Benefits for Australia

The transition to net zero represents a major economic opportunity for Australia – to diversify the economy, support growth, jobs and wages. These benefits are best realised through an orderly and efficient transition, and will increase if Australia scales new clean energy industries and exports.

5.4.1 Action supports investment, growth, jobs and wages while delay is costly

Under Treasury's Baseline Scenario Australia's economy continues to grow, with higher living standards and more jobs, supported by credible and ambitious action. The economy is projected to be 28% larger by 2035 and 81% larger by 2050, relative to current levels. In dollar terms, the economy is expected to be $2.2 trillion larger in real terms in 2050 than in 2025. Real GDP per capita is projected to be $12,000 higher in 2035 and $36,000 higher in 2050, compared to current levels.

An orderly transition also supports sustained increases in living standards, with employment projected to increase by 5.1 million people by 2050 and real wages projected to increase 31% over the 25 years to 2050. Firmed renewables continue to be the cheapest form of new generation investment and put downward pressure on power prices.

The Disorderly Transition Scenario illustrates the potential impacts if Australia delays further climate action. Increased policy uncertainty results in underinvestment and misallocation of capital. Insufficient early emissions reductions require rapid and more costly decarbonisation from 2040 to meet net zero. This leads to weaker economic outcomes, with the economy projected to be a cumulative $2 trillion smaller by 2050 compared to the orderly scenarios, and real wages are projected to be up to 4% lower, in 2050. A disorderly transition also leads to substantial capital stock being scrapped across the 2040s.

An orderly transition, where the direction of policy is clear, enables businesses to plan the investments they need to modernise processes and reduce their carbon emissions. Under the Baseline and Renewable Exports Upside Scenarios, investment is forecast to grow by 79% and 84% between 2025 and 2050.

The CCA's advice is consistent with these findings, noting that acting early and boldly delivers better outcomes than a late, incremental approach.

The Climate Change Authority advised:

> 'The high capital cost of new technology (e.g. green hydrogen, zero-carbon industrial plant, electric heavy vehicles) is best managed through certainty and sequencing. Without it, businesses risk being forced to invest in long-lived, emissions-intensive technologies that lock in costs and emissions for decades.'
>
> 'Recent energy price spikes are a clear example of the costs of delay….Early, coordinated action is Australia's best insurance policy against climate risks, energy volatility and lost economic opportunity. Planning and acting now is cheaper, fairer and smarter than cleaning up later.'
>
> 2035 Targets Advice, page 77

Under the Disorderly Transition Scenario, wholesale electricity prices are projected to be 17% higher on average during the 2030s and up to 54% higher in the 2040s compared to the Baseline Scenario. This is because delayed investment in renewable electricity generation drives a greater reliance on gas generation, which is widely projected to be more expensive.

Cumulative emissions to 2050 are 803 Mt CO_2-e or 15% higher under the Disorderly Transition Scenario than the Baseline Scenario.

5.4.2 Renewable exports support greater benefits

Leveraging Australia's comparative advantages in renewable energy will deliver broad-based benefits to Australians and help grow our exports. These are explored in Treasury's Renewable Exports Upside Scenario.

Economic growth is projected to be meaningfully higher from 2035 onwards relative to the Baseline. In the Renewable Exports Upside Scenario, real GDP per capita is projected to be about $38,000 larger in 2050 than 2025.

This delivers additional benefits through higher wages, higher employment and higher income. Real wages are around 1.6% higher in 2050 and wholesale electricity prices around 20% lower by 2050, compared to the Baseline Scenario. Employment growth is also greater, with occupations such as automotive and engineering trades works, and plant operators seeing expansion as a result of larger clean energy industries.

Australia's exports continue to grow. Green exports alone could be $68 billion higher in 2050 than in the Baseline Scenario, including green metals and renewable ammonia. In addition to economic benefits for Australia, these exports could contribute substantially to global emissions reductions, as discussed in Chapter 11.

5.4.3 Inaction would be costly

The Climate Change Authority advised:

> 'The CSIRO's modelling and Authority's analysis show any actual cost to the economy is negligible, while the benefits from investment in new green industries and avoided damages from climate change are enormous.'
>
> 'The true burden of climate change will lie in the cost of inaction: rising costs to adapt and respond to more frequent and extreme disasters, worsening inequality, and futures undermined for coming generations.'
>
> 2035 Targets Advice, pages 12 and 7

Australia committed to achieve net zero emissions by 2050 in October 2021. That commitment recognised that reducing emissions in line with the rest of the world is in our national interest, and that failing to act would lower economic growth, reduce investment, reduce export and employment opportunities, and increase energy prices.[11]

The cost of not pursuing net zero would be significant and consequential. The CCA's Sector Pathways Review indicates that delaying action to reduce emissions would increase the risk of:

- a later, more expensive and less orderly transition
- missed or delayed opportunities for cost-of-living relief through energy efficiency and electrification
- missing new green export opportunities
- adverse impacts on Australia's reputation, particularly in the region, and
- slower global momentum towards reducing emissions and hence heightened risks of dangerous climate change impacts.[12]

The report 'Australia's Net Zero Transformation: Treasury Modelling and Analysis' discusses the costs of not pursuing net zero in further detail.

6. Five decarbonisation priorities to achieve net zero emissions

Key Messages

The Australian Government will focus on five priorities to achieve net zero:

Clean electricity across the economy

Lowering emissions through electrification and efficiency

Expanding clean fuel use

Accelerating new technologies

Net carbon removals increased

There is clear evidence that an orderly and efficient transition to net zero will deliver a range of benefits to Australia's economy and communities. This chapter sets out five priorities to achieve net zero. The priorities provide a framework to guide governments, industry and communities in the transition.

Many of Australia's key policies and measures target one of these priorities and are outlined below. Others, such as the Safeguard Mechanism and ACCU Scheme, and public climate finance through the Clean Energy Finance Corporation (CEFC), advance multiple priorities. These important cross cutting measures are explored in Part 3.

The six sector plans provide further detail on the pathways, opportunities for abatement and policy directions for each sector. Sector plan snapshots are provided at Appendix 1.

Figure 6.1 Australia's five priorities for net zero

Decarbonise and expand the electricity network	Electrify and improve energy and materials performance	Switch to low-carbon fuels	Innovate to expand emissions reduction options	Scale up carbon removals to balance residual emissions

6.1 Decarbonise and expand the electricity network

Renewable generation, backed up by gas, batteries and hydro-power, is the lowest cost way to replace Australia's ageing coal generation fleet.[13] From 2010 to 2019, the cost of solar photovoltaic (PV) electricity has decreased by approximately 85%, while the cost of wind energy has also declined.[14] Lithium-ion battery costs have fallen by nearly 85% over this period, enabling increased adoption of electric vehicles and energy storage technologies.[15]

6.1.1 Progress to date

Government policy and falling technology costs have unlocked the benefits of renewable electricity for Australia. Already, over 40% of electricity in Australia's two major grids is renewable, representing significant progress to achieving 82% renewable electricity by 2030.

The Climate Change Authority advised:

> 'Continuing the transition to a renewables-based electricity system can deliver around half the emissions reductions required to achieve the recommended 2035 target'
>
> 2035 Targets Advice, page 8

However, challenges remain for rolling out large-scale renewables at sufficient scale and pace to meet our goals. Ensuring a stable and attractive investment environment, fast and durable approvals, community support, a sufficiently skilled and sized workforce, and reliable access to global supply chains are crucial to success (see Part 3). Government action to de-risk and incentivise new capacity includes:

- The $20 billion Rewiring the Nation program, which is upgrading and expanding transmission infrastructure to distribute clean electricity and create a more connected and resilient system.
- The Capacity Investment Scheme, through which the Government underwrites contracts to support new renewable generation and dispatchable projects. The Scheme was expanded in July 2025 and will now underwrite up to 26 GW of new renewable capacity and up to 14 GW of new dispatchable capacity.[16]
- The National Renewable Energy Priority List, which provides coordinated support for planning and approvals processes for identified priority projects.
- Establishing the legal and regulatory framework for offshore wind generation in Commonwealth waters, with six declared priority offshore renewable energy zones identified for feasibility licences.
- Supporting key projects that will unlock zero-emissions energy from pumped hydro generation, such as the Snowy 2.0 project and Marinus Link.

Consumer energy resources (CER) like rooftop solar and batteries are growing rapidly, supporting decarbonisation of our electricity system and enabling consumers to lower their bills. In 2024, an estimated 3.2 GW of new rooftop solar PV capacity was installed across Australia,[17] with small-scale solar contributing 32.5 TWh, or 11.5%, of total national electricity generation (an annual increase of 16%).[18] AEMO's Integrated System Plan (ISP), with which Treasury's Baseline Scenario is aligned, projects that rooftop and other distributed solar could contribute over 20% of total annual generation in the NEM by 2050.[19]

The Government's Cheaper Home Batteries Program is helping more Australian households install batteries. Over 55,000 batteries – with total storage capacity of over 1 GWh – have been installed in just over 2 months since the program commenced on 1 July 2025. The Community Batteries for Household Solar program is installing 400 medium-sized batteries to provide shared storage for households across Australia. AEMO's ISP Step Change scenario suggests 44 GW of CER storage could be installed by 2050, up from 1.5 GW in 2024.[20]

Effectively integrating these CER devices to optimise use of existing network infrastructure, generation, storage and consumption of electricity presents an opportunity to support a cost-effective and faster energy transition, system reliability, and lower energy bills for all consumers. The Consumer Energy Roadmap sets out national reform priorities to harness CER's full potential and deliver benefits and equitable outcomes to all Australian consumers.

Alongside action to improve national electricity networks, addressing regulatory barriers and planning processes to enable emerging industries to develop off-grid solutions or tailor on-grid connections will help to meet industrial energy needs. Energy flexibility can improve industrial competitiveness by reducing costs, optimising energy loads with production and minimising transmission costs across the grid. Opportunities for industry are discussed further in the Industry and Resources sector plans.

6.1.2 Future directions

- The Government is updating the CEFC's investment mandate to include a new focus on the rapid roll out of renewable projects to drive down electricity prices, and commit up to $2 billion more to the CEFC General Account, to be drawn down in line with these changes (see Chapter 10).
- The Government seeks to unlock long term investment in large scale firmed, renewable generation and storage capacity. An independent expert panel is currently undertaking a review of National Electricity Market (NEM) wholesale market settings. Its goal is to ensure the NEM remains fit for purpose as Australia transitions from ageing coal-fired power to firmed renewable energy sources like solar, wind, and battery storage. The expert panel will make recommendations to promote investment in firmed, renewable generation and storage capacity following the conclusion of the Capacity Investment Scheme.
- The Government will continue to drive investment in consumer energy resources to reduce pressure on the grid, including through uptake of solar and batteries, and virtual power plants. This includes opportunities for households as well as community, commercial and industrial properties.
- The Government will streamline approvals for renewable energy projects, including through reforms to the Environment Protection and Biodiversity Conservation Act (see Chapter 8).
- The Government will also explore ways to further unlock investment in renewable energy to accelerate emissions reduction in the electricity sector while maintaining energy security. This includes working with States and Territories through Renewable Energy Transformation Agreements and the Energy and Climate Change Ministerial Council.

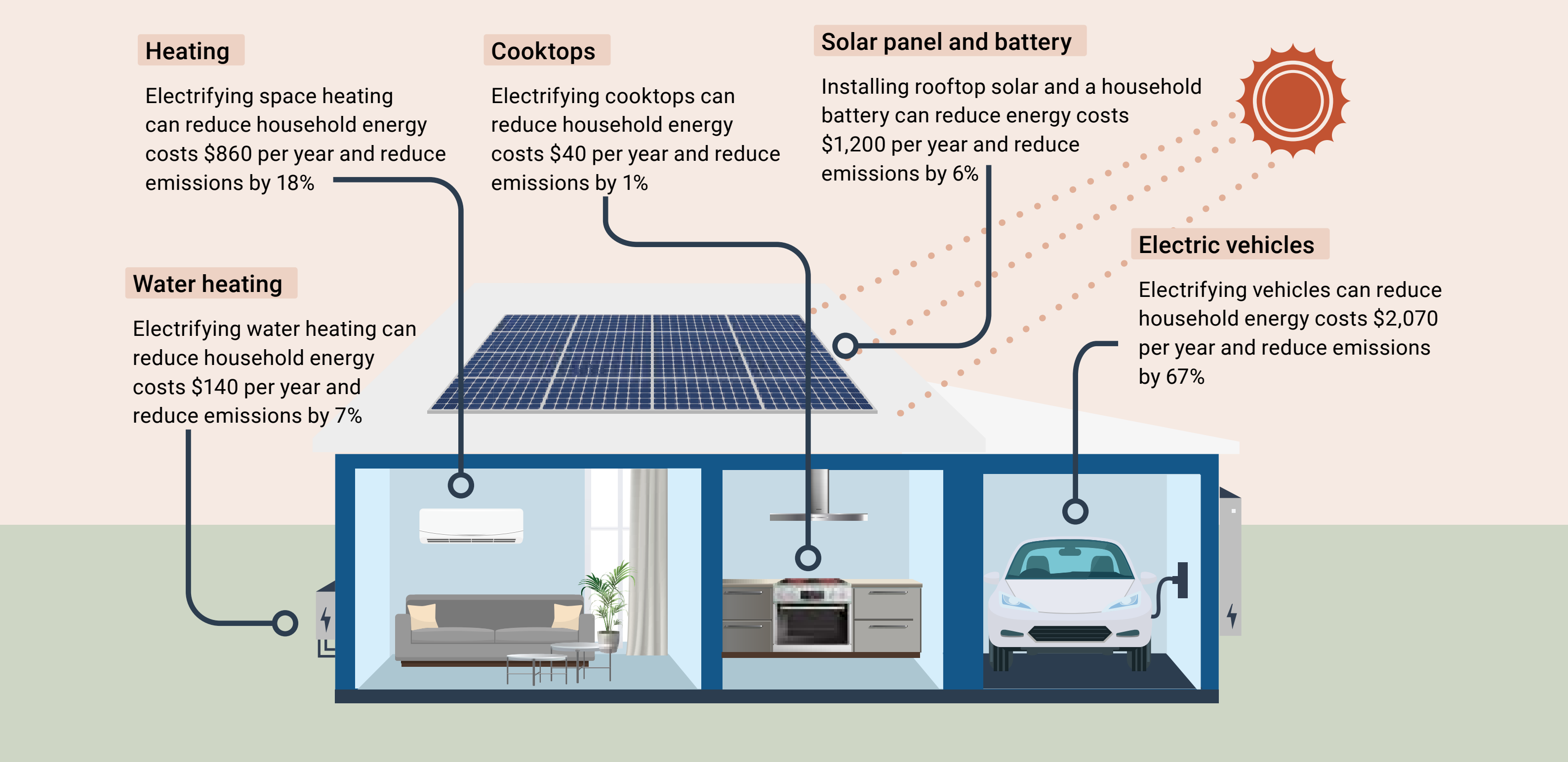
6.2 Electrify activities wherever possible and improve energy performance and materials efficiency

An orderly transition enables households and businesses to plan and make informed decisions when investing in long-life assets such as home renovations, household appliances like hot water and heating, and vehicles.

Improving energy performance* can provide significant savings at the household scale, even where upfront costs are higher. For example, Treasury analysis indicates that a typical Australian household that purchases solar panels, a battery, and electric vehicles, and switches from gas to electricity to power their household, could reduce their energy by around 40% or $4,300 a year after accounting for upfront and financing costs, compared to choosing gas appliances and internal combustion engine vehicles (Figure 6.2).

** Energy performance covers the broad management of energy demand, including energy efficiency; demand flexibility (or load shifting); and electrification or fuel switching.*

Figure 6.2 Modelled benefits of electrification for a typical household, Treasury Baseline Scenario**



**Notes: Annualised real costs from 2030 to 2050, including upfront financing and ongoing costs. Assumes a typical two-to-three-person household with two vehicles, average consumption for home heating, cooking and hot water, and purchases a 10.6kW solar system and 10kWh battery.

Using material resources more efficiently also helps reduce emissions across all sectors. Circular economy principles encourage using fewer virgin materials; designing products to be long-lasting, easy to repair, easy to disassemble and safe; and reusing and recycling materials at their highest value at the end of a product's useful life.

A more circular economy lowers energy demand and emissions by retaining existing goods and materials for longer. This in turn avoids emissions associated with new extraction, processing, manufacturing, transport and ongoing use of materials across their lifecycle. As an example, every tonne of scrap metal used in the production of steel delivers 1.5 tonnes of avoided CO_2 emissions.[21] CSIRO modelling suggests that doubling the circularity of Australia's economy by 2035 could contribute to abating up to 23% of greenhouse gas emissions by 2050.[22]

6.2.1 Progress to date

The Australian Government is working collaboratively with states and territories to give consumers the information they need to make informed choices, provide financial support to help key cohorts to electrify, regulate to expand access to efficient appliances and vehicles, and establish supporting infrastructure. Measures include:

- The Greenhouse and Energy Minimum Standards (GEMS) scheme, which regulates minimum energy efficiency standards for a range of products and equipment. It also ensures that information is available for consumers to make informed choices when purchasing products with energy rating labels or product packaging requirements. Since 2012, the *Greenhouse and Energy Minimum Standards Act 2012* has saved Australian households and businesses $12–$18 billion in avoided energy costs. In 2021–22 alone, it is estimated to have saved Australia between $1.3 billion and $2 billion in avoided energy costs while delivering greenhouse gas emissions savings of between 4.1 and 6.3 million tonnes – equivalent to around one-quarter of South Australia's annual emissions.

- The National Australian Built Environment Rating System (NABERS), which measures the environmental and energy performance of Australian buildings. This has seen consumers save almost $2 billion in energy bills and reduced emissions by approximately 13 Mt over the past two decades.[23]
- The $1.1 billion Social Housing Energy Performance Initiative (including $800 million from the Commonwealth) which will support energy performance upgrades to over 100,000 social housing properties by 2029.
- The Clean Energy Finance Corporation's (CEFC) $1 billion Household Energy Upgrades Fund which provides low-cost finance for energy performance initiatives. It works with co-financiers to create tailored and discounted green finance products which are easy for households to access.

Upfront cost barriers and split incentives remain a barrier for the one-third of Australians who rent or reside in multi-unit dwellings such as apartments.[24] The Government is actively addressing these barriers through the provision of accurate and accessible information for renters and landlords. It is also working with states and territories to provide financial support, including through the $100 million Community Solar Banks program, to provide shared solar for those who can't install their own systems. The Built Environment and Electricity and Energy Sector Plans provide further detail.

The Commonwealth is also supporting electrification in the transport sector.

- The New Vehicle Efficiency Standard is supporting uptake of efficient vehicles, including electric vehicles (EVs). The Standard will reduce costs to consumers and incentivise the supply of low and zero emission vehicles to Australian motorists.
- The $475 million Driving the Nation Fund is investing in cheaper and cleaner transport. This includes innovation through the Driving the Nation Program, delivered by ARENA; $39.3 million to the NRMA to deliver public charging stations across key highway routes, and $60 million through the DRIVEN Program to support installation of EV charging infrastructure at car dealerships and repairers.

These measures are discussed further in the Transport Sector Plan.

In the industry sector, the $400 million Powering the Regions Fund – Industrial Transformation Stream (ITS) is helping facilities reduce their greenhouse gas emissions. It supports projects that improve energy efficiency, switch to cleaner fuels, and electrify industrial processes. It also funds enabling technologies like energy storage and demand management infrastructure. This complements $1 billion of other Powering the Regions funding streams.

Alongside energy performance and electrification measures, the Australian Government is also providing the policy blueprint to drive Australia's circular economy transition. Australia's Circular Economy Framework includes an overarching goal of doubling circularity by 2035 and sets clear priorities and targets to reduce waste and keep materials in our economy for as long as possible. The framework focuses on 4 key sectors – industry, built environment, food and agriculture, and resources – to help drive the transition.

The Australia's Carbon Credit Unit Scheme recognises the contribution waste reduction and treatment can make to reducing emissions. Under the scheme's landfill and waste methods, reductions in waste emissions are eligible for credits where they meet requirements (discussed under 7.1.3).

The Climate Change Authority advised:

> 'Food and garden waste in landfills is a major source of emissions from the waste sector, so channelling waste to dedicated, low-emissions organics processing is an important step. Australian governments are working towards the goal of diverting 80% of waste from landfill by 2030.'
>
> 2035 Targets Advice, page 53

6.2.2 Future directions

Accelerating electrification and improving energy and material performance is a major priority for further work. This includes:

1. A further $85 million to accelerate energy performance by:
    a. modernising the Greenhouse and Energy Minimum Standards (GEMS) Act
    b. investing in the National Australian Built Environment Rating System (NABERS) for non-residential buildings
    c. expanding the Commercial Building Disclosure (CBD) program to more commercial building types beyond office buildings
    d. expanding the Nationwide House Energy Rating Scheme (NatHERS) to cover existing homes
    e. establishing a Demand-side Statement of Opportunities to complement existing system planning by the Australian Energy Market Operator (AEMO) and lower the cost of the transition for all consumers.

2. $50 million to help community sports facilities reduce their energy costs and climate-proof their facilities.
3. $40 million to accelerate the rollout of kerbside and fast charging.
4. Review the New Vehicle Efficiency Standard in 2026 to assess the policy's effectiveness, refine regulatory systems and mechanisms, and consider the framework in light of the 2035 target.
5. Exploring options for reducing barriers to electrifying small to medium facilities and industrial processes.
6. Exploring how to ensure business, industry and communities have the best signals, opportunities and frameworks to improve energy performance.
7. Implementing Australia's Circular Economy Framework to fast track the circular economy transition and double circularity by 2035.
8. Considering ways to improve solar and battery recycling, recovering key components so we can continue to reuse materials in support of the transition.
9. Working with states and territories to maximise the benefits new buildings can achieve by harnessing the efficiency and cost effectiveness of electrification.

6.3 Switch to low-carbon fuels

Some activities are currently not able to electrify, either because technologies do not exist, or because those technologies are not commercially competitive. In particular, high-heat manufacturing processes for products such as steel and cement and long-distance heavy road transport, air and sea travel, are unlikely candidates for electrification in the short to medium term.

For these activities, alternative fuels such as low carbon liquid fuels, biomethane, renewable hydrogen and renewable ammonia provide a pathway to decarbonisation. For some industry sectors that rely on coal, such as ironmaking, natural gas represents an immediate option to reduce emissions, with the prospect of transitioning to renewable hydrogen or other low-carbon fuels as they become cost-effective and available at scale (see Chapter 5).

Renewable hydrogen and other renewable gases: Renewable hydrogen is created through electrolysis, which uses renewable electricity to separate water molecules into hydrogen and oxygen.

Potential applications include powering a green metals industry, displacing natural gas in chemical manufacturing and high-heat industrial processing, and decarbonising long-distance heavy transport.

Other renewable gases, such as biomethane, are chemically identical to fossil methane and can be used as a direct substitute for natural gas. Biomethane is derived from biogas, which is produced using various organic materials as feedstock, such as green waste, food industry byproducts, agricultural and industrial waste.

Low carbon liquid fuels: LCLFs can be produced sustainably from waste materials, biomass, or by combining hydrogen from low or zero carbon feedstocks with captured carbon dioxide. Sustainable aviation fuels and renewable diesel are two examples of LCLFs that can be used as 'drop-in' replacement fuels, avoiding the cost of upgrading assets and infrastructure. Australia is already a significant supplier and exporter of biomass for LCLF production overseas.

Global demand for these commodities is expected to grow rapidly. For example, the International Energy Agency estimates global demand for hydrogen could reach 430 Mt by 2050, with 327 Mt of this demand met by renewable hydrogen;[25] up from 100 Mt produced in 2024, of which less than 1% was met by renewable hydrogen.[26]

6.3.1 Progress to date

Under Future Made in Australia, the government is helping kick-start development of low-carbon fuel industries by incentivising innovation and supporting production.

Research and development (R&D) will support cost-reductions in the production, transport and use of these fuels. Alongside R&D, incentivising production will yield on-site learnings and help to realise economies of scale, driving further efficiencies. The government is directing significant investment into these priorities, including:

- $250 million under the FMA Innovation Fund to supporting research and development for nascent LCLF technologies.
- $33.5 million under the Sustainable Aviation Fuel Funding Initiative to support the development of LCLF production from renewable feedstocks in Australia. Five LCLF projects have been approved, with others under consideration.
- $8 billion over 10 years from 2025 to accelerate investment in renewable hydrogen through the Hydrogen Production Tax Incentive and Hydrogen Headstart program.

Putting in place enabling systems like certification, standards and monitoring are critical to provide certainty to investors and potential customers on the emissions associated with production of LCLF and ensure that drop-in fuels align with rigorous safety standards. Government is working closely with industry to implement the frameworks and regulations that ensure best practice underpins growth including through:

- Amendments to the National Greenhouse and Energy Reporting Scheme to enable market-based reporting of specific LCLF types within shared infrastructure.
- Expanding the Guarantee of Origin (GO) Scheme to track and verify emissions from the production of LCLF and other commodities.
- A new fuel quality standard for (paraffinic) renewable diesel, enabling its supply in Australia.

6.3.2 Future directions

To build a supply chain for Australian low carbon liquid fuels, the Australian Government will invest $1.1 billion in a new Cleaner Fuels Program. This will help stimulate private investment in Australia's first onshore low carbon liquid fuel refineries, backing local innovators, making fuel supply more resilient and bridging the price gap for early adopters. The Government will engage with industry on how to make sure Australian liquid fuel users have a fair chance to capture the emissions reduction potential unlocked by low emission Australian fuels.

In addition, the government will pursue:

- Further collaboration with international trading partners to support the research, development and deployment of fuel alternatives and supporting infrastructure.
- National collaboration to support redirection of waste streams as feedstocks for production of LCLF.
- Development of a national Bioenergy Feedstock Strategy to establish a coordinated, national direction for the sustainable evolution of bioenergy feedstock production.

6.4 Innovate to expand emissions reduction options

Research and development, and scaled technology deployment, will be fundamental to unlocking cost effective abatement solutions for sectors where abatement options are not yet available or commercial.

Australia has an extensive innovation ecosystem, spread across all levels of government, the private sector and academia.

6.4.1 Progress to date

The **Australian Renewable Energy Agency (ARENA)** provides grants to accelerate the pace of pre-commercial innovation, improving the feasibility of emerging renewable energy technologies and growing their uptake (Figure 6.3).

The Government replenished ARENA's statutory funding to 2038-39 – a total of $8.2 billion– and expanded its mandate to include electrification technologies, energy efficiency technologies, and manufacture of renewable energy technologies.

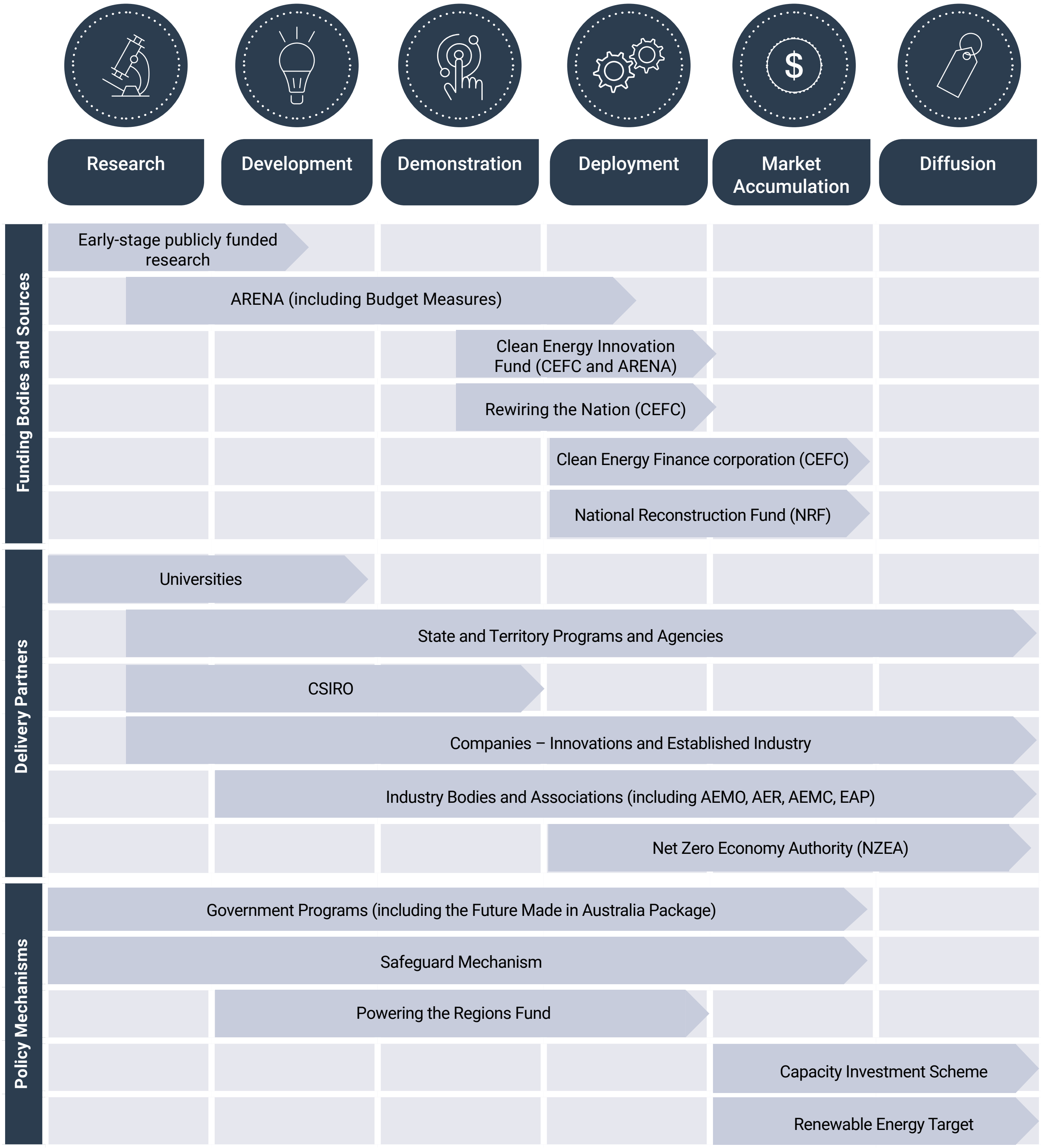
ARENA also plays a critical role in the transition to net zero as the body responsible for administering the $1.5 billion Future Made in Australia Innovation Fund. This supports pre-commercial innovation, demonstration and deployment of technologies to support green metals production, clean energy technology manufacturing and LCLFs.

The **Clean Energy Finance Corporation (CEFC)** is a specialist investor in Australia's net zero transition (see further Chapter 10). Part of their capital allocation is targeted at critical R&D opportunities in clean energy including:

- The $500 million Powering Australia Technology Fund to support projects and businesses developing or commercialising climate technology opportunities,
- The $200 million Clean Energy Innovation Fund which supports early-stage climate technology innovators to develop their technology.

Other special investment vehicles supporting technology deployment like the National Reconstruction Fund, are discussed in chapter 10.

Figure 6.3 ARENA's collaboration across the innovation chain. Source: ARENA Corporate Plan 2024-25 to 2027-28



Other organisations and forums fundamental to Australia's innovation landscape include:

- The **Commonwealth Scientific and Industrial Research Organisation (CSIRO**), which has led the development of a range of world-changing net zero focused innovations as well as working to tackle emissions from the most challenging sectors, such as steel, aviation and agriculture.
- **Cooperative Research Centres (CRCs)** bring together world-class universities, government and industry to address long-term challenges. Not limited to net zero, some of the current CRCs cover emissions in fuels, agriculture, buildings, heavy industry and waste. The Zero Net Emissions Agriculture Cooperative Research Centre (ZNE Ag CRC), which commenced in July 2024, has four targeted research programs to support sector decarbonisation. The Australian Government invested $87 million over 10 years to establish the ZNE Ag CRC.
- **Research and Development Corporations (RDCs)** which help drive agricultural innovation, where producers and the Australian Government co-invest in research and development. Emissions reduction is one goal of research across commodities, alongside improved productivity and competitiveness.
- Business investment supported by the **Research and Development Tax Incentive (RDTI).** The RDTI helps companies innovate and grow by offsetting some of the costs of eligible research and development. This program has already assisted private sector research in technologies like more efficient solar panels and more compact batteries.

The National Science and Research priorities include transitioning to a net zero future as a priority to align investment in science and research across industry and the science community. The Australian Government's current Strategic Examination of Research and Development will recommend ways to get more value from investment in research, harness and grow business investment in R&D, and leverage Australia's scientific strengths to address national priorities.

Many of the research and technology needs for net zero are global. International collaboration, including through partnerships, can create opportunities for deployment of international solutions domestically, and export of Australian technology and practices to overseas markets.

Australia has 10 bilateral climate and clean energy partnerships, and demonstrates leadership in multilateral organisations such as the IEA's Technology Collaboration Program and the Clean Energy Ministerial partnership.

Box 6.1 Australia and Germany's cooperation on energy and climate

In 2024 Australia signed an agreement with Germany to deepen cooperation on new renewable hydrogen supply chains. This includes a $660 million H2Global funding window to guarantee a purchase agreement for Australian hydrogen producers into the European market. This joint H2Global window will give Australian producers the opportunity to export to some of the world's largest renewable hydrogen markets, establishing new renewable supply chains with Europe and supporting a Future Made in Australia.

6.4.2 Future directions

Australia will continue to grow our innovation economy, to support emissions reductions. The Government will:

- Establish a new $5 billion Net Zero Fund within the National Reconstruction Fund, drawing from and refocusing existing capital to support major investments by large industrial facilities in decarbonisation and energy efficiency, and scale up manufacturing low emissions technologies
- Target R&D to reduce the embodied emissions within materials and direct emissions from construction activities including pre-fabricated and modular construction and low-emissions construction materials.
- Informed by the Government's Strategic Examination of R&D, look for ways to streamline and scale-up research collaborations that power the transition.
- Continue fugitive and methane emissions reduction at industrial facilities, including through delivery of a landmark study with the UN Environment Program to improve understanding of methane emissions, important for steel and energy supply chains (see section 7.1).
- Strengthen strategic partnerships with governments, industry and international partners to progress important climate technologies with the potential to drive down emissions beyond 2035.
- Accelerating new technologies is important to decarbonising heavy industry, with the deployment of those technologies incentivised by the Safeguard Mechanism, due for review in 2026-27.

6.5 Scale up carbon removals to balance residual emissions

Regardless of how effectively we reduce emissions, all available analysis indicates our economy will still be emitting greenhouse gases in 2050 (see Chapter 5). Carbon dioxide removal (CDR) refers to technologies, approaches and practices that remove CO_2 directly from the atmosphere and store it in the ocean, on the land surface or below ground, including in geological formations.

CDR includes land-based methods, like growing trees, as well as engineered removals through technologies such as Bioenergy with Carbon Capture and Storage (BECCS) and Direct Air Capture (DAC).

For all forms of removals, the storage must be long-term and durable. In addition to driving new removals, it is important to protect and maintain existing carbon stores, and regularly monitor to ensure the carbon remains stored.

6.5.1 Storing carbon in vegetation and soils

Australia has substantial, relatively low-cost potential for land-based carbon removals, particularly reforestation. Integrating carbon projects into agricultural land uses can improve productivity, increase soil moisture and reduce input costs. This provides an opportunity for farmers and land managers to diversify their income streams through carbon credits, improving their economic resilience.

But there is significant uncertainty around the scale and composition of land-based sequestration that may be taken up as Australia transitions to net zero. Estimates of the carbon sequestration potential of different land management practices and plant types vary widely, particularly over time and in light of the impacts of climate change. Sequestration rates will also depend on landholder decisions regarding whether and when to undertake carbon management projects.

Concerted effort throughout the transition will be needed to ensure that carbon projects in the land complement, rather than replace, food and fibre production, as discussed in Chapter 14.

6.5.2 Diversifying opportunities for carbon dioxide removal

While Treasury's analysis suggests engineered CDR technologies may only play a small role in the period to 2050, there are several reasons that continued research and development are important for these technologies.

Developing a range of approaches to balance residual emissions – rather than relying on land-based options alone – will make Australia's net zero transition more robust. Land-based sequestration is exposed to changing climate conditions and impacts, including increased frequency of extreme events such as bushfires, which can reverse carbon stores.

Engineered carbon removal and management technologies could complement land-based carbon removals. These technologies can abate large volumes of emissions with a relatively small land-footprint – particularly those using geological storage. They could become increasingly important to sustain net zero emissions – and potentially net negative emissions – beyond 2050.

The adoption of engineered CDR technologies is currently hindered by high costs. However, investment now could provide opportunity to innovate to reduce costs and provide industries with more options to offset their emissions.

6.5.3 Progress to date

The Australian Government has invested in developing engineered and land-based carbon storage domestically.

- The Australian Carbon Credit Unit (ACCU) Scheme provides a way for land managers to earn money for eligible carbon storage on their land. The Government has invested over $1 billion in the ACCU Scheme to date, unlocking over 169 Mt of abatement.[27] The Government is progressing reforms to the ACCU scheme, underpinned by $66 million in funding over 5 years. This includes a new proponent-led method development process and supporting increased First Nations participation (see further Chapter 13).
- The Carbon Farming Outreach Program is supporting producers and land managers, including First Nations Peoples, to understand their emissions and make informed decisions to manage them over time, including by increasing carbon stores in trees and soils.

Native revegetation planting, Australia.

- The government has provided $73.8 million over four years from 2024 to the Support Plantation Establishment program. This aims to increase future plantation forest resources available for processing while also contributing to Australia's emissions reduction targets.
- The Carbon Capture Technologies Program is committed to accelerating research, development and demonstration of carbon dioxide capture, removal and use technologies. The program has so far committed $65 million to 7 projects.

6.5.4 Future directions

To ensure Australia maintains a diverse and sustainable portfolio of scalable carbon removal options to balance residual emissions, the government will:

- Improve data collection and analytical capabilities to better understand land-use changes and opportunities for integration of carbon removal projects within agricultural production systems.
- Examine the carbon, biodiversity and agricultural productivity co-benefits that expanded landscape restoration efforts could deliver, strengthening the climate resilience of regional Australia.
- Open a second round of the Carbon Capture Technologies Program for $52 million to continue to accelerate the development of new carbon management technologies, critical to reaching net zero by 2050.
- Deliver a Carbon Dioxide Removal (CDR) Roadmap in partnership with CSIRO. The CDR Roadmap will consider the realisable potential of CDR in Australia, and options for how we can responsibly deploy and scale the industry.
- Consider options for developing, deploying, and scaling carbon management technologies. This includes supporting CSIRO and Geoscience Australia to assess the nation's carbon removal and storage potential, identify cost and capability gaps, and prioritise key technologies and research, building a strong evidence base to inform Australia's carbon management policy.
- Work with states and territories to review data and policy gaps to support efficient approval and permitting of processes to deploy carbon removal technologies at scale.

7. Reducing non-CO_2 emissions

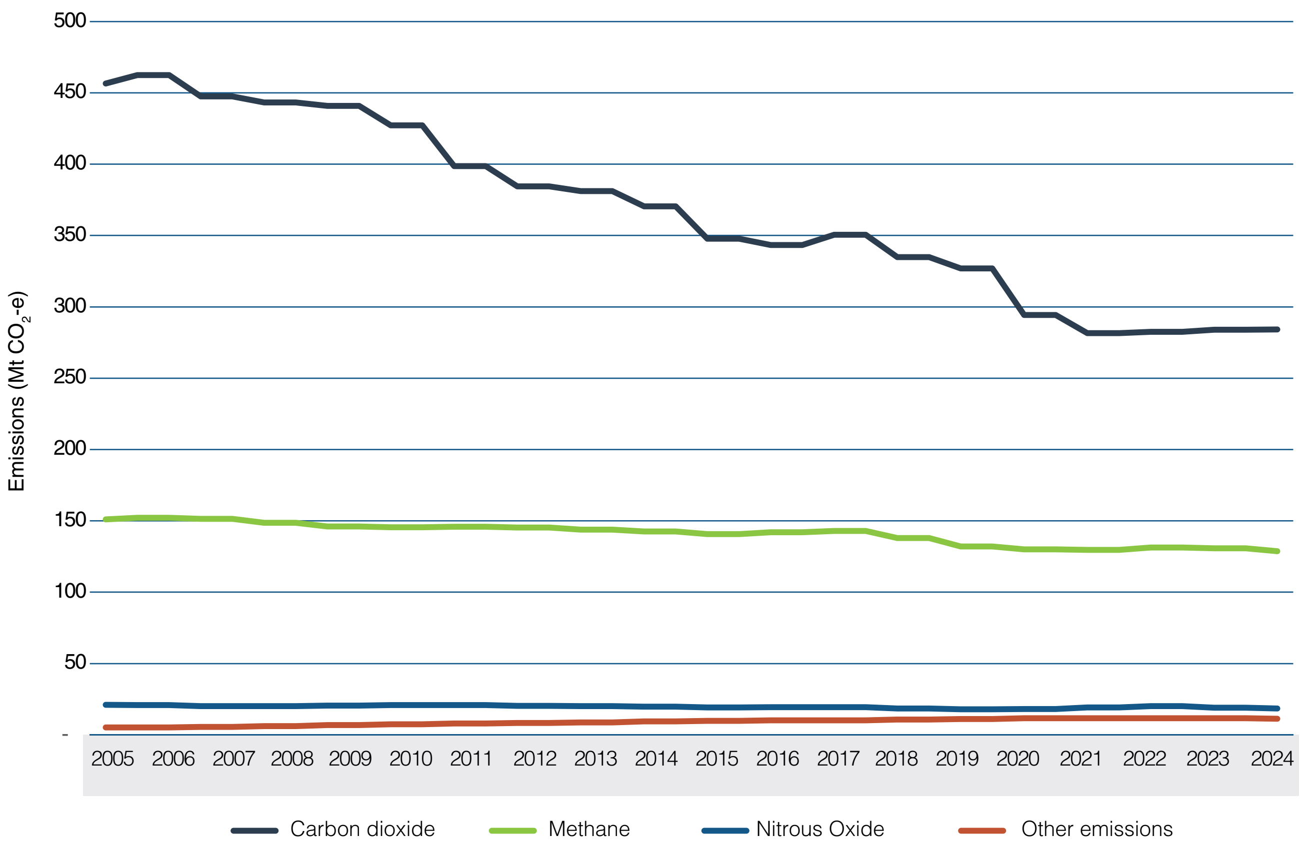
Key Messages

- Greenhouse gases such as methane and nitrous oxide contribute to climate change, and comprise a substantial share of Australia's emissions.
- The government is supporting methane emissions reduction in Australia, and working with other countries through the Global Methane Pledge.
- Australia is phasing-down HFCs under the *Ozone Protection and Synthetic Greenhouse Gas Management Act 1989* toward an 85% reduction from baseline in 2036.

While CO_2 emissions account for approximately 64% of Australia's total emissions in 2024 and have declined by about 38% from 2005,[28] Australia needs to address emissions from all greenhouse gases if it is to reach net zero (Figure 7.1).

Non-CO_2 emissions, such as methane and nitrous oxide accounted for 29% and 4% of our national emissions in 2024 respectively.[29] These can be compared to CO_2 through an emissions metric called global warming potentials (GWPs). Under the Paris Agreement, Parties are required to use 100-year GWP values (GWP-100) set out in the 2014 Intergovernmental Panel on Climate Change Fifth Assessment Report.[30] For example, nitrous oxide (N_2O) has a GWP-100 value of 265, which means every tonne of N_2O emitted has the warming impact of 265 tonnes of CO_2 and is expressed as 265 CO_2 equivalents (CO_2-e).

Figure 7.1 Emissions by greenhouse gas, 2005 to 2024



Cattle mustering, Western Australia, Australia.

7.1 Methane emissions

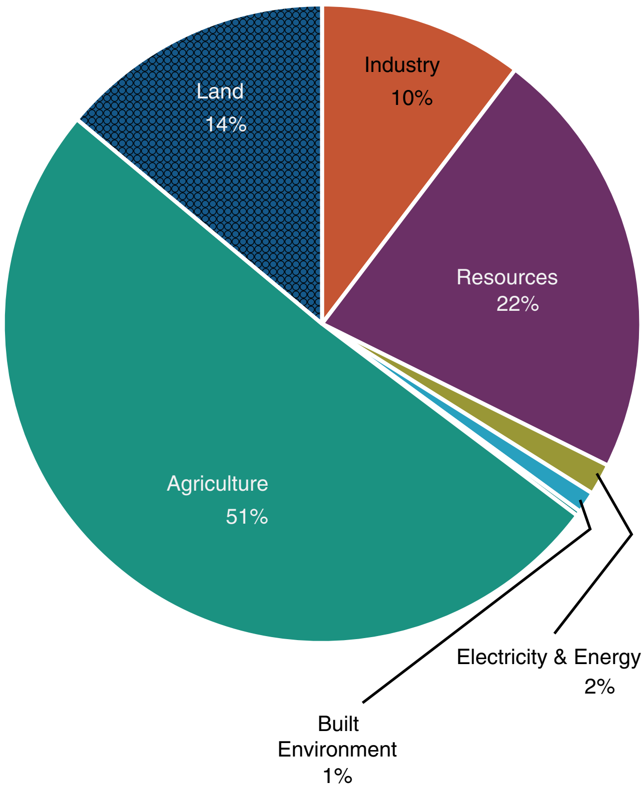
Methane is mainly produced by activities associated with livestock and cropping, fossil fuel extraction and distribution, burning of biomass (such as bushfires and controlled burning), and waste and wastewater treatment (Figure 7.2).

Methane does not stay in the atmosphere as long as CO_2, but absorbs much more energy while there. Methane has a GWP-100 value of 28, but has a global warming potential 84 times that of CO_2 over 20 years.[31] Acting now to reduce methane emissions can help reduce climate impacts in the next few decades. Strong methane emissions reduction could help limit the risk of overshooting the global temperature goals and provide benefits to the climate that reductions in CO_2 emissions cannot deliver alone.

Australia's methane emissions have declined since 2005, partly due to reductions from livestock and biomass burning (such as savanna fire management) in the agriculture and land sector (Figure 7.1).[32]

Strong and early reductions in methane emissions could make a significant contribution to reducing the extent of climate change. We are acting here in Australia and also working with other countries through the Global Methane Pledge to ensure significant global methane emission reductions are achieved by 2030.

Figure 7.2 Share of methane emissions in Australia by sector, 2024



7.1.1 Reducing methane emissions in the agriculture and land sector

The agriculture and land sector is Australia's largest source of methane emissions, with agriculture accounting for 51% (66 Mt CO_2-e) and land a further 14% (18 Mt CO_2-e) in 2024.[33] Methane is primarily produced from the digestive process of ruminant livestock (such as cattle and sheep). Methane emissions from the land sector are a combination of human-induced sources such as land conversion and clearing, and biomass burning in addition to natural sources such as wetlands.

There are limited options to reduce these emissions, particularly in extensive livestock grazing systems, however the Australian Government is investing in research to support commercially-viable methane solutions.

- The $29 million Methane Emissions Reduction in Livestock (MERiL) program provides support for researching and developing methane-reducing feed additives and forage legumes for livestock. Results from the studies showed significant methane reductions from the feed additives Asparagopsis seaweed and 3-NOP. The Government has now invested over $17 million to support the commercialisation and scaled-up production of Asparagopsis.
- The Zero Net Emissions Agriculture Cooperative Research Centre (ZNE Ag CRC), which commenced in July 2024, includes methane reduction from livestock as one of its four research programs. The Australian Government invested $87 million over 10 years to establish the ZNE Ag CRC, and a further $4 million over 10 years for the Department of Agriculture, Fisheries and Forestry to become a partner.

Improving measurement, reporting and verification (MRV) tools for farmers and producers will help keep track of methane and other emissions. This can uncover opportunities to improve farm practices to reduce emissions and costs, while bolstering farm productivity. The government is improving greenhouse gas accounting at national and farm scales, including developing voluntary emissions estimation and reporting standards for the sector, and supporting incorporation of the standards within GHG accounting tools and calculators. The Agriculture and Land Sector Plan provides further detail.

7.1.2 Reducing resources sector methane emissions

The resources sector is the second-largest source of methane emissions in Australia, accounting for 22%. In 2024 these were predominantly from fugitive methane emissions from coal mining (23 Mt CO_2-e), leakage from natural gas processing (2 Mt CO_2-e), and venting of methane associated with oil and gas extraction (1 Mt CO_2-e).[34]

The Safeguard Mechanism covered 77% of these emissions in 2024. It provides a key incentive for oil and gas producers to implement abatement options such as recovering and reusing methane emissions through installing new devices, electrification and detecting and repairing leaks. Many of these options are available at a low, or even no-net cost to operators, and are projected to make a substantial contribution to reducing fugitive methane emissions in coming years. The Australian Government will continue to work closely with state governments and their agencies so that coal mine methane abatement technologies can be safely and efficiently deployed.

The Safeguard Mechanism is being reviewed in 2026-27, which includes consideration of its incentives to drive onsite abatement. This includes incentives for methane abatement.

7.1.3 Reducing industry and waste sector methane emissions

The industry sector contributes about 10% of national methane emissions. Most of these emissions come from the waste subsector through landfills; wastewater and solid waste treatment also contribute alongside a small proportion from the industrial processing subsector.

States and territories regulate the operation of landfills and other waste facilities. The ACCU Scheme incentivises action beyond that required by regulation, through landfill and waste methods which cover projects such as:

- treating and destroying waste using eligible waste treatment equipment
- converting waste into biomethane to produce electricity
- separating organic waste from other waste.

There are over 220 waste-related projects registered under the ACCU Scheme; these have been issued over 51 million ACCUs cumulatively since 2010.[35]

Methane captured from a wastewater treatment facility is used to power the site in Nowra, New South Wales, Australia.

7.1.4 Ongoing improvement in monitoring methane emissions

The government tracks the latest science, technologies and practices to continuously improve the emissions data that underpins Australia's abatement policies and actions. This includes $10.2 million to improve fugitive methane emission estimation and reporting by:

- Establishing an Expert Panel, led by Australia's former Chief Scientist, to provide advice on the current scientific understanding of atmospheric measurement approaches to fugitive methane emissions, and whether and how those approaches could help improve Australia's fugitive methane emission estimates now and into the future
- Supporting a world's first study in Australia, coordinated by UNEP's International Methane Emissions Observatory (IMEO), to evaluate the capability of such approaches in a simulated surface mine setting
- Reviewing Australia's facility-level method for estimating fugitive methane emissions from surface mine coal extraction to inform continual improvement in our monitoring.

Findings from this work will make significant contributions to international understanding of approaches for the detection and quantification of fugitive methane emissions.

7.2 Synthetic greenhouse gas emissions

Synthetic greenhouse gases are manufactured chemicals commonly used in refrigeration, air conditioning, and fire extinguishing. Synthetic greenhouse gases can remain in the atmosphere for a long time, contributing to their high global warming potentials, however they only make up a small proportion of Australia's emissions at approximately 3%.[36]

Hydrofluorocarbons (HFCs) are the largest contributor to high global warming potential synthetic greenhouse gases in Australia. For example, HFC-134a, which has been widely used in automotive air conditioning, has a GWP-100 value of 1,300, meaning every tonne of HFC-134a emitted has the warming impact of 1300 tonnes of CO_2.

Australia was one of the first countries to ratify the Montreal Protocol on Substances that Deplete the Ozone Layer (the Montreal Protocol). An estimated 40 Mt CO_2-e was avoided since 1995 through Australia's successful phase-out of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs).[37] The Kigali amendment to the Montreal Protocol, agreed in 2016, included an agreement to a global phase-down of HFCs.

Australia's phase-down of HFCs under the Ozone Protection and Synthetic Greenhouse Gas Management Act commenced in 2018 and is reducing consumption of HFCs through an annual quota on imports of bulk HFCs that decreases every 2 years, reaching an 85% reduction from baseline in 2036. Australia commenced the phase-down earlier – and from a lower mandated baseline and with more frequent reductions – than it was required to do under the Montreal Protocol. For 2026 and 2027 the total import of bulk HFCs will be capped at 4.25 Mt CO_2-e and gradually reduce to 1.6 Mt CO_2-e in 2036.

HFC phase-down is contributing to Australia's greenhouse gas emissions reduction targets and is encouraging industry to move to alternative technologies using lower or zero global warming potential gases.

Work is continuing. Restrictions on the import of small split-system air conditioning units using high GWP HFCs commenced in 2024, and programs are underway across states and territories to encourage the uptake of more energy-efficient refrigeration and air conditioning equipment.

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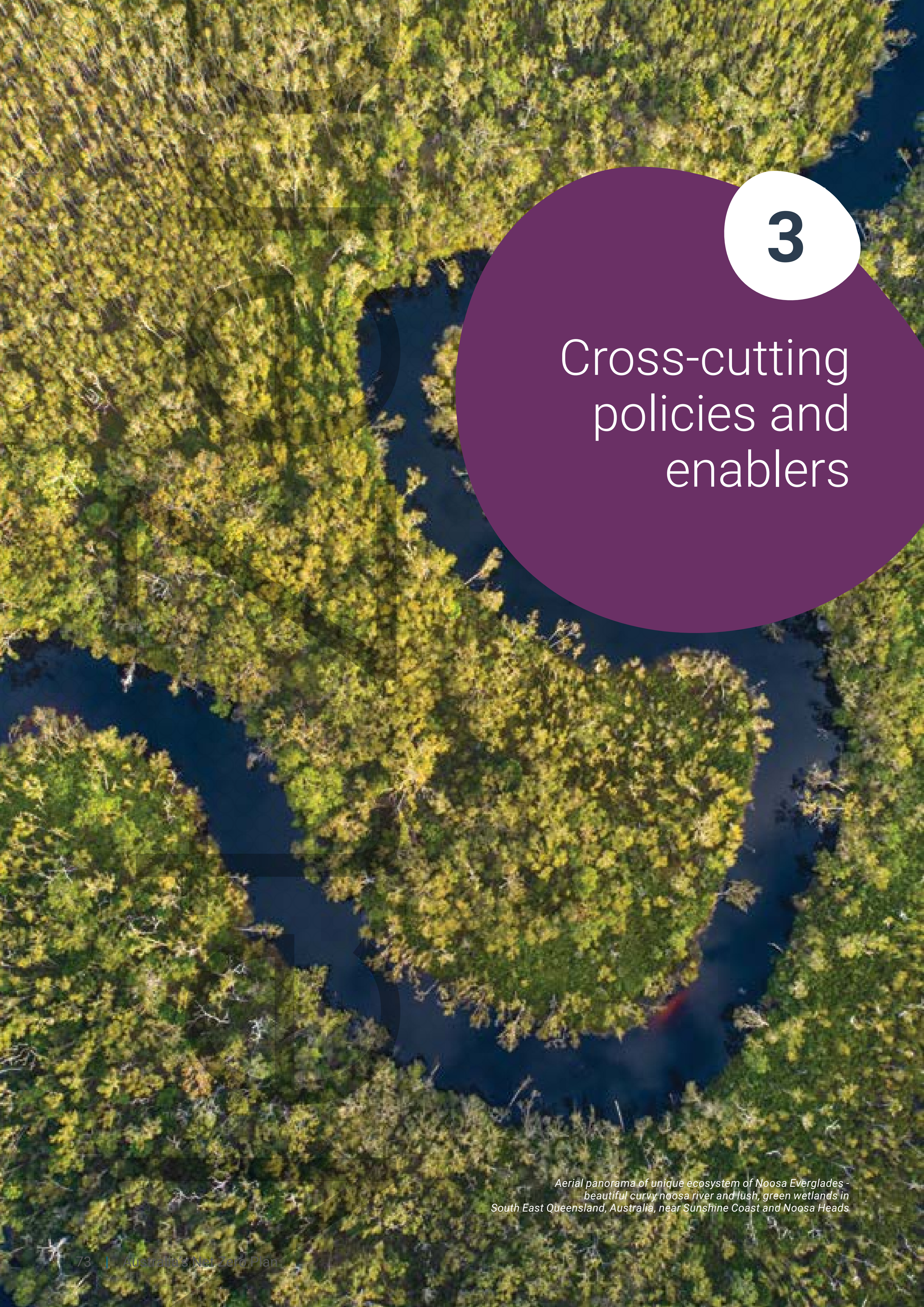

3

Cross-cutting policies and enablers

Aerial panorama of unique ecosystem of Noosa Everglades - beautiful curvy noosa river and lush, green wetlands in South East Queensland, Australia, near Sunshine Coast and Noosa Heads

Australia's transition to net zero is underway, but there remain barriers to achieving decarbonisation at the pace and scale required.

These include slow and complicated planning and approvals processes for renewable energy and enabling infrastructure, supply chain constraints, investment requirements, and workforce shortages.

The transition will require coordinated action across the economy to address these barriers. Getting these settings right will help share benefits across the country and build confidence, accelerating the transition to the pace we need to achieve our 2035 target and net zero by 2050.

8. Reforming approvals to transition sustainably

Key messages:

- Australia's net zero transition requires rapid deployment of major infrastructure projects.
- Planning and environmental approval processes need to be reformed to deliver faster outcomes and stronger environmental decisions.

The Climate Change Authority advised:

> 'Reforming Australia's planning system in a way that manages competing priorities while also accelerating planning and approval decisions, will need to be a key priority for governments.'
>
> Sector Pathways Review 2024, page 179

Australia has a long history of delivering major infrastructure projects. But the transition to net zero represents a step-change in scale, requiring more major projects across the country to be deployed at an accelerated pace. This includes wind and solar generation and transmission projects, mines and processing facilities for critical minerals, and other net zero industries. The deployment of new infrastructure will need to advance alongside the normal business of constructing housing, roads, and other infrastructure.

The total land area required to build Australia's renewable capacity and transmission network to 2050 is estimated to be a very small proportion of our total land mass.[1] In addition, wind turbines, solar arrays and transmission lines can coexist with other land-uses (for example, solar PV on buildings and windfarms integrated into broadacre cropping).

With the right systems in place, Australia can facilitate rapid deployment, while ensuring we meet our ambitions for protecting and restoring our natural environment, protecting food security and agriculture production, and preserving First Nations heritage. These are all essential for maintaining social licence for the transition.

This chapter explores the areas where governments are working to update planning, environmental approvals and other processes to balance sometimes competing priorities and deliver on multiple national objectives.

8.1 States and territories administer Australia's planning rules

The Climate Change Authority advised:

> 'Australian planning processes are often complex, requiring the involvement of multiple government agencies and multiple levels of government to progressively approve elements of a project.'
>
> Sector Pathways Review 2024, page 180

In Australia, land-use planning and environmental approvals are the responsibility of all levels of government, with state, territory and local governments having primary remit. Like the Australian Government, these jurisdictions are making efforts to accelerate approvals to support the timely deployment of large-scale renewable energy projects. For example, in November 2024, the NSW Government introduced the Renewable Energy Planning Framework to support renewable energy development, including within Renewable Energy Zones. The framework provides guidance and tools to increase transparency, improve investment certainty, and enable faster and more consistent approval pathways for projects that align with best practice.

8.2 The Commonwealth regulates issues of national significance

Australia's national environmental law is the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Most activities regulated under the EPBC Act are also subject to state and territory or local government laws. The EPBC Act applies to any activity that is likely to have a significant impact on identified nationally protected matters.

The Australian Government is committed to strengthening and streamlining our national environmental laws and establishing a national environment protection agency.

Reforms will deliver:

- stronger environmental protection and restoration
- more efficient and robust project assessments
- greater accountability and transparency in decision making

The reforms are about improving national productivity through faster and more streamlined environmental approvals as well as delivering greater environmental protections through strong new environmental standards.

8.3 This national challenge needs a federated response

While each state and territory is responsible for their own planning laws, national collaboration can help facilitate investment and faster deployment. This is especially critical in removing duplication between levels of government where a single project must undergo both state/territory and national approval.

The Australian Government is working with jurisdictions to support more effective environmental regulation, through reforms that are focused on reducing duplication and enhancing landscape-scale approaches for development and conservation.

National collaboration is also important to ensure water resource management is aligned with climate goals, alongside agriculture, industry and community needs and supports the natural environment. Many net zero technologies rely on water supplies including hydrogen, hydroelectricity, low-carbon liquid fuels and carbon sequestration. Suitable planning by each level of government is needed to ensure sustainable supply for all users.

To balance these needs and plan for sustainable water use, governments are collaborating on key water infrastructure and planning. Governments are considering principles and actions that will help plan for and manage demands for water, including in the context of net zero transition, through development of the National Water Agreement.

Collaboration also occurs through forums like the Environment Ministers Meeting and the Energy and Climate Change Ministerial Council (discussed further in Chapter 12). Bilateral efforts, such as the Renewable Energy Transformation Agreements between the Australian Government and individual states and territories have also delivered some progress. For example, the South Australian Agreement includes a commitment from the Australian Government to underwrite 1000 MW of new wind and solar and 400 MW of new storage capacity in South Australia through the Capacity Investment Scheme. The South Australian government will improve community engagement and planning and approvals processes to ensure projects can be built by 2030, among other measures.

The Australian Government has created the National Renewable Energy Priority List with states and territories to deliver a 'faster yes or faster no' to identified key renewables projects. Identified projects will receive additional support and facilitation through regulatory and environmental processes. They will still have the same scrutiny applied as any other project and continue to be required to meet all statutory requirements. The inaugural Priority List identifies 56 priority projects consisting of 24 transmission, and 32 generation and storage projects. If approved, these projects could deliver an additional 16 GW of generation and approximately 6 GW of storage capacity across the nation.

9. The role of carbon markets in Australia's transition

Key messages

- Carbon markets are an efficient way to drive emission reductions, and an important part of Australia's suite of policy measures.
- The Australian Government will continue implementing reforms to ensure Australia's carbon markets:
  - are effective and operate with high-integrity
  - complement other policies and measures
  - support broad participation
  - deliver additional benefits where appropriate
  - avoid adverse impacts, including to biodiversity and land access for agricultural production.
- Australia will play a constructive role to support robust and high-integrity international carbon markets.

Carbon markets incentivise cost-effective abatement within a robust measurement framework that helps ensure integrity. Broad participation from landholders, communities and businesses will help spread the benefits of climate action. Complementary and aligned policy, planning and market frameworks will support related objectives, including cultural and nature benefits, and agricultural productivity.

9.1 Australia's carbon markets

Carbon markets are markets in which carbon units, corresponding to a fixed quantity of greenhouse gas emissions or abatement, are exchanged within a defined framework. Australia has 3 national carbon market frameworks helping to achieve low-cost abatement:

1. The **Australian Carbon Credit Unit (ACCU) Scheme** incentivises carbon abatement through projects ranging from reforestation to energy efficiency. Proponents carry out projects to reduce emissions or sequester carbon. An **ACCU** reflects a tonne of carbon dioxide-equivalent sequestered or avoided (Box 9.1).

   ACCU Scheme projects are subject to strict eligibility criteria to ensure credited abatement is additional, measurable and evidence based. For a project to generate ACCUs, it must follow the rules set out in a method. Methods are required to meet legislated Offset Integrity Standards and the independent Emissions Reduction Assurance Committee determines whether these standards are met. Methods are also periodically reviewed to maintain integrity. Since 2011, the ACCU Scheme has delivered over 169 million tonnes of abatement across Australia, backed by more than $1 billion in government support.[2]

2. The **Safeguard Mechanism**, sets emissions limits known as baselines for large industrial facilities and covers 31% of Australia's emissions.[3] Covered facilities are required to either directly reduce their emissions on-site or surrender carbon units to meet their baselines. When a facility's emissions are below its baseline, it is issued **Safeguard Mechanism Credits (SMCs)** corresponding to the difference between its emissions and its baseline. SMCs are a type of carbon unit that can be traded or used by the facility.

3. **Voluntary Carbon Markets** enable companies and individuals to support emissions reductions beyond their own direct activities by purchasing carbon units. This may contribute to achieving voluntary corporate emission reduction targets; balancing the emissions impacts of a product or service such as air travel; or philanthropic efforts to reduce emissions. Both ACCUs and international carbon units (created from emission reduction projects overseas) are purchased in voluntary markets. Any purchases of international units do not count towards Australia's national emission reduction targets.

Box 9.1 The evolving role of the ACCU Scheme

The role of the ACCU Scheme in Australia's climate policy landscape has evolved substantially over time.

The *Carbon Credits (Carbon Farming Initiative) Act 2011* (CFI Act) established the legislative framework for ACCUs.

From 2012 to 2014, the ACCU scheme operated as a complement to the Carbon Pricing Mechanism. The mechanism set a carbon price for major emitters; those emitters could use ACCUs to help meet their obligations. The mechanism was central to Australia's emissions reduction efforts at the time, supported by new institutions like the Clean Energy Regulator and the Climate Change Authority.

After the Carbon Pricing Mechanism was repealed in 2014, the ACCU scheme became the central measure to drive emission reductions. In 2015, the government established the Emissions Reduction Fund and over subsequent years committed $3.1 billion under long term contracts to purchase a total of almost 250 million ACCUs.[4]

In 2022, Australia legislated stronger national emission reduction targets. The Safeguard Mechanism was reformed in 2023 to drive emission reductions at covered facilities, the New Vehicle Efficiency Standard was legislated in 2024, and the Capacity Investment Scheme was established to accelerate investment in renewable energy generation and clean dispatchable capacity. The ACCU Scheme remains a key tool but now operates as part of a broader suite of climate measures. The primary source of demand for ACCUs is now from Safeguard facilities.[5]

While these schemes operate under different frameworks, they are also linked. For example:

- under the Safeguard Mechanism, ACCUs can be surrendered by Safeguard facilities to help meet their compliance obligations, alongside SMCs.[6]
- voluntary market participants can purchase ACCUs to help meet their voluntary commitments.

Alongside these national frameworks, states and territories have their own mechanisms for incentivising least-cost abatement through carbon markets. For example, the Victorian Energy Upgrades program requires energy retailers to relinquish Victorian Energy Efficiency Certificates to government each year to meet regulatory obligations.

There are also markets that trade in energy savings or renewable energy production, such as the Commonwealth's Renewable Energy Target Scheme or NSW Renewable Fuel Scheme. While these markets trade units corresponding to a fixed unit of energy rather than carbon, they have many parallels to carbon markets and make a valuable contribution to emissions reductions.

At the international scale, carbon market frameworks allow for the trade of carbon units between countries. The framework established under Article 6 of the Paris Agreement supports the trading of Internationally Traded Mitigation Outcomes (ITMOs) to contribute to the achievement of nations' Nationally Determined Contributions (NDCs). These activities enable purchasing countries to achieve existing or more ambitious emissions reduction targets, potentially at a lower cost or on a faster timeline compared to what might be possible through domestic action alone. The Australian Government has been an active partner in establishing a robust framework for carbon trading through the Paris Agreement and continues to provide capacity building within the Indo-Pacific to enable broad participation.

9.2 Carbon markets support Australia's net zero transition

Governments are well placed to set emission reduction goals, but do not have complete information regarding abatement opportunities that exist across the economy. A key strength of carbon markets as a policy tool is that they encourage businesses to reduce emissions wherever they are most cost effective. This flexibility reduces the cost of meeting climate goals and can enable more ambitious goals to be achieved. Linkages across carbon markets can increase their efficiency; this is a key reason for allowing ACCUs to be used for Safeguard Mechanism compliance.

9.2.1 Safeguard and ACCU market operation

The Safeguard Mechanism allows facilities to meet their obligations by using a mix of on-site abatement and carbon units. Safeguard facilities with low-cost abatement opportunities take those up – both to meet their own baselines and to earn SMCs, which they can sell to others. Facilities with higher-cost abatement opportunities can meet their baselines by purchasing credits from others. This ensures the largest emitting industrial facilities contribute to national emissions reductions, while recognising that many need time to develop cost-effective abatement options. Similarly, businesses across the economy that can generate low-cost abatement through ACCU projects have an incentive to take those opportunities up, so they can sell the ACCUs to Safeguard facilities.

In this way, the Safeguard Mechanism encourages all covered facilities to invest in cost-effective abatement on-site, stimulates further abatement in other sectors, and achieves the overall emission reduction goal at least-cost.

Under the ACCU Scheme, every credit must be backed by real and measurable abatement, and methods must meet the legislated Offset Integrity Standards:

- **Additionality** – any carbon abatement that is credited would be unlikely to occur in the ordinary course of events
- **Measurable and verifiable** – the removal, reduction of greenhouse gases should be measurable and capable of being verified
- **Eligible carbon abatement** – abatement should be able to be used to meet Australia's international mitigation obligations
- **Evidence-based** – the approach to crediting should be supported by clear and credible evidence
- **Project emissions** – material greenhouse gas emissions emitted as a direct result of the project should be deducted
- **Conservative** – when an estimate, projection or assumption is made it should be conservative.

The ACCU Scheme also has existing controls to guard against adverse environmental, economic or social impacts. Eligibility requirements for projects include:

- obtaining eligible interest holder consents before ACCUs can be issued
- exclusion of certain types of offset projects due to likely adverse environmental and social impacts
- considering consistency with natural resource management plans
- obtaining regulatory approvals under all state, territory and national laws relating to land use and development, the environment and water.

Methods address specific environmental, economic and social risks, and the relevant minister must consider any adverse impacts that could arise from projects before making a method.

The Australian Government has established high-integrity measurement, reporting and verification protocols through the National Greenhouse and Energy Reporting (NGER) Scheme, which underpin reporting by Safeguard Mechanism facilities and calculation of SMCs. The NGER Scheme is subject to continuous improvement and periodic review by the Climate Change Authority.

9.2.2 Voluntary carbon market reforms

The Australian Government's Climate Active program provides an incentive for Australian businesses to voluntarily participate in a high-integrity voluntary carbon market. Climate Active certification is awarded to businesses and organisations that have credibly reached a state of carbon neutrality.

Established in 2010 as the National Carbon Offset Standard, and updated to Climate Active in 2019, the program provides principles for voluntary engagement with carbon markets. It has facilitated the use of more than 54.8 million carbon credits, including more than 3.3 million ACCUs and 51.4 million international carbon credits.[7]

Climate Active is currently under review and a decision about the future direction of the program has not yet been made. The government understands the need for certainty on Climate Active reforms and is carefully considering the role of the program alongside the changing policy landscape and community expectations around voluntary action, including how it interacts with Australia's new mandatory climate-related financial disclosures framework.

9.3 Future directions for Australia's carbon markets

Carbon markets are part of a portfolio of measures that will help Australia achieve net zero emissions by 2050. Carbon markets work alongside other key policies including risk-sharing arrangements like the Capacity Investment Scheme, sector-specific regulations like new vehicle and appliance efficiency standards, and research and industry development programs. These policies overcome a range of barriers to emissions reduction action that go beyond cost. The Australian Government will not introduce an economy-wide price on carbon and will instead maintain a suite of measures to drive emissions reductions in ways that strengthen our economic productivity, community and environmental outcomes.

Throughout the transition to net zero, the Australian Government will work with suppliers, purchasers, communities, trading partners and independent experts to sustain effective carbon markets that benefit communities, industries and the natural environment.

9.3.1 Continuous improvement in the ACCU Scheme

Demand for ACCUs is expected to increase over time, to support participants in compliance and voluntary markets to achieve their emissions reduction goals. The Australian Government is considering its future role as a direct purchaser of abatement, in light of the Safeguard reforms and the evolving role of the ACCU scheme.

Supply is currently strong. Around 19 million ACCUs were issued in 2024; this is projected to grow to 31 million in 2035.[8] Australia's Emissions Projections 2024 estimate the supply of new ACCUs, alongside existing holdings within the market, will be sufficient to meet projected demand out to 2035.[9]

The Australian Government will continue to improve the ACCU scheme so it contributes to Australia's net zero transition through:

1. Improving scheme governance, reinforcing integrity and transparency

Recent reviews by the Climate Change Authority (CCA), independent experts, and the Australian National Audit Office, have consistently found the ACCU Scheme is well designed, well administered, and contributing to Australia's transition to net zero.[10]

The Australian Government strengthened governance through legislative reforms in 2023, including to appoint a full-time chair to the Emissions Reduction Assurance Committee, bolster the independence of scheme administration and require increased audits for some projects. The government will continue to enhance transparency and integrity by increasing the amount of project information published by the CER, and requiring up-front consent from Native Title holders at project registration.

2. Bringing forward high-integrity supply

The government is increasing opportunities to generate high-integrity ACCUs from a diversity of activities. A new method has been developed to incentivise abatement at landfill facilities; this is on track to be finalised by the end of 2025. New methods to recognise carbon abatement from managed burning of savanna landscapes in northern Australia, and from managing agricultural land to store more carbon, are under development. The government is also investing in the Carbon Farming Outreach Program to support farmers and land managers to make informed decisions about participating in carbon markets (see Chapter 14).

To expand opportunities under the scheme, and foster innovation, the government introduced a proponent-led process to develop methods in 2024. This enables businesses, industry groups, researchers and others to propose new emissions reduction methods. The public register of proposals provides visibility and can help drive early support for technologies. Four proposals were prioritised in 2024, and method development is underway.

The scope of eligible activities under the scheme will change as the broader climate change policy framework evolves. For example, activities at Safeguard facilities are no longer eligible to create ACCUs for covered emissions, and multiple energy efficiency methods have been retired over the last few years because other policies have been developed that better support those activities.

3. Facilitating interoperability with the Nature Repair Market

The Nature Repair Market is incentivising biodiversity outcomes together with carbon abatement. The Nature Repair Market has been designed to align with the ACCU Scheme, with both schemes administered by the Clean Energy Regulator. Registrations for projects under the first Nature Repair Market method opened in March 2025, with the first project registered in August 2025. Under this method, eligible participants can design a project to earn both a tradeable biodiversity certificate and ACCUs where they meet relevant method requirements. The government will continue to consider opportunities for alignment as the Nature Repair Market scheme develops.

4. **Strengthening synergies between carbon removals and other land uses**

There are opportunities to store carbon in the land in ways that are consistent or complementary with other land uses, including agriculture. Activities such as regenerative agriculture, silvopastures, shelterbelts, and riparian plantings integrate carbon storage into farming practices. These can enhance agricultural productivity by improving the richness of soil and protecting crops, land and livestock from the elements.

Landholders can leverage carbon markets to deliver abatement outcomes and optimise use of their land. The government has heard stakeholder concerns about the risks of large-scale carbon farming compromising productive land, and potential impacts on local communities. Appropriate planning and co-ordination is needed to minimise transition risks and find a suitable balance between different land uses. Further analysis building on the work done to date will be important to help understand the nature of changes and impacts on communities, and inform responses. Chapter 14 and the Agriculture and Land Sector Plan explore this topic further.

The Climate Change Authority advised:

> 'Tree plantings that help meet the 2035 target could be established across a variety of land types, including marginal farmland, without compromising agricultural production or food security. Diversifying land use and developing new business activities that sequester carbon can give land managers and farmers new opportunities and income streams on their land.'
>
> 2035 Targets Advice, page 64

9.3.2 The Safeguard Mechanism

The Safeguard Mechanism is flexible and scalable. Its settings are calibrated to Australia's national emission reduction targets of 43% below 2005 levels by 2030 and net zero by 2050. To 2030, baselines for most facilities decline by 4.9% per year. The Safeguard Mechanism also sets strong baselines for new entrants, which helps ensure Australia's emissions trajectory is robust to changes in demand for our commodities, whether that be in energy commodities or new demand for critical minerals.

The government will conduct a review of the Safeguard Mechanism in 2026-27. This will consider:

- the emissions baseline decline rate from 2030 onwards
- the coverage arrangements, taking into account any competitive issues, abatement potential and regulatory compliance
- whether international units should be considered
- the use of SMCs (noting these credits provide a significant incentive for investment in onsite abatement) and offsets beyond 2030 (incorporating advice from the Climate Change Authority on the extent to which on-site abatement is being driven by the reforms, and whether any additional incentives are required)
- the treatment of flexibility mechanisms beyond 2030
- the suitability of arrangements for emissions-intensive, trade-exposed activities
- a range of other matters.ǂ

9.3.3 International carbon trading

Australia recognises that high-integrity international carbon markets can help achieve global emissions reductions targets. The Paris Agreement allows for **Internationally Traded Mitigation Outcomes** (ITMOs) to be exchanged between parties. This enables crucial finance to be accessed by countries that need it while supporting strong social and environmental outcomes, and can help countries achieve higher ambition targets.

Australia supports robust, high-integrity international carbon markets. The Australian Government worked alongside other countries to establish the framework for trading ITMOs through the Paris Agreement and provides capacity building within the Indo-Pacific. The Australian Government does not currently allow ITMOs to be used towards our national emissions reduction targets or for compliance purposes. Our focus is firmly on enabling our industries to reduce emissions domestically as this places them in the best position to capture the economic benefits of the transition to net zero.

Regardless of how Australia chooses to engage with international markets, Australia will continue to collaborate internationally to help build capacity for countries to participate in international cooperative approaches and increase their contributions to global emissions reduction.

The Climate Change Authority advised:

> 'Australia should not need to use international offsets to meet the 62–70% target by 2035.'
>
> 2035 Targets Advice, page 109

ǂ *A list of matters to be considered by the 2026–27 Review into the Safeguard Mechanism is contained in Attachment B to the Explanatory Statement to the Safeguard Mechanism Reforms Rules 2023*
Source: Federal Register of Legislation, Explanatory statement: National Greenhouse and Energy Reporting (Safeguard Mechanism) Amendment (Reforms) Rules 2023, Government of Australia, Canberra, August 2023

10. Attracting investment to achieve net zero

Key messages

- A clear and credible pathway to net zero provides certainty to investors which helps to attract investment.
- The Australian Government is investing strategically to de-risk and incentivise private capital, including foreign investment.
- Australia's **Sustainable Finance Roadmap** provides a pathway for mobilising the private capital required to achieve net zero, modernising our financial markets and maximising the economic opportunities associated with energy, climate and sustainability goals.
- Strong trading arrangements with partner countries will help attract investment in clean energy industries and improve access to technologies and inputs required for the transition.

The Australian Government is investing in our net zero future. However, government alone cannot finance the transition to net zero; private investment at all scales, from households and small businesses to institutional funds, is also required.

This chapter discusses the government's role in supporting private sector investment in deployment, infrastructure and equipment to deliver the transition.

10.1 Attracting domestic and foreign investment

The Climate Change Authority advised:

> '…there is a global reorientation in trade and investment underway as governments, regulators, and markets around the world transition to net zero emissions and Australia needs to adapt to these changes or risk the economic opportunities flowing to other countries.'

Sector Pathways Review 2024, page 192

Global capital flows are already shifting. Investors, both in Australia and overseas, are looking for long-term value that also serves to reduce global emissions. The International Energy Agency's annual World Energy Investment report has found that annual clean energy investments are set to rise to over US$2 trillion in 2025, double investment in fossil fuels.[11] The IEA reports the scale of global investment must increase further to keep temperature rises to within 1.5°C, including:

- doubling annual investment in renewables, grids and batteries
- tripling annual investment in transport, industry and buildings.

This creates opportunity for Australia.

The Sustainable Finance Roadmap helps to mobilise the significant private capital required to support net zero. The roadmap includes 3 pillars to strengthen the financial system and facilitate investment in the transition:

1. *Improve transparency on climate and sustainability* to help guide capital to net zero-aligned investments and build public confidence in the integrity of the financial system as a contributor to the transition. This includes holding businesses to account for greenwashing, such as through enforcement action by corporate regulators, and setting benchmarks through the Sustainable Finance Taxonomy.
2. *Financial system capabilities*, to strengthen Australia's position as an attractive destination for green capital by ensuring fit for purpose regulatory regimes.
3. *Australian Government leadership and engagement*, including issuing sovereign green bonds and promoting interoperable frameworks.

The Australian Trade and Investment Commission (Austrade) works with foreign investors to identify, attract and facilitate investment projects aligned to government priorities, such as Australia's net zero transformation. This work includes promoting Australia as a welcoming destination for investment, capitalising on the country's hard-earned reputation for:

- a safe and profitable investment destination
- strong environmental, social and governance (ESG) credentials
- cohesive action on climate across levels of government.

Since mid-2022, Austrade has facilitated over $15 billion of foreign investment across nearly 200 projects to support Australia's net zero transformation – delivering almost 22,000 jobs.

By applying robust review processes to foreign investment, Australia can enjoy the economic growth that comes from this capital, while maintaining our national security (Box 10.1).

10.2 Government is investing to crowd-in capital

The Government is working with the private sector to drive investment. While most of the investment will come from the private sector, the Government is providing targeted investment to multiply impact beyond what public finance can achieve alone.

Established in 2012, the Clean Energy Finance Corporation (CEFC) is the world's largest green bank, offering concessional loans to help attract private investment. Since its inception, the CEFC's loans have been instrumental in shoring up support for projects and investments that might not have otherwise attracted conventional finance. This has operated at all scales, from grid-scale renewable electricity, to concessional loans to households purchasing electric vehicles. The CEFC is also investing in a range of decarbonisation opportunities in other sectors, including agriculture, low-carbon liquid fuels and property.

The CEFC has delivered a triple benefit to the Australian public, by:

- accelerating the transition by proving the potential of various technologies, including a central role in establishing solar and battery storage
- increasing activity that has contributed to wages and economic growth
- earning a return on investment for the Australian taxpayer.

Over its history, the CEFC has attracted $3 of private funding for every $1 of public investment.[12]

At the start of 2025 the Government added $2 billion to the CEFC's general funding, allowing it to sustain its crucial investments in clean energy technologies. The Government is updating the CEFC's investment mandate to include a new focus on the rapid roll out of renewable projects to drive down electricity prices, and committing up to $2 billion more to the CEFC General Account, to be drawn down in line these changes.

The National Reconstruction Fund Corporation (NRF) provides debt, equity and guarantees to projects in priority areas of the Australian economy, including renewables and low-emission technologies.

The Net Zero Fund will be a new $5 billion sub-fund of the NRF to invest in decarbonisation of large industrial firms, including through capital expenditure to reduce emissions, and manufacturing renewable and low emissions technologies. The Net Zero Fund will drive decarbonisation and modernise industrial processes. The funds will be drawn from existing NRF capital and will be a refocusing of the NRF's priorities.

The Regional Investment Corporation (RIC) is another national investment vehicle funded by the Australian Government. The RIC specialises in low-interest loans for farm businesses and farm-related small businesses. In August 2025, the government announced an additional $1 billion in new loan funding to the RIC to expand support for the growth, resilience and sustainability of Australia's agricultural sector. The government will also broaden the RIC's loan scope to include assistance for improving climate resilience, boosting sector productivity and supporting agriculture to be part of Australia's net zero transition.

Other financial instruments and special investment vehicles also crowd-in private investment and support decarbonisation:

- The Capacity Investment Scheme underwrites private investment in renewable electricity generation and storage.
- Production tax incentives for critical minerals processing and renewable hydrogen attracts investment under Future Made in Australia.

The Australian Government has opened the Investor Front Door, with a pilot beginning in September 2025. The Investor Front Door is designed to streamline how investors and business interact with the government, helping support nationally significant projects navigate approvals processes and identify suitable government financing opportunities.

The Australian Government is also targeting capital to specific regions to help deliver a fair and equitable transition. The Net Zero Economy Authority is acting as a catalyst for investment and major project development in the regions most affected by the transition to net zero – the Hunter (NSW), Latrobe (VIC), Collie (WA) and Central Queensland. The NZEA's work is fostering job creation and actively supporting the transition by facilitating public and private sector participation and investment in transformational net zero projects, including working with established investment funds.

10.3 Investing to build resilience and secure supply chains

The Climate Change Authority advised:

> 'A heavy reliance on importing transition technologies from overseas means it will be essential for governments to work with industry and international partners to establish supply chains resilient to global economic, climate and geopolitical disruptions. This cannot be achieved by onshoring transition technology manufacturing in Australia alone.'

Sector Pathways Review 2024, page 195

The net zero transition can build national resilience to future risks and shocks by strengthening domestic capabilities and supply chains, especially where Australia has a comparative advantage in a low-emissions world. By strategically guiding private investment to industries that will reposition Australia upstream in supply chains, the government is reducing exposure to international disruptions and improving our sovereign capability.

For example, Australia has historically depended heavily on imports of petrol, diesel and aviation fuel, with only 13% of the petroleum feedstocks for Australian refineries coming from local sources.[13] To build a supply chain for Australian low carbon liquid fuels, the Australian Government will invest $1.1 billion in a new Cleaner Fuels Program. This will help stimulate private investment in Australia's first onshore low carbon liquid fuel refineries, backing local innovators, making fuel supply more resilient and bridging the price gap for early adopters. The Government will engage with industry on how to make sure Australian liquid fuel users have a fair chance to capture the emissions reduction potential unlocked by low emission Australian fuels. This will reduce reliance on imported fuels and unlock new export opportunities over time.

Other Future Made in Australia priorities include batteries and solar PV. Australia's National Battery Strategy outlines how Australia will build a diverse and competitive Australian battery industry that will improve Australia's supply chain resilience and economic security. It includes the $500 million Battery Breakthrough Initiative, delivered by ARENA, to promote the development of battery manufacturing capabilities in Australia. ARENA is also delivering the $1 billion Solar Sunshot program, supporting commercialisation of Australian innovations and scaling-up domestic solar PV manufacturing. This will improve supply chain security for a technology at the centre of the clean energy transition.

Box 10.1 Managing national security risks through the transition

Attracting foreign investment, strong trade relationships and robust supply chains are integral to Australia's transition. However, these arrangements can give rise to national security risks, which risk undermining confidence in the transition.

Australia must also manage cybersecurity risks for connected devices we are using to reduce emissions. Smart energy management devices, heat pumps, batteries and electric vehicles produce valuable yet sensitive data. This data helps reduce costs for consumers but raises risks, especially if the vendor of these technologies is owned, controlled or influenced by foreign governments with interests or values that conflict with Australia's. The 2023–2030 Australian Cyber Security Strategy seeks to address these types of risks while stimulating investment and providing clarity for industry, including in reducing emissions.

10.4 Trade relationships and settings are critical for investment

For decades, Australia has relied on international trade for prosperity.

As trading partners implement their net zero commitments, Australia's fossil fuel exporters are projected to experience declines in demand.[14] Treasury's modelling report notes that, should forecasts by the International Energy Agency be realised, Australian coal production could decrease by at least 71% to 2050 and Australian gas and LNG production could decline by at least 66% by 2050. In contrast, global demand for the commodities needed for the net zero transition, such as critical minerals like lithium and nickel, are projected to grow, alongside new growth sectors such as green ammonia and green metals.

Australia's comparative advantages in renewable energy and critical minerals can be combined with our strong trading partnerships, fair and competitive markets, open trade and investment and proximity to key markets in Asia to grow the value of our exports. In addition to the investment and jobs benefits, by displacing higher emissions production elsewhere, Australian exports could underpin emissions reductions beyond our borders.

Treasury considered how Australian production and export of green iron, green ammonia and lithium could contribute to global abatement, estimating Australia's production of these products could contribute 466 Mt CO_2-e to global decarbonisation in 2050. This is equivalent to 1.2% of global emissions and more than Australia's net emissions in 2024. This allows Australia to make a significant additional contribution to global efforts – beyond the decarbonisation of our own economy.

The Climate Change Authority advised:

> 'Australia can boost its contribution to the global goals of the Paris Agreement - over and above meeting a strong domestic emissions reduction target - by partnering with trading partners to decarbonise their energy systems and supply chains.'

2035 Targets Advice, page 14

Targeted partnerships are helping Australia position itself for success in global clean energy industries and markets. For example, the China-Australia Steel Decarbonisation Dialogue has been established to bring together the world's largest steel producer, China, and the world's largest iron exporter, Australia, to progress a sustainable steel sector. Australia currently exports over $100 billion a year of iron ore to China.[15]

Australia also has a range of bilateral agreements with some of our largest trade and investment partners to support scaling-up low-carbon technologies and collaboration on research and development; including with India, Germany, Singapore, Japan, the Republic of Korea, China, the Netherlands, and the United Kingdom.

These partnerships build on Australia's Free Trade Agreements, which add significant value across the Australian economy through access for our exports to important markets.

In addition, Australia engages in important multilateral groupings like the Climate Club and G20, which support the development of policies, approaches and standards on trade and clean energy.

Australia is driving coordinated international approaches to certify low emissions products that will facilitate trade, building on our Guarantee of Origin (GO) scheme. The scheme, commencing in late 2025, is a voluntary framework for emissions accounting of products and certification of renewable electricity. It supports the government's Future Made in Australia plan and underpins eligibility for government initiatives such as the Hydrogen Production Tax Incentive.

Australia has played a lead role in the International Partnership for Hydrogen and Fuel Cells in the Economy, the most advanced multilateral government forum considering a global approach for hydrogen certification. Through this cooperation, the Australian Government contributed to the development of hydrogen emissions accounting methodologies, which are now being given effect through the GO scheme.

Governments around the world are increasingly seeking to regulate trade in certain goods on the basis of their embodied carbon. The EU and UK are both developing border carbon adjustments (BCAs) to ensure that imported goods face similar carbon costs as domestic products, helping prevent loss of industries abroad and encouraging cleaner industrial production globally.

When fully implemented, these BCAs will apply to aluminium, cement, fertilisers, hydrogen, iron and steel. Importers will need to have a liability corresponding to the carbon emissions embedded in their imported goods, accounting for any emissions liabilities paid overseas. Thailand has also announced that it will implement an emissions trading scheme, accompanied by a border carbon adjustment.

Australia's climate policies already have strong measures to address the risk of carbon leakage to maintain the strength of Australian industries and ensure a level playing field through the transition. Australia has been considering how best to continue this over time (Box 10.2).

Box 10.2. Maintaining Australia's competitive advantages through addressing risks of carbon leakage

Carbon leakage occurs when companies, faced with emissions reduction requirements domestically, move production to overseas jurisdictions without such requirements. When differences in policy impact are large enough, local industry might 'leak' offshore and continue their activities beyond the reach of effective climate policy. This creates costs (loss of investment and industry) without global emissions reduction benefits.

Australia's Carbon Leakage Review was led by Professor Frank Jotzo and undertaken between July 2023 and March 2025. The review assessed carbon leakage risks and found existing policy measures, such as access to concessional Safeguard baseline decline rates and public co-investment, mitigate leakage risks in the short- to medium-term. However, for some sectors, the review considered settings may need to be augmented with additional measures over time.

The review examined whether further policy measures in the medium to longer term would further support a level playing field by ensuring domestic and imported goods face the same emission reduction obligations in the Australian market. The review recommended that a BCA be introduced for a select group of commodities that are at particular risk of carbon leakage from imports, with it initially covering cement and clinker, and to be considered for other commodities subject to further assessment. The review also noted consequential changes to the Safeguard Mechanism should be considered in any decision to implement a BCA.

The Australian Government will release the report from the review to continue discussions on its recommendations with impacted industries and will give further consideration to the issues and whether to implement a BCA in the 2026–27 review of the Safeguard Mechanism.

The review also recommended the government continue to actively engage in multilateral and plurilateral initiatives that could support the implementation of BCAs; such as through the development of interoperable standards and approaches to default emissions intensities or measurement of embedded emissions. The government will continue to engage in international forums such as the Climate Club, the IEA, the OECD's inclusive Forum on Carbon Mitigation Approaches, and APEC, to support interoperable approaches for implementation of domestic climate policies and help unlock the export potential of low-emission commodities.

11. Working in the net zero transition

Key messages

- A highly skilled and diverse workforce will be needed to underpin Australia's net zero transition. This requires ongoing training and investment.
- Supporting diverse workforce participation, especially building opportunities for women, will be essential for delivering the transition.
- Growth of new clean energy industries will create employment opportunities for Australians.

Australia's transition to net zero is an opportunity to build a more resilient, inclusive, and competitive economy.

This chapter outlines how government and business can build the skilled workforce needed for a successful transition.

11.1 Training and education are key

The Climate Change Authority advised:

> 'Australia's education system must be prepared for the new industries and skills required for the transition.'
>
> Sector Pathways Review 2024, page 187

Many occupations needed for the transition are already experiencing skills shortages. Ongoing upskilling, training and investment in our workers will be essential to enable broad workforce shifts to growing clean energy industries.

Jobs and Skills Australia (JSA) identified in its report, The Clean Energy Generation, that there are 38 critical occupations where demand for clean energy work is likely to increase by around 15% to 2030 – an increase of almost 240,000 workers based on the central scenario – to meet the government's target of 82% renewable electricity generation by 2030. The report found that the biggest worker shortages will be for electricians, with an additional 85,000 expected to be needed by 2050, 27% more than the currently projected supply.[16]

Treasury modelling indicates that if Australia realises its ambitions as an exporter of clean energy embodied products, this would create new employment opportunities. Occupations projected to be increasingly in demand include automotive and engineering trades workers, and machinery and stationary plant operators as a result of larger clean energy industries.

Infrastructure Australia's Delivering Net Zero Infrastructure: Workforce Report notes multiple sectors across the economy will need to draw upon the same pool of construction workers to continue operations while delivering their net zero targets. Coordinating efforts on overlapping workforce issues, such as in infrastructure and housing construction, will be needed to manage any potential cross-sector competition while continuing to strengthen the workforce with the right capabilities.

Australia will also need more university-qualified professionals for the transition. This will include engineers and project managers to plan new infrastructure, scientists to innovate new climate solutions and continue refining our understanding of climate systems, and sociologists to support the public to engage with the energy transition and have their say in how it should progress.

In recognition of this need, the Australian Government is targeting a tertiary qualification attainment rate of at least 80% by 2050, up from 60% today, covering both vocational education and training (VET) and university qualifications.

The Climate Change Authority advised:

> 'Strategic investment in skills and training can assist workers to transition into emerging clean energy and manufacturing industries, while helping to address capability gaps that would otherwise hold back growth.'
>
> 2035 Targets Advice, page 85

The long lead time of apprenticeships, degrees and other training pathways – often at least 3–4 years – means that targeted initiatives over the next few years will be crucial in building the workforce needed. The Australian Government, with states and territories, has prioritised 'supporting the net zero transformation' under the National Skills Agreement. The Australian Government is supporting greater participation in growing sectors by prioritising skills, developing stronger links between industries, and building awareness of opportunities. Key initiatives include:

- Fee-free TAFE, TAFE Centres of Excellence and the Key Apprenticeship Program, which are supporting Australians to take up opportunities in the net zero transition, including underrepresented cohorts such as women and First Nations people.
- National licensing for electrical trades to enable them to work seamlessly across states and territories without requiring separate licensing.
- A national network of 10 Jobs and Skills Councils (JSCs) to work with industry and the VET sector, to ensure training addresses existing and emerging skills needs to build the clean energy workforce.
- The Future Made in Australia agenda prioritises safe and secure jobs, and developing skilled and inclusive workforces, under its Community Benefit Principles. The government will consider these principles when weighing up options to support new industries.

11.2 Supporting regional workers and communities to seize net zero economy opportunities

The Climate Change Authority advised:

> 'New and growing industries can create economic opportunities for affected workers and regional communities, with support from governments including for re-training and upskilling of workers and the provision of public infrastructure.'
>
> Sector Pathways Review 2024, page 116

The benefits of the transition will not necessarily be evenly distributed. As Australia decarbonises, new industries are emerging while emissions-intensive industries in mining, manufacturing and transport undergo rapid change. As some roles disappear, others will emerge. Building on the existing skills of the energy industry workforce, this shift will require retraining workers to participate in and drive clean-industry growth. Many workers will enter new occupations in construction, electrical trades and advanced manufacturing.

The composition of occupations across industries and locations will change. Around 1.1% of the Australian workforce is employed in sectors directly exposed to the net zero transition, and an additional 4% of the workforce are employed in emissions-intensive sectors.[17] Where this employment tends to be concentrated in particular regions like the Hunter (NSW), Latrobe (Vic), Collie (WA) and Central Queensland, the move away from emissions-intensive industries will affect not just jobs, but local economies and community identity.

These communities are resilient, but they need to be supported – with clear plans, targeted investment, and a say in shaping their own future. The Australian Government is rolling out 3 key initiatives to support regions through the transition:

- Regional Workforce Transition Plans will offer tailored, place-based supports and services for workers, families and communities for regions expected to be heavily impacted by the transition.
- The Energy Industry Jobs Plan will help workers in coal- and gas-fired power stations and across relevant supply chains move to new jobs as those stations close. Employers across the supply chain will help workers to prepare, including with career counselling, financial advice and paid time off for training in formal qualifications or short courses. The Net Zero Economy Authority oversees this program in its priority regions.
- The Transitioning Workforce Fund will deliver tailored solutions to address barriers to transition for workers, communities, businesses and unions. By building community capability to overcome the specific barriers that individual communities face, they will experience a more orderly transition, even as employment and economic conditions change on the road to net zero.

The Australian Government will work closely with local communities in transitioning regions to establish consultative mechanisms, including through the work of the Net Zero Economy Authority and regional connections. This is discussed further in Chapter 14.

11.3 Equitable access to opportunities and diversity will strengthen Australia's workforce

The Climate Change Authority advised:

> 'Diversifying workforces can increase participation of under-represented groups and represents one of few ways to address the acute workforce shortages being experienced by transition industries now.'
>
> Sector Pathways Review 2024, page 186

Government and business must work together to maximise opportunity for all workers, especially where there has been inadequate workforce inclusion to date. This includes women, First Nations people, people with a disability, skilled migrants, and culturally and linguistically diverse communities.

Women face considerable barriers to participating in industries critical to the net zero transition, such as manufacturing, mining, construction and engineering. In construction and mining, women make up only 13% and 21% of the workforce respectively.[18] In gender-segregated sectors, women can face discriminatory or unsafe workplaces, sexual harassment, lack of suitable amenities, and limited flexible work opportunities. Most of the women employed are in sales or administration roles rather than on a worksite, contributing to an average gender pay gap of 25.3% and 19.8% between men and women in these industries.[19]

The Australian Government is supporting women's safe and equitable participation by working to prevent workplace sexual harassment and sex discrimination, improve women's access to safe and inclusive study, training and work opportunities in male-dominated industries, and accelerate meaningful progress towards gender equality in Australia. This includes through initiatives such as:

- Building Women's Careers Program
- Introducing positive duty into the *Sex Discrimination Act 1984*
- *Working for Women: A Strategy for Gender Equality* to guide the government's ongoing commitment to women's participation in the energy transition, leadership in climate policy, and centering First Nations women and girls in policy development.

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4

Working together

The transition to net zero is bigger than any one individual, community, business or government can tackle alone. Everybody has a role to play.

The transition offers major opportunities, including jobs in clean energy industries, regional development and greater collaboration with First Nations people. However, some communities will be particularly affected by the challenges the transition will bring. Government is focused on ensuring that Australians share in the benefits and are supported through the challenges.

Chapter 12

Discusses the roles of governments, the private sector, academia and research institutions, and communities, and how we are working with international partners.

Chapter 13

Outlines how First Nations people's connection to Country and culture is fundamental to climate action in Australia. It sets out how First Nations leadership is creating opportunities to reduce emissions and ensure benefits flow to First Nations communities.

Chapter 14

Outlines how government will work with and support communities and regions through the transition.

12. Roles and responsibilities

Key messages

- The Australian Government is working with all levels of government to provide the right policies and regulatory settings for net zero.
- The private sector is investing to decarbonise, prove and scale-up new technologies, and capitalise on new markets.
- Australia's universities and research organisations are leading the world in the development of new technologies.
- Coordination mechanisms like the Energy and Climate Change Ministerial Council, international forums and partnerships are helping to align efforts, share information and maximise benefits.

12.1 All governments are working towards net zero

State, territory and local governments are vital partners with the Australian Government in achieving our collective net zero ambition.

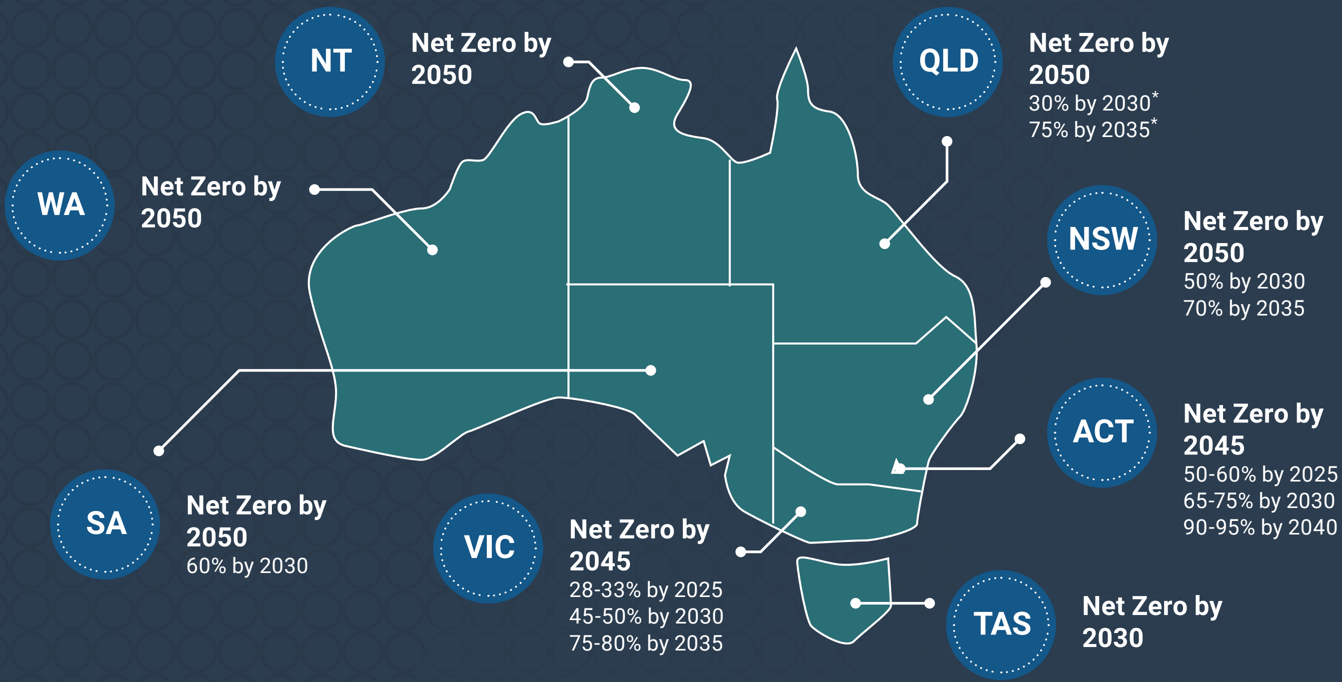
Over the last decade, states and territories have led the way. They have set interim and long-term emission reduction targets, supported by policies and targeted investment, to guide the transition in ways best suited to their jurisdiction (Figure 12.1). Our emissions reduction pathway will continue to be shaped by the efforts of states and territories.

States and territories are also partners in implementing major national initiatives, including investing in Community Solar Banks and the Social Housing Energy Performance Initiative to support electrification, reduce energy costs, build resilience and increase participation. They are delivering major infrastructure projects that will transform and decarbonise our energy and transport systems, such as Marinus Link, connecting the electricity network between the mainland and Tasmania, and the Sydney Metro Network.

Local governments lead and support community efforts to reduce emissions, as well as adapt to climate impacts. They play a central role through land-use planning, delivery of local transport, waste and recycling services, and management of municipal buildings and infrastructure – directly reducing emissions and building community capacity.

Local governments are on the front lines of climate impacts in communities. The Australian Local Government Association has published Adapting Together: Local Government Leadership in a Changing Climate, which outlines examples of the actions local governments can take to build resilience, and the economic benefits from local government action. The best outcomes will come from all levels of government working collaboratively to prepare for climate impacts and respond to challenges when they arise.

Figure 12.1 State and territory emissions reduction targets



ACT

The *ACT Climate Change Strategy 2019–2025* outlines steps being taken to build resilience to climate change impacts and meet the ACT's emission reduction targets, including net zero by 2045. While a new Strategy is currently under development, the separate *Integrated Energy Plan 2024–2030* is providing long-term guidance for the ACT's energy system transition. The Plan advances regulatory and policy settings that enable ACT households and businesses to invest and benefit from electrification.

NSW

NSW is developing a new *Net Zero Plan* to 2035 to chart a path to meet its legislated 2030 and 2035 emissions reduction targets and lay the foundation to be net zero by 2050. The new *Net Zero Plan* will reflect commitments to reduce emissions across the entire economy and will complement the *NSW EPA's Climate Change Policy and Action Plan*, which sets out a comprehensive program of increasing regulatory requirements to reduce emissions at facilities within the EPA's remit.

NT

The Northern Territory has been guided by the *Climate Change Response: Towards 2050* and associated *Three Year Action Plan* which outlined a strategy and actions for a pathway to net zero, while building climate resilience and unlocking economic opportunities in a low carbon future. The Northern Territory is developing a new policy position that aligns with its commitment to rebuild the Territory economy.

QLD

The Queensland Government has committed to net zero emissions by 2050 and working with industry sectors to develop plans to reduce emissions. Queensland will deliver an *Energy Roadmap* by the end of 2025. A net zero roadmap and emissions reduction plans for other critical sectors of the economy – industry, transport, land and agriculture, built environment, and resources – will be published in 2026. The net zero roadmap will also outline Queensland's adaptation priorities to ensure industries and communities are resilient.

SA

South Australia's *Net Zero Strategy 2024–2030* outlines the government's objectives, policy priorities and actions to reduce greenhouse emissions by at least 60% by 2030 and drive progress towards net zero emissions by 2050. The strategy aims to reduce greenhouse emissions across the economy while creating new jobs, developing new industries, supporting wellbeing, and enabling decarbonisation beyond state borders.

TAS

Tasmania's *Emissions Reduction and Resilience Roadmap 2024–29* connects the State's six sectoral Emissions Reduction and Resilience Plans and *Risk Assessment for Climate Change 2024*. It sets out a pathway for emissions reductions and climate resilience through support for businesses and industries to address while maintaining the State's target of net zero emissions to 2030 and beyond.

VIC

The Victorian Government is preparing its *2026–30 Climate Change Strategy* and new sectoral emissions reduction pledges. The Strategy will set the direction for Victoria reducing emissions to net zero by 2045 and strengthening climate resilience. It will build on the *2021–25 Climate Change Strategy* that outlined the state's plan for climate action while advancing innovation, investing in new industries and creating Victorian jobs.

WA

The *Western Australian Climate Policy* (*2020*) outlines a strategic vision for a climate-resilient and low-carbon future, targeting net zero emissions by 2050 through stakeholder collaboration and investment in green jobs and industries, and regional development. The *Sectoral Emissions Reduction Strategy for Western Australia* (*2023*) builds on this, outlining initial actions across all sectors to support the state government's net zero target.

*Interim emissions reduction targets in the *Clean Economy Jobs Act 2024 (Qld)* are being reviewed

The Australian Government is partnering with local government. For example, the $100 million Community Energy Upgrades Fund supports energy upgrades at existing local government facilities, including replacing gas heating in council-owned swimming pools, replacing street lights with energy-efficient alternatives, and incorporating battery storage at sporting fields, libraries, and community centres. These initiatives are reducing local energy costs, increasing resilience, and reducing emissions.

Like the Australian Government, many state, territory and local governments have committed to reaching net zero in their own operations, showing what can be done using electric transport, building upgrades, and power purchase agreements (Box 12.1).

Box 12.1 A net zero Australian Public Service by 2030

In 2023, the Australian Government released the Net Zero in Government Operations Strategy, which outlines the government's commitment to reduce the Australian Public Service's emissions to net zero by 2030.

The strategy describes actions towards reducing emissions from Australian Government operations and transitioning to net zero in areas like property, energy, procurement, fleet and travel.

Key actions include:

- transitioning to renewable energy, facilitated through a whole-of-government coordinated procurement of electricity
- improving building energy efficiency and electrification
- transitioning the APS fleet to zero emission vehicles where appropriate.

Progress is being made. In the 2023-24 reporting period, 38% of electricity consumed was certified from renewable generation, and 72% of ordered passenger vehicles were low-emission vehicles.[1]

12.1.1 Cooperation through ministerial councils and meetings

The Climate Change Authority advised:

> 'Strategic coordination between governments remains essential, particularly where borders are shared, infrastructure is interconnected, or investment and approval decisions and social impacts span jurisdictions.'

2035 Targets Advice, page 61

Ministerial councils and meetings have a central role in supporting effective collaboration across different levels of government. They help overcome shared barriers and provide an opportunity to showcase best practice and align efforts. Ministerial councils shaping the net zero transition include:

- Energy and Climate Change Ministerial Council
- Council on Federal Financial Relations
- Infrastructure and Transport Ministers' Meeting
- Agriculture Ministers' Meeting
- Environment Ministers' Meeting
- Skills and Workforce Ministerial Council
- Building Ministers' Meeting
- Planning Ministers' Meeting.

The Energy and Climate Change Ministerial Council (ECMC) is a forum for the Commonwealth, Australian states and territories, and New Zealand to work together on key reforms in energy and climate change. In August 2025, ECMC agreed 6 strategic priorities for the coming year, while recognising each jurisdiction may pursue its own policies on energy transformation according to its unique needs and circumstances, working collaboratively to deliver the best outcomes at a national level. The ECMC's priorities are:

- Addressing barriers to affordable, high-quality, safe, reliable and secure supply of electricity and gas that is fair and prioritises the interests of consumers throughout the energy transformation, including by supporting consumer energy resources.
- Ensuring all Australians, including regional, remote and First Nations communities, are empowered and supported to benefit from the energy transformation.
- Delivering a coordinated, strategic and timely approach to transforming our energy systems to meet net zero, capturing the opportunities of new diverse energy technologies including onshore and offshore generation, storage and transmission, and ensuring the resilience of the sector in the face of the changing climate.
- Driving the efficient and effective achievement of Australia's emissions reduction commitments, including net zero by 2050, and promoting Australian industries and businesses to attract international investment and capitalise on the global transition.
- Delivering a coordinated and comprehensive approach to Australia's adaptation and resilience to climate change, in all sectors of the economy.
- Delivering a coordinated and strategic approach to achieving improvements in energy performance and flexibility across the Australian economy, including facilitating increased electrification of activities.

The ECMC is also investigating a National Climate Change Partnership, which would provide a framework for government collaboration on climate mitigation, adaptation and resilience, and ensure ECMC focuses on addressing the highest shared climate priorities.

The Infrastructure and Transport Ministers' Meeting is focused on how to decrease transport-related emissions across jurisdictions. In August 2025, Ministers agreed to develop a national decarbonisation policy framework for whole-of-life carbon for transport infrastructure projects. This framework, supported by a flexible approach to national implementation, will support carbon reduction across every phase, from early planning to operation and end-of-life.

12.2 Australia's private sector drives innovation and investment

Australia's private sector is at the forefront of innovation and investment in Australia's net zero transition.

- 94% of ASX50 companies have set a net zero commitment.[2]
- Australia's largest banks are transitioning their financing activities to align with net zero, setting sector-specific policies, targets and transition plans for their emission intensive investments.[3]
- Australia's superannuation funds are also directly investing in initiatives and businesses that will reduce emissions and support climate action, while earning returns for shareholders and members.
- The Clean Energy Council estimates that investments in clean energy in Australia reached a record $12.7 billion in 2024.[4]

Australia's Sustainable Finance Roadmap provides a clear reform pathway to mobilise the private capital necessary to finance the net zero transition. The Sustainable Finance Taxonomy provides a common language for green and transition finance in Australia, supporting the allocation of capital towards activities that enable Australia's net zero ambitions.

Solar technology manufacturing, Newcastle, New South Wales, Australia.

12.3 Academia, universities and thought leaders

Innovation is critical for Australia to reach net zero (see Chapter 7). Australia's R&D ecosystem, academic institutions and thought leaders play an important role in developing the technologies, processes and practices we need to reach net zero. Partnerships between the researchers trialling new technology and the industries which can scale and deploy these solutions with people and communities across Australia are increasingly important.

Australia's research institutions, including universities and the CSIRO, as well as non-governmental organisations (NGOs) such as the Australian Conservation Foundation, the Climate Council, the Australian Council of Trade Unions (ACTU) and Australian Council of Social Service (ACOSS), are also advancing research and action to guide a fair and orderly transition.

12.4 Working with partners in the global net zero effort

Australia is working with international partners in global efforts to achieve net zero.

The Government is collaborating with key regional partners to unlock research, policy and investment in carbon management technologies, including transboundary CCS options. For example, Australia can support the decarbonisation of key regional and trading partners by safely and permanently storing captured CO2 emissions from those countries. Regional collaboration on transboundary CCS via the Regional Cooperation Initiative on Carbon Sequestration could generate the economies of scale needed to make carbon management technologies, such as CCS, a more accessible decarbonisation option for Australian industries and hard-to-abate sectors.

Australia is also partnering with countries in our region to act on climate change, transform their economies and increase their capacity to respond to climate impacts (Box 12.2).

Export Finance Australia (EFA) plays a key role in financing these initiatives. EFA is the Australian Government's export credit agency, providing loans, guarantees, bonds, insurance and equity to:

- support small and medium enterprises, larger companies and governments to realise Australia's export opportunities or contribute to export supply chains
- support Australia's economic resilience and security, and net zero transformation
- help finance sustainable infrastructure in the Indo-Pacific that has an Australian benefit.

On 5 December 2023 at COP28 in Dubai the Australian Government signed up to the Clean Energy Transition Partnership (CETP; also known as the Glasgow Statement). Through this, Australia committed to end new direct public financing for international unabated fossil fuel energy sector projects, except in limited and clearly defined circumstances. The government has amended the *Export Finance and Insurance Corporation (EFIC) Act*, so it now requires EFA to have regard to Australia's obligations under the Paris Agreement, our emissions reduction targets, and Australia's commitments under the CETP.

Box 12.2 Climate change in the Pacific

Many areas of the western Pacific, including Fiji, Samoa and New Caledonia, have experienced sea-level rises of 10 to 15 cm since 1993, nearly twice the global rate of change.[5] Sea surface temperatures have risen 3 times faster than the global average and marine heatwaves have doubled in frequency since 1980, significantly impacting ecosystems, economies, and livelihoods of our Pacific neighbours.[6] The Fijian government has identified 42 low-lying coastal villages for planned relocation due to inundation of homes and saltwater intrusion into arable land.[7]

Global action to reduce emissions is essential to protecting these islands, and the diverse peoples and cultures that call them home.

Australia is working with our Pacific partners to build capacity to adapt to these impacts and mitigate climate change. This includes working through the Pacific Islands Forum to implement the 2050 Strategy for the Blue Pacific Continent, including the Pacific owned, led and managed Pacific Resilience Facility. Through the Australian Infrastructure Financing Facility for the Pacific, Australia is also investing $350 million through the Pacific Climate Infrastructure Financing Partnership (PCIFP) to help the Pacific transition to renewable energy and fund critical climate adaptation works.

REnew Pacific is a key component of PCIFP. Over 5 years, this program is investing $75 million in off-grid renewable energy for Pacific and Timor-Leste communities, to support clean energy projects that improve health, education, agriculture, and communications. It offers grants and co-financing with NGOs, businesses, and governments to drive inclusive development. Launched at COP29, it builds on earlier partnerships to become the region's climate infrastructure partner of choice.

In 2025 Australia signed the world-first Australia-Tuvalu Falepili Union, in which Australia recognises Tuvalu's continuing statehood and sovereignty notwithstanding climate-related sea-level rise, commits to assist Tuvalu in response to major disasters, and supports mobility with dignity for the citizens of Tuvalu.

Australia is bidding to host the 31st Conference of the Parties (COP) in 2026 in partnership with the Pacific. The COP is the largest climate conference in the world. Hosting it would elevate Pacific voices in the global discussion – bringing global attention to the region's unique challenges and solutions, and accelerating global climate action and investment.

13. First Nations leadership in the transition

Key messages

- The First Nations Clean Energy Strategy is supporting economic opportunity and jobs for Aboriginal and Torres Strait Islander people as part of the clean energy transition.
- First Nations peoples' knowledge and connection to Country and culture can support emissions reduction and adaptation to climate change.

First Nations communities are crucial partners in the net zero transition. An estimated 70% of Australia's land and waters are owned, managed or co-managed by First Nations people and/or subject to other rights and interests including native title.[8] This underscores the central role First Nations communities must be afforded in managing the transition to net zero.

> First Nations communities are also experiencing the devastating effects of climate change on Country. First Nations-led solutions are needed to help adapt and improve resilience.

Working in genuine partnership with Traditional Custodians and First Nations communities is necessary to enable communities to shape and share in the economic benefits of the transition. For instance, First Nations peoples comprise just 1.9% of Australia's clean energy workforce, which presents an enormous opportunity for increased participation.[9] By empowering First Nations peoples to lead and participate in the net zero transition we can take meaningful steps to achieving the priority reforms of the National Agreement on Closing the Gap.

13.1 First Nations Clean Energy Strategy is a foundation for action

The First Nations Clean Energy Strategy 2024-2030 provides the foundation for climate action through the clean energy transition in partnership with First Nations peoples. It addresses the intersection between First Nations rights and interests and the clean energy transition to support First Nations peoples to lead and benefit from the transition wherever they live in Australia.

The First Nations Clean Energy Strategy prioritises collaboration, respect for cultural knowledge, and the development of clean energy projects that deliver social, economic, and environmental benefits to First Nations communities and the broader Australian community (Box 13.1). While the strategy was developed specifically for clean energy, the principles at the heart of the strategy are applicable across all sectors:

1. Aboriginal and Torres Strait Islanders, being the First Nations peoples of Australia, must be enabled to self-determine how they lead, participate in, and benefit from the clean energy transition.
2. First Nations peoples maintain their right to live on their land, with access to reliable and affordable clean energy.
3. First Nations peoples are stewards and custodians of Country, including the land, waters, skies and seas. This connection is ongoing and enduring.
4. Access to clean energy and a safe climate benefits all human and non-human life.
5. First Nations peoples' cultural heritage must be recognised, protected and celebrated throughout the clean energy transition.
6. Building genuine partnerships and collaboration is a shared responsibility. Government has a special duty of care to lead these efforts and ensure they are underpinned by robust and transparent data collection, monitoring and reporting.

The First Nations Clean Energy and Climate Change Advisory Committee provides advice to the Minister for Climate Change and Energy on the Strategy, including design and implementation of its communication and engagement plan, and developing its themes, objectives and initiatives.

The government has allocated $70 million in funding for the First Nations Clean Energy Program over 3 years starting in 2025-26. This includes:

- grants for First Nations peoples to access independent clean energy advice
- support to engage in clean energy project development
- access to clean energy information and resources
- policy development to increase access to finance.

An additional $4.6 million will enable continuation of the First Nations Clean Energy and Climate Change Advisory Committee for the lifespan of the Strategy to 2030.

This supports the government's continuing commitment to First Nations leadership and participation in program delivery.

Box 13.1 Net Zero technology can improve energy access for remote communities

Many remote First Nations communities face energy insecurity, being dependent on diesel generators which are unreliable, expensive and emissions intensive. Renewable microgrids, powered by solar, wind, and battery storage, offer a pathway to energy independence, reduced costs, lower emissions and better life outcomes.

The Australian Government is investing in First Nations Community Microgrids through a dedicated $75 million stream in the Australian Renewable Energy Agency's (ARENA) Regional Microgrids Program. This supports projects empowering First Nations communities to participate in their electricity supply arrangements and develop energy infrastructure, resolving barriers to deployment of microgrid solutions.

Under the program, ARENA will provide $13 million to the Remote Area Energy Supply (RAES) First Nations Community Microgrids Project in South Australia, with a matching financial contribution from the South Australian Government. This project will deliver high-penetration renewable energy microgrids to the remote communities of Yalata, Pipalyatjara and Oak Valley. Each community is currently reliant on diesel generation and faces high cost and unreliable energy access.

In the Northern Territory, ARENA will provide $1.4 million to Alice Springs based Ekistica, to lead a project to co-design a scalable, culturally appropriate energy service model tailored for First Nations homeland communities. Working closely with the Northern Territory Government, National Indigenous Australians Agency, Land Councils, Aboriginal Housing NT and other partners, the project will tackle long-standing inefficiencies in service delivery and place communities at the centre of decision-making.

13.2 Climate change on Country

First Nations peoples have managed Australia's natural environment for over 65,000 years and have experienced the climate changing over this time, with integral knowledge being passed down through generations. Many communities today maintain a deep and enduring connection to the land, seas and waters that make up their Country and Culture. This knowledge and connection to Country should guide Australia's efforts to tackle climate change across Australia.

Climate change on Country is already disrupting cultural practices and threatening the health, social and emotional wellbeing of communities. High temperatures risk delaying traditional ceremonies, bushfires and floods can damage Country including sacred sites, and extreme events are impacting community health, livelihoods and property. Regions such as the low-lying Torres Strait Islands are especially vulnerable to sea level rise. Limited ability to adapt to increased flooding is further compromised by existing cultural and societal challenges. First Nations-led solutions are needed to address these challenges (Box 13.2).

The Indigenous Protected Areas program supports First Nations people to care for their land and sea Country, including through adapting to climate change impacts and building resilience, in line with cultural priorities and knowledge systems.

First Nations peoples are also leading climate mitigation activities through active land management, participating in the Australian Carbon Credit Unit Scheme.

Projects such as savanna fire management (Box 13.3) provide opportunities for First Nations peoples to apply traditional knowledge and strengthen their connection with Country, while also reducing emissions. These projects generate carbon credits which provide income and employment within communities, and benefit biodiversity. Through the Carbon Farming Outreach Program, the Australian Government is partnering with the Indigenous Carbon Industry Network to develop tailored resources and training for trusted advisers of First Nations land managers to support their participation in carbon farming. The Nature Repair Market will also provide opportunities for First Nations people to take climate action through the development of government-accredited methods for nature repair, which can simultaneously support climate action by removing and storing carbon from the atmosphere.[10]

Box 13.2 Supporting First Nations led climate action and education

The Australian Government is supporting a First Nations-led response to the on-ground impacts of climate change. The government is working with regional leaders and Traditional Owners to deliver the Torres Strait and Northern Peninsula Area Climate Resilience Centre through a $15.9 million investment over 6 years (2022–23 to 2027–28).

The centre was developed following a regional roundtable in 2022. Torres Strait participants called for an approach that could connect Traditional Knowledge, lived experience and western science to design and identify climate action in communities across the region.

The centre has been created through a co-design process and implementation is being guided by regional leaders.

In late 2024, the centre released the Torres Strait and Northern Peninsula Area Climate Resilience Grant Program. The program was designed with regional leaders and provides up to $10.8 million over 3 years for the recruitment and training of local First Nations climate resilience officers, to lead practical climate adaptation projects and community education.
In early 2025, grants were awarded to 3 regional organisations.

The centre aims to create an enduring dialogue on climate change in the region across all levels of government to provide a consistent and coordinated response to climate challenges.

Kakadu National Park, Northern Territory, Australia.

Box 13.3 Cool burns, big impact - savanna fire management in action

In northern Australia, fire has always been part of the landscape. Today, supported by the ACCU Scheme, Traditional Owners and First Nations ranger groups are reintroducing customary strategic early dry season burning to reduce greenhouse gas emissions and generate income while supporting ecosystem health and cultural land management. As of June 2025, there are 86 projects registered nationwide under the ACCU Scheme's savanna fire management methods.[11]

Arnhem Land Fire Abatement (ALFA) is an Aboriginal-owned, not-for-profit organisation, which supports six registered savanna fire management projects across the Northern Territory, including the 28,000 km² West Arnhem Land Fire Abatement (WALFA) project.[12] WALFA combines First Nations fire knowledge and skills with scientific and technological tools to account for emissions reduction under ACCU Scheme requirements.

At the start of the dry season, Traditional Aboriginal Owners and rangers across Arnhem Land commence a cultural practice passed down through countless generations – carefully burning their custodial estates using sophisticated fire management practices.[13] Rangers break up savanna fuel loads with planned burns between April and July, reducing the risk of intense late-season wildfires that would otherwise release large amounts of methane (CH_4) and nitrous oxide (N_2O). To do this, they undertake extensive planning and consultation, protect important environmental, cultural and infrastructure assets in the landscape and apply planned low-intensity fire to the landscape. Burns are lit by aircraft, vehicles or on foot with matches and drip torches, in suitable weather conditions to protect people, wildlife and culturally significant sites.[14]

WALFA has generated over 2.5 million ACCUs, with more than 5.9 million tonnes CO_2-e abated across all ALFA projects.[15] The impact extends beyond carbon. Income from the WALFA project is reinvested into community priorities including ranger employment, equipment, ecological monitoring and homeland schools.[16] The WALFA project demonstrates that ACCU Scheme savanna fire management projects can reduce emissions, enhance biodiversity, reduce landscape threats, reinforce cultural land management rights and reinvest ACCU income into Aboriginal land management and community outcomes on Country.[17]

13.3 First Nations peoples in the global transition

With support from the Australian Government, First Nations peoples across Australia are advocating for the role of Indigenous Peoples on the world stage. As part of the United Nations Framework Convention on Climate Change (UNFCCC), Australia is pushing for the rights and interests of Indigenous peoples to be considered, and their leadership and participation in the transition to net zero to be enabled.

Through these international dialogues, Australia and international partners are working to share best practice around climate action and adaptation that enhances Indigenous engagement, and strengthen knowledge, technology and practices that support the agency of Indigenous and local climate action.

13.4 Strong partnership approaches underpin our transition

First Nations people are workers, small business owners and entrepreneurs who make a significant contribution to Australia's national economy and our international trade. Australia's net zero transition creates new economic opportunities.

The Australian Government has established the First Nations Economic Partnership to ensure a strong partnership approach to unlocking this potential. The Economic Partnership is investing $75 million to help build Native Title Prescribed Bodies Corporate Holders' capacity to deliver meaningful participation for Native Title holders and their communities, including through partnership with the private sector on clean energy projects.

The Net Zero Economy Authority is also working with First Nations communities to leverage the benefits of the transition and has established a First Nations' Working Partnership to guide its approach.

These partnerships enable Australia to move beyond isolated transactions towards building lasting partnerships that create and share wealth, and ensure First Nations leadership.

Australian Pavillion COP29 in Baku, Azerbaijan.

14. Working with communities

Key messages

- Government will work with communities, including regions most affected by the transition, to ensure they benefit through job creation, productivity growth and support for local industries.
- Effective planning can provide opportunities for land managers to support carbon, biodiversity and productivity goals through land-based abatement.

The Climate Change Authority advised:

> 'Gaining and maintaining social licence through trust, legitimacy and credibility is a critical success factor for projects necessary in Australia's transition to net zero.'
>
> Sector Pathways Review 2024, page 187

Decarbonising Australia's economy and realising the opportunities of the transition will not be possible without the insights, engagement and support of Australian communities.

Research and practical experience consistently demonstrated that communities are looking for comprehensive, transparent information on the transition and the tangible benefits for their local communities - as well as effective management of local environmental and other concerns.[18]

Our regions are at the forefront of the net zero transition, experiencing changes in production systems, job and market opportunities and the physical landscape. There are enormous opportunities for regions to be leading our clean economy, but there are also challenges that must be addressed to ensure no-one is left behind. Many communities are already actively engaging with the transition, while others need support to build their capacity to engage in discussions around new developments and land use in their local area.

The Australian Government is enhancing policies, planning and practices to ensure the benefits of the transition are shared with communities and diverse needs are balanced.

Albany, Western Australia, Australia.

14.1 Leadership to deliver community benefits

The Climate Change Authority advised:

> ' Governments can assist by proactively leading and coordinating engagement with communities to provide information, facilitating benefit sharing, receiving feedback and negotiating outcomes.'
>
> Sector Pathways Review 2024, page 180

The net zero transition will involve a shift to clean industrial operations across our regions, an expansion in electricity infrastructure, and opportunities to use land for multiple purposes to generate new streams of revenue. Consultation for the Net Zero and sector plans highlighted that stakeholders want the government to play an enabling role to help them realise these opportunities.

As part of the *Future Made in Australia Act 2024*, the Australian Government introduced the Community Benefit Principles to ensure that public investments deliver broad, tangible benefits to Australians. The principles state that Future Made in Australia support should:

- promote safe and secure jobs that are well paid and have good conditions
- develop more skilled and inclusive workforces, including by investing in training and skills development and broadening opportunities for workforce participation
- engage collaboratively with and achieve positive outcomes for local communities, such as First Nations communities and communities directly affected by the transition to net zero
- strengthen domestic industrial capabilities including through stronger local supply chains
- demonstrate transparency and compliance in relation to the management of tax affairs, including benefits received under Future Made in Australia.

By setting the standard for how large-scale net zero industries should support communities, the Australian Government is leading the way in delivering a fair and orderly transition for communities.

The Australian Government is also taking action to ensure communities are appropriately engaged in renewable development as Australia decarbonises its electricity system. There are diverse views and attitudes across the country regarding the local dimension of the energy transition, including the location of new renewable electricity infrastructure.

These are not easy challenges to grapple with. The government is working with communities to understand, and where feasible, mitigate their concerns. This is a shared responsibility with the private sector. Initiatives are underway including implementing the National Guidelines for Community Engagement and Benefits for Electricity Transmission Projects in partnership with states and territories. These guide project proponents' engagement with communities to minimise adverse impacts and ensure local benefits match community priorities. This complements the Australian Government's commitment to ensuring fair and transparent community engagement around renewable energy infrastructure (Box 14.1).

Box 14.1 The Australian Energy Infrastructure Commissioner

The Australian Energy Infrastructure Commissioner (AEIC) leads efforts to promote community engagement practices in the renewable energy transformation. The AEIC is responsible for:

- dispute resolution and engagement with local communities, including First Nations communities, about proposed or operating energy projects
- providing transparent information about the planning and operation of major energy projects and the renewable energy transition
- identifying and promoting best practices related to the planning, development and operation of energy projects.

In 2023, the former commissioner undertook an independent Community Engagement Review to advise on improving community engagement on renewable energy infrastructure developments. The review made 9 recommendations, which were accepted in full or in principle by the Energy and Climate Change Ministerial Council.

A Developer Rating Scheme is now underway as a pilot program. The Scheme will deliver an independent, voluntary, scorecard-based assessment of developers using objective measures. This will provide landholders and communities with reliable information about companies that propose new local energy infrastructure.

14.2 Balancing land-based abatement with other land management goals

The Climate Change Authority advised:

> ‘Balancing competing land uses is key to not only avoiding unintended consequences but also to earn social licence. Stakeholders highlighted that it will be important that actions to increase land-based removal also achieve multiple benefits, like biodiversity, social and cultural outcomes.’
>
> Sector Pathways Review 2024, page 101

Scaling up land-based abatement is a priority in Australia’s net zero transition (Chapter 6).

Unlocking the benefits of land-based abatement requires that we balance agricultural production, carbon storage and biodiversity objectives, including the water needs for each.

Australia’s landscape already supports a diverse range of activities. Governments, the private sector and communities play a role in finding the appropriate balance between different land uses in different places. However, decisions about how land is managed, which crops to grow, or which markets to access remain largely up to individual landowners.

Capacity building, such as through the Australian Government’s Carbon Farming Outreach Program, is helping land managers to make informed choices (as discussed in Chapter 9). Industry groups also play a role. For example, the Carbon Market Institute has introduced a code of conduct for promoting best practice integrity, transparency and accountability in the carbon market, including when engaging with First Nations communities.[19]

More can be done to manage risks and unlock further opportunities. The Australian Government is exploring ways to support uptake of carbon storage activities, especially where there are synergies with nature and productivity, including:

- working to encourage multiple benefits from ACCU Scheme projects including better recognition of co-benefits and fostering interoperability with the Nature Repair Market
- using policy design to encourage activities which integrate carbon storage with food and fibre production, rather than wholesale or large-scale land-conversion, particularly on highly productive agricultural land. This includes farm forestry and managing lands to increase soil carbon
- exploring options to strengthen data and analysis of land use to understand, track and manage changes and impacts over time.

Darlington Point Solar Farm, NSW, Australia.

14.3 Working with communities significantly affected by the transition

The net zero transition will affect all Australians, but will have particular impact on Australia's industrial regions. The Net Zero Economy Authority (NZEA) has been established to ensure regions, communities and workers are supported to manage the impacts, and share in the benefits, of the net zero economy. This includes:

- helping workers in coal and gas facilities affected by the transition to prepare for and find new, well-paid, safe and secure jobs
- supporting affected communities to prosper through economic development and investment
- being a trusted and influential voice to build understanding of, and shape policy on, the regional net zero transition.

Established in legislation, the NZEA is working closely with the regions that will be most affected by Australia's transition to net zero, currently prioritising efforts in Collie (WA), Central Queensland, the Hunter Region (NSW) and the Latrobe (Vic), as well as supporting consideration of transformational opportunities in the Pilbara (WA) and Upper Spencer Gulf (SA).

As these regions see coal-fired power stations close, the NZEA and the Department of Employment and Workplace Relations will support workers, communities and businesses to take the steps to transform their local economy. This will include supporting skills development, supply chain participation, and regional investment to create opportunities. Support for transitioning workforces including the Energy Industry Jobs Plan and Regional Workforce Transition Plans is discussed further in Chapter 11.

The NZEA joins an existing network of regional officials and Australian Government-funded regional initiatives that are closely connected to their communities.

Regional Workforce Transition Officers help business, industry, and communities, navigate and coordinate the transition to net zero in key employment regions. Regional Development Australia committee members and AusIndustry Regional Managers build on this network to provide valuable linkages between regional communities and the Australian Government. They inject local and regional views, concerns and interests from the community and industry in the policy process and program design.

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Table of boxes and figures

Darlington Point Solar Farm, NSW, Australia.

Abbreviations and acronyms

ACCU	Australian Carbon Credit Unit
ACTU	Australian Council of Trade Unions
AEIC	Australian Energy Infrastructure Commissioner
ARENA	Australian Renewable Energy Agency
CBAM	Carbon Border Adjustment Mechanism
CCA	Climate Change Authority
CCS	Carbon capture and storage
CCU	Carbon capture and use
CEFC	Clean Energy Finance Corporation
CER	Consumer energy resources
CIS	Capacity Investment Scheme
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide equivalent
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEEW	Department of Climate Change, Energy, the Environment and Water
ECMC	Energy and Climate Change Ministerial Council
EFA	Export Finance Australia
EMM	Environment Ministers' Meeting
ESG	Environmental, social and governance
EV	Electric vehicle
FAST-P	Singapore's Financing Asia's Transition Partnership
FGS	Future Gas Strategy
FNCES	First Nations Clean Energy Strategy
GDP	Gross Domestic Product
GO Scheme	Guarantee of Origin Scheme
GWP	Global warming potential
HFCs	Hydrofluorocarbons
IEA	International Energy Agency
IMF	International Monetary Fund
ISP	Integrated System Plan
ITMM	Infrastructure and Transport Ministers' Meeting
JSA	Jobs and Skills Australia
LCLF	Low carbon liquid fuel
Mt CO_2e	Million tonnes of carbon dioxide equivalent
NABERS	National Australian Built Environment Rating System
NAP	National Adaptation Plan
NCRA	National Climate Risk Assessment

NDC	Nationally Determined Contribution
NEM	National Electricity Market
NEVS	National Electric Vehicle Strategy
NGERS	National Greenhouse and Energy Reporting Scheme
NGOs	Non-Government Organisations
NRF	National Reconstruction Fund
NTEP	National Energy Transformation Partnership
NVES	New Vehicle Efficiency Standard
NZEA	Net Zero Economy Authority
PCIFP	Pacific Climate Infrastructure Financing Partnership
PM&C	Department of the Prime Minister and Cabinet
PV	Photovoltaic (solar)
R&D	Research and development
RD&D	Research, development and deployment
RETA	Renewable Energy Transformation Agreement
SAF	Sustainable aviation fuel
SFR	Sustainable Finance Roadmap
SWIS	South West Interconnected System
UNFCCC	United Nations Framework Convention on Climate Change
WALFA	West Arnhem Land Fire Abatement

Glossary

Abatement	A reduction in atmospheric greenhouse gases through emissions avoidance or removal and sequestration of carbon from the atmosphere.
ACCU project	Eligible offsets projects registered under the ACCU Scheme.
ACCU Scheme	An Australian Government scheme that offers landholders, communities and businesses the opportunity to run projects in Australia that avoid the release of greenhouse gas emissions or remove and sequester carbon from the atmosphere. It is enacted through the Carbon Credits (Carbon Farming Initiative) Act 2011 and the Carbon Credits (Carbon Farming Initiative) Rule 2015.
Active transport	Ways of travelling including walking, cycling and other physically active modes of transport that can be undertaken alone or combined with public transport.
Climate adaptation	In human systems, the process of adjustment to actual or expected climate and its effects, to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.
Carbon border adjustment mechanism	A mechanism that seeks to equalise the carbon compliance costs facing domestic and overseas production by imposing an adjustment at the border.
Carbon capture and storage (CCS)	A process in which carbon dioxide from industrial or energy related sources is separated (captured), conditioned, compressed and transported to a (usually geological) storage location for long-term isolation from the atmosphere.
Carbon capture and use (CCU)	A process in which carbon dioxide is captured and the carbon used in a product. The climate effect of CCU depends on the product lifetime, the product it displaces, and the carbon dioxide source (fossil, biomass or atmosphere).
Carbon credit	A tradeable unit that represents 1 tonne of carbon dioxide equivalent (t CO_2-e) stored or avoided by a project.
Carbon leakage	Carbon leakage refers to shifts in the production of emissions-intensive trade-exposed commodities from countries with more ambitious emissions reduction policies to those with weaker (or no) emissions reduction policies, due only to differences in policy stringency across countries.
Carbon offset	A type of carbon credit that represents a reduction in emissions – whether prevented from entering the atmosphere or removed from the atmosphere – that is used to compensate for emissions that occur elsewhere.
Circular economy	An economic system focused on reducing waste, reusing resources and designing products for longer life, recyclability and minimal environmental impacts.
Critical minerals	Critical minerals are metallic or nonmetallic materials that are essential to our modern technologies, economies, and national security, and whose supply chains are vulnerable to disruption.
Decarbonise	To stop or reduce carbon gases, especially carbon dioxide, being released into the atmosphere as the result of a process, like the burning of fossil fuels.
Demonstrated technologies	Technologies that are available but not yet widely adopted.
Early-stage technologies	Technologies that are still in the research, development and demonstration stage or are not yet ready to be deployed.
Electrification	Switching from energy sources, such as liquid fuels or gas, to electricity.
Embodied emissions	Emissions generated during the production and transportation of goods, from the extraction of raw materials to the manufacturing process and final delivery to the consumer. For infrastructure, embodied emissions come from the emissions embodied in the input materials, as well as the emissions generated during the construction and installation processes.
Emissions budget	A cumulative amount of emissions that can be emitted, e.g. 4,000 Mt CO_2-e, during a specified time period, e.g. 2021–2030.
Energy efficiency	The amount of energy required to perform given task or produce a given result. Increasing energy efficiency means using less energy for the same result.
Energy performance	Covers the broad management of energy demand, including energy efficiency; demand flexibility (or load shifting); and electrification or fuel switching.

Enteric fermentation	The process in animals by which gases, including methane, are produced as a by-product of microbial fermentation associated with digestion of feed.
Firming/firmed renewables	Ensuring reliability of electricity supply by supplementing variable renewable energy with dispatchable generation sources such as energy storage (i.e. batteries).
Fossil fuels	Fossil fuels include coal, petroleum, natural gas, oil shales, bitumens, tar sands, and heavy oils. All contain carbon and were formed as a result of geologic processes acting on the remains of organic matter produced by photosynthesis, a process that began in the Archean Eon (4.0 billion to 2.5 billion years ago).
Green metal	Iron, steel, alumina and aluminium produced with low or zero greenhouse gas emissions.
Greenhouse gases	Any gas (natural or produced by human activities) that absorbs infrared radiation in the atmosphere, leading to warming effects. Greenhouse gases include carbon dioxide, methane and nitrous oxide.
Hard-to-abate emissions	Emissions from essential processes and products with no near-term decarbonisation options.
Hydrofluorocarbons (HFCs)	A type of synthetic greenhouse gas, mostly used in refrigeration and air-conditioning equipment.
Hydrogen	A substance commonly used in industrial applications, such as the production of methanol and ammonia, and can also be used as a fuel. It is traditionally produced by stripping hydrogen from natural gas using steam, which produces carbon dioxide as a by-product. Low-carbon or renewable hydrogen can be produced from water using renewable energy.
Low and zero emissions technologies	Technologies that significantly reduce greenhouse gas emissions compared to traditional alternatives, and mitigate other environmental impacts.
Low carbon liquid fuel (LCLF)	Liquid fuels with lower lifecycle emissions than conventional fossil fuels. LCLFs can be sustainably produced from biomass, waste materials and/or green hydrogen.
Mature technologies	Technologies that are ready and available to be deployed now.
Microgrid	A set of distributed energy resources (see above) that provides energy generation and storage at a local level and can be controlled independently, either within a wider grid or as a standalone grid.
Mitigation	Reducing greenhouse gas emissions in order to stop climate change getting worse.
Mt CO_2e	Million tonnes of carbon dioxide equivalent. Is used to standardise different greenhouse gas emissions impacts on climate change to be reported as a single value. Usually shown in tonnes (t CO_2-e) or million tonnes (Mt CO_2-e).
Net emissions	The sum of anthropogenic greenhouse gas emissions to the atmosphere and anthropogenic removals of greenhouse gases from the atmosphere.
Net negative emissions	Metric-weighted anthropogenic carbon removals in excess of metric-weighted anthropogenic greenhouse gas emissions.
Net zero emissions (carbon neutrality)	An overall balance between greenhouse gas emissions and removals.
Prospective technologies	Emerging technologies or operational changes which are at an early stage of development.
Renewable energy	Energy from a source that is not depleted when used, such as wind or solar power.
Renewable fuels	Fuels made from biogenic and/or synthetic feedstocks (source materials), also referred to as ‘sustainable fuels’ and ‘low carbon liquid fuels’.
Residual emissions	The volume of gross anthropogenic greenhouse gas emissions (see Gross emissions) that remain after emissions reduction activities, but not including emissions removal. Also referred to as residual gross emissions.

Appendix A: Sector plan snapshots

Australian Government

Electricity & Energy Sector Plan

Sector Overview

Covers the generation of electricity, manufacture of petroleum products, the supply of gas, and other related services

- Directly accounted for around 1% of GDP in 2023, and underpins other sectors
- 34% of national emissions in 2024
- Emissions peaked in 2009 and are now 22% below 2005 levels, with renewables displacing coal
- Renewables have grown from 13% to 40% of generation in our two largest grids over the past 10 years

Abatement opportunities

Improve energy performance
through electrification, boosting energy efficiency and increasing demand flexibility

Decarbonise and expand electricity network
through investment in firmed renewables and incentivising consumer energy resources

Renewable gases
such as biomethane and hydrogen

Low carbon liquid fuels
like Sustainable Aviation Fuel and renewable diesel

Pathway to Net Zero

Emissions decline as our energy system becomes more efficient, more electrified and transitions to clean energy supply

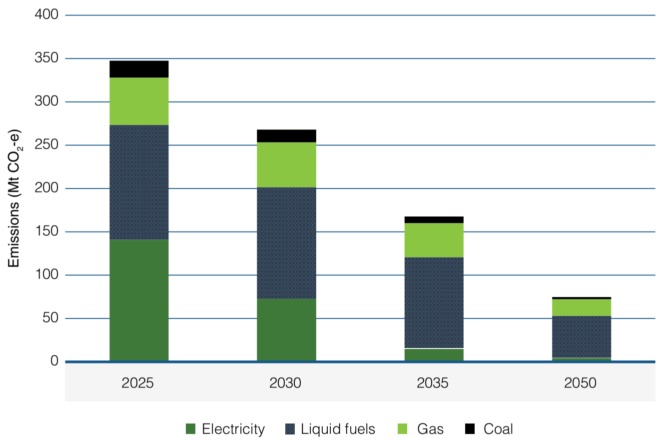


Figure: Electricity & energy sector emissions

Source: DDCCEEW and Treasury modelling and analysis 2025, Baseline Scenario. Pathways are illustrative only.

Key challenges

- Delivering better network utilisation and clearer market investment signals
- Timely deployment of infrastructure through smooth planning and approvals processes and connection processes
- Building social licence, and ensuring greater regional benefits
- Reducing cost and increasing availability of LCLF and renewable gases

Actions

1. Accelerate energy performance improvements

- National Energy Performance Strategy
- Household Energy Upgrades Fund and Social Housing and Energy Performance Initiative
- $50 million to support energy upgrades for community sports clubs
- Expand and reform existing rating and disclosure mechanisms such as Greenhouse Energy Minimum Standards, the Commercial Building Disclosure Program, and the Nationwide House Energy Rating Scheme
- Establish a Demand-side Statement of Opportunities
- $40 million to accelerate the rollout of kerbside and fast electric vehicle charging

2. Expand and decarbonise electricity supply

- Snowy Hydro 2.0
- Clean Energy Finance Corporation
- Capacity Investment Scheme
- Consumer Energy Resources Roadmap
- Cheaper Home Batteries program
- Grid Enhancing Technologies program, Accelerating Connections Fund, Enhancing Capacity of Existing Network Infrastructure
- Rewiring the Nation
- National Electricity Market Review

3. Develop renewable gases while maintaining supply security

- Safeguard Mechanism, including review in 2026-27
- Gas Market Review
- Guarantee of Origin scheme
- National Hydrogen Strategy, production supports and H2Global

4. Decarbonise liquid fuels while maintaining supply security

- Safeguard Mechanism, including review in 2026-27
- Future Made in Australia Innovation Fund
- $1.1 billion Cleaner Fuels Program

Phases of the transition

To 2030	To 2035	To 2050
• Renewable electricity generation increases to 82% on-grid • Rooftop solar and battery uptake expands, cutting bills and emissions • Electric vehicle uptake drives declines in overall liquid fuel demand • Renewable gas substitutes for some natural gas uses • Foundations of hydrogen and LCLF markets established	• Economy-wide energy efficiency improvements support growing demand • Demand flexibility is embedded as electrification of homes, businesses, low-heat industrial use and light vehicles continues • Orderly coal exit as firmed renewable electricity supply grows • Renewable gas supply scales up and begins to displace natural gas use that can't be electrified • Growing LCLF production supports a lower-emissions fuel mix	• The energy system is high performance: efficient, flexible and optimised to deliver reliable and secure renewable energy • Electricity demand grows significantly as new industries scale • Firmed renewables meet all our electricity needs • Natural gas increasingly replaced by renewable gases • LCLF comprises a significant proportion of remaining liquid fuel use and Australia is an advanced producer and exporter

Australian Government

Agriculture and Land Sector Plan

Sector Overview

Covers emissions and carbon storage from agricultural activities, land management and on-farm energy use

- Agriculture accounted for 2.4% of value-added GDP, 10.8% of exports, and 5.9% of rural employment in 2024
- Agriculture was 19.6% of national emissions and the land sector was a net sink equivalent to -16.5% of national emissions in 2024
- Agricultural emissions are dominated by methane from ruminant livestock and manure management, and nitrous oxide from agricultural soils
- Land sector has changed from a major net source of emissions to a large net sink. Agriculture emissions have been broadly stable

Abatement opportunities

Enteric fermentation
e.g. herd and pasture management, feed additives

Manure management
e.g. covered anaerobic ponds, anaerobic digesters

Agricultural soils
e.g. precision agriculture, enhanced efficiency fertilisers, fertiliser use efficiency

On-farm energy use
e.g. renewables, electrification, energy performance improvements, low carbon liquid fuels

Protect and enhance carbon stores in vegetation and soils
e.g. environmental plantings and farm forestry

Pathway to Net Zero

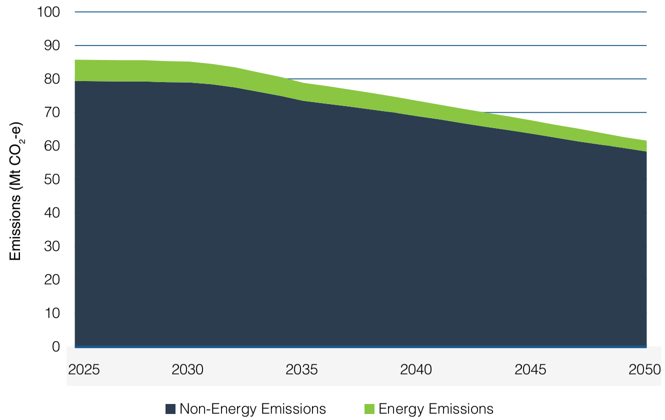


Figure 1: Agriculture sector emissions

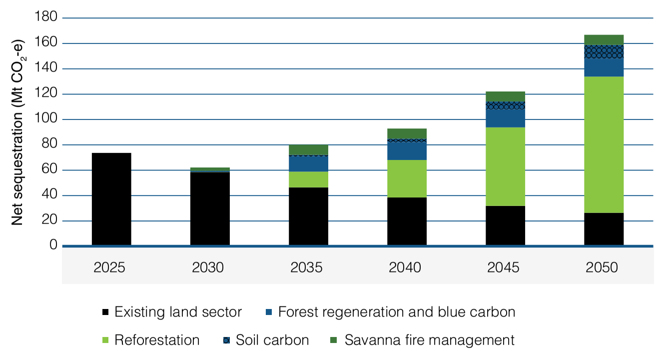


Figure 2: Land sector net carbon removals

Source: Baseline Scenario, Treasury modelling and analysis 2025. Pathways are illustrative only.

Actions

1. **Understand emissions at the enterprise and national level**
   - Voluntary emissions estimation and reporting standards, and incorporating standards into emissions calculators
   - Improving National Greenhouse Accounts to better reflect regional differences and mitigation actions
2. **Support innovation to deliver commercially viable abatement options**
   - Zero Net Emissions Agriculture Cooperative Research Centre
   - Methane Emissions Reduction in Livestock program
   - Investment in Rural Research and Development Corporations
3. **Strengthen on-ground action**
   - New $1 billion investment in the Regional Investment Corporation
   - Carbon Farming Outreach Program
   - Natural Heritage Trust Climate-Smart Agriculture Program
   - Clean Energy Finance Corporation
4. **Enhance the role of land in a net zero economy**
   - Australian Carbon Credit Unit Scheme
   - Nature Repair Market
   - Support Plantation Establishment Program
   - Australian Bushland Program
   - $1.1 billion Cleaner Fuels Program

Key challenges

- Diverse industry, with varying capacity to engage in decarbonisation
- Uplift and use of greenhouse gas accounting systems to support understanding of emissions
- Lack of commercially viable abatement options for use in agriculture
- Balancing land use for agricultural production, carbon storage, feedstocks and nature repair

Phases of the transition

To 2030	To 2035	To 2050
• Agriculture and land emissions and sequestration largely stable • Investments in technology solutions to reduce emissions longer-term • Investments in systems, knowledge and capacity to support on-ground action, with incremental electrification underway	• Emissions intensity of agriculture declining through herd and pasture management, more efficient use of inputs such as fertiliser, and energy performance improvements • Reforestation practices are increasing with incentives supporting wider uptake	• Technologies for agriculture emissions reductions are commercially viable and taken up at scale • Market signals, including demand for low-emissions intensity products and financial returns for carbon storage and nature repair, are stimulating on-ground action • The transition is benefitting local communities, supporting First Nations participation, increasing agricultural productivity, protecting and enhancing our biodiversity and contributing to food security • Agriculture and land are appropriately contributing to Australia's net zero goal

Australian Government

Built Environment Sector Plan

Sector Overview

Covers residential, commercial and public buildings, urban open spaces and water infrastructure

- Australia has more than 11 million residential and 1 million commercial and public buildings
- Construction subsector within the built environment accounted for around 7% of GDP in 2023
- 5% of national emissions in 2024
- Indirectly, accounts for almost half of emissions from electricity generation, and further emissions embodied in building materials
- Since 2005, direct emissions have risen by 30% resulting from increase in the number of buildings, specifically apartments
- Home energy ratings have risen to an average of 6.8 stars in 2025 from 1.8 stars in 2003

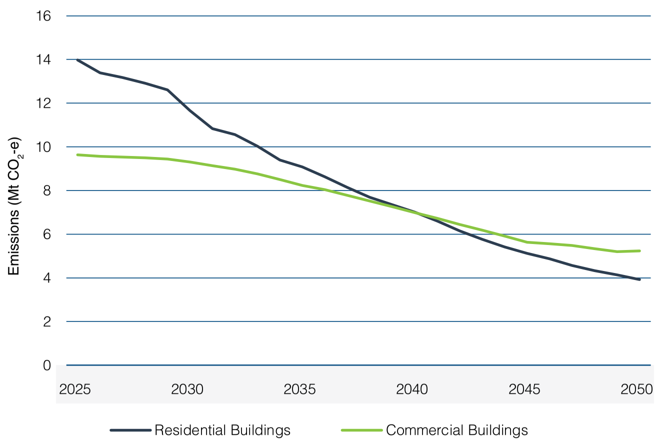
Abatement opportunities

Electrification of buildings

Improving energy performance
through energy efficiency and demand flexibility

Improve building designs,
material efficiency and embodied carbon within building materials

Pathway to Net Zero



Built Environment sector emissions

Source: Baseline Scenario, Treasury modelling and analysis 2025. Pathways are illustrative only.

Key challenges

- Retrofitting existing buildings due to upfront costs, or complexity for commercial, multi-use or multi-unit buildings
- Overcoming split incentives: where property owners incur the costs of upgrades, but may be reluctant to invest as energy savings bill benefits flow to tenants
- Ensuring equity for households facing additional barriers, for example low-income households face compounding issues as households with lower capital and more likely to rent
- Regulations for buildings are shared across all levels of government, creating complexity in achieving national consistency and potential for overlapping regulation

Actions

1. Accelerate electrification and increase energy performance

- National Energy Performance Strategy, including $1 billion Household Energy Upgrades Fund and $800M Social Housing Energy Performance Initiative
- Cheaper Home Batteries Program
- Modernise the Greenhouse Energy Minimum Standards
- Expand the National Australian Built Environment Rating System for non-residential buildings
- Expand the Commercial Building Disclosure Program
- Expand the Nationwide House Energy Rating Scheme (NatHERS) to cover existing homes
- $50 million to support energy upgrades at community sports clubs
- Clean Energy Finance Corporation

2. Continued collaboration with jurisdictions through Ministerial Councils for greater national consistency in building regulations and policies

- Implement the Trajectory for Low Energy Buildings
- Implement Consumer Energy Resources Roadmap

3. Innovation and deployment of technology to support material efficiency and low carbon options for concrete, cement and steel

- ARENA, including Future Made In Australia Innovation Fund
- Low Carbon Concrete Centre

Phases of the transition

To 2030	To 2035	To 2050
• Household and business energy efficiency upgrades and electrification are underway • Strong uptake of household batteries and solar • Frameworks to reduce embodied carbon established • Investment in research and development to support modern methods of construction • Phase down of high global warming potential refrigerants (HFCs) in air conditioning and refrigeration	• Households and business continue electrification and energy performance retrofits • Improved standards for new buildings • Appliance and equipment efficiency continuing to improve through standards and as new technology comes online • Introduce embodied carbon requirements for most buildings	• All users that can, have electrified • HFC phase down completed in 2036 • Embodied carbon in construction and renovation is minimised

Australian Government

Industry Sector Plan

Sector Overview

Covers manufacturing and processing of goods, refining and waste processes across 9 sub-sectors

- Accounts for the equivalent of 7.7% of GDP (2024), with 120,000 businesses generating $205.8 billion in gross value added
- 14% of national emissions in 2024
- The Safeguard Mechanism covers approximately 56% of industrial scope 1 emissions

Abatement opportunities

Improve energy performance
through energy efficiency and demand flexibility

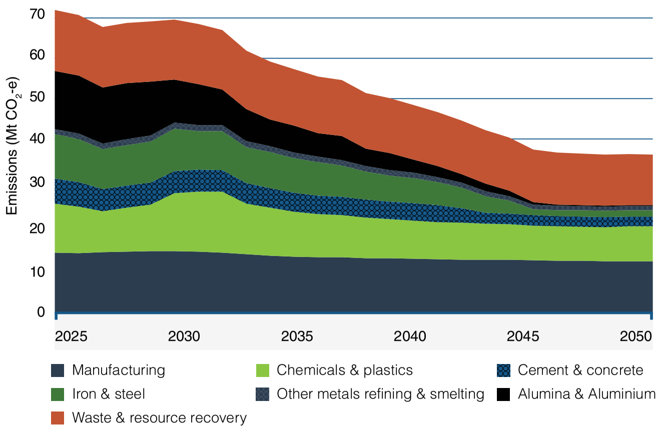
Electrify uses and processes where possible

Switch to alternative fuels and inputs where electrification not feasible
e.g hydrogen, low carbon liquid fuels

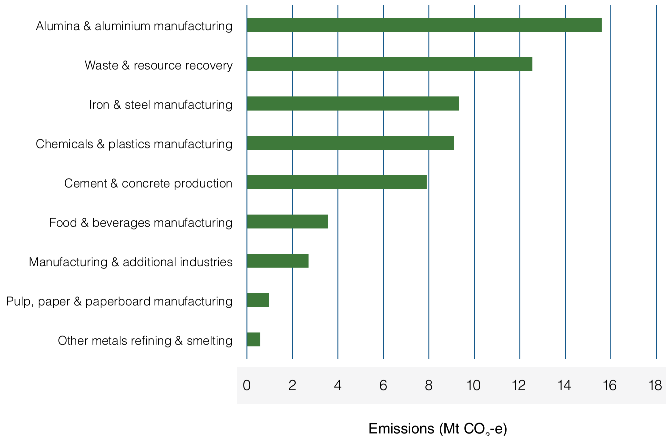
Key challenges

- Scaling supply of firmed renewable energy and low carbon fuels and incentivising electrification
- Development of commercially viable options for industrial processes requiring high-temperature heat or natural gas as a feedstock
- Maintaining the competitiveness of industrial facilities through the transition

Pathway to Net Zero



Industry sector emissions



Industry sector emissions sources 2024

Source: Baseline Scenario, Treasury modelling and analysis 2025.
Pathways are illustrative only.

Actions

1. Improve energy use now to reduce costs

- $5 billion support through National Reconstruction Fund
- Energy Efficiency Grants for Small and Medium Sized Enterprises
- National Energy Performance Strategy
- Safeguard Mechanism, including review in 2026-27

2. Electrify processes where possible

- Safeguard Mechanism, including review in 2026-27
- Clean Energy Finance Corporation
- Australian Renewable Energy Agency, including $40 million National Industrial Transformation Program and $400 million Industrial Transformation Stream
- Powering the Regions Fund

3. Switch to alternative fuels and inputs

- Safeguard Mechanism, including review in 2026-27
- National Hydrogen Strategy, Hydrogen Production Tax Incentive, Hydrogen Headstart
- $1.1 billion Cleaner Fuels Program
- Australian Renewable Energy Agency

4. Invest in technology opportunities to support the transition

- $1.5 billion Future Made in Australia innovation fund
- National Reconstruction Fund including a new $5 billion Net Zero Fund
- $1 billion Green iron investment fund
- $2 billion Green aluminium production credit
- $1 billion Solar Sunshot
- $500 million Battery Breakthrough Initiative, delivered by ARENA

Phases of the transition

To 2030	To 2035	To 2050
• Commercially available abatement technologies taken up, including electrification of low temperature heat processes • Foundations of hydrogen market established • Expand and decarbonise electricity supply (See energy and electricity sector plan)	• Heavy industry gradually deploying technologies such as electric boilers, high temperature heat pumps and mechanical vapour recompression as they become commercially available • Sub-sectors such as iron and steel, alumina and aluminium begin fuel switching and using alternative feedstocks such as hydrogen as they become available	• Growth of new industry opportunities in green metals, green chemicals, clean energy manufacturing and other areas of comparative advantage • Deployment of carbon management technologies, and any breakthrough technologies like flash ironmaking, molten oxide electrolysis or hydrogen plasma smelting

Australian Government

Resources Sector Plan

Sector Overview

Covers exploration and production of minerals, oil and gas, and coal resources. Also covers mine closure, decommissioning and rehabilitation

- Contributed 11.4% of Australia's GDP in 2024 and two thirds of Australia's total merchandise exports in 2025
- Contributes a significant proportion of global exports of LNG (20% in 2024) and metallurgical and thermal coal (46% and 19% in 2023)
- 22% of national emissions in 2024, mostly from gas and coal production
- Sector emissions saw a continual increase from 2005 through to 2020, but are now declining
- The Safeguard Mechanism covers 87% of the sector's emissions

Abatement opportunities

Reducing fuel combustion emissions
through electrification and low-carbon fuels e.g. LCLF and hydrogen

Reducing fugitive emissions
through ventilation air methane (VAM) abatement, leak detection and repair, pre-drainage of coal methane and reduced routine venting and flaring

Scaling up carbon management technologies
e.g. carbon capture and storage (CCS)

Pathway to Net Zero

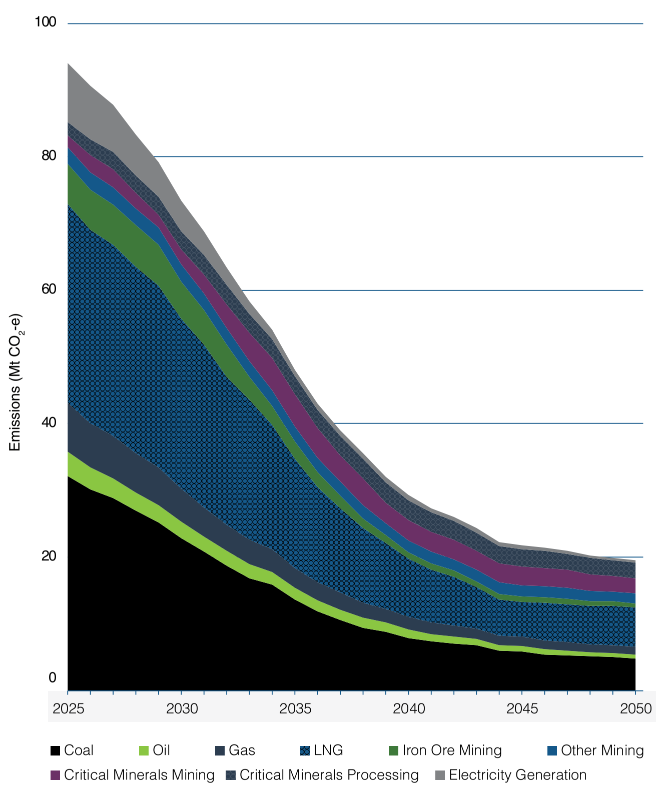


Figure 1: Projected emissions in the resources sector to 2050
Source: Baseline Scenario, Treasury modelling and analysis 2025. Pathways are illustrative only.

Actions

1. Reduce fuel combustion emissions
- Safeguard Mechanism, with review in 2026-27
- Future Made in Australia Innovation Fund
- Powering the Regions Fund
- Clean Energy Finance Corporation
- $1.1 billion Cleaner Fuels Program

2. Reduce fugitive emissions
- Safeguard Mechanism, with review in 2026-27
- Future Gas Strategy, including offshore venting and flaring
- Powering the Regions Fund
- Enhanced measurement, including expert panel
- Working with states on regulatory frameworks

3. Scale up carbon management technologies
- Safeguard Mechanism, with review in 2026-27
- National Reconstruction Fund
- Resourcing Australia's Prosperity

Key challenges

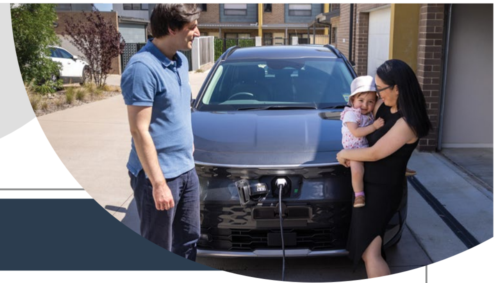
- Barriers to retrofitting abatement technologies to existing facilities, including cost, commercial, environmental and infrastructure
- Development of commercially viable low-carbon fuels, alongside deployment of firmed renewable energy
- Maintaining Australia's role as a reliable trading partner for minerals, metals and energy through the global transition

Phases of the transition

To 2030	To 2035	To 2050
• Reduced routine venting and flaring from oil and gas facilities • New resources facilities designed for electric power and improved energy efficiency, where technically and commercially feasible • Demonstration and commercialisation of electrified haulage and equipment • Demonstration of VAM abatement technology in Australian coal mines • Expansion of CCS	• Increased electrification and energy performance across the sector • Deployment of heavy electric vehicles and equipment, with greater penetration of low carbon liquid fuels and renewable energy in remote regions • Greater use of methane pre-drainage in coal mines • Scale-up of VAM abatement technology in coal mines • Use of CCS continues to grow	• Widespread use of VAM abatement and pre-drainage technologies in coal mines • Increased use of low-carbon fuels • Use of CCS continues to grow

Australian Government

Transport Sector Plan



Sector Overview

Covers light and heavy road transport, rail, maritime, aviation and the construction of transport infrastructure

- Accounts for 4.6% of Australia's GDP (transport, postal and warehousing industry, 2024) and underpins many other sectors
- 22% of national emissions in 2024
- After steady growth since 2005, emissions dipped in 2020-2022 with COVID restrictions but are now 21% above 2005 levels
- Electric vehicle uptake is accelerating, growing from 0.8% of new light vehicle sales in 2020 to 10% in 2025

Abatement opportunities

Electrification of light vehicles
and improved energy efficiency

Electrification of heavy vehicles
Low carbon liquid fuels (LCLF) or hydrogen where battery electric is not feasible

Track electrification, battery electric
LCLF or hydrogen where battery electric is not feasible

Hydrogen derived fuels
(e.g. methanol or ammonia), hydrogen and LCLFs

LCLF (Sustainable aviation fuel)
Electrification or hydrogen for short haul

Pathway to Net Zero

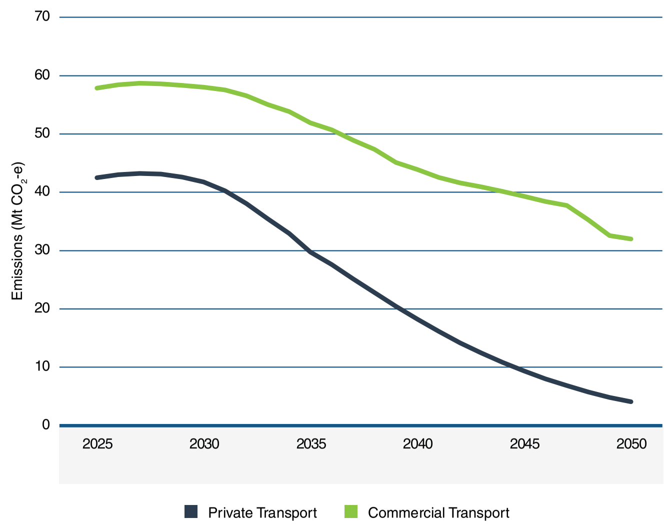


Figure: Transport sector emissions

Source: Baseline Scenario, Treasury modelling and analysis 2025.
Pathways are illustrative only.

Key challenges

- Accelerating rollout of EV charging infrastructure
- Solutions for longer range heavy vehicles, maritime and aviation not yet commercially viable
- Reducing cost and increasing availability of LCLF and hydrogen

Actions

1. **Invest in enabling low and zero emissions infrastructure**
   - Infrastructure Policy Statement & Infrastructure Investment Program
   - $100 million Active Transport Fund, High-Speed and Inland Rail
   - National Freight and Supply Chain Strategy
2. **Electrify and increase energy performance**
   - New Vehicle Efficiency Standard including 2026 review
   - National EV Strategy
   - Safeguard Mechanism including 2026-27 review
   - $40 million to accelerate the rollout of kerbside and fast electric vehicle charging
   - Electric Car Discount
   - Maritime Emissions Reduction National Action Plan
3. **Switch to low carbon alternatives**
   - $1.1 billion Cheaper Fuels Program
   - Guarantee of Origin & Fuel Quality Standards
   - National Hydrogen Strategy and production supports
   - Sustainable Aviation Fuel (SAF) Funding Initiative
   - Australian Jet Zero Council
4. **Innovate to expand cost competitive technology options**
   - $250 million Future Made in Australia Innovation Fund for LCLF
   - $475 million Driving the Nation Fund
   - $500 million Powering Australia Technology Fund
5. **Scale up efforts to reduce embodied emissions**
   - National Carbon Values for use in cost benefit analyses
   - National Sustainable Procurement in Infrastructure Guideline
   - $21 million for Low Carbon Concrete Centre
   - Future Made in Australia green metal investments

Phases of the transition

To 2030	To 2035	To 2050
• EVs become increasingly more affordable • On-going investment in charging infrastructure • Electrification of buses and small trucks • Trials for battery electric rail, short range maritime and aviation • Foundations of hydrogen and LCLF (including sustainable aviation fuel) markets established • Continued investment in active and public transport infrastructure	• EV market and charging infrastructure matures; significant proportion of light vehicles are EVs • Bi-directional charging and vehicle to grid capabilities scale up • Battery electric and hydrogen-fuel cells begin to be deployed for rail, short range ships and flights • LCLF and hydrogen market grows, supported by certification and accounting frameworks • National rail charging and refuelling network and intermodal hubs	• EVs, battery and hydrogen technologies widespread – including in rail and shipping • Bidirectional charging widespread, supporting grid capacity and stability • LCLF comprises a significant proportion of remaining liquid fuel use and Australia is an advanced producer and exporter • Low emission ports and airports operational

Australian Government

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Australian Government

Electricity and Energy Sector Plan

2025

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Acknowledgement of Country

We acknowledge the Traditional Owners of Country throughout Australia and recognise their continuing connection to land, waters and culture. We pay our respects to their Elders past and present.

Minister's foreword

I am pleased to present the Electricity and Energy Sector Plan. The plan sets out an ambitious and achievable pathway to reduce emissions while ensuring the affordable, reliable, secure and equitable supply of energy.

Energy underpins the Australian economy and our energy system is at a pivotal moment. Australia's ageing coal fired power stations are reaching their end of life. They are increasingly unreliable and expensive to maintain. The natural gas fields that powered Australian industry from the 1960s are depleting. Over 90% of our liquid fuel comes from imports so consumers have significant exposure to global oil prices. Energy also accounts for around 90% of our net emissions.

Australia's rich renewable energy resources provide a once-in-a-generation opportunity to capitalise on the global transition to net zero. We can use our abundant renewable energy to modernise our energy system and develop the new clean energy industries that will support our future prosperity. The energy transformation represents an opportunity to develop new industries, grow our regions, create new jobs and reduce energy bills for consumers.

The electricity system of 2050 will be delivered by wind and solar, backed by hydro, storage and gas. Today, two thirds of Australia's energy comes from gas and liquid fuels. Electricity generation will increase dramatically to support new demand as users switch from fossil fuels to electric alternatives, with domestic electricity demand projected to double by 2050. Firmed renewables provide the cheapest form of new generation available to support this demand.

The Australian Government has set an ambitious target of 82% renewable electricity by 2030. We are making good progress towards this target. Already, over 40% of the electricity in Australia's 2 largest grids is renewable. The Capacity Investment Scheme and Rewiring the Nation program will supercharge progress to 2030. And while there's a long way to go, sales of electric vehicles hit record levels in June 2025 – making up over 10% of the overall new car market. Around the nation, more and more households and businesses are providing their own energy with rooftop solar. The Cheaper Home Battery has delivered over 55,000 batteries – with total storage capacity of over 1 GWh – in just over 2 months since the program commenced on 1 July 2025.

But there is still so much more to do.

We also need to fuel-switch to lower emissions alternatives, which is why we are investing $1.4 billion to kickstart Australia's low carbon liquid fuel supply chain, including $1.1 billion for the new Cleaner Fuel Program. Electrification should be implemented wherever possible. Where electrification is not currently feasible – for example, some high-heat industrial processes – switching to low-carbon gases and liquid fuels should be prioritised.

Decarbonising our energy system includes energy performance improvements to make the most of Australia's energy resources. This means using energy more efficiently, and changing how and when we use energy to best take advantage of Australia's abundant renewables.

Governments, the energy sector, households, communities, businesses and industry, all have a role to play in the energy transformation. This plan shows how we can maximise the benefits of the energy transformation by ensuring the right incentives are in place to support industry and households to participate.

I thank industry, investors, community groups, unions, academics and others for their feedback in developing this plan. The energy transformation is a huge opportunity for our nation. Together we must keep working to seize that opportunity.

The Hon Chris Bowen MP
Minister for Climate Change and Energy

Contents

Executive summary

The Electricity and Energy Sector Plan is one of 6 sector plans developed alongside the Net Zero Plan. It supports the Government's 2035 emissions reduction target of 62-70% and charts an ambitious and achievable course for transforming our energy system to support net zero by 2050.

Clean energy is essential to decarbonising the domestic and global economies. The world is already shifting away from fossil fuels like coal, gas and oil, towards cleaner and cheaper energy sources. New investments are needed to modernise our energy system as global energy markets change, technology continues to develop, and our existing infrastructure reaches its end of life.

Our rich renewable resources are a powerful advantage in the changing global economy. We can target the new investment our energy system needs to support economy-wide decarbonisation and power economic growth in a way that benefits all Australians – while also supporting global emissions reduction through the export of products made with clean energy. These investments will drive productivity growth in our energy sector and across the economy.

Australia is already in the midst of this significant transformation. Households are actively investing in solar panels, batteries and electric vehicles. Private investment and government policies are driving a rapid transformation of our electricity and energy sector.

The Electricity and Energy Sector Plan sets out a roadmap for the next stages of our energy transformation. Long-term policy settings that are credible and stable will support higher levels of investment and growth. A clear pathway will help households, industry and governments successfully navigate and prosper through the transformation.

An orderly transition is in the interest of all Australians. Early and coordinated action will support economic growth, living standards and energy affordability. In contrast, a delayed and disorderly net zero transition would push up wholesale electricity prices through a greater reliance on ageing coal-fired power stations and more expensive gas-fired generation.

Setting a pathway to 2050

The plan sets out a pathway to 2050 characterised by 3 major shifts in our energy system.

1) **Using energy more efficiently**: We will use energy more wisely to reduce emissions, lower energy bills and minimise the infrastructure we need to build to support a growing economy.
2) **Electrifying and fuel-switching**: Where possible, energy users will switch from gas and liquid fuels to electricity. Over time, most remaining gas and liquid fuel users will transition to renewable gases and low carbon liquid fuels (LCLF).
3) **Scaling clean energy supply**: We will increase renewable generation like solar and wind, supported by batteries and other firming technologies. At the same time, we need to grow domestic production of renewable gases and liquid fuels to decarbonise hard-to-abate gas and liquid fuel uses.

These shifts will enable Australia's energy system to support a net zero economy, while continuing to deliver affordable, reliable and secure energy.

The energy transformation will occur in phases

Australia's energy system will undergo significant structural change on our pathway to 2050. These changes will occur in phases as technology, markets and energy demand evolves.

The Electricity and Energy Sector Plan describes this complex transformation through 3 broad phases.

- **Now to 2030.** Renewable generation increases to reach 82%, delivering significant emissions reductions in the electricity sector and setting Australia up to decarbonise other sectors through wide-spread electrification. Domestic markets for and production of renewable gases and LCLF are established.
- **2030 to 2035.** Electrification and energy efficiency drive decarbonisation across the transport, built environment and industry sectors, backed by continued growth in firmed renewable generation. Renewable gases and LCLF increasingly support decarbonisation in hard-to-abate sectors like high-heat industrial processes and aviation.
- **2035 to 2050.** A high-performance renewable electricity system supports economy-wide electrification. Fuel-switching accelerates as production of renewable gases and LCLF scales. By 2050, Australia's economy is underpinned by abundant clean energy.

These phases are consistent with the findings of Treasury's report, *Australia's Net Zero Transformation: Treasury Modelling and Analysis,* which highlights the need for a well-sequenced transition starting with the most efficient abatement options.

Actions in the plan focus on now to 2035, with a view to putting Australia on a firm path for the decades ahead. We can't know all our options to 2050 as technologies and the global economy evolve – but we can understand the best path forward given what we know today.

Australian households can benefit from this once-in-a-lifetime transformation

A typical household that installs solar and batteries and electrifies their home and vehicles could reduce their energy costs by as much as $4,300 per year on average, after accounting for upfront and financing costs. Governments, industry and communities will need to work together to ensure all Australians benefit fairly. Monitoring and evaluation mechanisms will track progress and guide adaptive policy responses as the energy transformation progresses.

This plan sets out 5 key actions to put us on the pathway to 2050

Transform energy demand, electrify where possible and use energy more efficiently and flexibly, by:

- expanding and reforming existing mechanisms to drive energy performance
- identifying, incentivising and increasing visibility of demand-side opportunities across the economy
- incentivising energy performance improvements where there are large opportunities.

Expand and decarbonise electricity supply by:

- incentivising private market investment in firmed renewables
- incentivising efficient network investment and use
- getting the most out of consumer energy resources (CER) like rooftop solar and batteries.

Develop renewable gases while maintaining supply security by:

- securing an adequate natural gas supply
- supporting natural gas users to electrify or switch to low carbon alternatives like renewable hydrogen
- establishing and scaling production of renewable gases.

Decarbonise the liquid fuel market while maintaining supply security by:

- electrifying light passenger and light commercial vehicles
- establishing and scaling Australia's domestic low carbon liquid fuel (LCLF) market and industry
- strengthening Australia's fuel security through the transformation.

Enable the transformation by:

- supporting investment and faster project approvals
- building a strong clean energy workforce
- developing supply chain security
- improving community engagement
- promoting a sustainable energy future
- ensuring a secure and resilient energy transformation.

New actions – a foundation for the next stage of the energy transformation

The Australian Government is committed to providing a stable and predictable framework for emissions reduction, backed by concrete policies and measures. Significant actions have been taken to date to decarbonise the energy sector.

This plan includes new policy actions that lay the foundations for the next stage of Australia's energy transformation. This includes actions that:

- improve energy performance, including:
    - expanding successful existing programs for energy ratings and standards in the built environment sector
    - establishing a Demand-side Statement of Opportunities (DSOO) as a critical step to unlocking further opportunities for energy consumers to benefit from the energy transformation
    - accelerating the rollout of kerbside and fast charging infrastructure for electric vehicles
- build a supply chain for LCLF, including a new $1.1 billion investment in the Cleaner Fuels Program
- continue to invest in the Clean Energy Finance Corporation (CEFC) by updating the CEFC's investment mandate to include a new focus on the rapid roll out of renewable projects to drive down electricity prices, and commit up to $2 billion more to the CEFC General Account, to be drawn down in line with these changes
- engage communities in the benefits of the energy transformation through a $50 million investment to upgrade community sports clubs by installing solar and batteries, energy efficiency upgrades and lighting, and climate adaptation improvements.

Electricity and Energy Sector Plan at a glance

Vision for 2050

Affordable, clean, equitable, reliable and secure energy supply that unlocks new economic opportunities in a net zero world

Strategic objectives

- Enable decarbonisation across the economy
- Deliver affordable, reliable and secure energy to Australians
- Capture new economic opportunities

Pathway to 2050

Accelerate **energy performance** and optimise system impacts

- Expand existing energy performance mechanisms
- Increase visibility of demand-side opportunities and incentives
- Incentivise energy performance improvements

Expand and decarbonise the **electricity system**

- Incentivise private investment in firmed renewables
- Optimise use of network infrastructure
- Get the most out of consumer energy resources

Develop **renewable gases** while maintaining supply security

- Secure an adequate natural gas supply
- Support natural gas users to electrify
- Establish and scale renewable gases

Decarbonise the **liquid fuel market** while maintaining supply security

- Electrify light passenger and light commercial vehicles
- Establish and scale up Australia's low carbon liquid fuel market
- Strengthen Australia's fuel security through the transition

Phases of the energy transformation

2030

Renewable electricity generation increases to reach 82%

2035

Electrification of homes, businesses, low-heat industrial use and light vehicles continues

2050

Renewable gases and low carbon liquid fuels support decarbonisation

Enabled by

- Supporting investment and faster project approvals
- Building a strong clean energy workforce
- Developing supply chain security
- Improving community engagement
- Promoting a sustainable energy future
- Ensuring a secure and resilient transformation

Delivering benefits to households

- Financial savings
- Health benefits
- Energy reliability and resilience

1. Introduction

1.1 About the Electricity and Energy Sector Plan

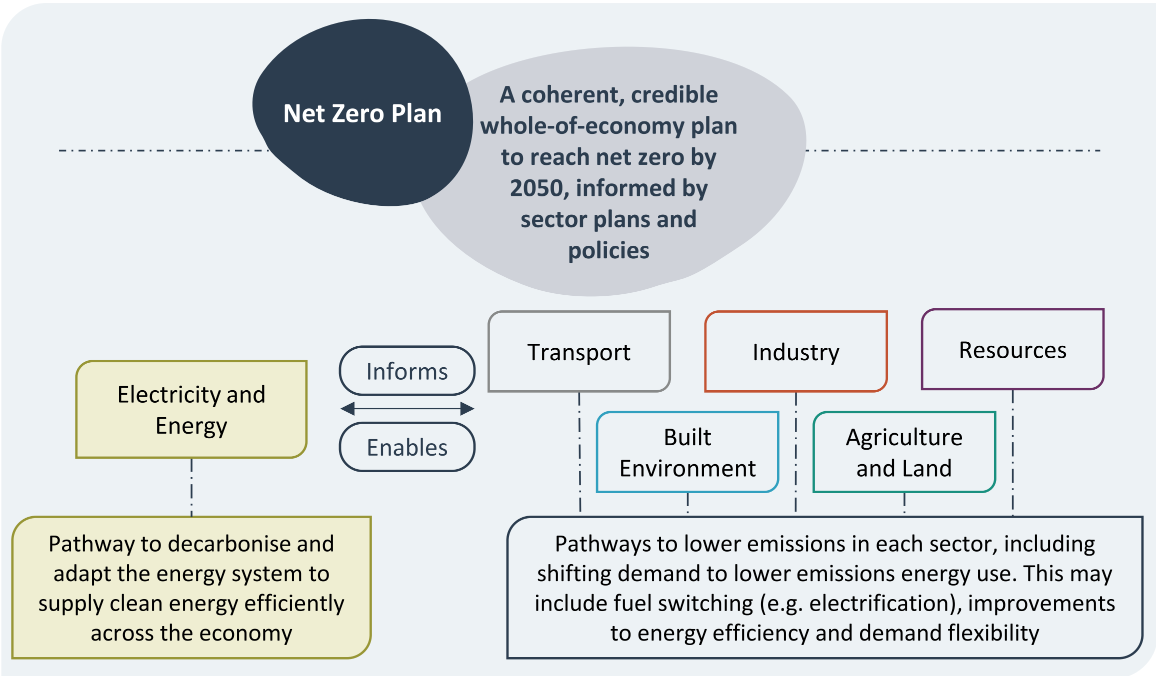
Energy underpins Australia's economy and is a major source of emissions. The sector must transition to cleaner sources of fuel to achieve the Government's 2035 emissions reduction target of 62-70%, reach net zero and support global decarbonisation efforts.

Right now, Australia is in the midst of this significant and complex energy transformation. We have a once-in-a-generation chance to seize the moment, modernise our energy system and power Australia's economic growth in a way that benefits all Australians.

The Electricity and Energy Sector Plan is one of 6 sector plans that supports the Net Zero Plan (Figure 1.1). It sets out a pathway for an ambitious and orderly transformation of the energy sector. It shows how we can establish reliable sources of clean energy that:

- unlock decarbonisation opportunities across all sectors of the economy
- capitalise on the clean energy export opportunities of a Future Made in Australia
- deliver affordable energy to all Australians.

Figure 1.1: The Net Zero Plan is underpinned by 6 sector plans



The plan has been informed by input from stakeholders, independent expert advice from the Climate Change Authority (CCA) and in-house analysis from across government. This includes insights from the Department of the Treasury (Treasury) modelling and supplementary energy market modelling conducted by the Department of Climate Change, Energy, the Environment and Water (DCCEEW). Insights from other government strategies (including the First Nations Clean Energy Strategy, National Hydrogen Strategy, Future Gas Strategy, and National Energy Performance Strategy) also informed its development.

Why we need a plan

Australia's electricity and energy sector is key to a prosperous net zero economy. The sector is at a pivotal moment and already experiencing rapid change. New investments and infrastructure are needed to modernise and secure our energy system, while global trends in technology and investment are driving changes in energy markets and lowering emissions around the world.

We can harness these changes to transform our energy system, reduce emissions and capture new economic opportunities. This will require early action and a coordinated transition.

Treasury's report *Australia's Net Zero Transformation: Treasury Modelling and Analysis* highlights that credible long-term policy frameworks will support investment and growth. Households benefit from an efficient and well-signalled transition to net zero. In contrast, a delayed or disorderly transition is costly for households, businesses and our economy, resulting in higher wholesale electricity prices, slower economic growth, less investment, fewer jobs and forgoing the export opportunities of a net zero global economy.

Australia's Net Zero Transformation: Treasury Modelling and Analysis

'Australia's ambitious and achievable plan to reduce emissions will support continued economic growth, 'higher living standards and employment.'

The Australian Government is committed to providing a stable and predictable framework for emissions reduction. This means setting clear ambition backed by concrete policies, like the Capacity Investment Scheme and other policies that are supporting our target of 82% renewable electricity by 2030.

The Electricity and Energy Sector Plan builds on this commitment. It sets a clear vision for a future where abundant clean energy underpins our economy and identifies the actions that are needed now to set Australia on a firm path to 2035 and beyond.

Realising this vision means transforming our energy system to be more affordable, reliable and secure as well as low emissions. Our path to 2050 will not always be easy – but the potential rewards are great (Figure 1.2).

The plan provides a framework not only for government policy, but also for private investment in the transformation. A clear pathway will help households, industry and governments successfully navigate and prosper through the transformation. It provides the certainty that businesses need to invest, transition their operations and grow.

Figure 1.2: Opportunities of the energy transformation

Seizing the opportunity

A productive net zero economy underpinned by abundant clean energy

Australia's abundant energy resources have underpinned our economic development over most of the past century. As global fossil fuel use declines, Australia has an opportunity to leverage our rich renewable resources to drive our future economic development.

A modern reliable energy system

Australia's energy infrastructure is ageing. We have an opportunity to modernise our system by investing in new and flexible technologies as we replace these ageing assets.

This includes investing in new technologies like artificial intelligence (AI), smart grids and energy intelligence systems that can improve the reliability and resilience of our system.

See 3.2 Energy performance and 3.3 Electricity

Greater consumer choice and lower energy costs for households

Australia's energy transformation is giving consumers more choice about how to meet their energy needs as new technologies and market offers emerge.

Already, consumer investment in solar, batteries and electric vehicles is pushing forward the transformation. The potential energy cost benefits are significant – with a fully electrified household that installs solar and a battery saving $4,300 a year, after accounting for upfront and financing costs.

See 5 What the plan means for Australians

Greater energy security in an increasingly uncertain world

Australia has the resources to produce abundant clean energy – not only renewable electricity, but also renewable gases and liquid fuels.

We can leverage these resources to meet more of our energy needs with domestic supply, reducing our exposure to global shocks and ultimately supporting our national security.

See 4.6 Ensuring a secure and resilient transformation

A healthier, more productive economy

The energy sector sits at the heart of any modern economy with improvements to energy productivity flowing on to other sectors of the economy. A cleaner, more efficient energy system can also improve air quality and public health.

See *Box 1.2 Energy and productivity* and *5 Household benefits*

Competitive energy costs to underpin our industrial sector

Australia has some of the best wind and solar availability in the world. These resources give us a comparative advantage in the renewable electricity and renewable hydrogen needed to power our industrial sector as it decarbonises.

With efficient market and investment signals, we can translate this advantage into internationally competitive energy costs for Australian industries.

See Box 1.1 Future Made in Australia and the Electricity and Energy Sector Plan

The opportunity to be a world-leading clean energy exporter

Australia is uniquely positioned to establish competitive export industries to meet growing international demand for green commodities.

By doing so, we can support global decarbonisation and secure our place in the changing global economy – all while creating new jobs and opportunities across Australia.

See Box 1.1 Future Made in Australia and the Electricity and Energy Sector Plan

1.2 Understanding our strategic context

Australia cannot decarbonise without clean energy

Energy is an essential input across all sectors of the economy: industry, resources, transport, the built environment, and agriculture and land. These sectors cannot decarbonise unless our energy system provides enough clean, affordable energy to meet their needs.

Australia has made substantial progress growing renewable generation in recent years, with renewables now making up over 40% of generation in our two largest grids. Despite this, fossil fuels (coal, natural gas and petroleum) remain the largest source of energy in our economy.

Fossil fuels release emissions:

- during processing, transport and storage (*fugitive emissions)*
- when they are burned to generate electricity *(electricity emissions)*
- when they are used as a direct energy source in other sectors *(end-use emissions).*

This means that most of Australia's emissions come from producing and using energy – with energy accounting for the bulk of emissions in almost all sectors of the economy (Figure 1.3 and Figure 1.4).

To support the decarbonisation of the Australian economy, our energy system needs to deliver clean energy in a way that is smarter and more efficient. This energy must be affordable, reliable, secure and delivered fairly. Achieving these objectives will require a whole-of-system transformation in how we supply, use and manage energy.

Figure 1.3: Most of Australia's emissions come from energy production and use

Australian emissions by source, 2023-24, Mt CO2-e

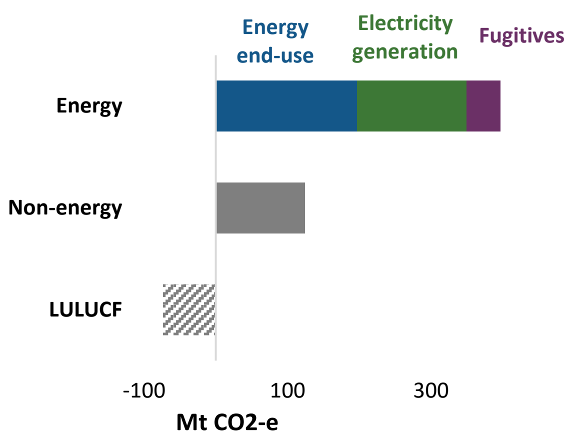
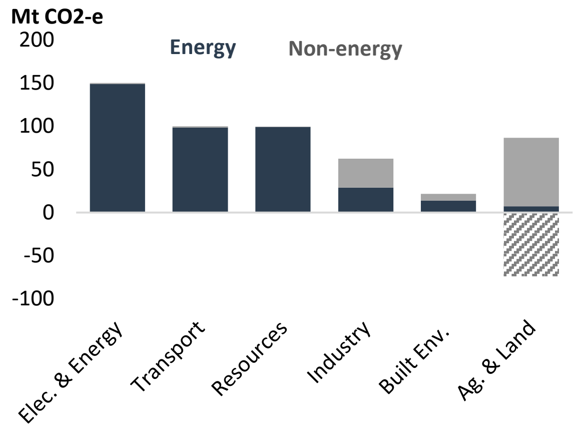


Figure 1.4: Energy accounts for the bulk of emissions across most sectors

Emissions by sector, energy vs non-energy, 2023-24, Mt CO2-e



Source: DCCEEW analysis based on Quarterly Update of Australia's National Greenhouse Gas Inventory December 2024.

Note: Energy emissions are emissions from the United Nations Framework Convention on Climate Change (UNFCCC) energy sector, including electricity generation, stationary energy, transport, and fugitive emissions. Non-energy emissions are emissions from the UNFCCC agriculture, industrial processes and product use, waste and land use, land use change and forestry sectors.

These charts show total energy emissions across the economy. The Net Zero Plan and Treasury modelling allocates the end-use of energy to the relevant sector plan (i.e. emissions from energy are split across sectoral plans) and only emissions from electricity generation, petroleum products manufacturing, gas supply, pipelines, and a small proportion of services are allocated to the Electricity and Energy Sector Plan.

Australia's energy transformation will lay the foundations for our economic future

Australia is an energy-rich nation and the energy sector has been a major source of growth and productivity for our economy. Australia's energy sector will continue to support our economy in coming decades, but in new ways.

Abundant coal and gas resources have supported our development as a strong export economy. We are now one of the world's largest energy exporters and Australia's energy industries – including exports – have accounted for around 6% of our annual national income on average over the last decade.[1]

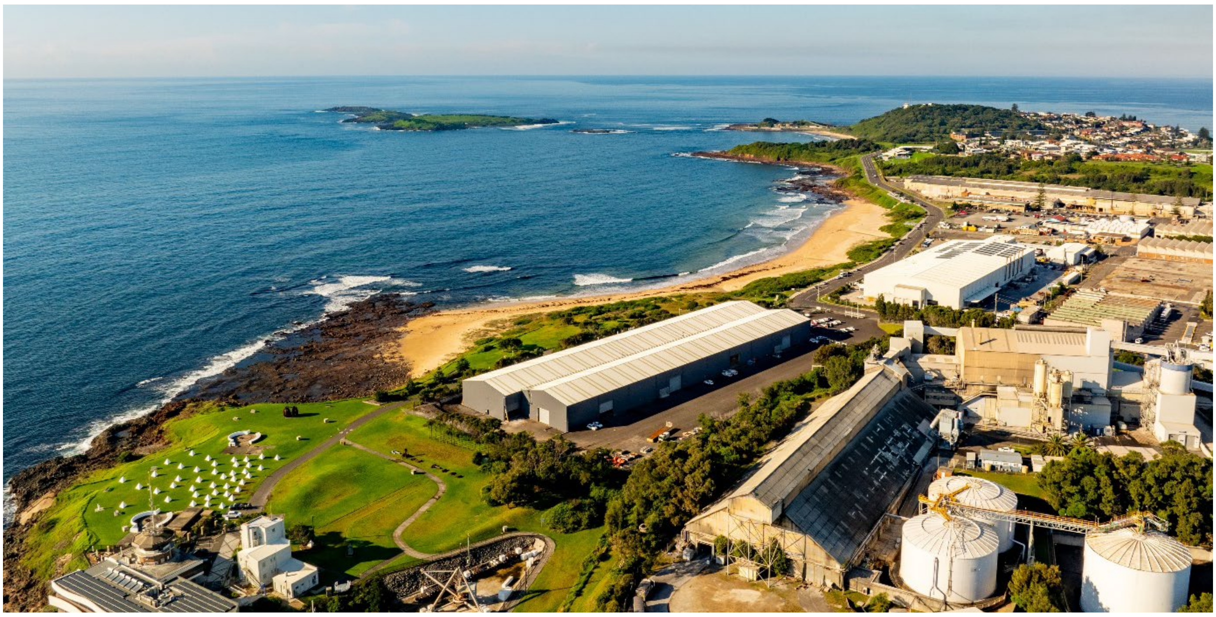
Australia is also rich in renewable energy resources. This includes our abundant wind and solar and the potential to produce the feedstocks needed for renewable gases and LCLF.

The world economy is changing as it moves towards net zero, and a structural shift away from fossil fuels is already happening in global energy markets. Demand for fossil fuels will fall and demand for low emissions products will grow as our trading partners decarbonise.

Australia is well-placed to capture new opportunities in the changing global economy. Our renewable resources offer a powerful source of competitive advantage, and we are uniquely positioned to produce clean energy at volumes exceeding our domestic needs.[2] We can make a meaningful contribution to global emissions reduction by exporting products with embedded clean energy.

Australia can leverage these resources to drive long-term growth and prosperity. We have an opportunity to develop new, export-oriented clean energy industries – strengthening priority supply chains and becoming an indispensable part of the net zero global economy.

To realise this opportunity, which underpins the Government's **Future Made in Australia** agenda, we must capitalise on our natural advantages to build a world-leading clean-energy sector (Box 1.1).



[1] ABS (2024a)
[2] See, for example, Graham P (2023) and Finighan (2024)

Box 1.1: Future Made in Australia and the Electricity and Energy Sector Plan

The Future Made in Australia agenda is a plan to maximise the economic benefits of net zero and secure our place in a changing global economy. It focuses on attracting investment to make Australia a leader in renewable energy, allowing us to build competitive new export industries and creating more jobs and opportunities across the country.

The Electricity and Energy Sector Plan supports a Future Made in Australia. It sets out a pathway to transform our energy sector to deliver affordable clean energy across the economy. This includes cost-competitive renewable electricity that will support priority industries like green metals.

The Electricity and Energy Sector Plan also sets out a pathway to scale new forms of clean energy like renewable hydrogen and LCLF – both identified as priority industries under the National Interest Framework.

- **Renewable hydrogen** is a zero-emissions gas produced using renewable electricity.
- **LCLF** can be produced sustainably from waste materials and biomass or by combining hydrogen from low or zero carbon feedstocks with captured carbon dioxide (e-fuels). Some examples include sustainable aviation fuels and renewable diesel.

Renewable hydrogen and LCLF have been identified as priority sectors because they can leverage Australia's abundant renewable resources to support decarbonisation domestically and among our trade partners. For LCLF, Australia also has the competitive advantages of abundant renewable feedstocks and advanced farming practices.

Under Future Made in Australia, the Government is helping kick-start development of low-carbon alternative fuel industries by incentivising innovation and supporting production. This includes support for **renewable hydrogen** through the Hydrogen Production Tax Incentive and Hydrogen Headstart program, and for **LCLF** through the FMA Innovation Fund and the Sustainable Aviation Fuel Funding Initiative.

Clean energy manufacturing another priority industry under the Future Made in Australia agenda. This industry is critical because the energy transformation is contingent on having a reliable supply of clean-energy technologies and equipment.

The Government released Australia's National Battery Strategy to outline how Australia will build a diverse and competitive Australian battery industry and is investing in domestic battery manufacturing capabilities through the Battery Breakthrough Initiative, delivered by the Australian Renewable Energy Agency (ARENA). ARENA is also delivering the $1 billion Solar Sunshot program to support commercialisation of Australian innovations and scale-up domestic solar PV manufacturing.

Global trends are changing energy markets around the world

Global energy markets are changing as the world transitions to new forms of energy. Investment, technology and policy developments are all driving a shift from fossil fuels to cleaner, cheaper sources of energy.

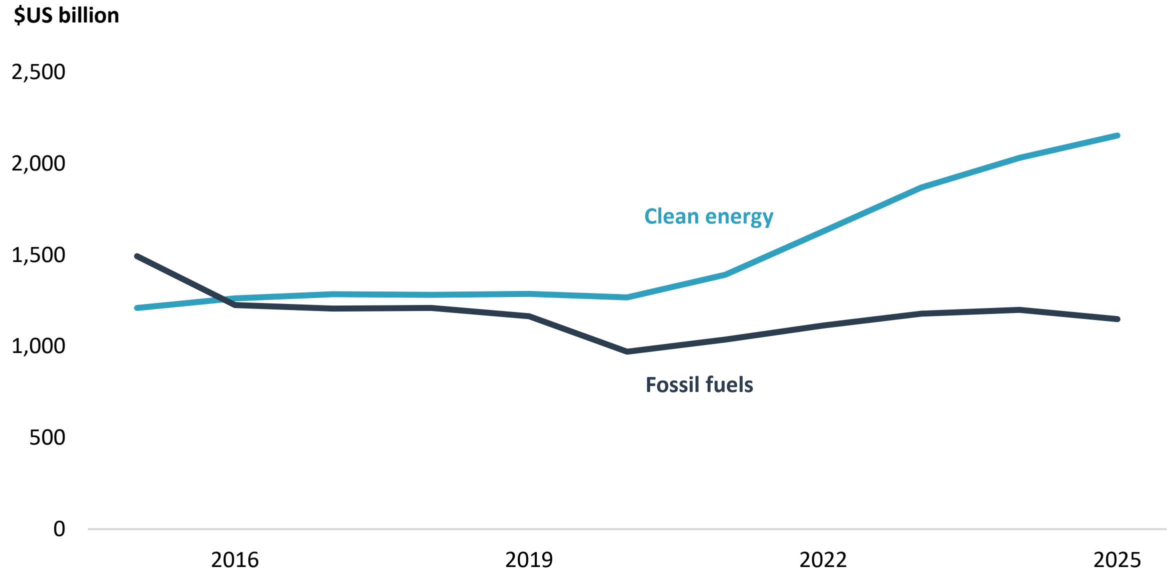
International Energy Agency – World Energy Investment 2025

'Rapid growth in spending on energy transitions over the past 5 years was kicked off by post-pandemic recovery packages and then sustained by a variety of economic, technology, industrial and energy security considerations, not only by climate policies….Emissions reductions provide a powerful reason to invest, but are often not the primary driver for investment in technologies that are increasingly mature and cost-competitive.'

Global investment in clean energy is around double the level of investment in fossil fuels (Figure 1.5). The International Energy Agency (IEA) now expects global fossil fuel use to peak before 2030.[3] Renewable electricity generation is set to overtake coal in 2025, providing more than one-third of global electricity generation.[4]

Figure 1.5: Global investment in clean energy has overtaken investment in fossil fuels

Global clean energy and fossil fuel investment, $US billion



Source: IEA 2025, World Energy Investment 2025.
Note: Data is expressed in constant 2023 $US, market exchange rates.

[3] IEA (2024a)
[4] IEA (2025b)

Climate Change Authority – 2035 Targets Advice

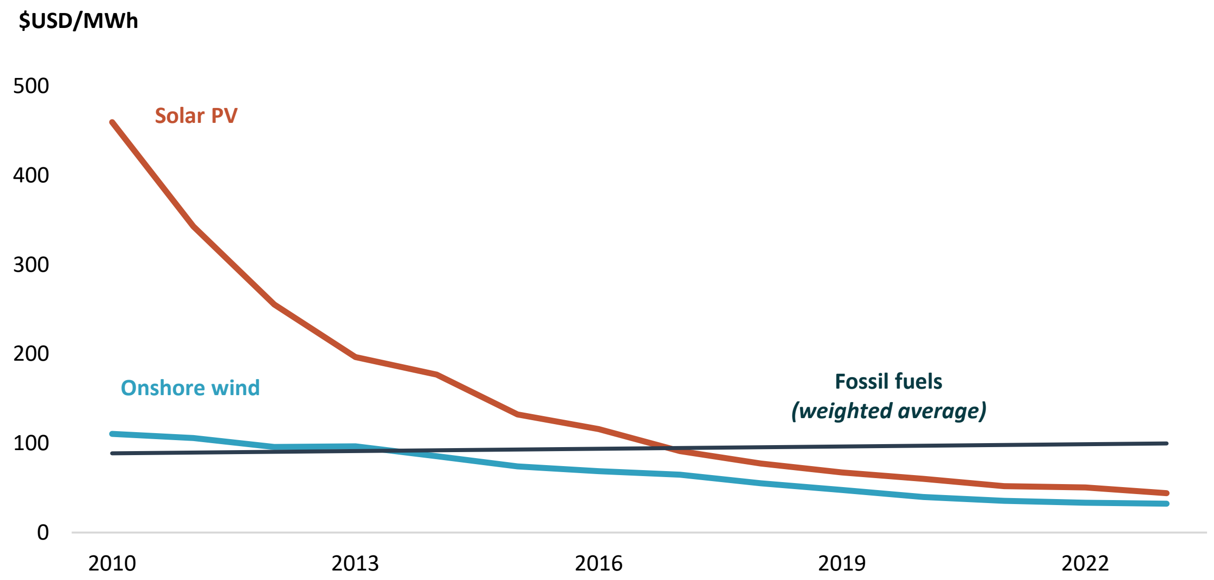
'Recent actions of the US Government are unlikely to materially hinder Australia's decarbonisation efforts. With many clean energy projects in the US stalled, and the expertise and innovation capacity sidelined, Australia now has a strategic opportunity to attract displaced capital, capability and innovation to accelerate its own transition and secure a competitive edge.'

Recent geopolitical developments have increased uncertainty about the outlook for climate action from some countries. This near-term uncertainty is unlikely to slow the pace of clean energy investment, although it may affect the location and nature of that investment. Australia is well placed to attract investment to support its energy transformation.

The economics of renewable electricity have improved dramatically over the past decade as these technologies have become cheaper and more effective. Globally, the cost of clean energy technologies more than halved between 2010 and 2023.[5] The cost of both solar photovoltaic (PV) and lithium batteries has fallen around 90% since 2010, while costs for onshore and offshore wind have fallen by more than 60% (Figure 1.6). This means that renewables are not only cost-competitive with fossil fuel generation – they are the least-cost option for new build generation.[6]

Figure 1.6: Renewable generation technologies outcompete fossil fuel alternatives on cost globally

Global average levelised cost of electricity, $USD/MWh, 2010-2023



Source: IRENA 2024, Renewable Power Generation Costs in 2023.
Note: Fossil fuel data only provided for 2010 and 2023.

[5] IRENA (2024)
[6] Ibid

New investment is needed to modernise our energy system

The coal-fired power stations that formed the backbone of our electricity system are ageing and increasingly unreliable. Most of our coal-fired power capacity is over 40 years old and due to close in the next decade, which will extend their operational life beyond the historic retirement age of 42 years.[7] Firmed renewables provide the cheapest form of new generation available to replace these assets as they retire.[8]

At the same time, electricity demand is expected to grow dramatically as Australians electrify their cars, homes and businesses, clean energy industries emerge, and the digital economy grows. Significant investment in our electricity system is needed to support growing demand and replace coal-powered capacity.

This investment has the potential to drive significant improvements in energy sector productivity – with implications across the economy (Box 1.2). Because energy sits at the heart of any modern economy, productivity improvements in the energy sector can flow on to improved competitiveness, efficiency and growth across sectors.

Investment in new forms of energy can also help improve Australia's energy security. We import over 90% of our liquid fuel needs, so petrol and diesel users are exposed to global oil prices. The natural gas fields that powered Australian industry from the 1960s are depleting. Global oil and gas prices also impact our domestic gas price, with flow-on impacts in electricity markets given the role of gas-powered generation in setting prices. Increasing domestic production of clean energy, gases and liquid fuels will increase supply security and reduce our exposure to these volatile global markets.

[7] DCCEEW analysis of Bowyer and Edis (2025)
[8] Graham P, Hayward J and Foster J (2025)

Box 1.2: Energy and productivity

Productivity is a measure of how effectively we use the finite resources in our economy. Productivity growth occurs when we make better use of these resources – the physical capital, people and ideas that make up our economy – to create more value from the same inputs.

Australia's energy transition will involve a transformational level of investment in our economy. This goes beyond investment in physical assets like solar panels or transmission lines. We will also need to invest in our people, to build the skilled workforce we need, and to invest in innovation across the energy sector.

These investments will modernise our energy system and deliver direct improvements in energy sector productivity. Opportunities to improve energy sector productivity include:

- **Improving energy performance** – that is, improving the way we manage energy demand by using energy more efficiently and optimising the energy system to deliver reliable and secure low-emissions energy. Improving performance reduces energy demand and avoids overbuilding infrastructure, resulting in sustained savings across the economy.
- **Electrification** is a key component of energy performance that can deliver immediate productivity benefits to Australia's economy. Electric technologies are generally more energy efficient, and often more cost-effective, than fossil fuel alternatives.
- **New technologies** like AI, smart grids and energy intelligence systems can unlock the full capacity of existing transmission and distribution networks, increasing the use of existing assets. Utilising these assets more efficiently will lower costs and enable Australia to better allocate finite capital and labour resources to other high-value uses across the energy sector.

This scale of investment will also drive economy-wide productivity improvement and growth in the decades ahead. The increasing appetite for investment is already testing regulatory and approval processes, and there is competition for the skilled labour needed to complete projects. Streamlining these processes, expanding the energy workforce and supporting project delivery were key themes of the August 2025 Energy Roundtable and will be critical to getting the full productivity benefits of Australia's energy transformation.

1.3 Working together to deliver the energy transformation

Governments are working collaboratively to support the transformation

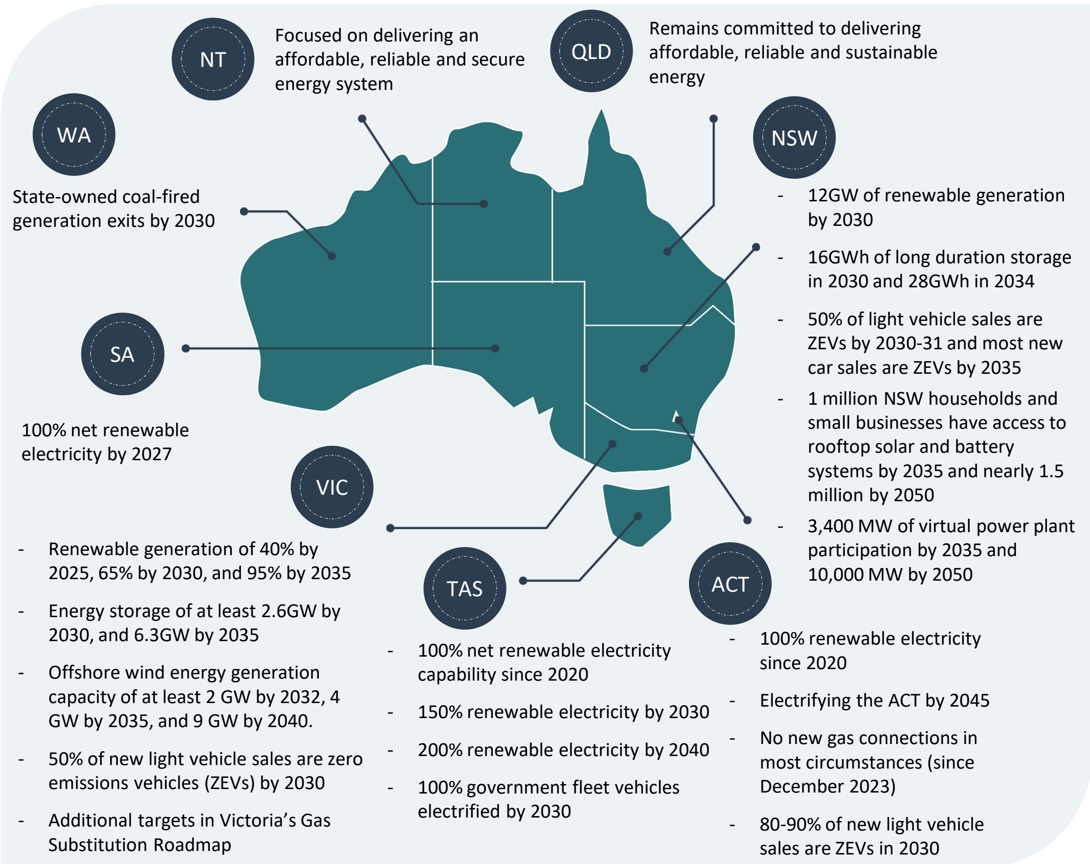
Driving the clean-energy transformation is a joint responsibility of all governments. The Australian Government is working closely with governments of all levels to support a smooth transition.

The Government has played an active role in the energy transformation in recent years. As technologies and markets mature, the focus of government will shift to enabling private industry to deliver the transformation. Clear market signals, such as those provided by existing policies like the Safeguard Mechanism, are the most efficient and effective means of driving decarbonisation across the economy.

Many of the policies required to decarbonise the electricity and energy sector are at least partly the responsibility of the states and territories to implement. Electricity supply, for example, is regulated under state and territory cooperative and jurisdiction-specific legislation. Local governments also play a key role with planning approvals, supporting the needs of their communities, and deploying renewables and storage on local government-owned real estate.

Like the Australian Government, the states and territories have set a target of net zero emissions by 2050 or earlier, alongside supporting energy targets and priorities (Figure 1.7).

Figure 1.7: State and territory energy targets and priorities



Note: State and territory energy targets and priorities are accurate as of 16 September 2025. Queensland is currently reviewing its energy targets.

The diverse energy systems across jurisdictions means each state and territory faces its own challenges and priorities. Recognising this, the Energy and Climate Change Ministerial Council (ECMC) provides a forum for Ministers from the Australian Government and each state and territory government to collaborate towards a net zero future.

The ECMC is underpinned by the National Energy Transformation Partnership (NETP), which provides a framework for the Australian Government, and state and territory governments to collaborate on the transformation of Australia's energy systems to net zero by 2050. Through the NETP, governments work together to identify issues of focus to guide actions taken by governments to help achieve the ECMC's strategic priorities and ensure Australian households, businesses and communities experience the benefit of the transition.

Building on the NETP, the Australian Government has also negotiated bilateral Renewable Energy Transformation Agreements (RETAs) with South Australia, Western Australia, the Australian Capital Territory, Tasmania, Victoria and New South Wales (NSW) to support additional ambition on top of existing commitments and help deliver new renewable generation and storage. Agreements about priorities for Rewiring the Nation support have also been entered into with NSW, the Northern Territory, Tasmania, Victoria and Western Australia. The Government will continue working closely with jurisdictions to deliver an orderly transition.

The role of the private sector and the community

Government action alone is not enough. We need the private sector and the community engaged, investing, thinking, innovating and employing. The energy transformation will be driven by private investment at a scale not seen since the mining investment boom. The Australian Government's Sustainable Finance Roadmap outlines priority measures to help mobilise the significant private capital needed to reach net zero, modernise Australia's financial markets, and maximise the economic opportunities associated with energy, climate and sustainability goals.

This plan builds on the input and insights of stakeholders across the energy sector (Box 1.3). Investors and industry stakeholders have been clear that policy and market signals are needed to provide certainty to enable investment decisions and encourage innovation that supports a high-performing energy system. These enabling frameworks and market settings will support industry's increasing role to mobilise private capital towards net zero-aligned investments and innovation to drive the energy transformation.

Ensuring community support and social licence is essential to the success of the energy transformation. While governments play a key role in supporting this, industry needs to meaningfully engage with communities, First Nations people and landholders on renewable-energy projects. Gaining community acceptance and trust, and delivering local benefits, will support smooth project delivery. The Government is helping to inform this process through its Developer Rating Scheme.

There is also an increasing role for individuals and businesses. Household and business investment is already driving changes in our energy system as Australians adopt technologies such as rooftop solar and batteries, and invest in energy efficient appliances, heating solutions and insulation. Sustaining this investment is key to reducing emissions and lowering energy costs for Australian households.

Box 1.3: What we heard

The Electricity and Energy Sector Plan is informed by extensive stakeholder consultation, including:

- 176 submissions to a public consultation paper from members of the public; community and consumer advocacy groups; state, territory and local governments; investors; the energy industry and peak bodies; large energy users; unions; think tanks and academia
- targeted roundtables with key stakeholders, including consumer and community groups, investors and engineering professionals
- ongoing discussions with industry experts, market bodies, state and territory governments.

Five broad themes emerged which were critical in shaping the plan:

1) **Provide a clear vision and long-term policy direction** for industry, investors and communities, including setting targets or milestones, establishing clear policy frameworks, and designing energy markets and systems that are fit-for-purpose for the future energy mix.
2) **Improve coordination and planning** across all levels of government, including across regulation and workforce policy.
3) **Manage an orderly transition**, including addressing price impacts and ensuring adequate energy supply.
4) **Drive adoption of new technologies and innovation** to decarbonise, including providing targeted support to build new low carbon fuel and clean energy industries, and providing incentives to shift behaviour.
5) **Provide support for households, businesses and communities** to participate and benefit from the energy transformation.

Stakeholders also emphasised the importance of addressing energy affordability, security and reliability; the need to plan for a range of technology outcomes; the role for government in addressing barriers to household and community participation in the energy transformation; and the importance of driving environmental outcomes.

2. Electricity and energy in Australia

2.1 The electricity and energy sector sits at the heart of Australia's economy

Australians rely on a combination of electricity, gas and liquid fuels to meet our energy needs. The bulk of this energy still comes from fossil fuels like coal, natural gas and oil (Figure 2.1).

As a result, a significant share of Australia's emissions come from the production and use of fossil fuel energy. Electricity generation accounts for 34% of current emissions.[9] Energy end-use accounts for a further 43% of current emissions.[10]

The energy system is complex. Each of the energy sub-sectors is interlinked, but they have distinct market structures and dynamics. This is partly because each energy type has unique characteristics that shape how they are supplied, transported and used across the economy.

Electricity is produced by transforming a primary energy source – like coal or wind – into electric energy. This energy is delivered across the country through a network of power lines. Electricity is used in every sector of the economy – for heating, cooling and cooking and to power devices, appliances and industrial equipment.

Gaseous fuels can be used as a direct energy source by households and businesses for cooking and heating, and for industrial processes like steelmaking. It is also used for electricity generation and as an input ('feedstock') to produce chemicals like ammonia. Almost all the gas used in Australia is natural gas, a fossil fuel which is transported across the economy through a network of pipelines.

Liquid fuels are used as a direct energy source for transport and to power machinery, including in the mining and agricultural sectors. Australia uses a variety of liquid fuels across the economy, including petrol, diesel and aviation fuels. A small proportion of diesel is also used for electricity generation. These fuels are mostly derived from crude (fossil) oil.

Energy needs also vary significantly by economic sector. Some sectors are more energy-intensive, and some activities require specific fuel types - for example, aircraft need a high-density liquid fuel. The cost and availability of decarbonisation options vary across fuel types and user requirements.

Our past energy choices reflect historical costs and availability of technology to power different activities. But technology options and costs are changing rapidly. In recent years, Australia's abundant renewable resources and significant cost declines in deploying solar and wind generation have driven much of Australia's decarbonisation progress. Further cost declines and technological availability will continue to drive decarbonisation and transform our energy mix.

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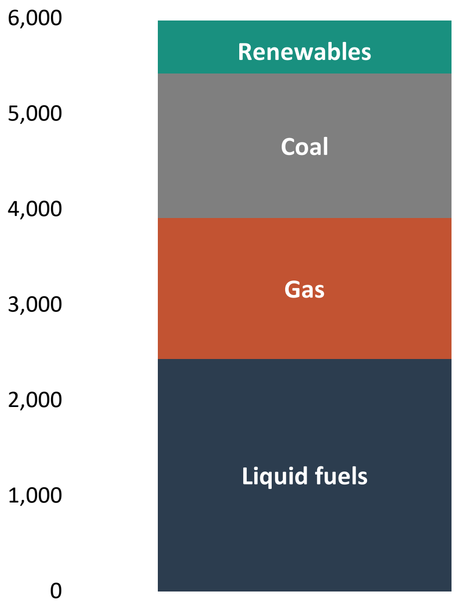
[9] DCCEEW (2025b)

[10] Ibid. End-use emissions are calculated as the sum of Transport and Stationary energy emissions. Fugitive emissions account for a further 11% of current emissions. Most fugitives occur in the coal, oil and natural gas industries and are addressed in the Resource Sector Plan.

Figure 2.1: Australian energy supply and consumption, 2023-24

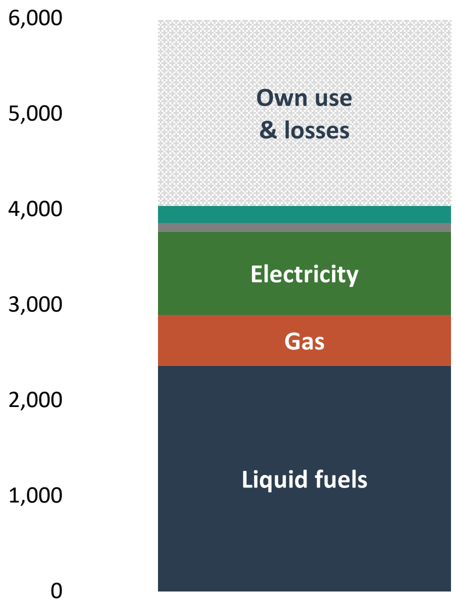
Around 90% of Australia's energy supply comes from fossil fuels

Primary energy supply, PJ



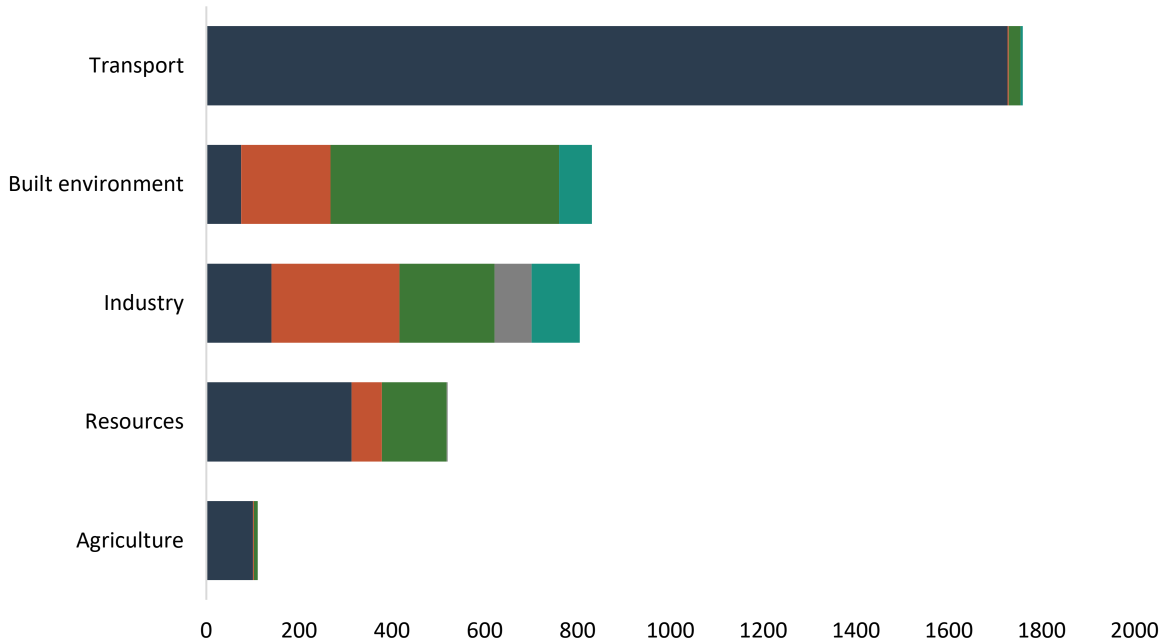
This energy is either used directly or transformed into electricity for use across the economy

Total energy consumption, PJ



Energy use varies significantly by sector

Total final energy consumption by sector, PJ



Source: DCCEEW 2025, Australian Energy Update 2025.

2.2 Emissions outlook for the electricity and energy sector

Australia's Net Zero Transformation: Treasury Modelling and Analysis

'The modelling finds that expanding the supply of renewable energy continues to be the most cost-efficient abatement opportunity, reducing emissions in the electricity sector directly and enabling broad-based decarbonisation through electrification. Fuel switching and efficient use of energy will become increasingly important over time, enabled by improving abatement technologies, and scaling up carbon removals will be required to offset residual emissions later in the transition.'

Australia's abundant renewable resources mean the electricity and energy sector is a key pillar for decarbonisation. The sector has already contributed substantially to emissions reduction to date – with annual electricity emissions peaking in 2009, and falling 22% since 2005.[11] Expanding renewable generation directly reduces emissions from electricity generation and unlocks decarbonisation opportunities across all sectors of the economy.

Treasury modelled 3 scenarios to explore how the Australian economy could evolve under different net zero transition pathways. Two of these scenarios broadly reflect the Government's Net Zero Plan: the *Baseline Scenario* where Australia builds on existing climate policies, and the *Renewable Exports Upside Scenario* where Australia captures a larger share of global green commodity markets. A third scenario, the downside *Disorderly Transition Scenario*, assumes Australia does not set a credible 2035 emissions reduction target, but resumes a trajectory towards net zero in 2050 from 2040 onwards.

The Treasury modelling provides useful insights on the potential cost-effective timing, sequencing and size of sectoral contributions to the economy-wide emissions reduction task. Supplementary energy modelling by DCCEEW provides further insight into the impacts, opportunities and risks of these changes in the electricity and energy sector.

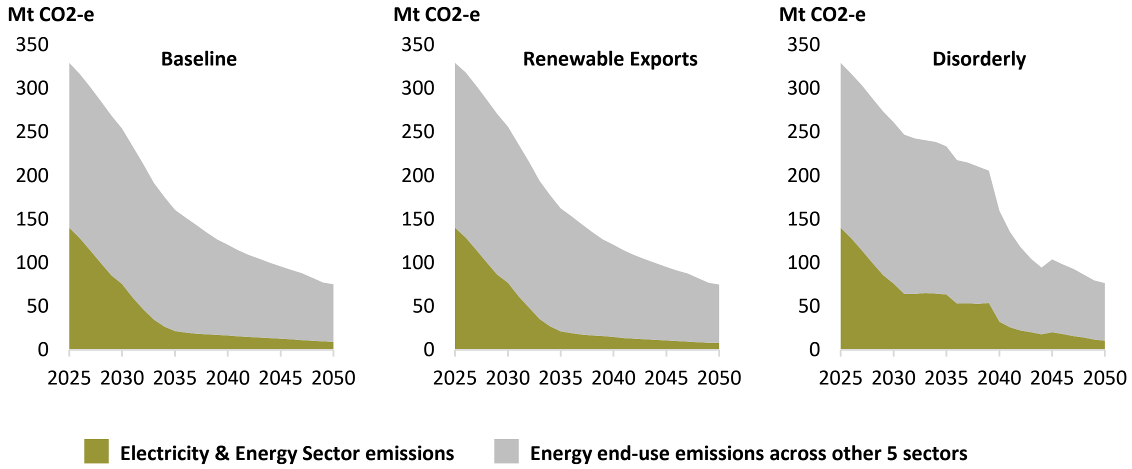
Energy-related emissions decline steadily to 2050 under the Baseline and Renewable Exports Upside scenarios. Electricity and energy sector emissions decline rapidly over the next decade, while emissions from energy end-use across other sectors fall more slowly as it takes time for users to electrify or switch to low carbon alternatives. In contrast, emissions decline more slowly under the Disorderly Transition Scenario (Figure 2.2).

The Disorderly Scenario is projected to increase wholesale electricity prices by 17 per cent on average during the 2030s and up to 54 per cent in the 2040s, relative to the Baseline Scenario. In contrast, investing in Australia's renewable exports potential could unlock broader competitiveness and help reduce cost-of-living pressures on households by reducing wholesale electricity prices by around 20 per cent by 2050, relative to the Baseline Scenario.

Under Treasury's modelling, the electricity sector drives substantial emissions reductions, particularly to 2035 – both through and beyond achievement of the 82% renewable electricity target. Decarbonisation of the electricity grid continues under all 3 modelling scenarios, showing that the most cost-efficient abatement opportunity for Australia is to expand the supply of renewable energy.

[11] DCCEEW (2025b)

Figure 2.2: Energy related emissions to 2050, by sector and scenario, Mt CO2-e



Source: Treasury modelling. Note: Energy end use covers emissions from the UNFCCC categories 'Stationary Energy' and 'Transport' across the 5 other sector plans.

Under the Baseline Scenario, emissions in the electricity sector fall from 140 Mt CO2-e in 2025 to 9 Mt CO2-e in 2050. Consistent with the Australian Energy Market Operator's (AEMO) 2024 Integrated System Plan, reductions in electricity emissions are primarily driven by decisions of coal-fired power generators to exit. In Treasury's modelling the east-coast National Electricity Market (NEM) has only 2 GW of coal capacity remaining by 2035. The Wholesale Electricity Market (WEM) in south-west Western Australia follows a similar decarbonisation trajectory.

Understanding the most prospective abatement technologies and pathways across sectors ensures that this plan will meet the evolving needs of Australia's diverse energy users. The other 5 sector plans provide detailed pathways to reduce end-use emissions in their sector. This plan adopts a whole-of-system view and focuses on decarbonising energy supply and improving energy performance to support these sector-specific decarbonisation pathways.

End-use emissions across the other 5 sectors fall substantially over the period to 2050 as gas and liquid fuel users either electrify or transition to low carbon alternatives. All sectors of the economy contribute to emissions reductions to achieve net zero by 2050, but the pace of decarbonisation varies across sectors given underlying differences in technology and the availability, feasibility and relative cost of abatement opportunities.

The Treasury modelling finds that electrification is a key source of low-cost emissions reductions, particularly for transport, the built environment, and some processes in the industry and resources sectors. Under both the Baseline and Renewable Export Upside Scenarios, renewable generation continues to expand beyond 2030 to support economy-wide electrification. Improvements in energy efficiency also support emissions reduction in the near term.

Over the longer-term, emerging technologies are anticipated to support decarbonisation in hard-to-abate sectors including some industrial sectors and heavy transport. Some industries – such as steel and alumina – are expected to transition to natural gas as a lower-emissions alternative to coal before making the transition to renewable electricity and hydrogen by 2050. LCLF are expected to offer an increasingly cost-effective decarbonisation pathway over time, supporting a reduction in diesel- and aviation fuel-related emissions by 32 Mt CO2-e and 5 Mt CO2-e respectively between 2035 and 2050 in the Baseline Scenario.

3. Setting a pathway to 2050

3.1 Australia’s energy transformation: A whole-of-system view

Australia’s energy sector will require significant structural change as our economy moves to net zero. This change will not be linear or uniform across the energy sub-sectors. Differences in technology and market readiness mean each sub-sector will transition and decarbonise at its own rate.

Setting a pathway to 2050 requires a whole-of-system view rather than considering each sub-sector (e.g. electricity, gas, liquid fuels) in isolation. This is because changes in one part of the system have flow-on effects across the system.

The Electricity and Energy Sector Plan describes a decarbonisation pathway between now and 2050 for the energy system as a whole. This pathway is characterised by 3 major shifts in our energy system (Figure 3.1).

Figure 3.1: The 3 major shifts driving Australia's energy transformation

An increasingly efficient energy system to support growing demand	A higher share of electricity in our energy mix	A shift from fossil fuels to cleaner energy sources

Emissions will decline as our energy system becomes more efficient, more electrified and transitions to cleaner sources of energy.

These system-wide shifts are described over the page in Figure 3.2 to Figure 3.5. The remainder of this chapter sets out more detailed pathways to improve energy performance and transform the electricity, gas and liquid fuel sub-sectors.

Setting out a pathway over distinct time periods to 2050 helps us to understand the key phases Australia’s energy transformation and monitor progress over time. It provides a structure for action now that will unlock opportunities in future decades. Clear ‘no-regrets’ actions will ensure we achieve our strategic objectives. Longer-term directions maintain flexibility so we can harness opportunities as they become available.

We know that certain actions are needed now to set us on the path to 2050. As we look further into the future, we have less certainty about how the energy system will develop. We can’t know all of our options to 2050 as technology and the global economy evolve – but we can understand the best pathway forward given what we collectively know today.

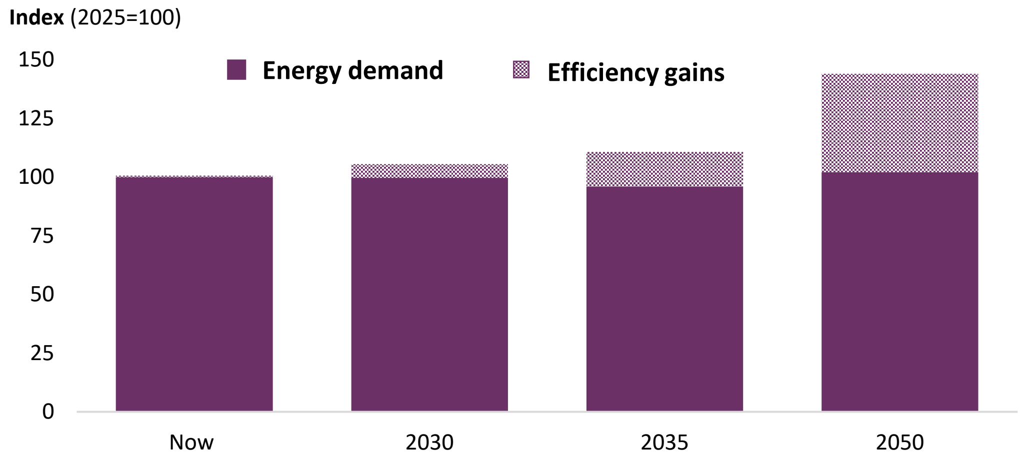
The plan therefore predominantly focusses on actions needed on the path to 2035, but with an eye to the years and decades beyond that.

The 3 major shifts driving Australia's energy transformation

1. An increasingly efficient energy system to support growing demand.

Improving energy performance will allow Australia to get more out of our energy inputs and existing energy infrastructure – with energy consumption broadly flat to 2050 even as the economy grows strongly. Our energy system becomes more efficient and the amount of useful energy in the economy grows as we move away from fossil fuels. DCCEEW analysis shows that efficiency gains can deliver energy savings at the point of use of around 30% by 2050.

Figure 3.2: Domestic energy consumption to 2050, Baseline Scenario, indexed against 2025 demand

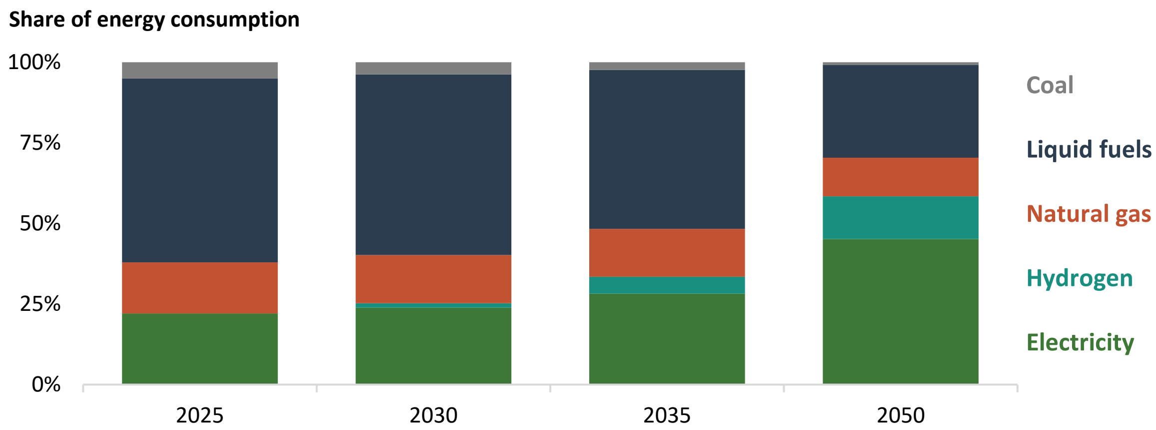


Source: DCCEEW analysis.
Note: Energy demand estimated by DCCEEW based on Treasury's Baseline Scenario. Efficiency gains estimated by DCCEEW.

2. A higher share of electricity in our energy mix.

Electricity makes up an increasing share of our energy mix as energy users electrify and new industries grow – with electricity demand doubling by 2050 under the Baseline Scenario. Gases and liquid fuels will play a continued but more specialised role in the economy, powering high-value sectors like ironmaking and aviation in the long term.

Figure 3.3: Energy consumption mix to 2050, Baseline Scenario, %

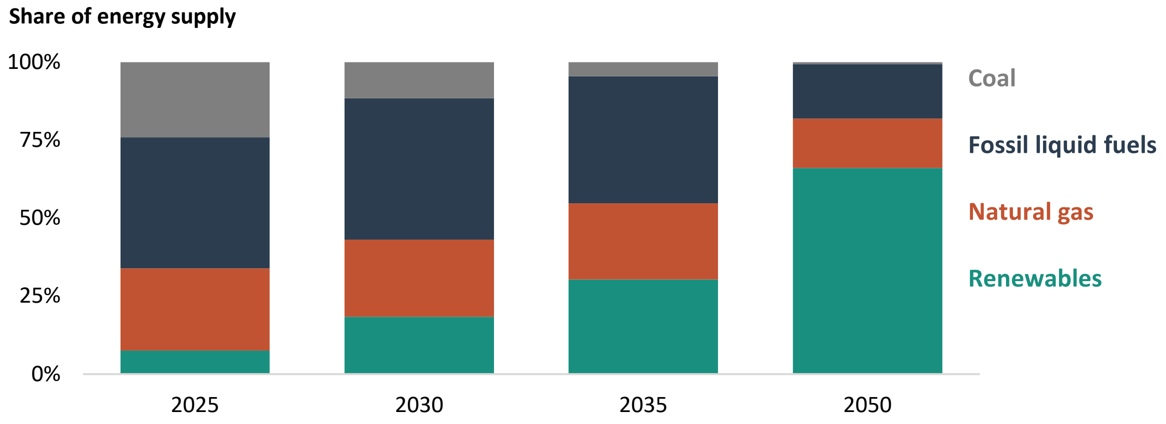


Source: DCCEEW and Treasury modelling.
Note: Energy consumption is fossil fuels energy and electricity consumed by end-use sectors. It excludes fossil fuels used in conversion sectors such as electricity generation, LNG plants, and electricity used in renewable hydrogen production. While gas used as a chemical feedstock and coal used in iron and steelmaking are sometimes excluded from final energy consumption, they are included here as significant standalone domestic economic activities.

3. A shift from fossil fuels to cleaner energy sources.

Electricity generation is already shifting from coal to renewables. Growing domestic production of renewable gases and LCLF will support the gradual decarbonisation of our gas and liquid fuel markets to support ongoing, high-value energy needs. Under the Baseline Scenario, renewable energy supply expands almost 8-fold. Renewables increase their share of total primary energy supply from less than 10% in 2025 to two-thirds in 2050.

Figure 3.4: Energy supply mix to 2050, Baseline Scenario, %

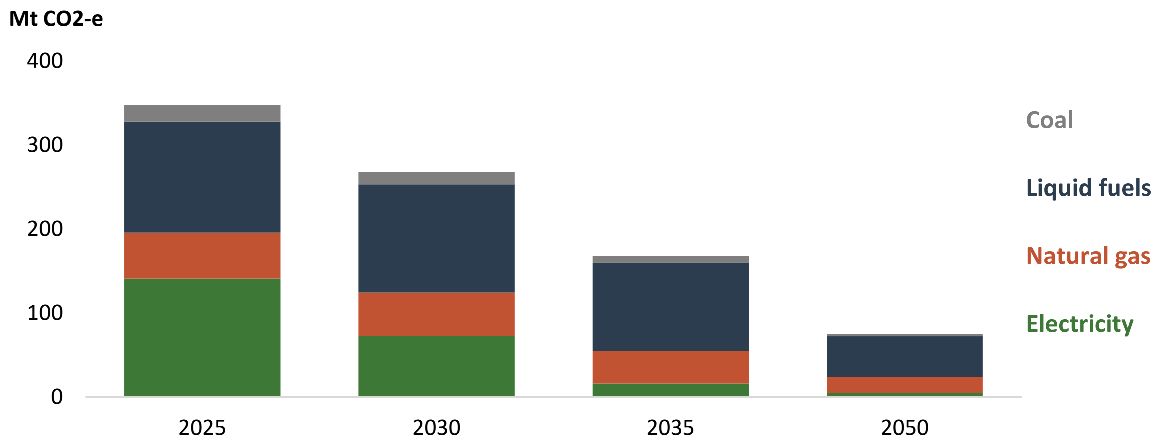


Source: DCCEEW and Treasury modelling.
Note: Renewable energy supply includes renewables used to generate electricity or to produce renewable gases and low carbon liquid fuels.

Overall, Australia's energy system becomes more efficient, more electrified and more renewable through the energy transformation.

Emissions decline across all fuel types as energy performance improves and our energy supply shifts from fossil fuels to renewable electricity, gases and liquid fuels.

Figure 3.5: Emissions by fuel type to 2050, Baseline Scenario, Mt CO2-e



Source: DCCEEW and Treasury modelling.

3.2 Energy performance

Decarbonising Australia's energy system starts with making the best use of our energy resources. That means using energy more efficiently, and changing how we use energy to take advantage of Australia's abundant renewable resources. Improving energy performance will help every sector decarbonise at lowest cost, supporting the Australian Government's productivity agenda while keeping energy reliable and affordable.

A pathway to 2050

2030	2035	2050
Coordinated policy is driving improvements across the economy	Energy performance improvements have supported achievement of the 2035 Target	Australia's energy system is high performance

Policy directions to put Australia on the pathway to 2050

Expand existing energy performance mechanisms	Increase visibility of demand-side opportunities and incentives	Incentivise energy performance improvements

New actions

The Australian Government has provided $85 million to accelerate energy performance by:

- expanding successful energy performance ratings and standards programs: Greenhouse and Energy Minimum Standards Program; Commercial Buildings Disclosure Program; National Australian Built Environment Rating System and Nationwide House Energy Rating Scheme
- establishing a Demand-side Statement of Opportunities to complement existing system planning by AEMO, highlight opportunities to improve productivity within the energy system, and lower the cost of the transition for all consumers.

The Government is also building on existing investments in EV charging infrastructure with a further $40 million to accelerate rollout of kerbside and fast charging for electric vehicles.

Overview

Energy is a critical input to every sector and an important part of the household budget for all Australians. Improving energy performance helps ensure the best use of Australia's energy resources and is directly linked to higher productivity across the economy.

Energy performance is a broad concept that refers to how well we manage energy demand. A high-performance energy system is one which uses energy efficiently and is optimised to deliver reliable and secure low-emissions energy. Actions that improve energy performance include:

- **Increasing energy efficiency** – using less energy for the same task or result. This can be done by adopting more efficient appliances and materials, or retrofitting buildings to waste less energy.
- **Electrification and fuel-switching** – replacing the use of fossil fuels with less costly and/or less emissions-intensive fuels, including renewable electricity, renewable hydrogen, biofuels and e-fuels.
- **Increasing demand flexibility** – increasing the capability to shift electricity demand to times when renewable electricity is more abundant or cheaper. This can include heating water when solar generation is high, or storing solar energy in batteries for evening use.

Driving demand-side action through these energy performance levers, whether it be electricity, gas or liquid fuel demand, can deliver benefits across the energy system (Figure 3.6).

More broadly, improving how energy is produced, transported, and consumed will support system-wide efficiency. Greater access to CER like rooftop solar, batteries and virtual power plants reduces reliance on large-scale generators and electricity networks. This helps reduce infrastructure build and energy losses.

Our energy system is becoming more efficient as we move away from fossil fuels. Much of the energy stored in fossil fuels is lost as heat during production or use, while clean energy technologies tend to be more efficient. For example:

- around 66% of the energy stored in coal is lost during the electricity generation process – while losses during renewable generation are close to zero.[12]
- conventional vehicles experience energy losses of 70-90%, with most of this energy lost as heat. In comparison, electric cars have energy losses of less than 20%.[13]

Overall, up to half of all global primary energy is currently lost and never provides users with any services or benefits. A clean energy system has 33% less loss and 31% more useful energy.[14]

[12] DCCEEW (2025a)
[13] US Department of Energy and the US Environmental Protection Agency (2025b)
[14] Rystad Energy (2024)

Figure 3.6: Summary of key levers for improving energy performance

Levers	Energy efficiency	Electrification and fuel switching	Demand flexibility
What it involves	Using less energy to perform the same activity by: • adopting more efficient appliances and materials • retrofitting buildings to be more efficient • using energy in a more efficient way.	Switching to a more efficient fuel that converts more input energy to useful work, has lower emissions and is more cost-effective, including: • electrifying, i.e. switching to electricity • switching from coal to gas.	Increasing the capacity and capability for energy users to: • change the time electricity is used • store electricity for use later.
Examples	Using more energy-efficient fridges Ensuring houses are well-insulated, reducing heating and cooling needs Using fuel-efficient cars or using active transport where accessible.	Using electric vehicles over internal combustion engines, which waste more energy as heat or sound Using a heat pump for manufacturing processes rather than gas Steel producers electrifying iron ore smelting furnaces.	Scheduling water heating or electric vehicle charging to soak up excess midday solar Increasing the capacity for flexible commercial or industrial loads to respond to market signals.
How it supports the transformation	Reduces how much energy we need across the economy Reduces peak electricity demand and the amount of energy infrastructure we need.	Supports using lower emissions fuels Reduces how much energy we need across the economy.	Reduces peak electricity demand and the amount of energy infrastructure we need Improves grid stability and utilisation Aligns demand with when clean electricity is available, reducing the cost of the transformation.

Accelerating energy performance is critical to decarbonisation

Net Zero Plan – Treasury Modelling and Analysis

'The modelling finds that electrification is a key source of low-cost emissions reductions, particularly for transport, the built environment, and some industrial manufacturing processes. Improvements in energy efficiency are also a significant contributor to reducing emissions and energy bills as electricity demand increases.'

Improving energy performance is the fastest and cheapest way to decarbonise the economy

Improving how energy is produced, transported, and consumed will support economy-wide energy efficiency (Box 3.1). Using energy more efficiently and optimising our use of renewable electricity reduces how much fossil energy we need to power our economy. It also reduces the amount of electricity generation and network infrastructure needed, minimising the risk of costly over-build.

Actions that improve energy efficiency reduce the effort and investment required to get to net zero through more costly supply side measures.

- They provide the quickest and cheapest emissions mitigation options.

  For example, the NSW Energy Savings Scheme reduced emissions by 8.6 Mt CO_2-e between 2019 and 2023, at an average abatement cost 31 to 36% lower than for renewable projects with equivalent emissions reductions.[15]

- Greater energy efficiency increases economic productivity and makes businesses more competitive.

  For example, reducing manufacturing energy use by 100PJ over the next decade could deliver a sustained increase (improvement) in industry productivity by around +0.09%, compared to the fall in the decade to 2022-23 of -0.08%.[16]

- Reducing gas and liquid fuel demand minimises the low-carbon fuel and offsets needed to decarbonise hard-to-abate sectors.

Box 3.1: Measuring economy-wide energy efficiency

We measure **economy-wide energy efficiency** using **final energy intensity**.

Final energy intensity measures the amount of energy used by consumers, like households and industry, per unit of economic output. It is calculated as total final domestic energy consumption, divided by gross domestic product (GDP).

While this metric can be impacted by changes in the composition of the economy, it is useful for comparing Australia's progress on demand-side action to other countries. The effects of energy efficiency improvements need to be considered for households, industry sectors and the economy as a whole.

[15] NSW Government Department of Climate Change, Energy, the Environment and Water (2025)
[16] DCCEEW analysis of ABS (2015)

The private market, supported by government, has led to changes in how we use energy. Australia's final energy intensity improved by around 13% over the pre-COVID decade. This was driven in part by businesses and households investing in upgrades to reduce energy bills, as well as government regulations, standards and programs. A macroeconomic shift towards less energy-intensive industries, such as services, has also contributed.

More recent policy and private action has improved Australia's energy performance outlook. Under current policies, final energy intensity is now expected to improve almost 20% over the decade to 2035 – an acceleration compared to the pre-COVID decade.

Improving energy performance enables a reliable and affordable energy transformation

A high-performance system meets demand more efficiently. Improved energy performance and CER uptake directly reduces the amount of electricity that consumers draw from the grid. Demand flexibility can reduce the need for new generation and network infrastructure while also supporting system security (Box 3.2).

This helps to avoid overbuilding infrastructure, resulting in sustained savings across the economy and lower energy bills – not only for the consumer investing in the upgrades, but for all households and businesses.[17]

- Switching to more efficient electric technologies can deliver significant savings for energy users. A household that electrifies and installs solar panels and a battery could save around $4,300 per year, after accounting for upfront and financing costs (see *5.1 Household benefits*).
- Minimising peak demand reduces wholesale electricity prices by lowering the amount of expensive gas-fired generation required to firm renewables, particularly over winter (see *3.3 Electricity*). More efficient and flexible electricity demand also makes it easier to achieve higher levels of renewable penetration in the grid and delivers more efficient utilisation of the grid, lowering costs for all users.
- Reducing the amount of new network infrastructure investment reduces network tariffs on energy bills. Network investment costs are passed onto consumers and accounted for almost 40% of the average energy bill in 2023-24.[18] The NSW Energy Savings Scheme, which deferred an estimated $168 million of network investment, saved households an estimated $98 per year and businesses $277 per year on electricity bills over 2019 to 2023.[19]

Households and businesses make significant investments in assets like cars, appliances and industrial equipment, which often have multi-decade lives. Replacing these assets when they reach their end-of-life with energy efficient and 'flexible' electric options also avoids locking in more costly infrastructure.

[17] Graham, Meher-Homji, Havas and Foster (2023)
[18] ACCC (2024)
[19] NSW Government Department of Climate Change, Energy, the Environment and Water (2025)

Box 3.2: Demand flexibility can support Australia's energy transformation

Households, businesses and industry can help to shift when energy is used to better match when renewable electricity is available. This has benefits for improving grid stability, reducing peak demand and managing supply shortfalls – which reduces the firming and infrastructure investment required to meet electricity demand through the transformation (see *3.3* Electricity). This includes:

- Matching daily demand to periods of high renewable output, for example by shifting evening energy use to the middle of the day
- Adjusting energy use over longer periods of lower energy availability, such as through winter
- Temporarily adjusting energy demand from the grid to support the system during emergency events. This can prevent blackouts during extreme weather events.

'Smart' electric appliances, timers and batteries can help households use energy more flexibly. Business and industry can support grid stability by adopting on-site energy storage to support participation in grid demand management schemes. Research and development (R&D) for technologies that enable this for more energy users can increase this potential.

Analysis by DCCEEW illustrates some of the potential benefits of flexible demand in the NEM (Figure 3.7). This analysis compares the Baseline Scenario with a sensitivity that assumes greater flexibility for on-grid hydrogen production and some industrial load. The additional flexibility results in reduced generation investment, lower system costs, and lower reliance on gas powered generation to support the grid and associated emissions.

Figure 3.7: Potential benefits of flexible demand in the NEM

From 2035-2050 in the NEM

$3 billion	15%	10%
in net market benefit	less gas usage	lower emissions

New market incentives may be needed to deliver efficient levels of demand flexibility. This will need to be supported by appropriate regulation and standards (e.g. the National CER Roadmap).

Source: DCCEEW and Treasury modelling.

The energy performance pathway to 2050

Energy performance will need to improve through the transformation to 2050. More can be done to accelerate progress on energy performance. Along the pathway to 2050:

- Energy efficiency improves across sectors
- Electrification and fuel-switching reduce emissions and support economy-wide energy efficiency
- Demand flexibility is increasingly integrated into our electricity system.

Figure 3.8 sets out the key milestones on this pathway to 2050.

The Australian Government has committed to accelerating energy performance improvements. At the 2023 United Nations Framework Convention on Climate Change Conference (COP28), Australia committed to working with member countries to achieve the Energy Efficiency Pledge of doubling the average rate of global energy efficiency improvements from 2% to 4% every year until 2030.[20]

Energy performance improvements are particularly important to support the 2035 Target. DCCEEW analysis suggests a 25% improvement in economy-wide energy efficiency by 2035 would be an ambitious and achievable contribution to meeting our 2035 emissions reduction target.

Relative to a current policies trajectory,[21] this level of improvement could:

- **abate substantial CO2-e emissions, with cumulative savings of 33 Mt CO2-e between 2025 and 2035**, or around 9% of the estimated emissions gap between the Baseline Scenario and a current policies trajectory.
- **reduce total final energy consumption by 187 PJ in 2035**, or almost 50% more energy savings due to energy performance to 2035 compared to the current policies trajectory.
- **increase productivity** across industries.

To coordinate longer-term action, the Australian Government has set out a National Energy Performance Strategy (NEPS), developed in close collaboration with state and territory governments. In the near-term, it prioritises improving access to information, reducing upfront costs of energy performance improvements, and addressing split incentives such as between landlords and tenants.

Existing initiatives supporting residential energy performance include the Household Energy Upgrades Fund and the Social Housing Energy Performance Initiative to support upgrades in Australian homes. The 2024 amendment to the Australian Renewable Agency (ARENA) Act also permanently expanded ARENA's mandate to support electrification and energy efficiency, with programs like the Industrial Transformation Stream of the Powering the Regions fund supporting key industrial efficiency improvements. Innovation and technological progress, including on AI can also help optimise and manage energy demand.

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[20] Note: the COP28 Energy Efficiency Pledge measures energy efficiency using primary energy intensity, that is primary energy consumption divided by GDP. Primary energy consumption includes both final energy consumption and energy own use and losses, such as energy lost while transforming fossil fuels into electricity. Our definition of energy efficiency is narrower; see IEA (2024d).
[21] Based on Australia's emissions projections 2023 'with additional measures' scenario; DCCEEW (2023).

Figure 3.8: Energy performance milestones on the pathway to net zero

Milestones on the path to 2050

2030	2035	2050
Coordinated policy is driving improvements across the economy	**Energy performance ambitions have supported achievement of the 2035 Target**	**Australia's energy system is high performance**
✓ Household and business energy efficiency upgrades and electrification is supported by clear information ✓ Regulation, standards and markets are in place to incentivise investment in technologies that improve energy performance ✓ New consumer energy resources investments are well integrated and responsive to price signals ✓ Commercial and industrial equipment is energy efficient and has the capability to flex, where possible	✓ Every household has the information, capability and incentives to electrify ✓ Many businesses and low-heat industrial users have electrified ✓ The share of consumer energy resources that can be orchestrated is increasing ✓ Market settings incentivise increasing industrial & large user demand flexibility ✓ Demand flexibility is embedded across most user types	✓ All energy users that can have chosen to electrify ✓ The electricity system is underpinned by efficient and flexible assets ✓ Consumer energy resources are fully integrated to maximise system performance ✓ Market settings, regulation and policy incentivise large electric loads to operate flexibly to support system stability

- ✓ Electrification of households, business and industry is enabled by an efficient, reliable and secure electricity grid
- ✓ All households can access or benefit from energy performance improvements

Energy efficiency improves across sectors

Government measures across the Commonwealth and states and territories are supporting progress on energy efficiency. Further sector-specific opportunities are identified in other sector plans, including expanding access to energy ratings for homes, commercial buildings and appliances and implementing key elements of the updated Trajectory for Low Energy Buildings, which are addressed in more detail in the Built Environment Sector Plan. There are also opportunities to address incentive gaps, such as for some commercial and industrial facilities to perform efficiency upgrades beyond state and territory white certificate schemes, grant programs and the Safeguard Mechanism.

Improvements in energy efficiency are particularly important to support broad-based electrification. For example, under the Baseline Scenario, NEM demand would be over 20% higher by 2050 without energy efficiency improvements. Reduced demand from energy efficiency helps relieve supply pressures to build renewables and firming capacity, and augment electricity networks.

Electrification and fuel-switching reduce emissions and support economy-wide energy efficiency

Electrification can be an effective way to decarbonise key sectors including buildings, transport, and some industry and resources sub-sectors. Electrification is also a key lever for improving whole-of-economy energy efficiency, because electric technologies tend to be more efficient than their fossil fuel alternatives.

State and territory governments are supporting **residential electrification**. Electric options are already cost-competitive for many uses, like household heating or passenger cars – with 125,000 gas hot water systems replaced with electric systems annually.[22] The cost of electric technologies is expected to fall further as adoption and innovation grow.

There are significant opportunities to accelerate **industrial electrification.** Electric technologies like industrial heat pumps are currently available to electrify some industrial processes. New technologies will make electrification more viable for a wider range of processes. Despite this, electricity consumption in the manufacturing sector has changed minimally over the last 10 years, increasing as a share of total energy consumption by less than 2 percentage points from 23.6% to 25.5%.[23] Where electrification of fossil fuel activities is not viable, fuel switching to low emissions gas and liquid fuels can support an alternative decarbonisation pathway.

As households and businesses electrify, there will be a need to manage system impacts and ensure no one is left behind.

- Electrification increases electricity demand and may place greater pressure on electricity networks, particularly as large industrial users electrify. 'High quality' electrification is vital. This means improving appliance and equipment efficiency and flexibility to reduce the impact of electrification on the grid. Choosing the right combination of 'smart' appliances and equipment to support demand flexibility while electrifying will maximise benefits.
- Accelerating electrification has implications for disconnections from gas networks and the viability of continuing to use gas for remaining users. The cost of staying connected to the gas network will grow in the absence of targeted action as network costs are spread across a smaller group of consumers, which could have equity implications if lower income households are least able to switch.

These considerations are discussed in more detail in *3.3* Electricity and *3.4* Gaseous fuels.

Demand flexibility is increasingly integrated into our electricity system

Households and smaller businesses can participate in demand response programs, particularly when their electricity demand and production is aggregated through virtual power plants. On the other hand, many large users participate on an individual basis including by:

- scheduling their load profiles to align with high and low price periods, or dynamically shifting loads in response to market signals
- enrolling in market mechanisms to respond to periods of high demand or critical events affecting the grid through the Reliability and Emergency Reserve Trader Scheme
- responding to grid management requirements such as frequency control ancillary services.

[22] CCA (2024b)
[23] DCCEEW (2025a)

Market operators currently lack visibility of energy users' capacity to operate flexibly, even when that capacity is being actively deployed through agreements with suppliers or networks. This can lead to sub-optimal market interventions, such as unnecessary peak electricity generation or deployment of frequency control ancillary services to stabilise the grid.

There is significant scope to further unlock industrial potential, but this will require greater market operator visibility of industrial loads and supporting large energy users to build capability. The potential for industry to participate in demand flexibility programs will depend on operational imperatives, as well as having the right market arrangements, signals and incentives. To support this, energy market bodies have been developing reforms including to the recently established Wholesale Demand Response Mechanism.

Providing the right incentives to shift energy use in the design of the NEM can also unlock demand flexibility. This is being considered by the Government-commissioned independent expert review of the NEM's wholesale market settings, as part of their examination of how to promote investment in firmed renewable energy generation and storage capacity beyond 2030 more broadly.

Accelerating energy performance to 2035

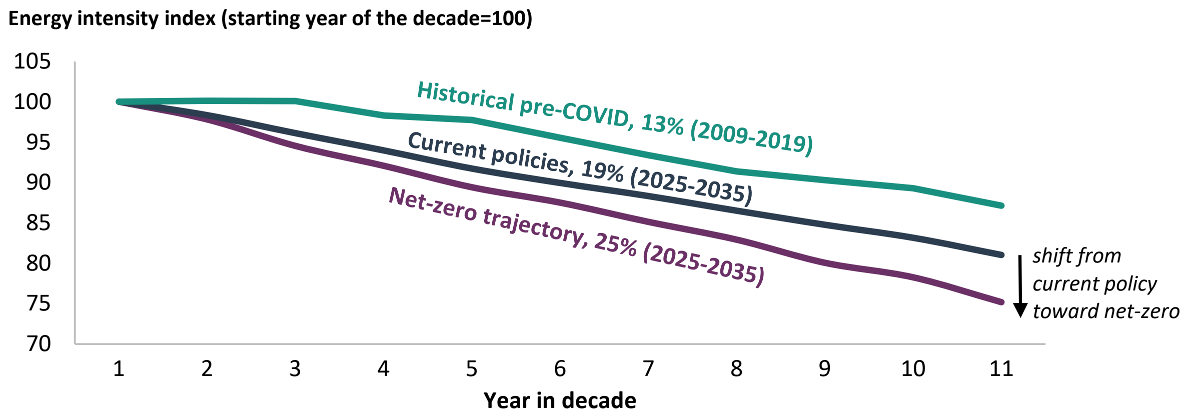
DCCEEW analysis suggests a 25% improvement in economy-wide energy efficiency by 2035 would be an ambitious and achievable contribution to meeting our 2035 emissions reduction target. This is based on achieving levels of improvement in energy efficiency and electrification consistent with Treasury's Baseline Scenario.

The benefits of achieving this level of economy-wide energy efficiency improvement depend on the specific pathway taken. For example, quicker adoption of electric vehicles that saves the transport sector 10 PJ per year could increase industry multi-factor productivity by 0.15%.

Enhanced policy settings can help put Australia on this pathway. Existing policy settings have substantially improved the outlook for economy-wide energy efficiency over the coming decade. Nonetheless, there remains a gap between what current policy achieves, and the level of improvement in economy-wide energy efficiency that is consistent with a least-cost net-zero aligned pathway (Figure 3.9).

Figure 3.9: Current policies have already improved Australia's energy performance– but there is more to do

Economy-wide energy efficiency improvement over the past and next decade, index

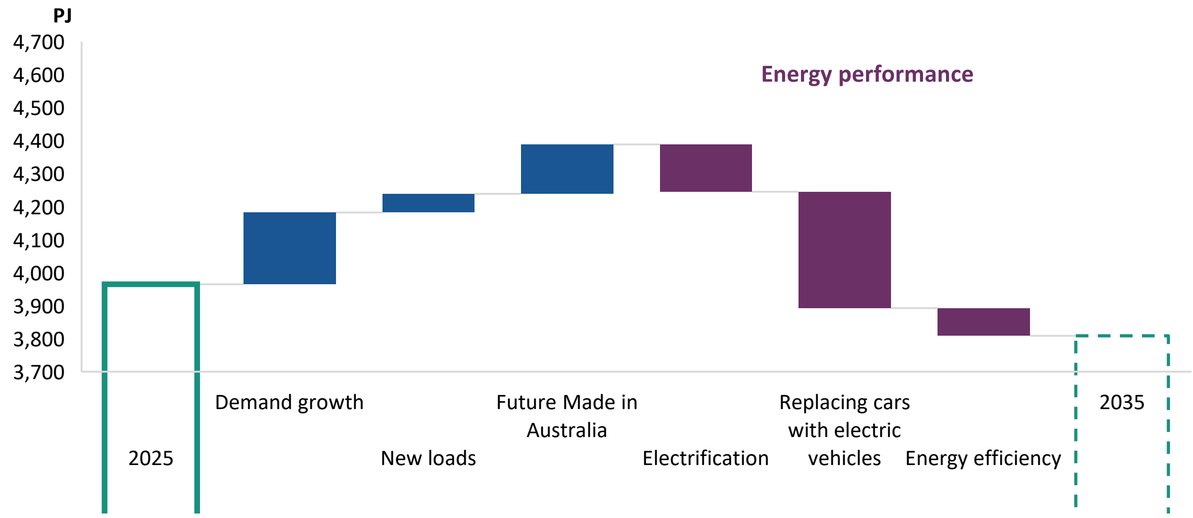


Source: DCCEEW analysis using DCCEEW 2023, Emissions Projections 2023.

DCCEEW analysis explores one possible path to accelerating improvements in economy-wide energy efficiency. Under this path, EV adoption accelerates to reach over a third of the vehicle fleet by 2035. Electrification and technical energy efficiency improvements also deliver significant energy savings. Achieving this level of improvement would offset expected increases in energy demand from electrification, economic growth and new industries to 2035 – allowing other sectors to grow (Figure 3.10).

Figure 3.10: Energy performance improvements can offset expected increases in energy demand to 2035

Key drivers of changes in energy demand to 2035, PJ



Source: DCCEEW analysis using DCCEEW 2023, Emissions Projections 2023; consistent with Treasury's Baseline Scenario.

Policy directions to put Australia on the pathway to 2050

This plan sets out economy-wide policies that complement policies in other sector plans to improve energy performance in their sector. There are 3 key areas where government action can accelerate progress in the near-term.

Figure 3.11: Energy performance policy directions

Expand existing energy performance mechanisms	Increase visibility of demand-side opportunities and incentives	Incentivise energy performance improvements

Expanding existing energy performance mechanisms.

The Australian Government is expanding proven energy rating and standards programs in the residential and commercial built environment to give Australian households and businesses better information and signals to improve their energy performance and reduce costs. This includes:

- modernising the Greenhouse and Energy Minimum Standards (GEMS) Act to account for demand flexibility in appliance and equipment standards and expanding the application of GEMS requirements to commercial and industrial sectors
- investing in the National Australian Built Environment Rating System for non-residential buildings
- expanding the Commercial Building Disclosure (CBD) program to more commercial building types beyond office buildings, and expanding the Nationwide House Energy Rating Scheme (NatHERS) to cover existing homes.

The Government is also building on existing investments in EV charging infrastructure with a further $40 million to accelerate rollout of kerbside and fast charging for electric vehicles.

Increasing visibility of demand-side opportunities and incentives.

The Australian Government is establishing a Demand-side Statement of Opportunity (DSOO), to be developed in collaboration with AEMO and states and territories via the ECMC. This will help to ensure the energy system is ready for new electricity loads, and identify opportunities to reward consumers for providing demand services and avoid costly system build out where flexible demand can achieve an equivalent system outcome. The DSOO would complement AEMO's existing supply-side Gas and Electricity Statements of Opportunities and integrated system planning.

Additional actions include:

- working with the ECMC to address recommendations by the National Electricity Market Review Panel that support more flexible demand in the NEM
- continuing policy and analytical work to help manage economy-wide electrification, including through enhanced analysis and understanding of incentives and barriers to electrify, and monitoring the pace of electrification to consider unintended outcomes
- updating the National Energy Performance Strategy to coordinate further action.

Incentivising further energy performance improvements.

There are large opportunities to incentivise more efficient network investment and operation for commercial and industrial energy users that are not captured under the Safeguard Mechanism.

3.3 Electricity

Electricity in Australia today

22%	of Australian total final energy consumption	**Over 40%**	renewable generation share in our 2 largest grids
34%	of Australia's emissions	**8%**	of electricity generation is off-grid

Electricity in Australia's energy transformation

Electricity is central to Australia's decarbonisation as firmed renewables can drive emissions reduction and enable economy-wide electrification. The sector will significantly expand and transform to meet demand from electrification and new industries. A system dominated by variable renewable electricity will be more distributed, bidirectional and will require sufficient long-duration firming.

A pathway to 2050

2030	2035	2050
82% renewable electricity	**Orderly exit of coal through the 2030s**	**Transition to a net zero system**

Policy directions to put Australia on the pathway to 2050

Incentivise private investment in firmed renewables	**Optimise the use of our network infrastructure**	**Get the most out of consumer energy resources**

New actions

At the start of 2025 the Government added $2 billion to the Clean Energy Finance Corporation (CEFC) general funding, allowing it to sustain its crucial investments in clean energy technologies.

The Government will update the CEFC's investment mandate to include a new focus on the rapid roll out of renewable projects to drive down electricity prices, and commit up to $2 billion more to the CEFC General Account, to be drawn down in line with these changes.

The Australian Government has commissioned a Review of the NEM wholesale market settings and will work with states and territories to consider the recommendations.

Overview

Electricity is crucial for modern life, powering essential aspects of our daily activities, businesses and infrastructure.

Australia's electricity systems were originally powered by coal-fired generators, which have long underpinned both supply and system security. Many of today's coal plants are now nearing the end of their operational life and are increasingly unreliable.

As these plants are retired, they are progressively being replaced by renewable sources like solar, wind, and firmed by battery storage. Renewables now supply over 40% of electricity in the NEM and the South West Interconnected System (SWIS) – Australia's 2 largest grids.[24] This shift is being driven by government support for climate action and the falling costs of mature renewable technologies.

The renewable rollout is being complemented by enhanced peaking, firming and system security measures to ensure system reliability and security. This includes pumped hydro and natural gas-fired generation, which plays an important role in managing periods of low renewable generation, particularly in winter. Renewables provide the cheapest form of new generation even when accounting for these additional firming costs.

At the same time, our electricity system is becoming more dispersed and bidirectional. Households are playing a more active role in energy markets by generating, storing and flexibly using electricity. With solar panels installed on more than a third of Australian homes, there is more rooftop solar capacity than all of the remaining coal fired generators, providing around 11% of Australia's electricity generation.

The expansion of renewable generation has already driven substantial emissions reductions since 2005. Continued growth in renewables will further reduce electricity sector emissions and enable economy-wide decarbonisation through electrification.

Reaching 82% renewable electricity by 2030 is a major milestone on the path to net zero, supporting Australia's target of reducing emissions to 43% below 2005 levels by 2030. To meet this goal, the pace of utility-scale renewable and storage deployment has accelerated and will need to continue to grow. Beyond 2030, maintaining a strong build rate will be essential to support our 2035 Target and meet a doubling of current electricity demand by 2050.

This comes with challenges – there is a need for private market investment to maintain a high renewable build rate, alongside ensuring sufficient long-duration firming and better use of existing network infrastructure and CER.

[24] DCCEEW analysis of Open Electricity (2025)

The electricity pathway to 2050

Australia's energy system will expand and transform to support our transition to a net zero economy.

Continued momentum in the rollout of firmed renewable generation will be key to decarbonising Australia's electricity system. Australia's on-grid electricity system is decarbonising rapidly, with the 2 largest grids now supplied by over 40% renewable energy. These grids together supply nearly 90% of the electricity used across Australia.

Australia's Net Zero Transformation: Treasury Modelling and Analysis

'Strong investment in renewable energy remains foundational to Australia's efficient transition, and emission reduction will be required across all sectors. The modelling finds that expanding the supply of renewable energy continues to be the most cost-efficient abatement opportunity, reducing emissions in the electricity sector directly and enabling broad-based decarbonisation through electrification.'

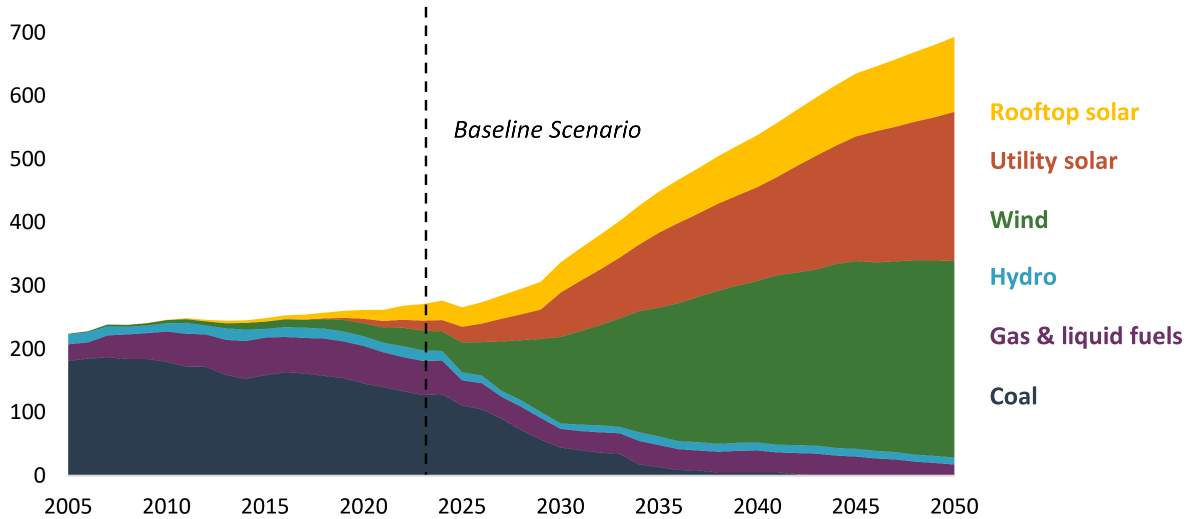
Renewables will also be key to decarbonising Australia's off-grid electricity systems, which provide around 8% of total generation and are essential for our remote communities and industries. Gas-powered generation currently provides 80% of total off-grid generation, and most of Australia's oil-fired generation occurs off-grid. When both on and off-grid generation is included, electricity is supplied mostly by coal (46%), renewables (35%), and gas (17%).

By 2050, our electricity system will be dominated by renewable sources (Figure 3.12). Variable generation will comprise a mix of utility-scale and rooftop solar, alongside both onshore and offshore wind. Dispatchable generation will primarily rely on hydro and gas-powered sources. Batteries will also play a crucial role in energy storage, particularly in managing daily demand fluctuations, and will assist in providing reliable energy supply for regional and remote communities. Network infrastructure is expected to be optimised and delivered cost-effectively, with the grid underpinned by efficient and flexible assets.

Figure 3.13 sets out the key milestones on this pathway to 2050.

Figure 3.12: Australia's electricity generation mix will increasingly shift to renewables

Electricity generation mix in Australia, Baseline Scenario, TWh



Source: DCCEEW and Treasury modelling. Note: Excludes storage discharge.

Figure 3.13: Electricity milestones on the pathway to net zero

Milestones on the path to 2050

2030

82% renewable electricity

- ✓ Renewable generation has expanded to 82% while the market is driving further investment as Capacity Investment Scheme support sunsets
- ✓ Rooftop solar and batteries continue to expand, cutting bills and emissions
- ✓ Expanded firming capacity, including gas-powered generation, is supporting the renewable rollout
- ✓ Settings are in place to incentivise investment in long-duration firming
- ✓ Regional and remote communities are starting to transition to renewables
- ✓ Settings are in place to support new off-grid generation for Future Made in Australia industries

2035

Orderly exit of coal through the 2030s

- ✓ Coal exits are orderly and supported by firmed renewables
- ✓ Renewable generation continues to grow to support the 2035 Target
- ✓ Post-NEM Review market settings to promote investment in firmed, renewable generation and storage capacity in the National Electricity Market
- ✓ Low emissions long-duration firming technologies continue to scale
- ✓ Demand flexibility and well integrated consumer energy resources support grid stability
- ✓ Increasing off-grid and small grid generation supplies Future Made in Australia industries

2050

Transition to a net zero system

- ✓ Renewable generation capacity expanded to deliver low-cost electricity
- ✓ Firming capacity is net zero emissions with remaining gas-powered generation fully abated
- ✓ Remote communities are powered by renewables backed up by clean firming
- ✓ The electricity grid is underpinned by efficient and flexible assets
- ✓ The electricity system has accommodated significant off-grid investment as Future Made in Australia industries scale

- ✓ Electricity remains affordable, reliable and secure
- ✓ Consumers are empowered to more actively participate in the electricity retail market if they choose (e.g. through virtual power plants)
- ✓ Social licence for the renewable transition is maintained
- ✓ Network infrastructure is constructed and utilised efficiently

Our electricity system will need to expand to meet demand from electrification and new industry growth, including from data centres (Box 3.3). Energy efficiency improvements will offset some of this growth – as detailed in *3.2 Energy performance*. The profile of electricity demand will also change, with greater variability in generation, changing peak demand and new large loads.

By shifting from coal to renewables, scaling renewable supply, and improving performance of our networks and how we use electricity, Australia can decarbonise the sector and service new demand. Whilst there is a clear technological pathway for the decarbonisation of electricity supply, challenges remain in rolling out the required generation and network infrastructure (see *4 Enabling the transformation*).

It will be critical to manage electricity system security – the system's capability to withstand and recover from disturbances and contingencies – as Australia's energy transformation gathers pace and synchronous power plants like coal exit the system. Through the ECMC, governments are working collaboratively with energy market bodies and networks to ensure we have appropriate regulatory frameworks, technological innovation and policy settings in place to maintain a stable, reliable and safe power system through the energy transformation.

Box 3.3: Artificial intelligence and data centres

Digitalisation is a key driver of productivity in the Australian economy and underpins significant growth opportunities. The rapid growth of data centres is a market response to these opportunities, which will grow further with the expected expansion in AI-driven demand. AI can help optimise energy management, enhance grid stability, and mitigate cybersecurity risks.

While data centres deliver significant benefits, they are increasing electricity demand and present challenges for the grid. Data centres require a continuous energy supply, and generally prefer to draw a consistent load from the grid, which needs to be balanced with the variable nature of renewable energy.

AEMO estimates the electricity consumed in the NEM by data centres is currently around 4 TWh (2% of grid demand). AEMO forecasts consumption to grow to around 12 TWh by 2029-30 (equivalent to 6% of the NEM's grid-supplied electricity), reaching around 34 TWh (or 12% of the grid supplied electricity) by 2049-50.[25]

A crucial tool for managing the integration of data centre loads into the energy system will be the deployment of flexible demand. In the US, Google has reached agreements with 2 energy providers to reduce its electricity consumption for AI on request during periods of high demand.[26]

The Australian Government is working with states and territories, energy market bodies, network service providers and the data centre industry to harness the opportunities from the growth in data centres, while managing the implications for Australia's electricity systems.

[25] AEMO (2025)
[26] Kearney (2025)

Long duration firming will be critical in a system dominated by variable renewable electricity

As we shift to renewables and coal exits the electricity system, long-duration firming options, including gas-powered generation, will act as a backup in periods of low renewable generation and high demand.

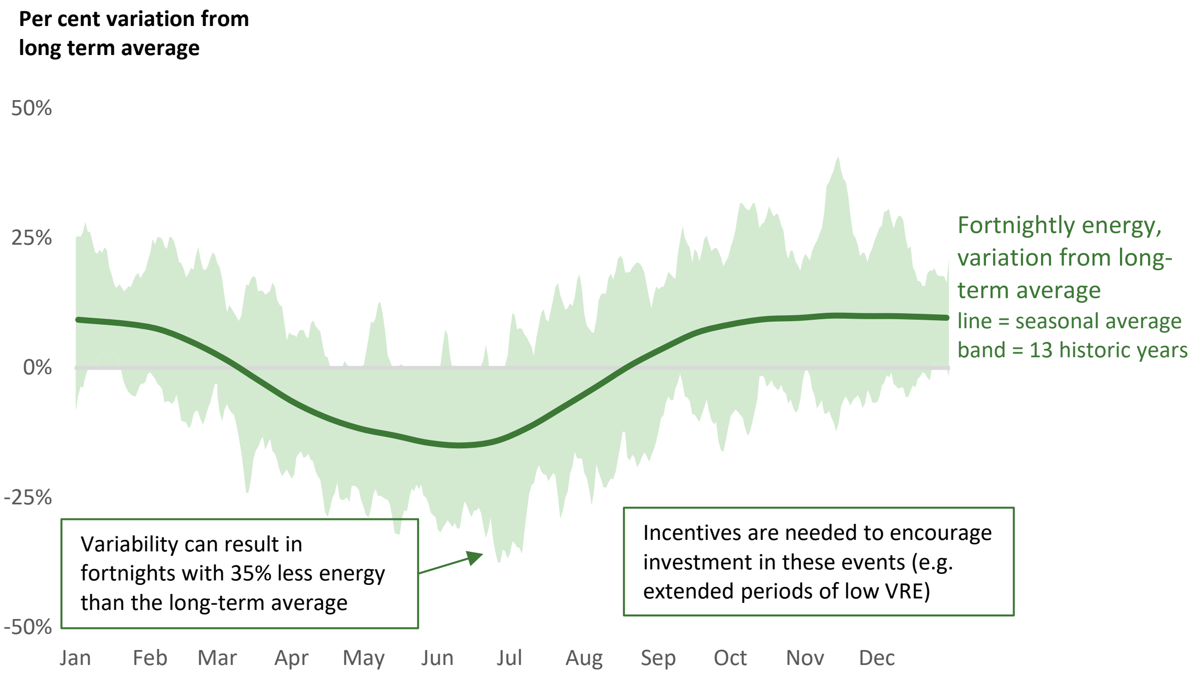
A diversified mix of renewable generation sources like solar, onshore and offshore wind will, on average, reduce seasonal variability since solar output alone is consistently lower in winter (Figure 3.14).

Clean long-duration energy storage technologies like batteries and pumped-hydro can also be used to manage predictable, daily and seasonal fluctuations in generation. However, these technologies may become depleted during periods of low solar and wind generation.

During these challenging periods, gas-powered generation is currently the most affordable solution for long duration firming, offering the cheapest insurance against periods of extended low generation. Under the Baseline Scenario, gas-powered generation in the NEM represents around 5% of total capacity, but just 3% of total generation in 2050.

Figure 3.14: Australia's electricity system will need to be resilient to fluctuations in renewable output

Variable renewable energy (VRE) variation from long term average, across 13 years of historic weather patterns



Source: DCCEEW analysis of AEMO 2024, Integrated System Plan.

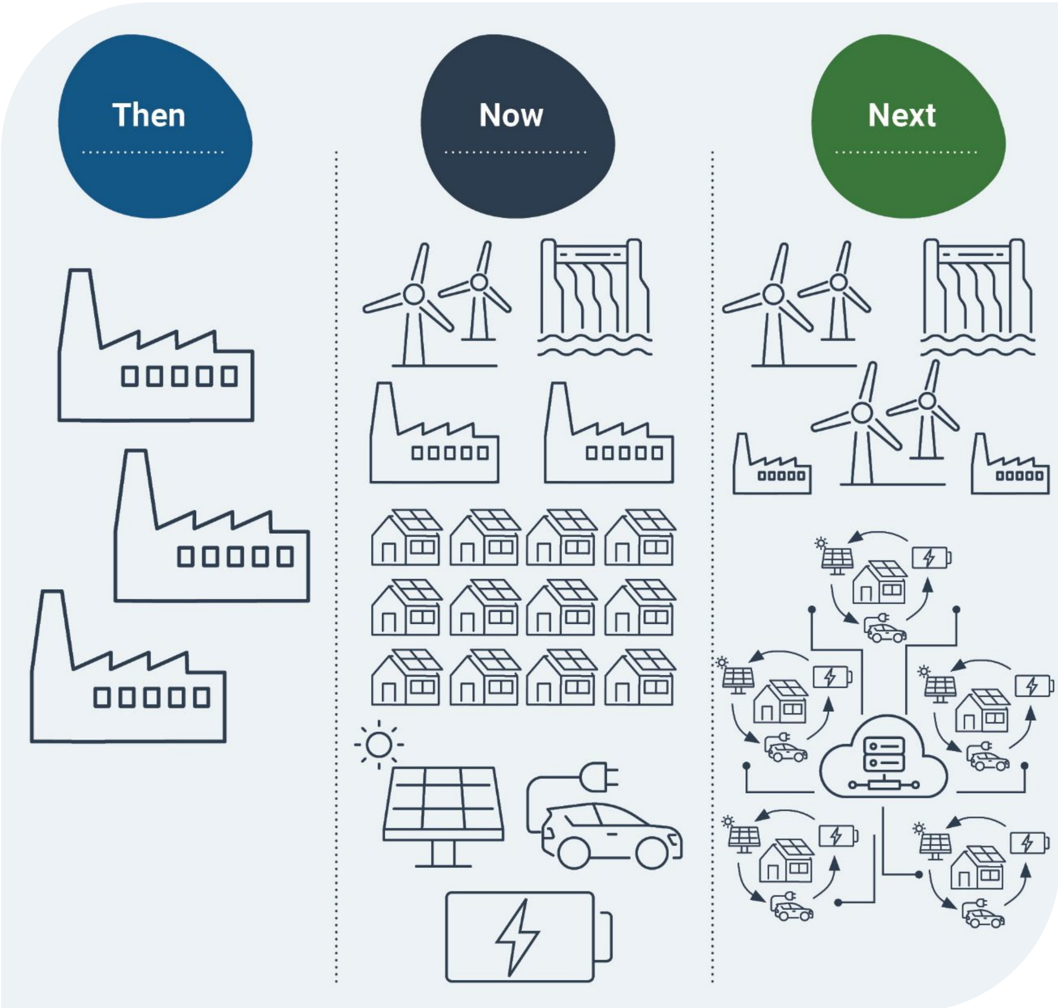
An increasingly bidirectional and decentralised electricity system unlocks opportunities

Households and businesses will also play a more active role in generating and storing electricity. What was once a relatively straightforward, one-directional market where large generators like coal-fired generators supplied electricity to consumers, is now evolving into a decentralised model that supports 2-way power flows (Figure 3.15).

This transformation is being led by the uptake of CER – such as rooftop solar panels, electric vehicles and home battery storage – which enables households, industries and businesses to generate, store and manage their own electricity. Complementary services like virtual power plants, aggregation services, bidirectional charging and home energy management systems can further empower consumers to optimise their energy use. The CCA has highlighted the significant potential of solar and batteries on commercial and industrial properties, as well as rural properties, as an important opportunity for Australia.[27]

As CER deployment accelerates and innovative technologies are developed, the electricity system is becoming more dynamic, with a greater number of participants and increasingly blurred lines between supply and demand. While this creates a more complex system, it also unlocks opportunities to reduce overall system costs and deliver better value to consumers.

Figure 3.15: Australia's evolving electricity system



[27] CCA (2025b)

An expanded electricity grid will support new demand

Electricity generation more than doubles by 2050 in the Baseline Scenario to meet new demand from electrification and new emerging industries.

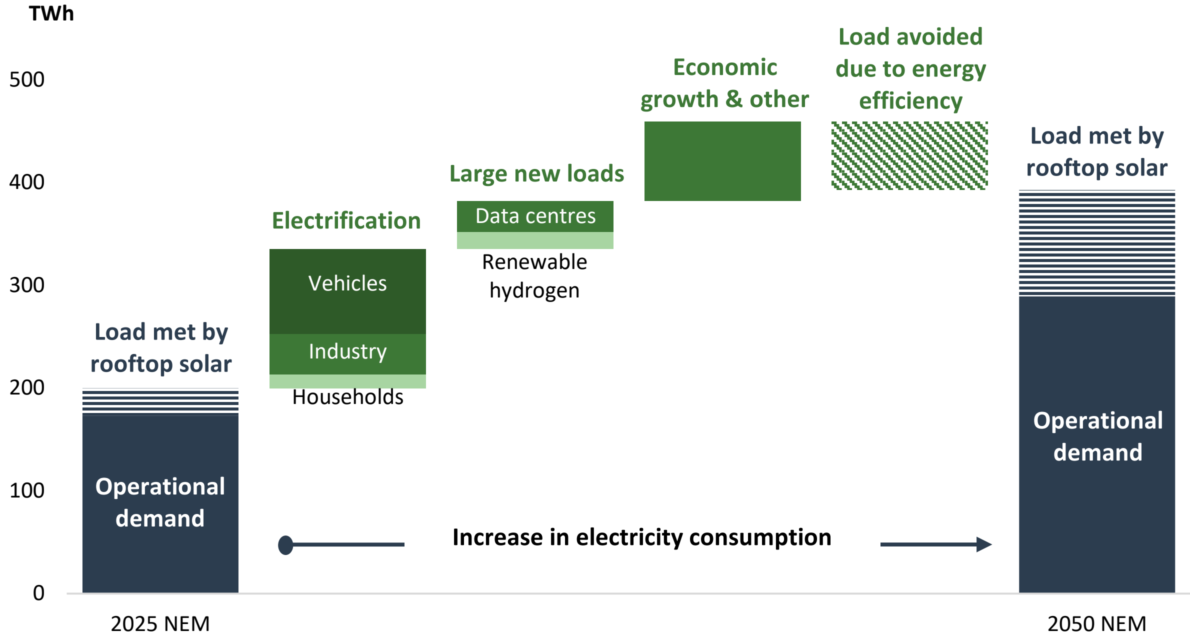
For some sectors currently reliant on gas and liquid fuels, switching to electricity may be a cost-effective decarbonisation strategy, as electric technologies are generally more energy efficient, and firmed renewables are now the most affordable form of new generation. New industrial loads will also contribute to an increase in on-grid demand. Data centres in particular are anticipated to be a major driver of electricity demand in coming decades.

For our major grids, electrification and economic growth will be a major driver of demand growth under the Baseline Scenario (Figure 3.16).

Energy efficiency improvements can partly offset the impact of demand growth, reducing the need for new generation capacity. The impact on operational demand – that is, the amount of electricity that needs to be supplied by utility-scale generators – is also offset by rooftop and other distributed solar generation.

Figure 3.16: Underlying demand in the NEM will increase significantly to 2050 – with energy efficiency and rooftop solar playing an important role to limit the increase in operational demand.

Electricity consumption in the NEM, TWh, Baseline Scenario



Source: DCCEEW and Treasury modelling. Note: Rooftop solar includes other distributed solar.

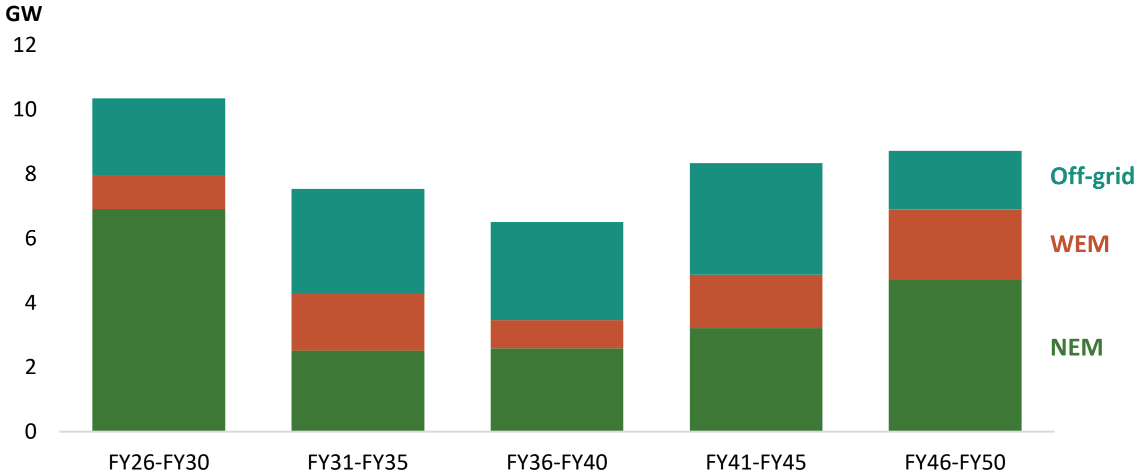
A growing off-grid system will support new industries

Some emerging industries – like renewable hydrogen, green metals, and critical minerals processing – will be established in off-grid locations that best leverage Australia's comparative advantage in low-cost renewables. As a result, off-grid generation increases under the Baseline Scenario. The sustained buildout of renewables includes significant off-grid investment, particularly between 2030 and 2045 (Figure 3.17).

Small and off-grid electricity consumption depends on the scale of new clean energy embedded export sectors. For example, small and off-grid electricity consumption for renewable hydrogen production is projected to increase from zero in 2025 to 110 TWh and 481 TWh in 2050 under the Baseline Scenario and Renewable Exports Upside Scenario, respectively.

Figure 3.17: A high renewable build rate will be sustained to 2050, including significant off-grid investment

Average annual VRE capacity build, GW, Baseline Scenario



Source: DCCEEW and Treasury modelling.

Enabling these industries to develop outside of our major grids can help to reduce their operating costs by taking advantage of lower cost renewable generation, optimising their facility energy loads with production, and minimising transmission infrastructure costs. However, this investment will come at a time of heightened competition for workforce, equipment and capital.

Policy directions to put Australia on the pathway to 2050

The Government's 82% renewable electricity target, alongside ambitious state and territory targets, is driving a national transformation towards a more affordable, cleaner and reliable electricity system. To date, government support has focused on catalysing investment to scale clean electricity supply.

Key government initiatives

- The Capacity Investment Scheme is accelerating investment in renewable electricity and clean dispatchable capacity to meet future demand.
- Rewiring the Nation is investing in new and upgraded grid infrastructure to connect renewables and storage more efficiently, enabling timely project delivery and lowering costs for consumers. Projects like Marinus Link will further enhance grid resilience.
- The Australian Government, together with states and territories, energy market bodies and industry, is working to prioritise reforms to boost grid productivity, allowing more renewable power to flow to households and businesses and lowering energy bills. Pathways include the Grid Enhancing Technology grants program, and by addressing barriers to deployment via support for AEMO to accelerate grid connection of renewable generation and storage assets.
- The NETP fosters collaboration across the Australian Government and state and territory governments to coordinate planning, enhance energy security, and implement nationally significant transmission projects.
- The National CER Roadmap, the Small-scale Renewable Energy Scheme (SRES) and the Cheaper Home Batteries program (Box 3.4) are enabling consumers to participate in the energy transformation.

Australia's electricity system is evolving rapidly. Sustaining this momentum is essential to ensure an orderly transformation that delivers lasting benefits for all Australians. Further action is needed to incentivise private investment in firmed renewables and efficient network investment. Continued innovation and productivity will also be important. AI has the potential to deliver significant benefits for our electricity systems by optimising energy usage, supporting grid stability through predictive maintenance, and better integrating renewable energy by improving supply and demand predictions.

Box 3.4: Cheaper Home Batteries Program

The Government is rolling out the Cheaper Home Batteries Program to help more people install batteries.

Australian households, businesses and community organisations can get a discount of around 30% on the upfront cost of installing small-scale battery systems (5 kWh to 100 kWh, with the discount available up to 50 kWh). Over 55,000 batteries – with total storage capacity of over 1 GWh – have been installed in just over 2 months since the program commenced on 1 July 2025.

This program is helping consumers reduce electricity bills at the same time as reducing broader system costs. This will support Australians to make the most of cheap and clean solar power, storing it for later use, while reducing peak demand and creating a more stable electricity grid.

There are 3 key areas for government action in the near-term (Figure 3.18).

Figure 3.18: Electricity policy directions

Incentivise private market investment in firmed renewables post 2030	Optimise the use of our network infrastructure	Ensure households can get the most out of their consumer energy resources

Incentivising private market investment in firmed renewables post 2030

Beyond 2030, economy-wide electrification and new industry growth will continue to drive demand for renewable electricity, clean dispatchable capacity and other firming technologies.

As shown above in Figure 3.17, a high renewable build rate will need to be maintained to 2050. In recent years, significant government action has supported the build out of renewables and strong private investment. Sustaining this level of investment will require electricity markets and policies to provide investment certainty for clean electricity, as we transition away from a model driven by government support. Several critical enablers must also be in place to achieve the required infrastructure build out - such as social licence, planning and approvals, supply chains and workforce, discussed in *4 Enabling the transformation.*

Sufficient firming services will be needed to complement a system dominated by variable renewable electricity. On average, a more diversified generation mix will reduce seasonal variability and the associated need for firming. The development of an offshore wind industry will enhance energy security and resilience by providing power when solar and onshore wind are unavailable. Improvements in energy performance, in particular demand flexibility, will also reduce the scale of firming required.

Box 3.5: The NEM Review

In November 2024, the Australian Government announced a review of NEM wholesale market settings by an independent expert panel, chaired by Associate Professor Tim Nelson.

The purpose of the review is to recommend wholesale market settings to promote investment in firmed, renewable generation and storage capacity in the NEM following the conclusion of Capacity Investment Scheme tenders in 2027. The Panel will make actionable recommendations to support reforms to the NEM wholesale market to support the achievement of Australia's National Electricity Objectives to deliver reliable, competitively priced, safe and secure electricity services, supporting the long-term interests of consumers and prosperity of Australia's economy. The Panel is expected to deliver final recommendations to Government and the ECMC in late 2025.

The NEM Review Panel is considering several measures to ensure wholesale market settings in the NEM are fit-for purpose to promote investment in generation capacity, and short- and long- duration firming beyond 2030 (**Box 3.5**). As part of this, the NEM Review Panel's draft report recommends establishing an entry mechanism that addresses misalignment between the long-term revenue certainty investors need and the short-term focus of electricity buyers. The Panel notes that establishing this mechanism would provide an enduring framework and clear price signals for the electricity investments our future electricity system requires.

ECMC has agreed to high-level principles to inform the detailed design of the new mechanism to support continued investment through the energy transformation. Following receipt of the NEM Review Panel's final report, the Australian Government will work with states and territories through ECMC to consider the recommendations made.

At the start of 2025 the Government added $2 billion to the Clean Energy Finance Corporation (CEFC) general funding, allowing it to sustain its crucial investments in clean energy technologies. The Government will update the CEFC's investment mandate to include a new focus on the rapid roll out of renewable projects to drive down electricity prices, and commit up to $2 billion more to the CEFC General Account, to be drawn down in line with these changes. This will enable the CEFC to continue to crowd-in private capital for initiatives to modernise our electricity system and reduce emissions across the economy.

Incentivising efficient network investment and use

Making the best use of expanded network infrastructure will enable the delivery of affordable, reliable and secure electricity. AEMO has estimated that around 5,000 km of transmission lines are needed in the next decade on the east coast. At the same time, using existing infrastructure more efficiently can minimise the need for expensive new projects and support delivery of the 82% target.

Delivering network projects efficiently and cost-effectively will minimise overbuild and associated costs to consumers. There is also scope to use our existing transmission and distribution network infrastructure more efficiently. This includes:

- improving network productivity, such as addressing congestion and network black spots
- non-network solutions including adopting increasingly available and cost-competitive battery storage, flexibility services and grid enhancing technology.

Governments play an important role by ensuring Australia's system planning processes and network regulation are fit for purpose. This can make the grid more stable, reliable, affordable and safe.

The Grid Enhancing Technologies program will drive innovation by supporting development and utilisation of new grid technologies. The Accelerated Connections Fund will trial faster, more efficient connections for critical renewable generation and clean storage projects. These initiatives will unlock more renewable energy, enhancing reliability, reducing costs and delivering benefits to developers and consumers.

At the request of the Australian Government, the Australian Energy Market Commission (AEMC) has made several rule changes to improve how transmission networks are developed to benefit consumers. The Government will continue to monitor this to address inequalities in the cost burden of paying for network infrastructure, to avoid excessive costs passing through to electricity consumers and to encourage increased utilisation and innovation.

Enhancing the use of distribution networks could deliver projects faster at lower cost, and improve the reliability of supply for regional communities. For example, distribution network renewable energy zones could unlock more utility-scale renewable generation. Distribution network batteries could be well positioned to reduce pressure on the grid. Better utilising distribution networks can also help to increase the rate of deployment and coverage of kerbside EV charging.

Getting the most out of consumer energy resources

ECMC agreed to the National CER Roadmap in July 2024. The Roadmap sets out national reform priorities to harness CER's full potential and deliver benefits and equitable outcomes to all Australian consumers.

By 2050, under the Baseline Scenario there is 86 GW of distributed solar connected to the NEM, up from 23.7 GW in 2025. Households install 44 GW of CER storage by 2050, up from 1.4 GW in 2025.

Consumers can benefit from highly integrated CER as it can help manage minimum demand and reduce peak demand, provide essential system services, and reduce the need for costly network upgrades, grid scale generation and storage investments. Balanced regulation of new energy technologies and services can facilitate this engagement by ensuring adequate consumer protections are in place. Consumer protections can help build trust that the control of CER by third parties – necessary to coordinate technologies and realise possible benefits – is safe, in their interest, and does not require them to become energy experts. Evolving consumer protections are discussed in *5.2 A fair and equitable transformation.*

3.4 Gaseous fuels

Gaseous fuels in Australia today

13%	of Australian total final energy consumption is from natural gas	**74%**	of Australia's natural gas is exported
21%	of Australia's emissions come from natural gas supply and use	**18PJ**	of renewable gases produced in 2024 – 1% of domestic gas consumption

Gaseous fuels in Australia's energy transformation

Natural gas will remain an important contributor to Australia's economy and energy security, but its role will need to change to support the net zero transition. Overall gas demand is expected to decline over time as households, businesses and some industrial users electrify. For some uses – particularly electricity generation, high-heat processes or as a chemical feedstock – natural gas will continue to play a role. In the short term, new sources of gas supply are needed to support the transformation. By 2050, gas users have transitioned to renewable gases like hydrogen or biomethane where possible, with remaining natural gas use abated.

A pathway to 2050

2030	2035	2050
Natural gas is supporting an orderly transition	Renewable gases and natural gas are supporting strategic sectors	Remaining gas use is decarbonised with strong renewable gas uptake

Policy directions to put Australia on the pathway to 2050

Secure an adequate natural gas supply	Support natural gas users to electrify	Establish and scale renewable gases

New actions

The Australian Government is undertaking a Gas Market Review that will examine existing regulatory settings and consider long-term policy settings for Australia's gas markets with a focus on ensuring efficient investment, availability of gas and meeting emissions reduction targets.

Overview

Natural gas has been integral to Australia's economy for more than half a century – heating homes and businesses, providing peaking power via gas-powered electricity generation (GPG) and powering industry.

Natural gas supply and use accounts for 21% of Australia's emissions.[28] In the short term, new supply is needed to avoid shortfalls and support the transformation. However, we will need to reduce natural gas use and transition towards lower emissions alternatives over time to reach net zero.

Some uses of gas, such as residential use and low-temperature industrial heat, can be phased down over time with the uptake of available alternatives. Even without the benefit of solar and batteries, switching to electric appliances can reduce energy costs for households by more than $1,000 per year on average compared to a non-electrified household. When solar and batteries are installed as well, the savings rise to over $2,200 (see *5.1* Household benefits).

Other uses, such as in industries reliant on high-heat processes or gas as a feedstock, will persist for longer as they currently have limited technical or commercially viable alternatives. Natural gas will also be important to support emerging strategic industries, such as green metals production, and GPG will remain an important source of long-duration firming for variable renewable generation.

As set out in the Future Gas Strategy, natural gas supply will shift to support these higher-value and non-substitutable uses. This will allow an overall gas demand declining alongside a transitional increase in gas use for electricity firming and some industrial applications. A secure and adequate domestic gas supply is critical to support these sectors, and to support energy affordability while households and businesses electrify.

The gas decarbonisation pathway will vary across sectors and over time. Electrification and energy efficiency should be prioritised wherever possible to reduce emissions and take some pressure off tightening supply. Scaling and the commercialisation of renewable gases will be key to the longer-term decarbonisation of those sectors that will continue to rely on gaseous fuels.

Australia is also a major exporter of liquefied natural gas (LNG) and will remain a trusted and reliable trade and investment destination to help trading partners on their own paths to net zero. The Resources Sector Plan describes the decarbonisation pathway for Australia's gas extraction and processing sector.

[28] DISR (2024)

The gaseous fuel pathway to 2050

Net Zero Plan – Treasury Modelling and Analysis

'The modelling projects that emissions from gas use decline by 70 per cent to 2050 under the Baseline Scenario. Natural gas use is projected to shift towards higher-value and non-substitutable use cases

'Energy efficiency, electrification and fuel switching technologies are expected to enable reduced gas demand by industrial users and households over time, as capital stock turns over and electric appliances become more cost efficient.'

Natural gas provides 13% of Australia's final energy consumption. Around 5 million households use it for cooking, hot water and space heating. Natural gas is the largest source of energy for industry, with the vast majority of gas consumption used for heating purposes. It is also an important feedstock in a wide range of products such as fertilisers, plastics, explosives and medicines.

Gas is also an important source of electricity generation, accounting for 17% of electricity generation overall (including 6% in the NEM). GPG supports the electricity grid in peak demand periods, and over time, will shift to provide firming for renewable generation, while also acting as a strategic backup in 'still and dark' periods in the NEM and WEM. GPG also supplies many remote mine sites in WA and provides 84% of electricity generation in the Northern Territory.

Gaseous fuel demand will vary across sectors and over time on the path to net zero. To ensure an orderly transition, we must balance the ongoing need for natural gas where alternatives are not available or commercial with the need to steadily reduce its use (Figure 3.19).

Figure 3.19: Decarbonisation pathways differ between natural gas users

Residential, small commercial users and low-heat industrial users will need to be encouraged and supported to electrify wherever possible and improve energy performance. This will reduce emissions and enable supply to be directed to non-substitutable uses.

Existing industrial and commercial users that rely on natural gas for high-heat processes (such as alumina refining) or as a chemical feedstock currently have no viable alternatives. This means that there will be an ongoing need for natural gas to support industry until renewable alternatives are commercially viable and available at scale.

Coal-to-gas switching in some industries, like ironmaking and alumina refining, can support decarbonisation, with some industries like cement also co-firing alternative fuels from waste streams to replace coal. This delivers direct emissions reductions and ensures the ongoing viability of these industries while Australia's renewable gas industry is established, or alternative production methods are commercialised at scale.

Emerging industries, such as green metals and ammonia production, may require natural gas for a period of time while Australia's renewable gas industry is established or alternative production methods are commercialised at scale.

Gas-powered generation will be critical to maintain grid reliability and support the integration of variable renewable generation as coal retires. Batteries have proven commercially viable to balance renewable energy over the course of a day, but gas is currently the best technical option to 'back up' variable renewable generation for longer periods. This will be critical during extended renewable droughts.

Figure 3.20: Gaseous fuel milestones on the pathway to net zero

Milestones on the path to 2050

2030	2035	2050
Natural gas is supporting an orderly transition	Renewable gases and natural gas are supporting strategic sectors	Remaining gas use is decarbonised

Natural gas supports strategic sectors through the transition as overall use declines

Natural gas supports the rollout of renewables	Emissions from gas use are declining	Users transition to alternatives where possible and remaining uses are abated
✓ GPG supports the renewable rollout ✓ Residential and commercial users are electrifying ✓ Secure natural gas supply supports industries like steelmaking to start the transition away from coal	✓ GPG firming supports an orderly exit of coal ✓ Residential and commercial electrification continues ✓ Industrial gas demand is declining as low heat processes are electrified and the renewable gas industry scales	✓ GPG acts as a strategic backup for renewable generation ✓ Natural gas users have transitioned to clean alternatives wherever possible ✓ All remaining natural gas use is abated

✓ A secure supply of natural gas to meet critical uses while users transition to alternatives

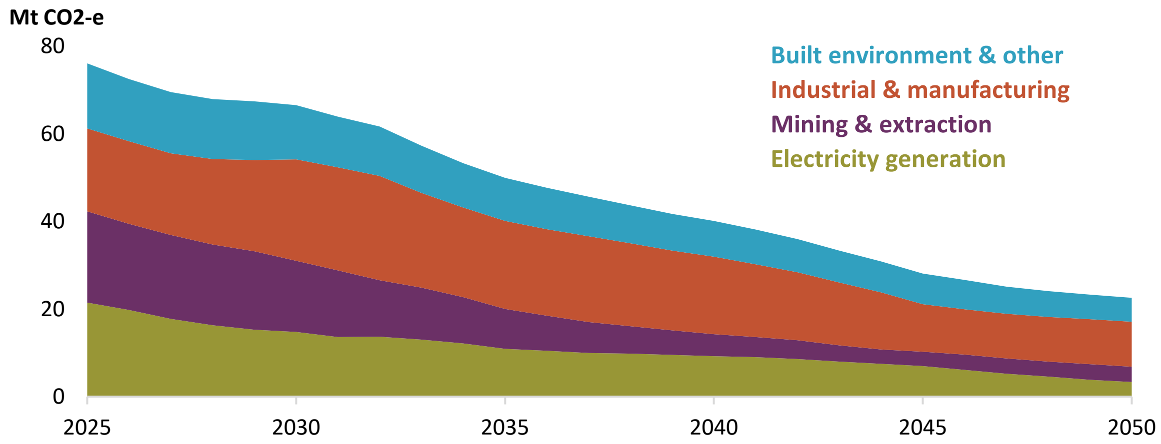
Renewable gas supply scales to support Australian industry

Domestic renewable gas markets are established	Australia's renewable gas markets are growing	Australia is a mature renewable gas producer
✓ Enabling frameworks for domestic renewable gas markets are established ✓ Biomethane production is emerging to meet demand for low emissions gas ✓ Hydrogen projects are established and operating	✓ Australia's biomethane production is established ✓ Domestic hydrogen demand is growing as existing industries decarbonise and green industries scale ✓ Hydrogen production is starting to scale and export	✓ Australia's gas supply and residual use is decarbonised ✓ Well-established biomethane markets continue to deliver low emissions energy for gas users ✓ Australia is established as a major exporter of hydrogen

✓ Social licence for renewable gases is maintained

Natural gas use will shift towards higher-value and non-substitutable use cases over time. Emissions from gas use decline substantially to 2050. The emissions trajectory varies across sectors, reflecting the different needs and decarbonisation options available to Australia's diverse gas users (Figure 3.21).

Figure 3.21: Emissions from domestic gas use by industry grouping, Baseline Scenario, Mt CO2-e



Source: Treasury modelling. Note: 'Other' includes built environment, agriculture and transport industries.

Electrification should be expedited wherever possible to ensure gas is available for non-substitutable uses.

- The pace of electrification will depend, in part, on the rate of asset turnover in different sectors and the relative fuel costs of electricity and gas. The share of natural gas demand that can be electrified will increase over time as technology improves; for example, if electric furnaces are developed for higher-heat processes.
- Even where technically feasible, electrification may not currently be commercially viable, or users may face other barriers to electrification – including upfront costs, grid capacity constraints, long lifespan of existing gas appliances, difficulties in integrating electric technology within existing processes and lack of familiarity with new technologies.

Renewable gases like hydrogen and biomethane will need to be scaled to support the non-substitutable uses of natural gas. For example, biomethane can be injected directly into existing gas networks and has been operating at scale in Europe and North America. Biomethane met over 40% of Denmark's overall gas demand in 2024.[29] Jemena's Malabar Wastewater Demonstration Plant is the only biomethane production facility in operation in Australia. The biomethane produced at the facility is injected into the shared gas network.

Emissions from gas will start to decline as policies are put in place to drive the uptake of alternatives. This trend should continue as new alternatives such as renewable hydrogen emerge as a commercially viable option. By 2050, it is anticipated that Australia will be a mature renewable gas producer and many remaining gas users will have transitioned to clean electricity and renewable gases. Remaining residual fossil gas used for GPG and hard-to-abate industrial processes could be abated with carbon capture and storage technology.

[29] IEA (2024c)

Policy directions to put Australia on the pathway to 2050

The Australian Government has already taken steps to decarbonise gas use, including significant support for development of a renewable hydrogen industry. There are 3 key areas for government action in the near-term (Figure 3.22).

Figure 3.22: Gaseous fuels policy directions

Secure an adequate natural gas supply	Support natural gas users to electrify	Establish and scale renewable gases to support decarbonisation over time

Secure an adequate natural gas supply

A secure and affordable supply of natural gas is key to an orderly transition. AEMO is forecasting peak day gas shortfalls for southern states from 2028 under certain conditions and an annual structural gas supply shortfall from 2029.

New sources of supply, gas transport capacity and storage are needed to mitigate forecast shortfalls. Investment in natural gas will be needed in the short to medium term to meet demand. Over the longer term, actions to reduce gas use and scale renewable gas supply will support energy security by taking pressure off natural gas supply. But the next few years are a critical period in which investments in natural gas supply and associated infrastructure will be needed.

The Australian Government has also established a range of mechanisms to support gas supply adequacy, including the Australian Domestic Gas Security Mechanism (ADGSM), the Gas Market Code and the Heads of Agreement with East Coast LNG exporters. The Government is undertaking a Gas Market Review to examine these mechanisms and consider long-term policy settings for Australia's gas markets with a focus on ensuring efficient investment, availability of gas and meeting emissions reduction commitments (**Box 3.6**). The review is expected to report to the Government by the end of 2025.

The Australian Government is also working with the states and territories to consider whether to expand AEMO's powers to allow it to address infrastructure constraints contributing to forecast gas supply shortfalls, if needed. A draft regulatory package (Bill, Rules and Regulations) will be provided to Ministers for consideration by the end of 2025, followed by public consultation, and then final consideration no later than mid-February 2026. The Australian Government and jurisdictions are also exploring policy options to address gas supply and cost issues in the medium term, committing to further work to reduce gas demand and identify barriers to gas supply and storage projects.

Box 3.6: Gas Market Review

The Gas Market Review (the Review) is examining the effectiveness of existing regulatory instruments (ADGSM, Gas Market Code and Heads of Agreement). A best practice regulatory framework is critical to support investment and ensure Australia’s energy security, including in the transition to net zero emissions and for the energy security of Australia’s trading partners. The focus of the Review is consistent with the objectives of the Future Gas Strategy, including supporting decarbonisation of the Australian economy, safeguarding energy security and affordability, entrenching Australia’s reputation as an attractive trade and investment destination and helping our trade partners on their own paths to net zero.

The Review will also consider options to consolidate and streamline regulations to create a long-term stable regulatory environment to support investment certainty. Any reforms will be mindful of existing commercial contracts (including export contracts) and trade law, including under current regulations. Key areas of focus are: ensuring sufficient domestic gas supply, reasonable gas prices, market transparency, conduct and good faith rules, competition in gas supplier and user markets, impacts on the competitiveness of Australia’s LNG industry, and the roles of the energy market bodies (the Australian Competition and Consumer Commission (ACCC), AEMO and the Australian Energy Regulator (AER)).

Support natural gas users to electrify

Electrification of homes and businesses is possible as there are widely available electric alternatives to household gas appliances. Some users, including low-income households, renters and those in community housing, face barriers to electrification because of up-front cost challenges, or housing tenure/type. Other consumers may face barriers in accessing information.

Where possible, commercial and industrial users should also be encouraged to switch to low-emissions alternatives (for example, industrial heat pumps may be suitable for some low temperature applications in food production). ARENA and CEFC are investing in accelerating development and deployment of clean technologies to support this transition.

Over time, as some users electrify and disconnect from the gas network, it is possible that network costs for remaining natural gas customers will increase. This is because the costs of maintaining the gas network will be shared by a shrinking pool of customers. All levels of government will need to work together, alongside energy regulators, to ensure the impacts from electrification and demand reduction on the gas network are managed in an equitable manner.

The Government is continuing policy and analytical work to help to manage economy-wide electrification including through enhanced analysis and understanding of incentives and barriers to electrify and monitoring the pace of electrification to consider unintended outcomes.

The Government will also work with states and territories through ECMC on opportunities for households and businesses that are seeking to transition away from gas to other forms of energy as part of the energy transformation.

Establish and scale renewable gases to support decarbonisation over time

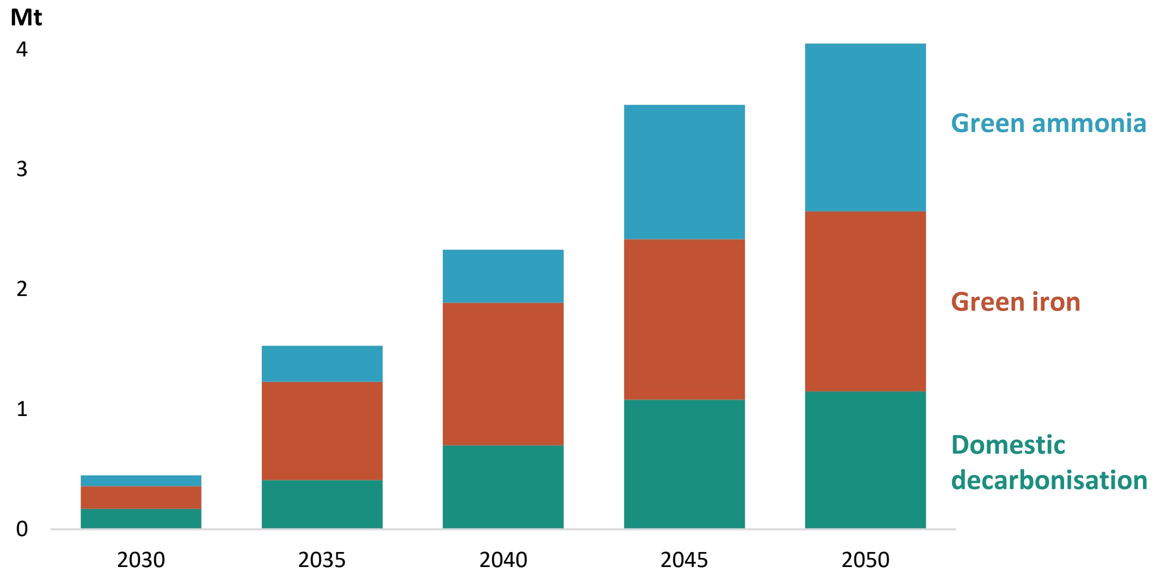
Over time, where electrification is not feasible, Australia will need to substitute natural gas with renewable alternatives (such as biomethane and hydrogen). Natural gas will remain a primary fuel source for many large industrial users until renewable gases are commercially available, or alternative technologies are developed and commercialised at scale. This means that developing renewable gases is critical to deliver long-term emissions reduction.

- Biomethane is a renewable and low-emissions gas that can be injected directly into the existing gas network. Internationally, biomethane production is a mature process that has been operating at scale.
- Hydrogen is a longer-term proposition as it will require new infrastructure to be built, and the industry will take time to scale (Figure 3.23). Australia can leverage our abundant renewable electricity generation to produce globally competitive hydrogen at scale.

The uptake of low emissions fuel will depend on the relative costs and availability compared to natural gas, the capital costs required to retrofit existing facilities in the case of gas-to-hydrogen switching, and action under the Safeguard Mechanism. The most likely on-going gaseous fuel users will be large-scale industrial users and GPG. Over time, these users may have to make capital investments in upgrades or replacement of their machinery or processing technologies to ensure they are compatible with low emissions gases. Where this is not feasible, offsets or carbon capture and storage will be needed to ensure ongoing natural gas use is fully abated.

The Australian Government is taking steps to support a domestic renewable gas industry. Enabling frameworks for renewable gases are underway – such as through the Guarantee of Origin Scheme and National Greenhouse and Energy Reporting Scheme. The Government is also working with the states and territories through ECMC to develop potential national approaches to a renewable gas policy.

Figure 3.23: Hydrogen supply and demand to 2050, Mt, by end use sector, Baseline Scenario



Source: Treasury modelling.

Australia has significant biomethane potential, but scaling production will require secure feedstock supply chains. The Australian Government has committed to strategically examine the potential to grow the bioenergy feedstock industry. A National Bioenergy Feedstocks Strategy will support a coordinated approach to developing the feedstock industry, in a way that maximises opportunities for agriculture and forestry producers but does not create concern around food security.

Significant support to grow Australia's hydrogen industry has been provided through the 2024 National Hydrogen Strategy, which builds on existing announcements like the expansion of the Hydrogen Headstart program, the Hydrogen Production Tax Incentive, funding for developing hydrogen hubs and the establishment of the Guarantee of Origin scheme to provide certification of renewable hydrogen.

The National Hydrogen Strategy includes a range of actions focused on unlocking cost-competitive hydrogen production, prioritising the most prospective sectors for hydrogen-based decarbonisation, ensuring community benefits from growing the industry, and working with international partners. Driving international hydrogen partnerships and markets will create spillover benefits for domestic users. For example, Australia and Germany have signed an agreement to cooperate on new renewable hydrogen supply chains through a $660 million H2Global funding window to open European markets for Australia's renewable hydrogen producers. Supporting investment in production, storage and distribution infrastructure will be important as the hydrogen industry scales.

Since the release of the National Hydrogen Strategy, hydrogen projects in Australia and globally have faced headwinds. This highlights the importance of targeted government support, and regular monitoring and evaluation processes to ensure policy adjusts appropriately to changing circumstances.

3.5 Liquid fuels

Liquid fuels in Australia today

Over 50%	of Australian final energy consumption is a liquid fuel	**Over 90%**	of the liquid fuel we use is imported as refined products or indirectly as crude oil
30%	of Australia's emissions come from the end-use of liquid fuels	**Less than 1%**	of Australia's liquid fuel needs are met by low carbon liquid fuels (LCLF)

Liquid fuels in Australia's energy transformation

Liquid fuels are critical for our economy, providing more than half of our final energy demand. Decarbonising our liquid fuel use will require electrification where possible, and development of a low carbon liquid fuel market for remaining users. This will improve energy affordability for households and businesses while strengthening Australia's fuel security.

A pathway to 2050

2030	2035	2050
LCLF markets are established	Emissions intensity of liquid fuels is declining	Fuel market consists primarily of LCLF

Policy directions to put Australia on the pathway to 2050

Continue to electrify light passenger and commercial vehicles	Establish and scale Australia's LCLF market	Strengthen Australia's fuel security

New actions

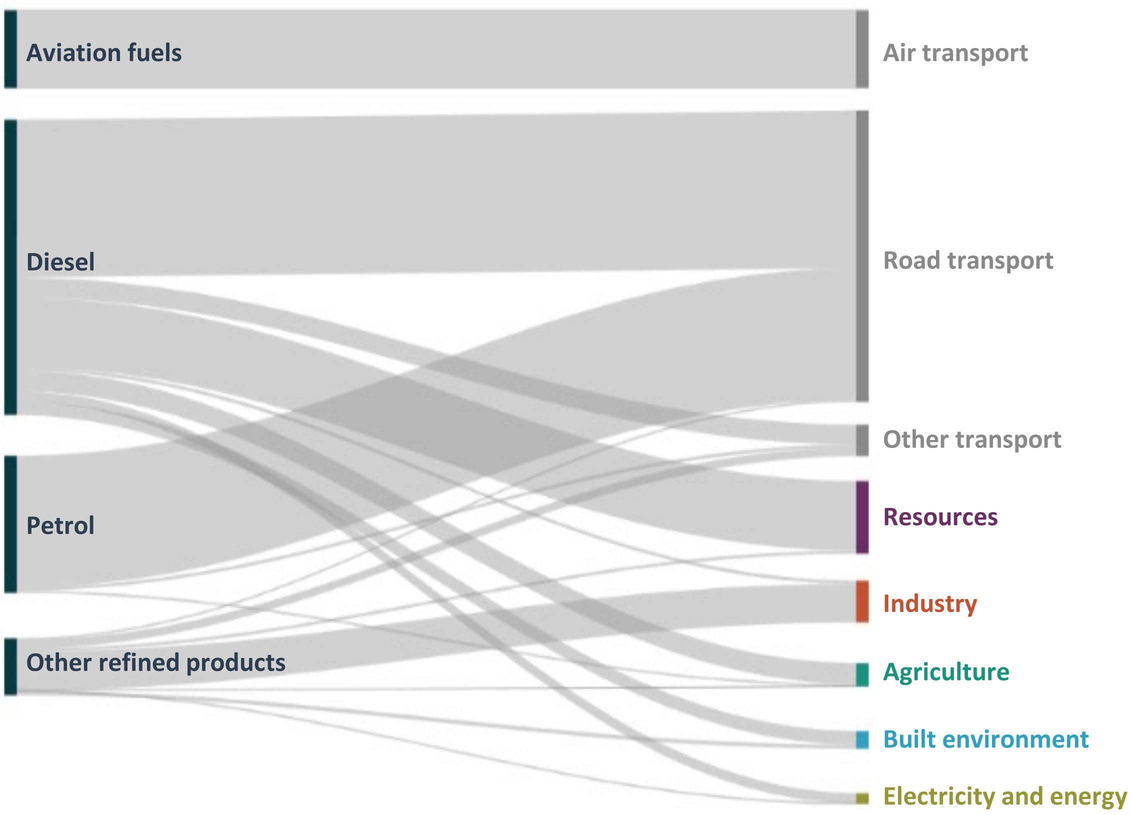
The Government will build on existing investments in electric vehicle charging infrastructure with a further $40 million to accelerate rollout of kerbside and fast charging. The government will leverage the complementary strengths of distribution networks and electric vehicle charge point operators to deliver up to 10,000 public chargers.

To build a supply chain for Australian low carbon liquid fuels, the Australian Government will invest $1.1 billion in a new Cleaner Fuels Program. This will help stimulate private investment in Australia's first onshore low carbon liquid fuel refineries, backing local innovators, making fuel supply more resilient and bridging the price gap for early adopters. The Government will engage with industry on how to make sure Australian liquid fuel users have a fair chance to capture the emissions reduction potential unlocked by low emission Australian fuels.

Overview

Liquid fuels (including petrol, diesel and aviation fuel) are integral to our economy (Figure 3.24). The energy density of liquid fuels, ease of distribution and storage and relative safety of use mean they provide over half of Australia's final energy consumption, with diesel alone providing more energy across the economy than electricity.

Figure 3.24: Liquid fuel use across the Australian economy, PJ



Source: DCCEEW 2025, Australian Energy Update 2025.

Fuel affects the lives of all Australians. The transport sector relies significantly on liquid fuels. Mining and agriculture rely on liquid fuels to power machinery. Remote parts of Australia use liquid fuels to generate power. Fuel prices are a significant contribution to household energy costs, and impact the price of goods and services through freight costs.

Australia relies on global markets for our liquid fuel supply, with over 90% of the fuel we use coming from imports (as refined products or indirectly as crude oil). Our fuel prices are linked to international markets, so Australian consumers have significant exposure to global oil prices.

Liquid fuels are a major source of emissions as most are derived from crude oil. LCLF currently account for less than 1% of Australia's fuel use. Renewable fuels will be key to reducing emissions from existing assets, and from activities that are hard to electrify, as they provide a drop-in replacement for fossil fuels without compromising engine performance. We have an opportunity to establish a domestic LCLF industry and reduce emissions, improve fuel security and create new sources of employment in regional areas.

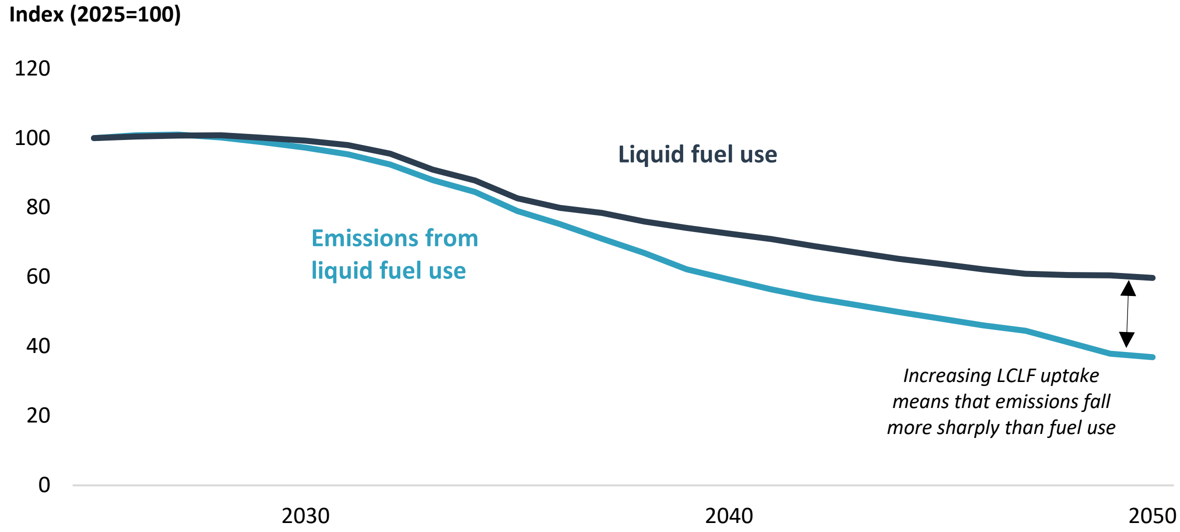
Liquid fuel demand on the path to net zero

Liquid fuels will play a declining but still significant role in Australia's energy mix as we move towards net zero.

Under Treasury's Baseline Scenario, liquid fuel demand peaks around 2030 and falls by around 40% by 2050. This reflects a structural shift in energy demand as many liquid fuel users move to electric or hydrogen alternatives. The emissions intensity of our liquid fuel mix also falls as demand for LCLF increases (Figure 3.25).

The outlook varies by fuel type. While petrol demand declines to 2050, diesel and aviation fuel will continue to play a significant role in the Australian economy given the current lack of cost effective low carbon alternatives for some users (Figure 3.26 and Figure 3.27).

Figure 3.25: Liquid fuel use and emissions to 2050, Baseline Scenario, indexed against 2025 levels



Source: DCCEEW and Treasury modelling.

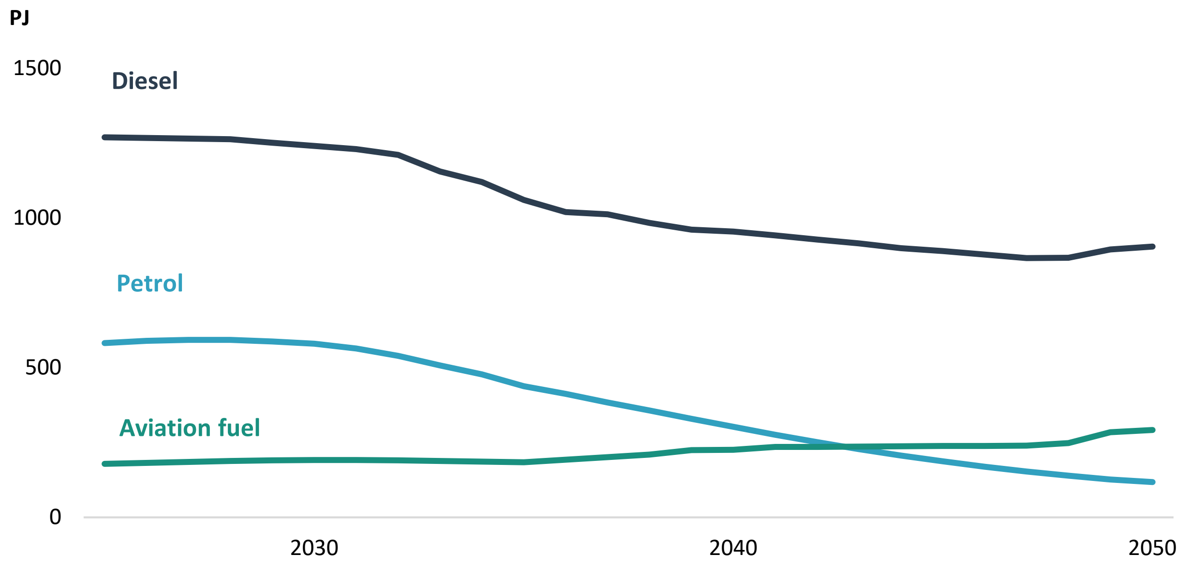
Figure 3.26: Liquid fuel demand out to 2050 will vary by fuel type

Petrol is predominantly used for passenger transport. As a result, petrol demand is expected to decline rapidly through the 2030s as vehicle efficiency improves and electric vehicle uptake accelerates.

Diesel is used for high-performance needs like road, rail and maritime freight, mining equipment, and machinery. Under the Baseline Scenario, demand declines from around 2030, as fuel-switching options increase and older assets are replaced with electric or hydrogen-based alternatives. Nonetheless, diesel will remain part of Australia’s energy mix as fuel-switching may not be viable for all users.

Aviation fuel is the primary energy source for air transport. The net zero pathway will rely heavily on sustainable aviation fuel for medium and long-haul flights to 2050 due to range and payload constraints of other technologies. Some short haul and regional flights may decarbonise through battery and hydrogen powered aircraft as these technologies mature. Aviation is expected to increase its reliance on liquid fuels beyond 2050, as demand for air transport increases.

Figure 3.27: Emissions from liquid fuel types to 2050, Baseline Scenario, PJ



Source: DCCEEW and Treasury modelling.

The liquid fuels pathway to 2050

Australia's Net Zero Transformation: Treasury Modelling and Analysis

'Low-carbon liquid fuels are expected to offer an increasingly cost-effective decarbonisation pathway over time. Studies by CSIRO and others have found that while low-carbon liquid fuels are currently more expensive than their unabated fossil fuel counterparts, costs are expected to decrease over the medium-term as technology and scale improves.'

Australia needs to reduce fossil fuel use and increase the supply of LCLF. To do this, our liquid fuels market will need to evolve significantly. The plan sets out a credible pathway to transition the liquid fuels sector to 2050, with an emphasis on fuel-switching and scaling LCLF supply. The milestones along this pathway are outlined in Figure 3.28. The Transport Sector Plan outlines detailed decarbonisation pathways for each transport mode and transport infrastructure.

By 2030, electrification should be well underway for light vehicles. Electrification is also feasible and already used for some buses, vans and trucks. Other significant fuel uses, including in heavy vehicles, maritime, rail, aviation, mining and manufacturing, cannot be readily electrified in the near-term due to long distances and high load demands.

The timeframe for electrification is influenced by the vehicle and equipment turnover rate, market availability of electric alternatives, and progress on developing adequate ancillary infrastructure like charging infrastructure. Fuel-switching technologies for these sectors will need to be developed and commercialised. In the short to medium-term LCLF will be needed to support decarbonisation efforts of these industries.

By 2030, industry invests in projects to establish Australia's LCLF market, supported by enabling frameworks set by government. We expect the LCLF supply chain will be a mix of local production and imported fuels.

By 2035, the emissions intensity of the liquid fuels market will be declining. Petrol demand will continue to decline with electric vehicle uptake and diesel's decline will start as electrification and hydrogen technologies become available. The LCLF share of the market will grow to support fuel-reliant sectors that have limited options to decarbonise. Over time our LCLF industry will need to innovate in feedstock practices and expand production pathways to support decarbonisation efforts across the economy and manage fuel security needs.

By 2050, Australia's liquid fuel market is decarbonising as demand for liquid fuels continues to decline as sectors transition off liquid fuels (including petrol, diesel and LCLF) to electrification and hydrogen technologies. Users with high performance requirements, such as aviation, maritime and heavy transport, will continue to rely on LCLF and blended fuels for energy. Australia should be a major advanced LCLF producer, with partnerships and export arrangements in place to provide fuel security to the region.

Through the transition it is expected that fuels will remain secure, accessible and affordable. LCLF can support this by increasing fuel options and reducing our reliance on imports; however, this is only one element. The Australian Government's broader fuel security policy settings will also help the market move towards net zero in an orderly and cost-effective manner.

Figure 3.28: Liquid fuel milestones on the pathway to net zero

Milestones on the path to 2050

2030	2035	2050
Low carbon fuel markets are established	**Emissions intensity of liquid fuels is declining**	**Fuel market consists primarily of LCLF**

Fossil liquid fuel use decline as users electrify

Fuel switching is underway in some sectors	**Fossil liquid fuel use is declining as new technologies support fuel switching**	**Remaining liquid fuel users are served by the LCLF market**
✓ Electrification and efficiency standards are reducing liquid fuel use from light transport ✓ Technologies to decarbonise heavy transport, haulage and other uses are being commercialised ✓ Diesel generation is being replaced by firmed renewable generation	✓ Accelerating electrification continues to reduce liquid fuel use from light transport ✓ Heavy transport is transitioning to electric or hydrogen alternatives where possible ✓ LCLF demand is growing for liquid fuel users with legacy equipment or who lack fuel switching options	✓ Liquid fuel supply has shifted towards higher-value and non-substitutable uses. Electric and hydrogen technologies are used where possible ✓ Firmed renewable generation has replaced diesel ✓ Remaining liquid fuel users – aviation, agriculture and mining – have transitioned to LCLF or LCLF blends

LCLF grow to support decarbonisation and fuel security

Australia's LCLF market is established	**LCLF demand and supply is growing**	**Australia is a mature LCLF producer**
✓ Enabling frameworks for a domestic LCLF market are established ✓ Supply chains are established and secure for domestic LCLF production ✓ Domestic LCLF projects are established and operating	✓ LCLF supply is growing and accessible to key liquid fuel dependent sectors ✓ LCLF demand is established and growing, especially in heavy transport, manufacturing, agriculture and mining ✓ New LCLF technologies, including feedstocks, start to emerge ✓ LCLFs support our national and fuel security	✓ LCLF makes up the majority of liquid fuel market and supports Australia's national security ✓ New LCLF technologies continue to roll out ✓ Australia is an established producer and exporter of advanced LCLF

✓ Liquid fuel supply remains secure, accessible and affordable for Australian users.

Policy directions to put Australia on the liquid fuels pathway to 2050

The Australian Government has already undertaken significant steps to put the liquid fuels sector on the pathway to 2050. There are 3 key areas for government action in the near-term (Figure 3.29).

Figure 3.29: Liquid fuels policy directions

Electrifying light passenger and light commercial vehicles	Establishing and scaling up Australia's LCLF market	Strengthening Australia's fuel security through the transformation

Electrifying light passenger and light commercial vehicles

The technology to fuel-switch for light vehicles is already available. The National Electric Vehicle Strategy supports the uptake of electric vehicles. The New Vehicle Efficiency Standard is encouraging car manufacturers to supply more electric vehicles to Australia, improving consumer choice and making it easier and cheaper to access popular models. Over time, it will make all vehicles more efficient.

The Driving the Nation Fund is also enabling the shift to electric vehicles by expanding the national rollout of EV charging and hydrogen refuelling infrastructure, as well as supporting investment in fleets. The government will build on existing investments in EV charging infrastructure with a further $40 million to accelerate rollout of kerbside and fast charging – supporting vehicle choice for more Australians – especially those without access to home charging.

Establishing and scaling up Australia's LCLF market

Australia has significant LCLF potential (Box 3.7). Acting now to establish this industry, identified as a priority under the Future Made in Australia agenda, will set Australia up to meet near term emissions reduction targets, provide certainty for LCLF investments, and enable onshore production before 2030, supporting fuel security.

The Australian Government is working on the enabling framework for LCLF supply, including expanding the Guarantee of Origin to include LCLF products. A market-based accounting framework and renewable diesel fuel quality standard are already in place.

To help establish the LCLF industry, the Australian Government has provided $250 million to support pre-commercial innovation, demonstration and deployment of LCLF as part of the Future Made in Australia Innovation Fund. This builds on the momentum of the Sustainable Aviation Fuel Funding Initiative, which has provided $33.5 million across 5 projects to date. Project support is also available through low-cost project finance from the Clean Energy Finance Corporation.

To build a supply chain for Australian LCLF, the Australian Government will invest $1.1 billion in a new Cleaner Fuels Program. This will help stimulate private investment in onshore LCLF refineries, backing local innovators, making fuel supply more resilient and bridging the price gap for early adopters. The Government will engage with industry on how to make sure Australian liquid fuel users have a fair chance to capture the emissions reduction potential unlocked by low emission Australian fuels.

Box 3.7: Australia's LCLF opportunity

The global LCLF industry has undergone fundamental changes over the past decade driven by national commitments to decarbonise and improve fuel security, and the declining cost of LCLF technologies.

Australia currently exports feedstocks for LCLF refining offshore. We have an opportunity to expand our domestic LCLF industry, combining our abundant biomass resources and renewable energy potential. The CSIRO projects a LCLF industry could contribute between $6 billion to $12 billion annually in direct benefits, with greater gains for regional communities, including diversified income streams for farmers.

The CSIRO report finds that by 2050, Australia could have sufficient biomass production capacity to produce over 12 GL of LCLF per year – roughly equivalent to our current domestic fuel industry and around a quarter of total fuel demand. LCLF will not only help to decarbonise hard-to-abate sectors of the economy but provide Australia with sovereign capability and resilience.

The National Bioenergy Feedstocks Strategy will support a coordinated approach to developing a feedstock industry in a way that creates opportunities for agriculture and forestry producers to complement their ongoing contribution to domestic and global food supply. As the demand for LCLF grows, innovation in feedstock pathways could bolster Australia's ability to become a major and diversified LCLF producer. To help maintain Australia's clean energy industry output in the longer-term, it will be important for government to continue to promote LCLF through international partnerships and forums and support industry to seek out export opportunities in the region.

Strengthening Australia's fuel security through the transformation

Australia's fuel security has historically relied on a combination of domestic fuel production and fuel diversity in terms of sources and supply chains. The Australian Government is committed to maintaining fuel security through the transformation to net zero. There are a range of government programs, policies, and initiatives in place to help regulate the liquid fuels market, reduce fuel emissions and maintain fuel security. For example, the *Fuel Security Act 2021* supports Australia's sovereign capability to maintain fuel supplies.

The Government will review, consolidate and build on these efforts to ensure our approach to fuel security remains fit for purpose as the fuel market and broader economy transitions. This includes ensuring the Act, and other complementary market policies, support and incentivise the LCLF that will play an increasingly important role to 2050. That includes building supply of LCLF and integrating output from these production facilities into Australia's fuel market.

The energy transformation will also strengthen our fuel security. Switching to electric vehicles and establishing domestic production and refining of LCLF using domestic feedstocks will bolster fuel security by cushioning Australia from the impact of international supply chain disruptions. Domestic production will enhance Australia's national defence capability through increased operational independence and resilience.

4. Enabling the transformation

Achieving action on the electricity and energy sector pathway will require sustained effort by governments and industry in underlying areas that are critical to enabling the energy transformation (Figure 4.1). The Australian Government has made significant progress to deliver these enablers – including working with states and territories to improve coordination and oversight.

The Government has also established the Net Zero Economy Authority (NZEA) to support regions, communities and workers significantly affected by the transformation to manage the impacts, and share in the benefits, of the net zero economy. This includes helping workers in closing coal and gas-fired power stations, and affected businesses in their supply chain to prepare for and find new well-paid, safe and secure jobs.

Government-led efforts have been important to accelerate investment. This will need to be complemented by policies to support the private sector's role in driving the transformation.

Figure 4.1: Priorities to enable and support the energy transformation

4.1 Supporting investment and faster project approvals

Decarbonising energy supply to 2050 will require significant investment across the energy sector. While investment in renewables has picked up in recent years, even higher levels of private capital will need to be mobilised.

The Clean Energy Investor Group's 2025 member survey indicates systemic barriers, including planning assessments, grid connection processes and environmental approvals, are slowing investment and causing delays, which can undermine project financial viability.[30] These issues were also raised by stakeholders during consultation on the plan.

Through RETAs, governments are working together to deliver new reliable renewable generation and storage to Australia's electricity grids to support achieving 82% renewable electricity nationally by 2030. RETAs set out roles and responsibilities to help address market and non-market barriers to renewable energy investment, drive better social and economic outcomes for all Australians, and support an affordable, reliable and resilient energy system.

The Australian Government is committed to strengthening and streamlining our national environmental law, the *Environment Protection and Biodiversity Conservation Act 1999,* and establishing a national environment protection agency. Shortening approval times can have a meaningful impact on the rate of return, increasing the economic value of projects.

The Government, in collaboration with the states and territories, created the National Renewable Energy Priority List to coordinate support for regulatory planning and environmental approval processes for priority energy projects. All levels of government must continue efforts to accelerate planning and approvals processes to keep pace with the speed of transition, while also protecting our environment.

Government and industry stakeholders will also need to provide the right signals to foreign capital, and governments will need to streamline processes for inward investment. Action on this has commenced, with the Future Made in Australia agenda delivering a new 'Front Door' for investors with major, transformational investment proposals to make it simpler to invest in Australia and attract more global and domestic capital.

Continued innovation will also be critical to drive the energy transformation, given uncertainty around the viability, long-term costs and scalability of some emerging technologies. Technological change in generative AI also has the potential to transform energy systems and improve how we manage significant increases in energy demand through the transformation.

Sustained investment in R&D across a portfolio of technologies, by governments and the private sector, is necessary to drive this innovation. The CSIRO has launched the National Energy Analysis Centre which is vital new research infrastructure to support, accelerate and de-risk Australia's complex energy transformation. ARENA and the CEFC also support investments in the latest technologies to generate, store, manage and transmit clean energy.

[30] CEIG (2025)

4.2 Building a strong clean energy workforce

A highly skilled clean energy workforce is critical to the energy transformation. A new generation of workers is required, both from existing energy sectors and through new pathways into clean energy. Australia is currently experiencing relatively low ongoing unemployment rates, which is contributing to skilled worker shortages across the economy – including in sectors key to the clean energy transformation.

Jobs and Skills Australia's report titled *The Clean Energy Generation*, estimates that the biggest worker shortage will be for electricians. Around 85,000 more electricians are expected to be needed by 2050, 27% more than the projected supply.[31]

To meet this increased demand, the sector will need to attract and retain more workers and upskill and retrain workers for new and emerging industries. The sector would also benefit from increasing participation of diverse cohorts in energy sector roles, including women, First Nations people and people with disability. Building a skilled workforce will take coordinated and sustained effort across governments and the private sector.

The National Skills Agreement is a 5-year funding agreement through which the Australian Government invests in strengthening the vocational education and training (VET) sector, in partnership with the states and territories. Supporting the net zero transformation is an agreed priority under this agreement.

A national network of 10 Jobs and Skills Councils (JSCs) provides industry with a strong, strategic voice to ensure Australia's VET sector delivers better outcomes for learners and employers. The JSC for the energy, gas and renewables sectors, Powering Skills Organisation (PSO), is helping to inform and shape the clean energy transformation, collaborating with industry to build the required clean energy workforce.

Apprenticeships will play a key role in delivering the skilled workforce needed to build Australia's future. The Government has several financial and non-financial programs in place that are available to support apprentices and employers training in high-priority occupations, such as clean energy. This includes the New Energy Apprenticeship stream of the Key Apprenticeship Program, which provides targeted support to skills development and creates a pipeline of skills to deliver Australia's clean energy future.

NZEA's [Energy Industry Jobs Plan] provides support to workers impacted by the closure of coal-fired and gas-fired power stations, to prepare and transition to new employment. Professor Roy Green is leading a statutory review of the Energy Industry Jobs Plan to consider its effectiveness and whether it is achieving what the Parliament intended.

ECMC is also collaborating on workforce issues to build the skills and capability we need to reach net zero and provide opportunities for Australians to build meaningful careers in the energy sector.

[31] Jobs and Skills Australia (2023)

4.3 Developing supply chain security

There is increasing pressure to secure the technologies, infrastructure, components and raw materials required to deliver the energy transformation. This is occurring against the backdrop of increasing global economic uncertainty, risks to established supply chains, and global competition for resources.

The Australian Government is addressing renewable energy supply chain constraints. This includes:

- domestic initiatives like the National Renewable Energy Supply Chain Action Plan, Solar Sunshot program, National Battery Strategy including the Battery Breakthrough program, and the Future Made in Australia Innovation Fund
- international initiatives like the Quad Clean Energy Supply Chain Diversification Program.

These efforts will be strengthened by ongoing engagement with industry, to proactively notify government of early warning signs of disruptions to critical supply chains.

The national circular economy transition will also support supply chain security through more efficient material use (see *4.5 Promoting a sustainable energy future*). Circular supply chains encourage resilience by maintaining a circular flow of materials – recovering, retaining or adding to their value.

4.4 Improving community engagement

Australia's energy transformation will rely on the contributions and support of communities across Australia. Key among these are Australia's First Nations peoples (Box 4.1) and regional communities that will host new energy infrastructure.

Community acceptance is crucial for the success and speed of the energy transformation. The 2023 Community Engagement Review highlighted several challenges to building community acceptance.

Engagement on new infrastructure is critical to building trust and delivering local benefits to affected regions. The Australian Government is working with developers to proactively engage with communities, First Nations peoples and landholders to ensure benefits are shared and tailored to local priorities, in line with the guiding principles of the Government's Regional Investment Framework. This includes through the Capacity Investment Scheme, which considers a developer's approach to delivering social outcomes when assessing projects, resulting in significant community benefits over the lifetime of the scheme.

The recommendations of the Community Engagement Review span both Australian Government and state and territory responsibilities. Through the ECMC all governments have agreed to implement a broad range of activities in response to the Review. The majority of activities forming the ECMC's response are now substantially progressed or completed.

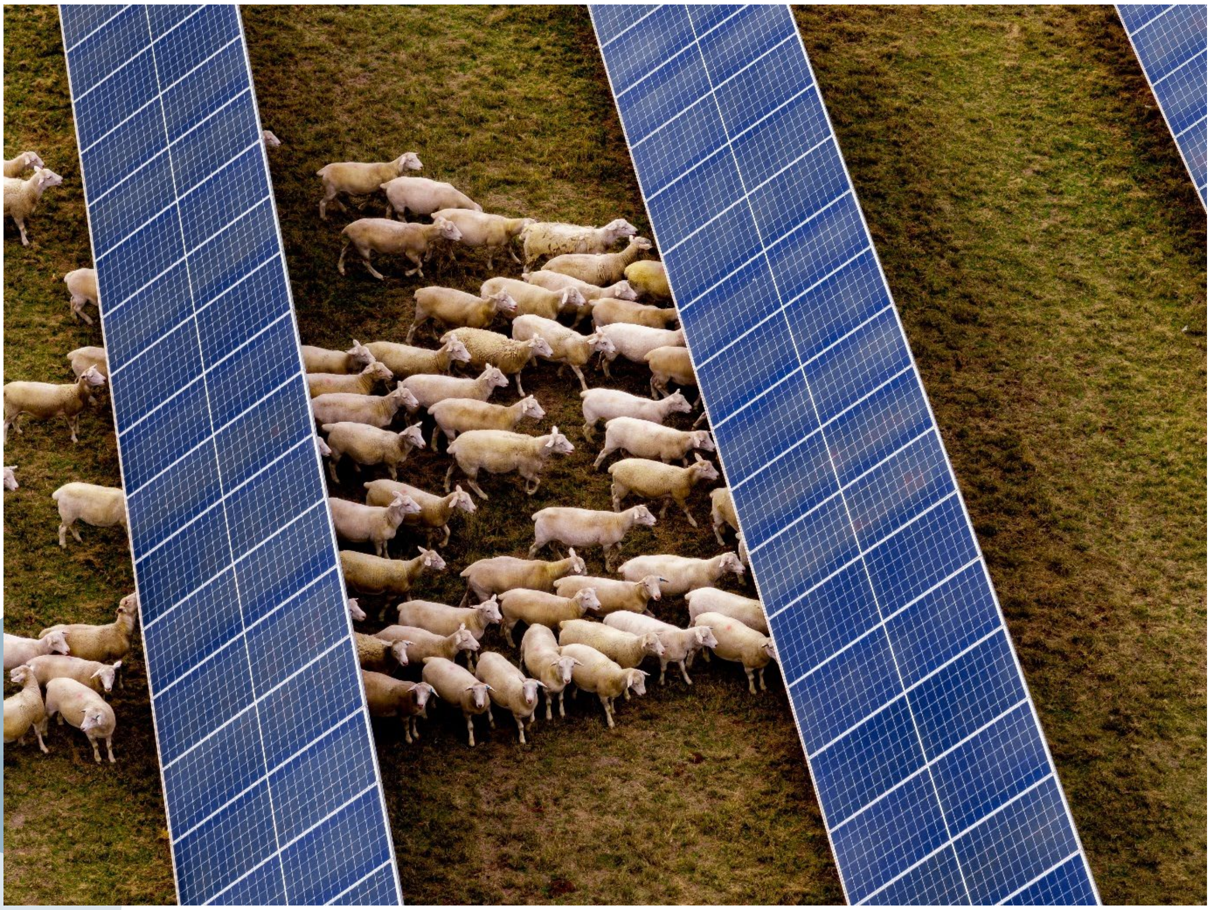
The Government is encouraging renewable energy developers to strengthen engagement practices. This includes the commencement of the Developer Rating Scheme pilot to foster trust and transparency in developers' practices, and publishing guidelines to set a nationally consistent approach to community engagement for transmission projects. A final report on the response to the Community Engagement Review will be provided to ECMC by the end of 2025.

Box 4.1: First Nations Clean Energy Strategy

Government and industry play an important role in partnering with First Nations people to realise their rights and interests, and empower them to benefit from, and drive, the clean energy transformation.

The First Nations Clean Energy Strategy 2024-2030 is the national framework to enable First Nations people to lead, participate in and benefit from the energy transformation. The Australian Government has provided $74.6 million to support the participation of First Nations organisations and communities in the development of clean energy projects. The funding will accelerate development of First Nations-led projects and support research to address barriers First Nations people and communities face when participating in clean energy projects and programs.

ARENA is additionally funding projects to deliver cleaner, more reliable and affordable electricity to remote First Nations communities through the First Nations Community Microgrids Stream of its Regional Microgrids Program. In August 2025, ARENA announced it would be providing $18 million to fund 3 projects in South Australia, Western Australia and the Northern Territory. The Net Zero Plan outlines initiatives to support First Nations participation in the net zero transition more broadly, including participation in land use abatement programs.



4.5 Promoting a sustainable energy future

The energy transformation will present future environmental challenges, as decommissioned renewable energy equipment enters the waste stream, and energy sources (such as hydrogen and biomass energy production) require water as a critical input.

Addressing renewable waste challenges requires a comprehensive policy framework through government-led regulations, industry-led initiatives and public-private partnerships. Australia's Circular Economy Framework sets the national direction with clear priorities and targets to reduce waste and keep products and materials circulating at their highest value for as long as possible.

Embedding circular economy principles within the energy sector presents a significant opportunity to build new economic value across the energy supply chain while reducing waste, emissions and environmental impacts. With Australia's circularity rate estimated to be 4.6% (compared to the global average of 7.2%), achieving a more sustainable energy future will require effort across all sectors – including the private sector prioritising investments that adopt circular practices.[32]

The Australian Government is continuing to work with jurisdictions on options for a national stewardship scheme to manage the waste challenge as solar panels reach their end-of-life and considering how this could support a domestic re-manufacturing industry. NSW will work with other states to develop a regulatory impact statement while the Australian Government will work with states to proof a national stewardship scheme, reporting back to the ECMC in early 2026.

The Government has developed various initiatives to improve the efficiency of water use in energy production and ensure the long-term sustainability of Australia's water resources. This will include the new National Water Agreement and National Hydrogen Strategy 2024. An ongoing focus on water sustainability across government and non-government stakeholders will be important to a lasting and efficient transition. The Australian Government will continue to explore further opportunities for sustainable water management, including by promoting greater circularity and considering more recycling and reuse of water.

4.6 Ensuring a secure and resilient transformation

Energy security and resilience are critical to the transformation. The National Climate Risk Assessment shows that critical infrastructure, including our energy systems, is vulnerable to most climate hazards – which are projected to increase in frequency and/or severity with increasing global warming.

It will be critical for developers and system operators to draw on relevant frameworks – such as the National Adaptation Plan and the Critical Infrastructure Resilience Strategy and Plan – to strengthen our energy systems. Regulators will also play an important role by ensuring energy market participants uphold their legislated responsibilities to maintain a resilient energy system.

The energy sector faces diverse threats in the face of a complex geostrategic and economic environment, extreme weather events driven by a changing climate and a continued prevalence of cybercrime. The Australian Government is committed to working with industry to uplift the security and resilience of our critical infrastructure, recognising the serious impact natural hazards, malicious

[32] ABS (2024b)

cyber activity and other threats could have on the operation of these systems and dependent infrastructure. Equally, market participants also have obligations under the *Security of Critical Infrastructure Act 2018*, the National Electricity Law and other legislation to take action to protect infrastructure and work with government to prepare for and respond to disruptions.

The increasing digitisation of energy infrastructure contributes to its efficient operation and ensures Australians have access to affordable, secure and reliable energy. However, this digitisation can – if not carefully managed – increase exposure to supply chain and cybersecurity threats. The Australian Government is responding through a range of measures such as investment into the supply chain for essential technology and ensuring regulation keeps paces with these changes in technology, such as through the *Cybersecurity Act 2024* and introduction of standards to improve the security of consumer energy devices.

The Australian Government continues to work closely with the sector, including through the Trusted Information Sharing Network, to ensure regulatory settings and voluntary action deliver targeted, effective and proportionate investment in security and resilience. These settings are carefully managed alongside the need to encourage a reliable pipeline of investment (including foreign capital), keep costs as low as possible and maximise productivity in the sector.

5. What the plan means for Australians

Net Zero Plan – Treasury Modelling and Analysis

'The ongoing rollout of cost-effective, clean energy will deliver substantial benefits to households and industry.'

People are at the centre of the energy transformation. Ensuring all Australians are the beneficiaries of these changes is essential to achieving an ambitious and orderly energy transformation. This means prioritising fairness and equity and designing the energy system to operate in people's interests.

Consumers can benefit from greater cost savings, health and energy resilience through energy efficiency upgrades, electrification, flexible consumption and rooftop solar and battery installations. Where the technology exists at sufficiently low cost, businesses and industry can also increase their productivity and competitiveness through improved energy performance, with examples of opportunities discussed in the Industry Sector Plan and other sector plans.

To ensure no one is left behind, clear and trusted information, fit-for-purpose consumer protections and removing barriers to participation can enable consumers to benefit from a cleaner, more affordable, reliable and resilient energy system.

5.1 Household benefits

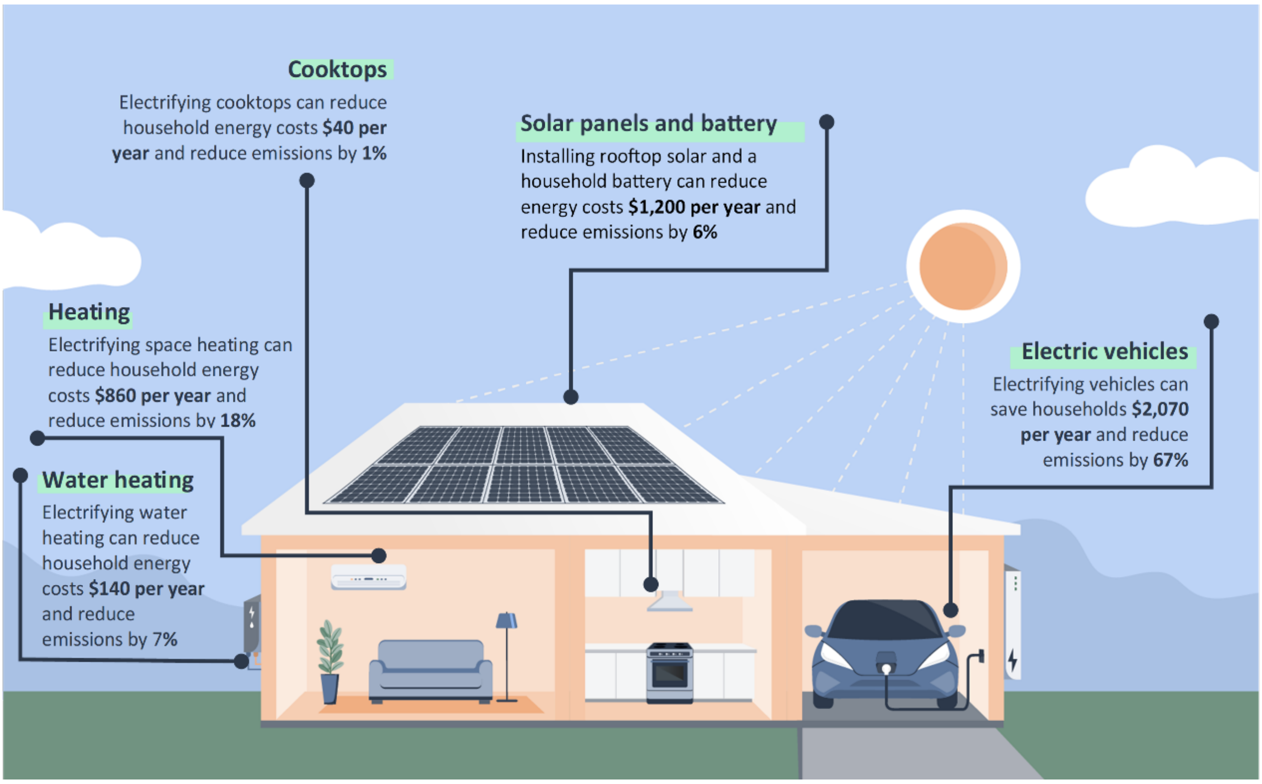
Financial savings

Electric appliances are significantly more efficient and cheaper to run than combustion-based alternatives. Households which can electrify, choose more efficient appliances and install solar panels and batteries, can significantly reduce their grid electricity consumption and energy bills.

Treasury modelling indicates a typical Australian household that electrifies key appliances, purchases electric vehicles and installs solar panels and a battery, can reduce their energy costs by as much as $4,300 per year, after accounting for upfront and financing costs (compared to a household that purchases gas appliances and internal combustion engine cars).

Some households face significant barriers to electrification, including one-third of households who rent their home or are living in apartments. Households that cannot make all these upgrades can still benefit from an orderly transition to net zero.

Figure 5.1: Modelled benefits of electrification, under the Baseline Scenario



Note: Annualised real costs from 2030 to 2050, including upfront, financing and ongoing costs. Assumes a typical two-to-three-person household with two vehicles, average consumption for home heating, cooking and hot water, and purchases a 10.6kW solar system and 10kWh battery. For more detail, see 'Australia's Net Zero Transformation: Treasury Modelling and Analysis. Financing can be reduced by Australian Government, state or territory supports and loans, such as the Household Energy Upgrades Fund. Direct capital support for social housing upgrades is also provided through the Social Housing Energy Performance Initiative.

Source: Treasury modelling.

Health benefits

Electrification can significantly improve air quality and health. Indoor gas appliances have been linked to lung and cardiovascular damage especially in children, increasing the chance of developing asthma. About 12% of asthma cases across Australia can be directly attributed to gas stovetops.[33] Outdoors, fossil fuel combustion is the leading source of particulate matter, costing our economy around $13.9 billion annually in health impacts from air pollution.[34] Reducing light diesel vehicle emissions by 55% could save $3.8 billion in health costs from 2026 to 2040.[35] Adopting EVs also reduces noise pollution – around 70% of which comes from road traffic in Australia.[36] Increasing thermal efficiency of homes also improves liveability of homes. Actions that improve energy performance more broadly can support achievement of Australia's National Health and Climate Strategy.

Energy reliability and resilience

A more distributed energy system boosts self-sufficiency, reliability, and resilience, particularly where disaster events or volatile weather can disrupt electricity supply. Access to rooftop solar and battery storage can mitigate the impact of extended outages and network damage.

Rural and remote communities can benefit from cheaper and more resilient energy supply through greater access to community solar and batteries. Many small communities rely on diesel generators, either in individual buildings or as part of a micro-grid. These make communities vulnerable to volatile diesel prices linked with global markets or adverse weather events that disrupt supply.

Box 5.1: Coober Pedy Microgrid

Coober Pedy, a remote mining town in South Australia, has traditionally relied on off-grid electricity generation supplied by diesel generators. Supported by ARENA, the Coober Pedy Hybrid Renewable Power Station combines 4MW wind generation, 1 MW solar generation, a 1 MW/500 kWh battery and other integration technologies with a back-up diesel power station.

It has delivered lower cost and more stable electricity, at world-leading renewable energy penetration rates. Over the first 5 years of operation, the project saved 2,189kL of diesel and achieved an average renewable energy penetration of 75.3% (with the project operating on 100% renewables for its longest continuous period to date in December 2019 for 97 hours).

[33] Knibbs et al (2018)
[34] Economic cost of lives lost and burden of disease from $PM_{2.5}$ (fine particulate matter); DCCEEW analysis applying economic value to lives lost and burden of disease from AIHW (2021)
[35] DCCEEW and DITRDCA (2023)
[36] Department of Health (2018)

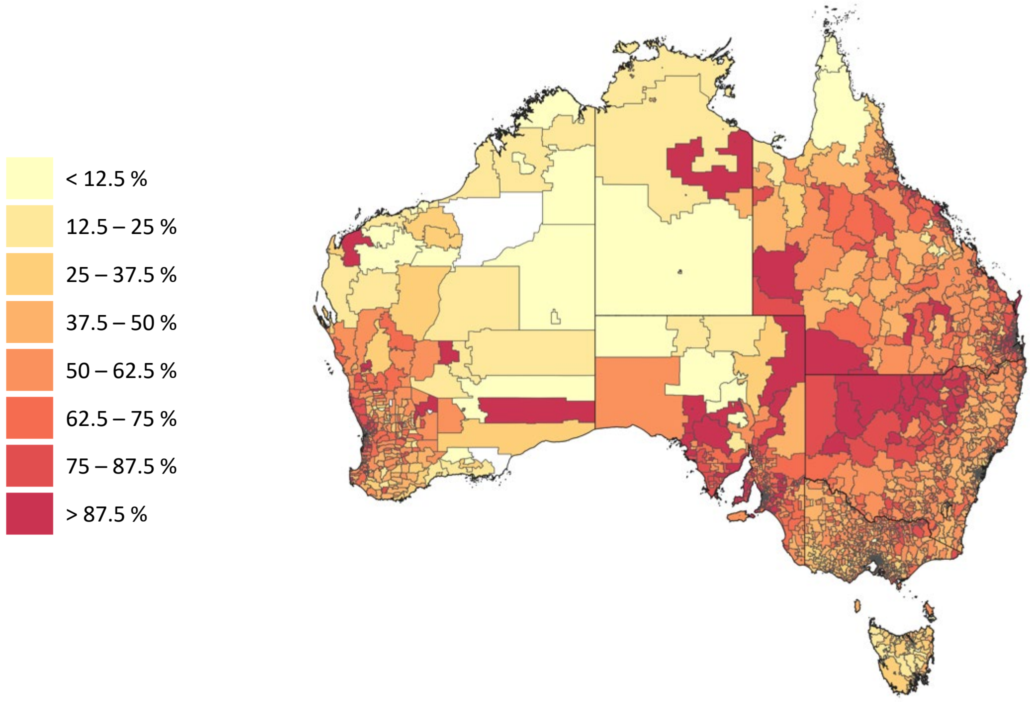
Outer suburb and regional households are benefitting from access to rooftop solar

Around 35% of households in Australia have rooftop solar. However, adoption of rooftop solar varies across postcodes, particularly in urban centres where high-density buildings reduce opportunities for rooftop installation (Figure 5.2).

In general, installed rooftop solar capacity increases the further away postcodes are from the CBD. Conversely, postcodes closer to the CBD generally report higher average incomes. While upfront costs can be a barrier to rooftop solar uptake, this analysis indicates households from a range of income levels are sharing in the benefits of the energy transformation. This trend is less prominent in Brisbane, which has significantly higher levels of rooftop solar across a broader range of postcodes, reflecting Queensland’s abundant solar resources (Figure 5.3).

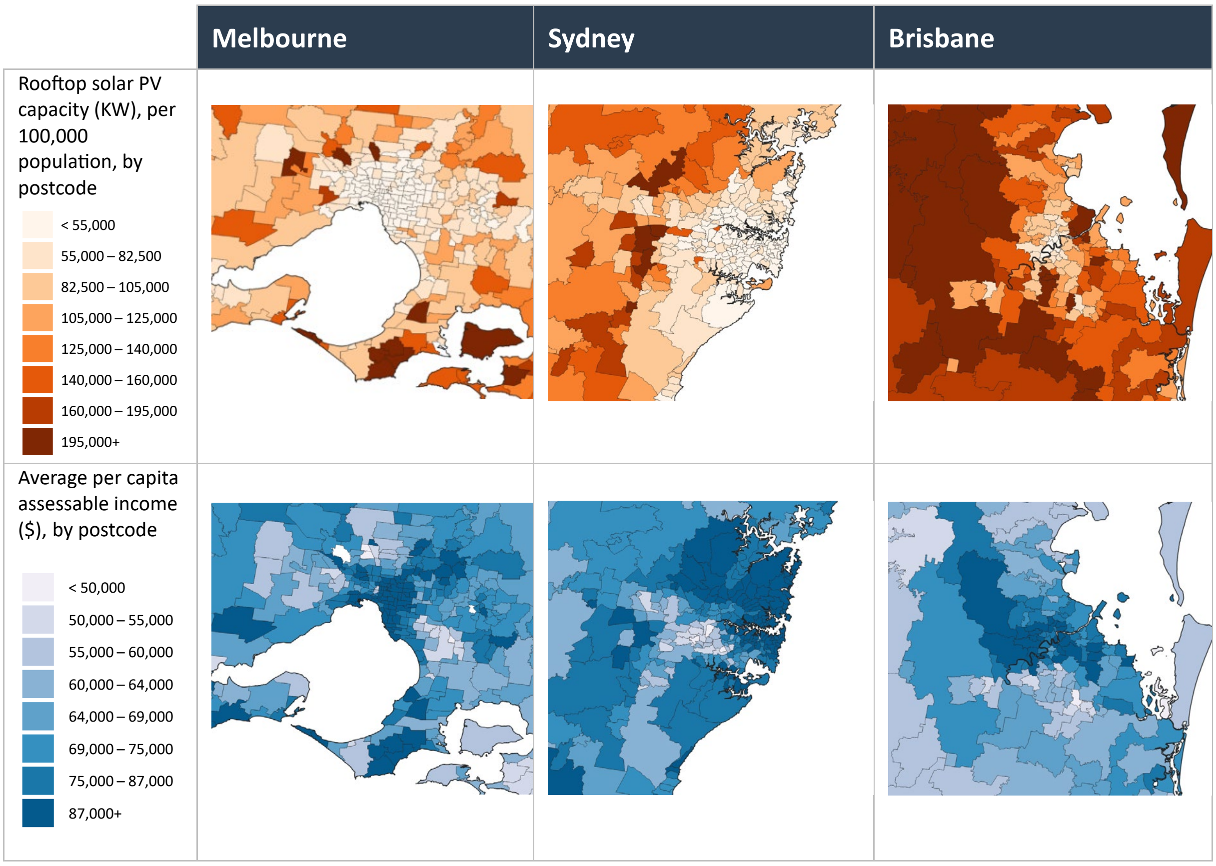
Figure 5.2: Uptake of rooftop solar, by postcode, %

Key: Light yellow – Low % of households have rooftop solar in this postcode
Dark red – High % of households have rooftop solar in this postcode



Source: DCCEEW analysis based on small-scale installation postcode data, Clean Energy Regulator 2025.

Figure 5.3: Uptake of rooftop solar and average income per capita, by postcode



Source: DCCEEW analysis of small-scale installation postcode data and digital boundary files; CER (2025) and ABS (2021).

5.2 A fair and equitable energy transformation

Collaborative efforts across all levels of government and industry are critical to maximise the benefits of the energy transformation for all Australians, including removing barriers and avoiding negative consequences for vulnerable groups. Barriers and opportunities include:

- **Information barriers:** Energy service offerings can be complex to navigate. Clear, easily accessible and trusted sources of information that meet diverse linguistic needs are necessary to increase information access.
- **Upfront capital:** Not all households have access to finances for upfront capital costs required for household upgrades, adopting electric vehicles and installing rooftop solar and batteries.
- **Split incentives:** Tenants who benefit from home upgrades may have little control over upgrade decisions, and landlords have limited incentives for upgrading leased homes.
- **Apartment dwellers:** Apartment dwellers may lack control over installation of rooftop solar and household batteries. Households in more densely populated areas may also have less access to electric vehicle charging.
- **Regional and remote communities:** Consumers in remote and regional communities often rely on off-grid electricity generation and could benefit from greater access to shared community microgrids and batteries.
- **First Nations communities:** The energy transformation brings opportunities to address high energy insecurity and a need to implement fit-for-purpose consumer protections for First Nations communities.

The Australian Government is taking action to support all Australians access clean energy and the benefits of higher performance homes and vehicles. Information platforms like energy.gov.au provide advice to consumers to assist with energy upgrades. Assistance is also offered through CEFC energy performance upgrade loan programs, ARENA microgrid grant programs, and ongoing implementation of strategies like the First Nations Clean Energy Strategy, the National CER Roadmap and the National Energy Performance Strategy.

The Government is also delivering $50 million over 4 years from 2025-26 to deliver energy performance upgrades for community sports clubs to climate-proof community sports facilities, promote inclusive climate action and harness the potential of sport as a vehicle to engage everyday Australians in the energy transition.

The energy transformation is also creating significant opportunities for regional revitalisation and economic diversification. Regional communities have grown around where much of the country’s energy infrastructure is located and industrial activity takes place, and some of these communities are facing a considerably uncertain future due to energy transformation challenges. NZEA is helping to ensure regions, communities and workers are supported to manage the impacts, and share in the benefits, of the net zero economy.

Evolving consumer protections

The existing regulations and frameworks that support energy customers – including the National Energy Customer Framework – recognise that access to essential energy services needs to be protected.

The Australian Government is reviewing regulatory protections including price protections to ensure market settings continue to enable and incentivise competition and deliver for consumers in the electricity retail market.

- The Government will reform the Default Market Offer (DMO) to better protect standing offer customers and ensure those customers can access a fair price for electricity.
- In response to a review of the *Prohibiting Energy Market Misconduct (PEMM) Act 2019*, the Government will consult on expanding the current protections around retail pricing to ensure companies do not over inflate prices in response to cost increases, as well as introduce measures to ensure companies are not engaging in cross-market manipulation between wholesale and financial markets.
- The Government will also extend the sunset date of the PEMM to 1 January 2031 to maintain current consumer protections.

At the same time, our energy market is changing. Energy customer regulations and frameworks were designed for a time where households and businesses were primarily purchasers of energy. These are no longer fit-for-purpose for a modern energy system, where electricity flows both from the grid to consumers and from consumers to the grid. Encouraging new arrangements between customers and the market needs to be balanced with managing potential risks for consumers, including those who do not engage with new products and services.

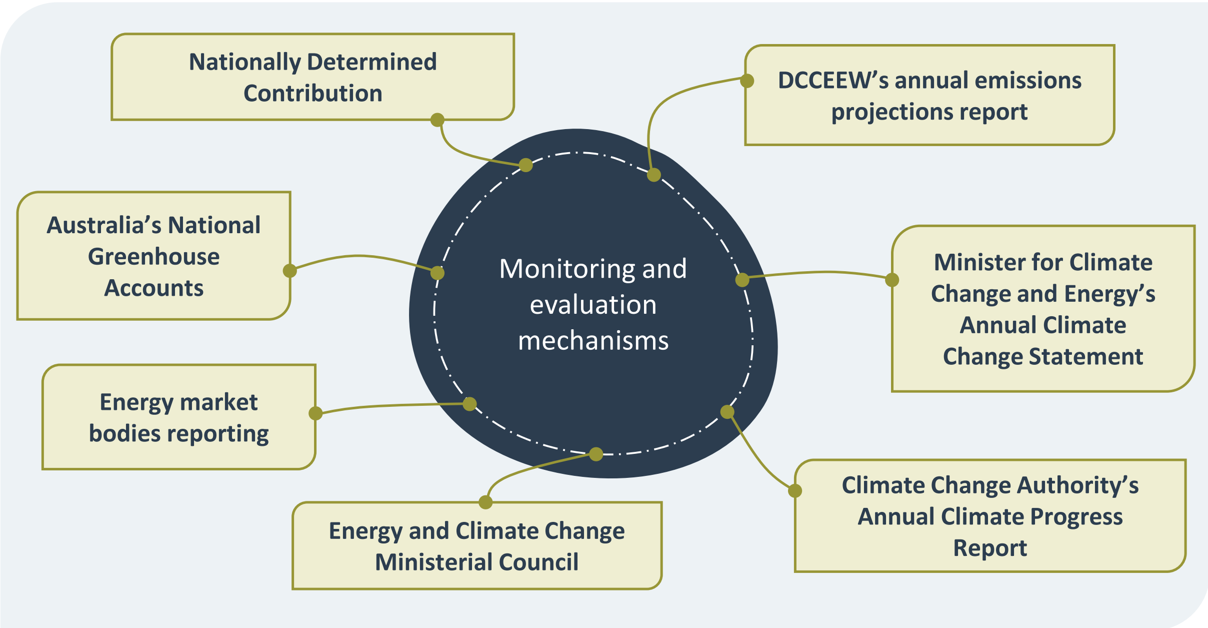
To reflect these shifting circumstances, the Australian Government is also working with states and territories through ECMC to modernise and strengthen Australia's energy consumer protection regimes, including establishing the Better Energy Customer Experience (BECE) program. The BECE program, endorsed by Energy Ministers at the March 2025 ECMC, will take a holistic approach to reviewing the consumer protection frameworks that underpin the relationship between consumers and the energy market to assess whether reforms are needed to support consumers through the energy transformation and beyond.

Alongside the BECE program, the National CER Roadmap will progress reforms to ensure consumers will benefit from CER and new energy services by extending consumer protections to new service offerings where they are not already covered by existing electricity consumer protection laws.

6. Monitoring and evaluation

Monitoring and evaluation throughout the energy transformation will be critical to ensure Australia is on track to meet our emissions reduction targets and the milestones outlined in this plan. Australia has robust mechanisms in place to monitor and evaluate progress on climate and energy commitments (Figure 6.1). These mechanisms will provide the evidence base to track progress under this plan and form advice on policy interventions where required.

Figure 6.1: Australia's climate and energy monitoring and evaluation mechanisms



The Paris Agreement requires countries to update their emissions reduction commitments, or Nationally Determined Contributions (NDC), every 5 years. This allows Australia to review and ratchet our national targets in light of the progress of Australia's energy transformation and broader decarbonisation efforts.

The Australian Government produces the annual emissions projections report. These projections provide estimates of Australia's greenhouse gas emissions and provide a transparent assessment of historical and projected emissions in the electricity and energy sector to guide government and industry decarbonisation efforts.

The *Climate Change Act 2022* (the Act) embeds important accountability and transparency mechanisms for assessing and communicating Australia's progress on climate action. Under the Act, the Minister for Climate Change is required to table an Annual Climate Change Statement in Parliament, setting out progress towards achieving Australia's emissions reduction targets. The statement must also report on the effectiveness of policies that contribute to achieving Australia's targets, including energy policies.

To inform the Statement, the Act requires the CCA to provide independent advice on Australia's progress. The CCA's Annual Progress Report monitors emissions reductions and evaluates policy progress using a set of leading indicators for each sector, including energy.

Meeting Australia's emissions reduction targets requires joined-up effort across all levels of government. ECMC provides a forum for sharing of jurisdictions' progress towards their emissions targets, and to monitor the implementation of key reforms. The ECMC reports to the National Cabinet annually on work to achieve its strategic priorities.

Australia's energy market bodies – AEMO, AEMC and the AER – regularly undertake reviews and provide advice on the electricity and gas markets. DCCEEW oversees administration of Australia's liquid fuel security framework. These arrangements ensure comprehensive evidence-based information and analysis is available to support strategic decision-making and guide the energy transformation.

Australia's existing monitoring and evaluation mechanisms position us well to track progress on the Plan and review and refine policy settings over time to respond to changing circumstances and needs.

Abbreviations and acronyms

ACCC	Australian Competition and Consumer Commission
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Agency
CCA	Climate Change Authority
CEFC	Clean Energy Finance Corporation
CER	Consumer energy resources
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEEW	Department of Climate Change, Energy, the Environment and Water
ECMC	Energy and Climate Change Ministerial Council
EV	Electric vehicle
GDP	Gross Domestic Product
GPG	Gas-fired power generation
GWh	Gigawatt hour
IEA	International Energy Agency
ISP	Integrated System Plan
LCLF	Low carbon liquid fuels
LCOE	Levelised cost of electricity
LNG	Liquefied natural gas
Mt CO2-e	Million tonnes of carbon dioxide equivalent
NABERS	National Australian Built Environment Rating Scheme
NDC	Nationally Determined Contribution
NEM	National Electricity Market
NETP	National Energy Transformation Partnership
NZEA	Net Zero Economy Agency
PV	Photovoltaic (solar)
The plan	Electricity and Energy Sector Plan
R&D	Research and development
RETA	Renewable Energy Transformation Agreement
SWIS	South West Interconnected System
TWh	Terawatt hour
UNFCCC	United Nations Framework Convention on Climate Change
VRE	Variable renewable energy
WEM	Wholesale Electricity Market
ZEV	Zero emissions vehicle

Glossary

Abatement	A reduction in atmospheric greenhouse gases through emissions avoidance or removal and sequestration of carbon from the atmosphere.
Carbon capture and storage	A process in which carbon dioxide from industrial or energy related sources is separated (captured), conditioned, compressed and transported to a (usually geological) storage location for long-term isolation from the atmosphere.
Circular economy	An economic system focused on reducing waste, reusing resources and designing products for longer life, recyclability and minimal environmental impacts.
Critical minerals	Critical minerals are metallic or non-metallic materials that are essential to our modern technologies, economies, and national security, and whose supply chains are vulnerable to disruption.
Decarbonise	To stop or reduce carbon gases, especially carbon dioxide, being released into the atmosphere as the result of a process, like the burning of fossil fuels.
Demand flexibility	Increasing the capability to shift electricity demand to times when renewable electricity is more abundant or cheaper. This can include heating water when solar generation is high, or storing solar energy in batteries for evening use.
E-fuels	Synthetic fuels produced from renewable electricity, hydrogen and captured CO2 that can be used as direct fuel substitutes in existing engines and infrastructure.
Electrification	Switching from energy sources, such as liquid fuels or gas, to electricity.
Energy efficiency	The amount of energy required to perform given task or produce a given result. Increasing energy efficiency means using less energy for the same result.
Energy performance	Covers the broad management of energy demand, including energy efficiency; demand flexibility (or load shifting); and electrification or fuel switching.
Firming/firmed renewables	Ensuring reliability of electricity supply by supplementing variable renewable energy with dispatchable generation sources such as energy storage (i.e. batteries).
Fossil fuels	Fossil fuels include coal, petroleum, natural gas, oil shales, bitumens, tar sands, and heavy oils. All contain carbon and were formed as a result of geologic processes acting on the remains of organic matter produced by photosynthesis, a process that began in the Archean Eon (4.0 billion to 2.5 billion years ago).
Green metal	Iron, steel, alumina and aluminium produced with low or zero greenhouse gas emissions.
Greenhouse gases	Any gas (natural or produced by human activities) that absorbs infrared radiation in the atmosphere, leading to warming effects. Greenhouse gases include carbon dioxide, methane and nitrous oxide.
Gigawatt hour (GWh)	A measure of electrical energy in terms of the use of one gigawatt of power for one hour, equal to 1,000 MWh.
Hard-to-abate emissions	Emissions from essential processes and products with no near-term decarbonisation options.
Low carbon liquid fuels (LCLF)	Liquid fuels with lower lifecycle emissions than conventional fossil fuels. LCLFs can be sustainably produced from biomass, waste materials and/or green hydrogen.
Microgrid	A set of distributed energy resources that provides energy generation and storage at a local level and can be controlled independently, either within a wider grid or as a standalone grid.
Mitigation	Reducing greenhouse gas emissions in order to stop climate change getting worse.
Mt CO2-e	Million tonnes of carbon dioxide equivalent. Is used to standardise different greenhouse gas emissions impacts on climate change to be reported as a single value. Usually shown in tonnes (t CO2-e) or million tonnes (Mt CO2-e).

Net emissions	The sum of anthropogenic greenhouse gas emissions to the atmosphere and anthropogenic removals of greenhouse gases from the atmosphere.
Net zero emissions	An overall balance between greenhouse gas emissions and removals.
Renewable energy	Energy from a source that is not depleted when used, such as wind or solar power.
Renewable hydrogen	Hydrogen produced through electrolysis using renewable electricity.
Residual emissions	The volume of gross anthropogenic greenhouse gas emissions (see Gross emissions) that remain after emissions reduction activities, but not including emissions removal. Also referred to as residual gross emissions.
Gigawatt hour (GWh)	The volume of electrical energy provided by one gigawatt of power for one hour, equal to 1,000 MWh.
Sustainable Aviation Fuel	Renewable or waste-derived aviation fuels that meet sustainability criteria.
Terawatt hour (TWh)	The volume of electrical energy provided by one terawatt of power for one hour, equal to 1,000 GWh.

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Australian Government

Agriculture and Land Sector Plan

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Acknowledgement of Country

We acknowledge the continuous connection of First Nations Traditional Owners and Custodians to the lands, seas and waters of Australia. We recognise their care for and cultivation of Country. We pay respect to Elders past and present, and recognise their knowledge and contribution to the productivity, innovation and sustainability of Australia's agriculture, fisheries and forestry industries.

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The Hon Julie Collins
Minister for Agriculture,
Fisheries and Forestry

The Hon Chris Bowen
Minister for Climate
Change and Energy

As a nation, we pride ourselves on our world-class agriculture, fisheries and forestry industries and spectacular natural environment. They are essential to Australia's economic prosperity and the wellbeing of our communities. However, the climate in which producers and land managers operate is rapidly changing. Global action to reduce emissions is required to protect our industries and landscapes from the negative impacts of climate change and Australia must play an active part. Through collective effort and strong industry leadership we can harness opportunities from the net zero transition.

Agriculture and land have already made important contributions to Australia's emissions reduction efforts. But more is needed. For the first time, the Agriculture and Land Sector Plan establishes a framework for the sectors to appropriately contribute to Australia's net zero target. The plan establishes the foundations for future action and explores pathways as we chart a course to 2050. It is one of six sector plans supporting the Government's *Net Zero Plan*, which together, cover all major sectors of the economy.

Addressing climate change must go hand in hand with supporting prosperous industries, thriving communities and a healthy natural environment. With that in mind, the plan's development has been guided by three important principles we outlined at the Sustainable Agriculture Summit in 2024.

First, agricultural decarbonisation must be achieved with the sector, not imposed on the sector. We can only achieve our shared climate goals through partnership and collaboration. Our progress will rely on industry ambition and action, underpinned by community support. The development of this plan was informed by extensive stakeholder consultation, and we thank everyone for their engagement in submission processes, workshops, roundtables and many other valuable discussions. Your contributions have shaped the direction for the sector to 2050 and beyond.

Second, while action on climate change is necessary to ensure food security, action will not come at the expense of food security. The Government's modelling shows Australia can reach its climate goals while maintaining a strong

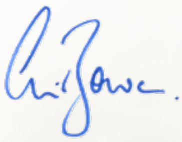
Senator the Hon Murray Watt
Minister for the Environment and Water

agricultural sector. Agriculture and land will play a vital role in contributing to the net zero transition while meeting growing food and fibre demand.

Third, while agriculture and land must make an appropriate contribution to net zero, they will not be taken for granted to balance emissions from other sectors. Through the *Net Zero Plan*, the Government has committed to taking early and consistent action across the economy and prioritised the delivery of clean and affordable energy. Carbon storage activities in the land will need to be well-planned and provide economic opportunities to producers and land managers who choose to pursue them.

We do not have every element in place yet, but we will continue to shape the pathway to 2050 in collaboration with industry, communities and with all levels of government. Together we can overcome the challenges and unlock new opportunities well into the future.

The Hon Julie Collins
Minister for Agriculture, Fisheries and Forestry



The Hon Chris Bowen
Minister for Climate Change and Energy

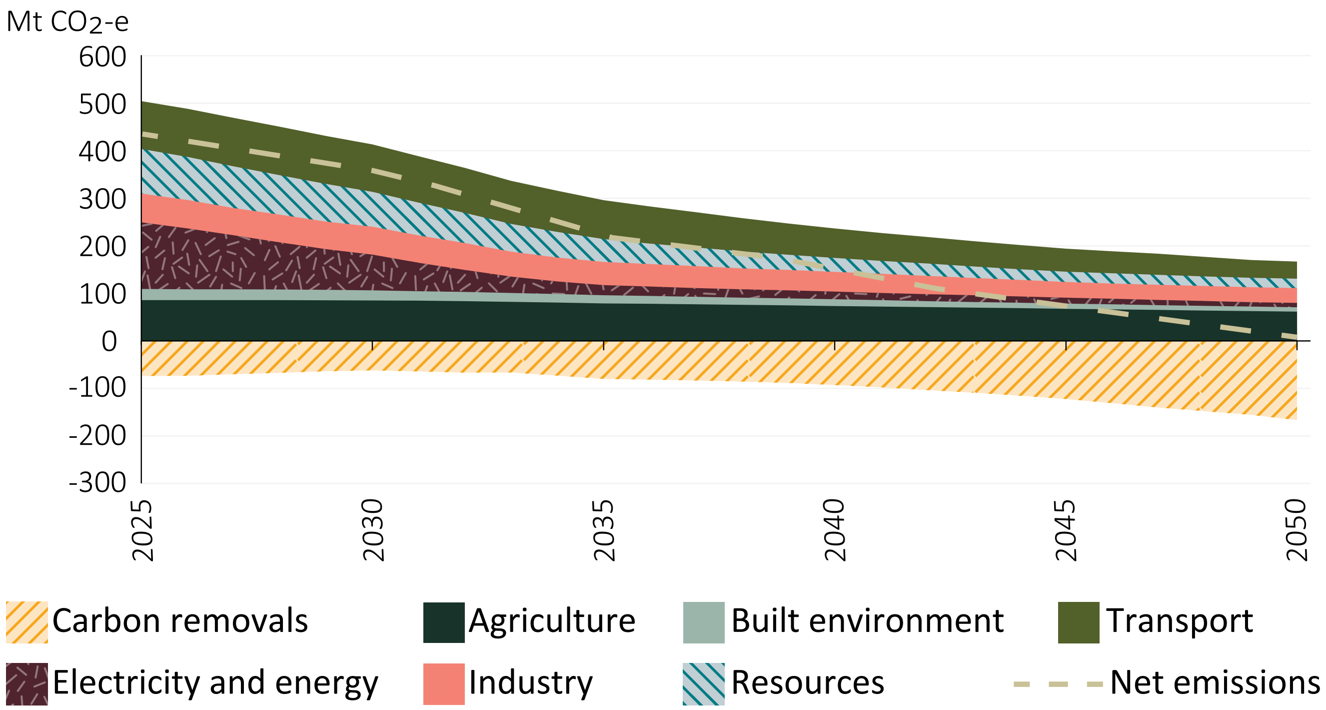
Senator the Hon Murray Watt
Minister for the Environment and Water

Executive summary

The effects of climate change are already being felt across the globe. In Australia and overseas, governments, industry groups and businesses are taking steps to reduce their emissions and limit the worst impacts of climate change. By taking a proactive approach, we can harness opportunities that arise from shifting market expectations, identify emissions and productivity improvements, and optimise for carbon and nature in our landscapes.

Australia's agriculture and land sectors make up a significant part of Australia's greenhouse gas emissions. Reducing emissions associated with agricultural production and growing carbon stores in the land will be critical for Australia to meet its net zero by 2050 goal. In the Baseline Scenario modelled by the Treasury (Figure 1), agriculture emissions are projected to reduce by 28% and the carbon sink in the land is expected to increase by 126% to 2050. These changes are not targets, rather they are indicative of one potential pathway agriculture and land may take in a cost effective economy wide transition to net zero in 2050.

Figure 1 Projected emissions under the Baseline Scenario, by Sector



Source: Treasury modelling

The Agriculture and Land Sector Plan outlines a framework to enable these outcomes (Figure 2). Three strategic objectives underpin an appropriate contribution from the sectors towards Australia's net zero goal.

First, Australian producers remain global leaders in low-emissions food and fibre production. Action on climate change cannot come at the expense of food security. Therefore, continued efficiency gains and improvements to the emissions intensity of production will be necessary to meet growing demand while contributing to emissions reduction goals.

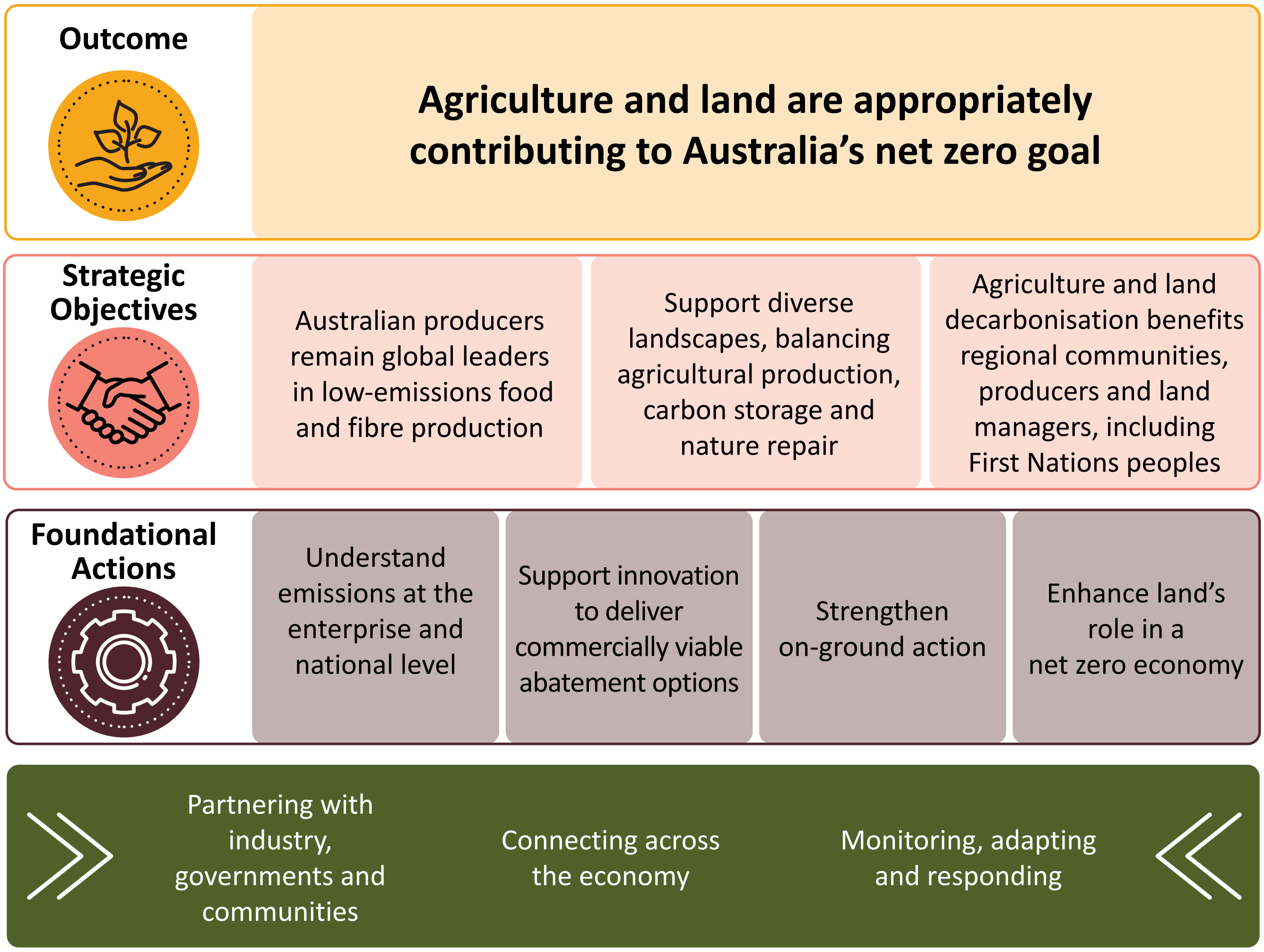
Second, we must support diverse landscapes that balance agricultural production, carbon storage and nature repair. Growing carbon storage in the land is critical for Australia to meet its net zero goal. However, in doing so, we must consider multiple priorities and land uses.

Finally, decarbonisation of agriculture and land must deliver real benefits for regional communities, producers and land managers, including First Nations peoples. It is critical to enable a fair and orderly transition for regional, rural and remote communities.

To achieve these multiple objectives, four foundational areas for action have been identified:

1. understand emissions at the enterprise and national level
2. support innovation to deliver commercially viable abatement options
3. strengthen on-ground action
4. enhance the role of Australia's land in a net zero economy.

Figure 2 Framework for agriculture and land to contribute to Australia's net zero goal



The Australian Government is investing in a range of programs that support these actions, building on extensive work already underway from across the sectors and other levels of government. The Government has announced a further $1 billion for loans from the Regional Investment Corporation. This funding will support the expansion of the corporation's scope to support improved climate resilience, emissions reduction and sector productivity as we move towards net zero by 2050. There are also opportunities that will flow from the Government's $1.1 billion investment in a Cleaner Fuels Program.

Government investment is expected to be complemented by strong action from industry groups and the private sector. Moving forward, we will work together in partnership and collaboration to chart the pathway to 2050.

1

Introduction

Credit: Joshua Smith

Agriculture and land are critical to Australia's economic prosperity and wellbeing, providing food and fibre for tens of millions of people across the world and supporting valuable ecosystem services. These activities underpin communities, industries and the natural environment. But the effects of climate change are already widely felt. More frequent and extreme weather events, together with changing seasonal conditions, are increasing pressure on productivity, farm performance, water resources and landscape health (ACS 2025).

A global response to limit the worst impacts of climate change is underway. As part of that effort, Australia has committed to a 43% reduction in emissions by 2030 and a 62–70% reduction in emissions by 2035 below 2005 levels, then to reaching net zero emissions by 2050.

Reaching these goals requires a whole-of-economy approach. The Agriculture and Land Sector Plan (the plan) explores the role for agriculture and land in supporting these national outcomes. It is one of six sector plans under the Australian Government's Net Zero Plan (Box 1).

Agriculture and land, including vegetation management and forestry, have already made valuable contributions to Australia's emissions reductions, but further efforts will be needed. The plan explores how these sectors can continue to make an appropriate contribution to Australia's climate goals by reducing emissions and storing more carbon. It considers the strategic objectives that must be achieved alongside further decarbonisation and sets out the foundational actions that will enable our producers and land managers, including First Nations peoples, to continue playing an important part in the net zero transition.

Decarbonisation in agriculture and land must be achieved in partnership with industry, not imposed on it. That is why development of the plan has been underpinned by extensive and ongoing stakeholder engagement, including a public submission process, workshops, roundtables, a summit and regular discussions. Throughout engagement, stakeholders expressed a strong commitment to the transition to the net zero economy and playing their part. Many producers and land managers are actively exploring options to reduce emissions and support healthy landscapes.

The plan is the next step in an ongoing partnership between governments, industry, communities, and the private sector as we chart a course to economy-wide net zero by 2050. It will build on the work already underway, including by state, territory and local governments.

Box 1 The Net Zero Plan

The *Net Zero Plan* sets out Australia's pathway to achieve our legislated target of net zero greenhouse gas emissions (GHG) by 2050. The *Net Zero Plan* identifies 5 priority decarbonisation actions to reduce key emissions sources across the economy:

1. decarbonise and expand the electricity network
2. electrify and increase energy and materials performance
3. switch to low-carbon alternatives
4. innovate to expand technology options
5. scale up carbon removals to balance residual emissions.

The Agriculture and Land Sector Plan particularly supports innovation of abatement solutions and the scaling up of carbon storage in the land in alignment with the sector's decarbonisation pathway set out in chapter 3.

Benefits of taking action

The effects of climate change are already being felt across landscapes and farming communities (Box 2). Analysis has shown that recent seasonal conditions (2001 to 2020) reduced the profitability of Australian broadacre farms by an average of 23%, or around $29,200 per farm, relative to the previous 50 years (Hughes & Gooday 2021). Going forward, climate change poses significant risks to the productivity and profitability of primary industries, and the quality of food and fibre products (ACS 2025).

Climate change is also exacerbating threats to the natural environment, increasing the risk of ecosystem transformation or collapse, and the loss or extinction of native species. In turn, the degradation of Australia's ecosystems is limiting the ability of natural landscapes to store carbon and reducing nature's resilience to climate impacts (ACS 2025). Adaptation is critical (Box 3), but there are limits to what can be achieved through adaptation alone. Reducing emissions globally, with Australia playing its part, is a fundamental step in avoiding the most severe impacts of climate change over coming decades.

Box 2 Average warming in Australia

+1.51°C

Average warming in Australia since national records began in 1910 (BOM & CSIRO 2024).

As Australia exports around 70% of agricultural production (ABARES 2025), reducing emissions is critical for positioning the industry to be internationally competitive on the basis of its sustainability into the future. The majority of 136 of the largest global agrifood companies have made net zero commitments or set emissions reductions targets, some of which will impact global food and fibre supply chains (Purdie 2024). As global economies decarbonise, markets, supply chains and consumer preferences will shift with implications for Australian agriculture. A proactive approach to lowering emissions from food and fibre production will position industry to harness new opportunities and ensure ongoing access to markets and capital.

Australia is already well placed in this regard. Australian cattle and grain producers operate with lower than average emissions intensities compared to other major agricultural exporter countries (Read et al. 2023). Australian producers also have relatively low application rates of fertiliser and pesticides, which may be driven in part by Australia having one of the lowest levels of agricultural support globally. Research shows that agricultural producer support policies, such as subsidies and tariffs, are linked to environmental harm and higher GHG emissions (Read et al. 2023).

Further action to reduce emissions will be required to enable producers to maintain their competitive advantage and capitalise on the increasing market expectations around sustainability and nature outcomes. Taking action on climate can also have direct economic benefits for producers and land managers by helping to identify new business opportunities and boost resilience. Understanding emissions sources and options for reducing emissions can enable management decisions that align with business priorities and future plans.

Achieving Australia's net zero transition and ambitions to protect, repair and better manage nature can and should be complementary. Nature provides the foundation for thriving societies, prosperous economies and regional jobs. Industries like agriculture, fisheries, forestry, tourism, construction and manufacturing all derive resources from nature and depend on healthy, well-functioning ecosystems. In Australia, and overseas, nature is under pressure from climate change, habitat loss, invasive species, pollution and unsustainable use of natural resources.

As a signatory to the Convention on Biological Diversity's Kunming-Montreal Global Biodiversity Framework (GBF), Australia is committed to halting and reversing biodiversity loss by 2030. This commitment and Australia's contribution to the GBF is set out in Australia's Strategy for Nature 2024–2030. Reducing emissions and storing more carbon can support the national targets in our Strategy for Nature, including to minimise the impact of climate change on biodiversity and ensuring priority degraded areas are under effective restoration. Similarly, designing ecosystem restoration activities to be resilient to changes in water availability, temperature and extreme events can provide carbon storage co-benefits and help progress Australia's net zero goal.

Box 3 Enhancing adaptation and resilience to climate change

Decisive action to reduce emissions is essential to limiting the future impacts of climate change. At the same time, climate change is already causing significant and increasing harm to Australia's economy, society and environment, including primary production (ACS 2025). The Australian Government recognises the importance of considering decarbonisation, escalating climate risks and adaptation to changing conditions together. Incorporating these considerations as part of the agriculture and land sectors' net zero pathway will help ensure action is designed to deliver emissions reductions in a hotter and more volatile climate and to harness adaptation co-benefits.

To better prepare for and manage the increasing risks from climate change, the Government has delivered Australia's first National Climate Risk Assessment and National Adaptation Plan.

The *National Climate Risk Assessment* represents the first comprehensive overview of the impacts Australia will face under future climate scenarios, based on the best available scientific evidence compiled by the Australian Climate Service. The assessment identifies several increasing risks to primary industries and the natural environment, including increased time spent in drought, further declines in water availability in major agricultural regions, and greater pressure on native species.

The *National Adaptation Plan* sets out the Australian Government's policy framework to respond to the findings of the National Climate Risk Assessment. It provides a vision for a well-adapted Australia, and current and prospective actions for key sectors including primary industries and food, and the natural environment. The adaptation plan also outlines principles to guide future action. It provides the Australian Government context for adaptation planning, to assist other levels of government, businesses and the community.

Drought is one of the many climate risks that producers will continue to face with increasing frequency and severity. Resilience to drought requires tailored and practical support. The Government provides secure and continuous funding through the Future Drought Fund to support producers and regional communities to build their drought and climate resilience. Concessional loans are also available through the Regional Investment Corporation to prepare for, manage through and recover from financial disruption due to drought, natural disasters, and cumulative events.

Australia's food system is a national strength but it is under increasing pressure from risks, such as climate change, biosecurity threats, geopolitical instability and supply chain vulnerabilities. The Australian Government has committed to developing a National Food Security Strategy in consultation with industry, community and government to boost the productivity, resilience and security of Australia's food system.

Australia must continue to build on its adaptation and resilience efforts to effectively respond to climate impacts on primary production, the environment, the economy, regional communities and other disproportionately impacted cohorts. Efforts must support a range of outcomes including drought resilience, water-use efficiency, soil health, innovation, and availability of climate information.

2. Emissions from agriculture and land

This plan covers emissions and carbon storage associated with activity in agriculture and the land. This includes the emissions from electricity and fuel use associated with the agriculture, fisheries and forestry industries. Emissions that occur beyond the farm gate – such as emissions from the manufacturing and transport of fertiliser, chemicals and animal feed – are addressed in other sector plans.

Emissions from agriculture and land arise from diverse biological sources (Figure 3). Unlike other sectors, agriculture emissions are dominated by methane from enteric fermentation in ruminant livestock and management of manure (Box 5), and nitrous oxide from agricultural soils.

The agriculture and land sectors make up a significant part of Australia's GHG emissions (Box 4).

Box 4 Emissions from agriculture and land in 2023–24

19.6%: Agriculture's contribution to Australia's net emissions

The land sector is a net sink, equivalent to **−16.5%** of Australia's net emissions

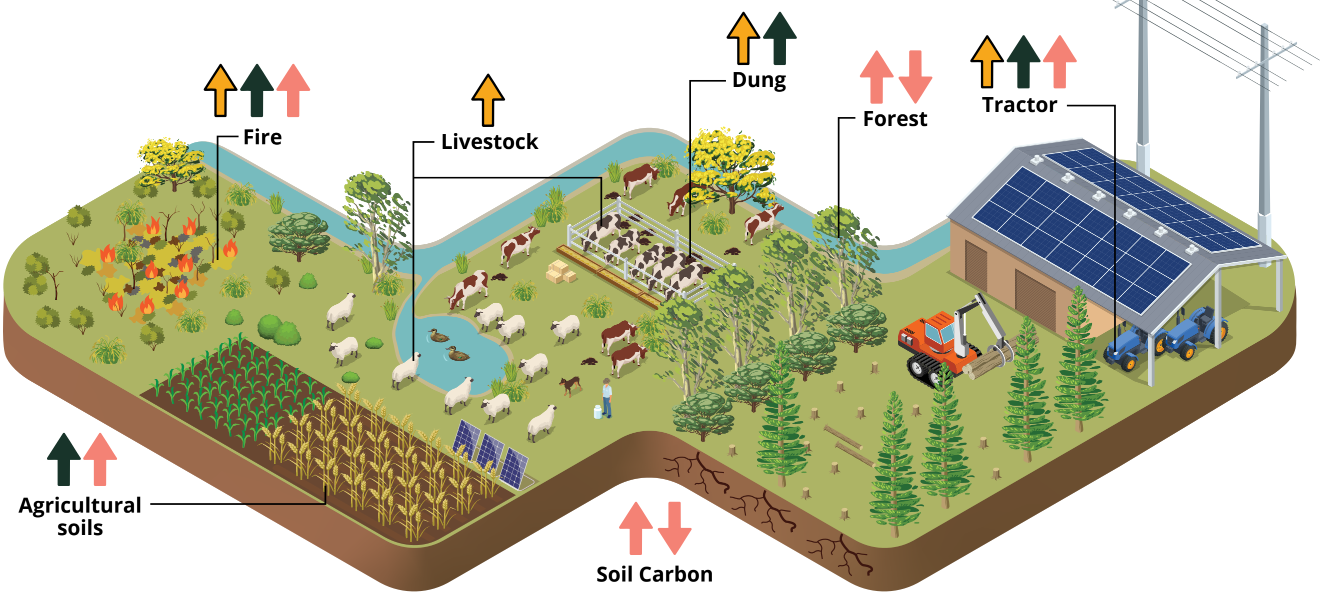
Note: agriculture emissions include electricity and fuel use

Figure 3 Scope of the Agriculture and Land Sector Plan

METHANE (CH_4)
Methane is mainly released from ruminant livestock digesting plant matter. Small amounts are also produced as manure breaks down, from waterbodies, and during the burning of plant matter and fossil fuels.

NITROUS OXIDE (N_2O)
Nitrous oxide is mainly released from soils from the application of nitrogenous fertilisers, animal waste and crop residues. Small amounts are also released during the burning of plant matter and fossil fuels.

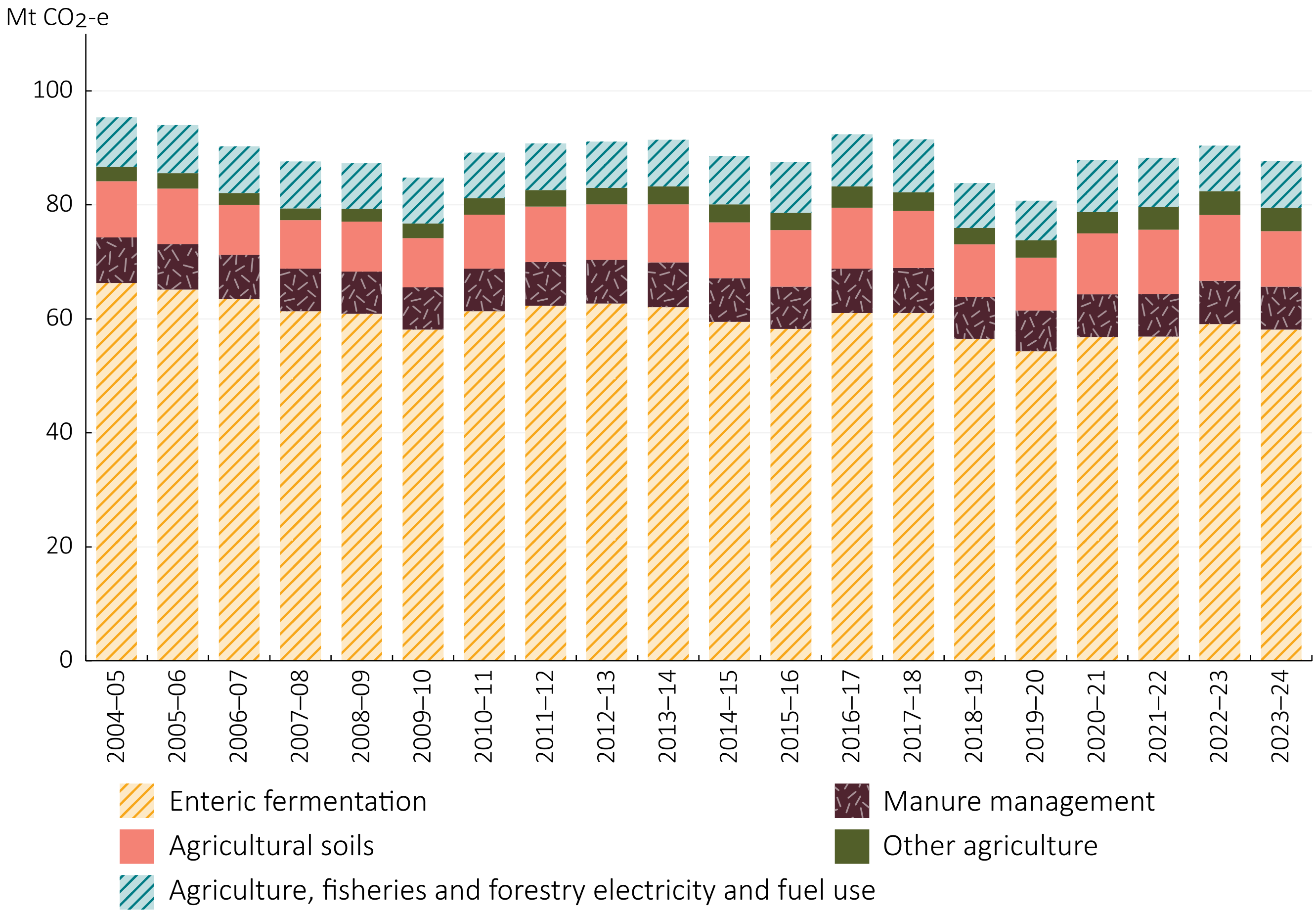
CARBON DIOXIDE (CO_2)
Carbon dioxide is mainly released through the burning and decay of organic matter, the burning of fossil fuels, and liming and urea application. CO_2 is also captured and stored in growing plants and in soils.



Agriculture emissions have remained relatively stable since 2004–05 (Figure 4), fluctuating in response to market and climatic conditions. For example, since 2004 periods of decline in absolute agriculture emissions can largely be attributed to reduced livestock numbers and crop production under drought conditions (DCCEEW 2025a). Over the same period, the land sector changed from a net source to a net sink (Figure 5) – driven by a reduction in conversions of forest to agricultural land uses, declines in harvesting of native forests and expansion of forest cover including through plantation establishment (DCCEEW 2025a).

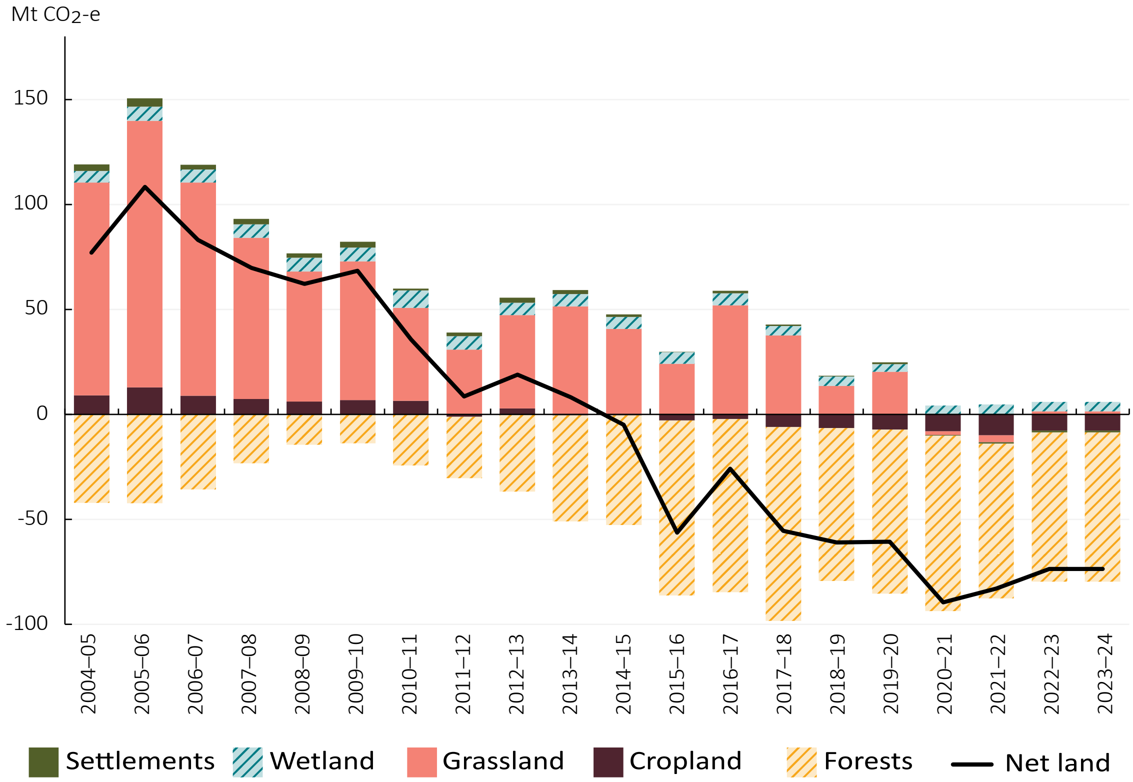
In commercial fisheries and aquaculture, the largest sources of emissions are from electricity and fuel use. Actions taken in the *Electricity and Energy Sector Plan*, the *Maritime Emissions Reduction National Action Plan*, and the *Transport and Infrastructure Net Zero Roadmap and Action Plan* will have a direct impact on the industry's ability to decarbonise.

Figure 4 Emissions from agriculture



Source: DCCEEW 2025b

Figure 5 Emissions from land use, land-use change and forestry



Source: DCCEEW 2025b

Box 5 Methane in the spotlight

Methane emissions, including those from agriculture, are the second largest cause of climate change after carbon dioxide emissions and account for approximately 30% of present-day warming (OECD 2025).

Methane emissions have a high potency and short lifetime relative to carbon dioxide. This means that reducing methane emissions has significant climate benefits in the near-term, which is critical to slowing warming and keeping Paris aligned targets within reach (IPCC 2023).

The Intergovernmental Panel on Climate Change (IPCC) (2023) has presented emissions pathways that keep warming to 1.5°C, or well below 2°C, to align with the Paris Agreement. These IPCC pathways show that significant reductions in global methane emissions are needed. That is why it is important for agriculture to take all available steps that can reduce methane in a productive and profitable way. Chapter 4 discusses a range of foundational actions to support this goal.

3. Contribution to net zero

Agriculture and land's contribution to net zero will depend on many factors – technologies, financial markets, policy settings, international commitments and community choices. The future will also be shaped by the readiness of producers and land managers to take advantage of opportunities that emerge at both the sector and business level. This plan is not setting an emissions reduction target, although many businesses and industry groups are setting their own emissions reduction goals. Instead, the plan makes it clear that agriculture and land must play an increasingly important role in Australia's net zero transition.

The pathway to 2050

Under current policies and technologies, it is projected that agriculture emissions will remain relatively flat to 2040 (DCCEEW 2024). The land sector is projected to remain a net sink to 2040, albeit at a reduced level (DCCEEW 2024).

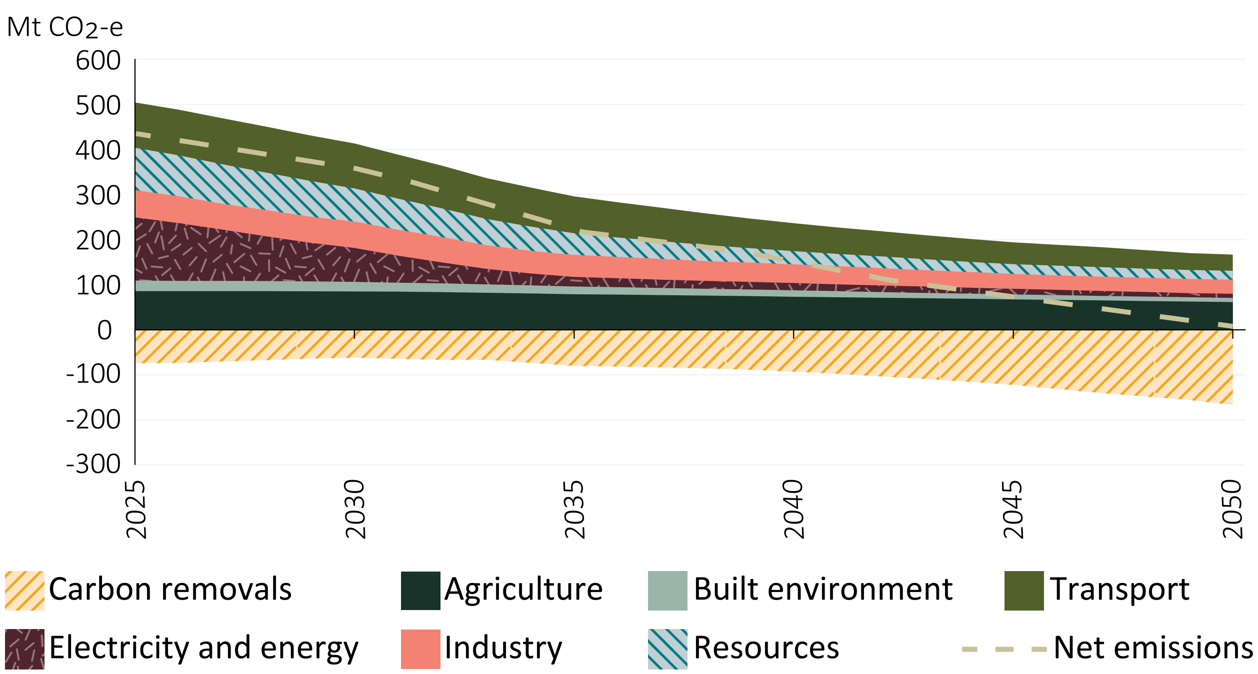
If Australia is to meet its emissions reduction targets, contributions from agriculture and the land will need to increase.

A range of analyses indicate potential pathways to net zero for Australia, including the Climate Change Authority's *Sector Pathways Review* (2024) and recent modelling and analysis undertaken by the Treasury (2025) to help inform the development of the *Net Zero Plan*. These show there are opportunities to reduce agriculture's absolute emissions and emissions intensity by 2050. There is also a need to increase carbon stored in the land, to balance residual emissions from agriculture and other sectors in 2050.

The Treasury's Baseline Scenario (Figure 6) illustrates one possible pathway for the agriculture and land sectors in a cost-effective economy-wide transition to net zero by 2050, based on the best available information today. While the scenario is not representative of emissions reduction targets for the sectors, it provides useful insights on the potential timing and sequencing of emissions reduction contributions. In the scenario, agriculture and land appropriately contribute to Australia's net zero goal.

Under the Baseline Scenario, agricultural production is projected to increase by 32% to 2050 while the sector's emissions decrease, with outcomes underpinned by improvements in emissions intensity of production (Figure 7).

Figure 6 Projected emissions under the Baseline Scenario, by Sector



Source: Treasury modelling

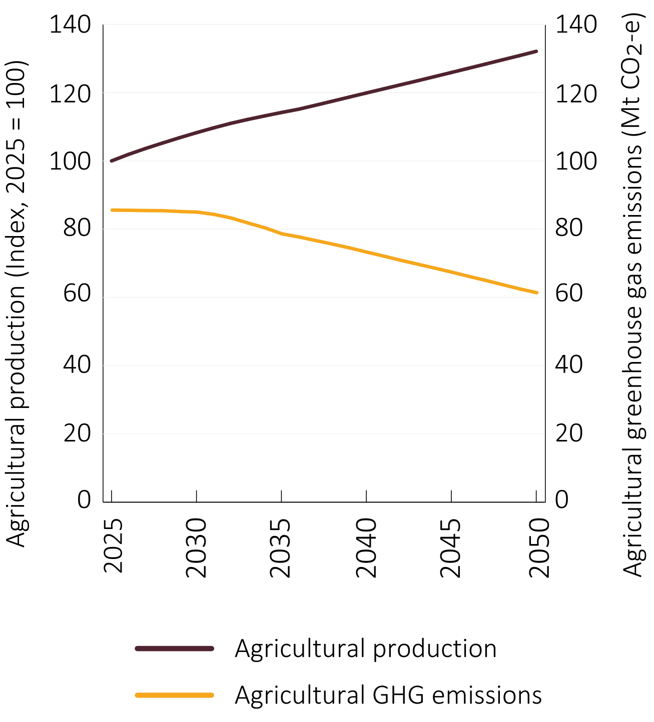
Agriculture

Looking in more detail at agriculture under the Baseline Scenario, emissions are projected to remain steady through to 2030. Improvements to emissions intensity continue to be achieved as available technologies and practices are more widely adopted, supporting absolute emissions reductions to 2050.

In ruminant livestock, adoption of technologies and practices, such as feed additives and genetics, are projected to contribute sizeable emissions reductions to 2050. Reductions in nitrous oxide emissions are driven by increased adoption of slow-release fertilisers, crop rotation, nitrification inhibitors and precision agriculture. There are also opportunities for gradual electrification in agriculture, fisheries and forestry – for example, through a shift away from diesel-powered light vehicles and machinery, towards their electrified counterparts.

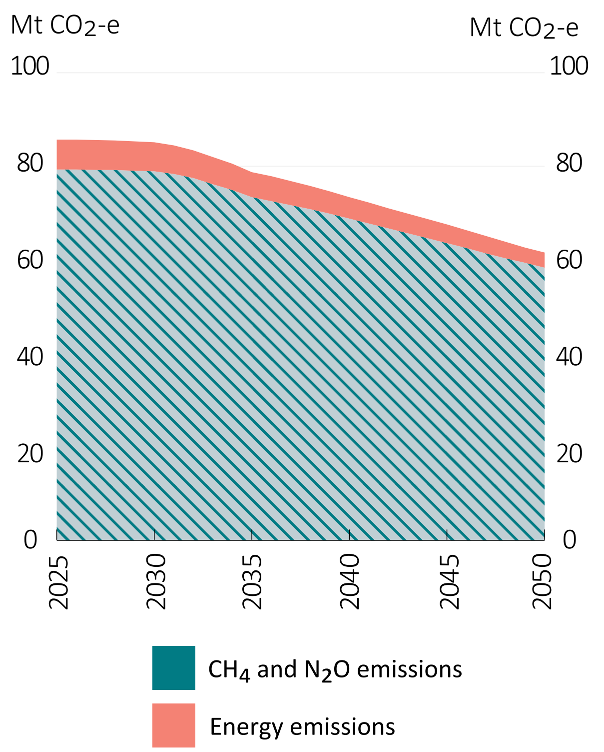
By 2050, emissions from agriculture and from energy used in the agriculture, fisheries and forestry industries could reduce to 62 Mt CO_2-e from 86 Mt CO_2-e in 2025 under the Treasury's Baseline Scenario (Figure 8). This relatively limited level of emissions reduction reflects the fact that while technologies will advance and implementation costs are expected to fall, barriers to larger reductions are projected to remain. As a result, agriculture will have residual emissions in 2050. The residual emissions are equivalent to 37% of economy-wide emissions (excluding land use, land-use change and forestry) in the Treasury's Baseline Scenario.

Figure 7 Agricultural production to 2050 under the Baseline Scenario



Note: Includes production from agriculture, fisheries and forestry
Source: Treasury modelling

Figure 8 Energy, methane and nitrous oxide emissions in agriculture to 2050 under the Baseline Scenario



Source: Treasury modelling

Land

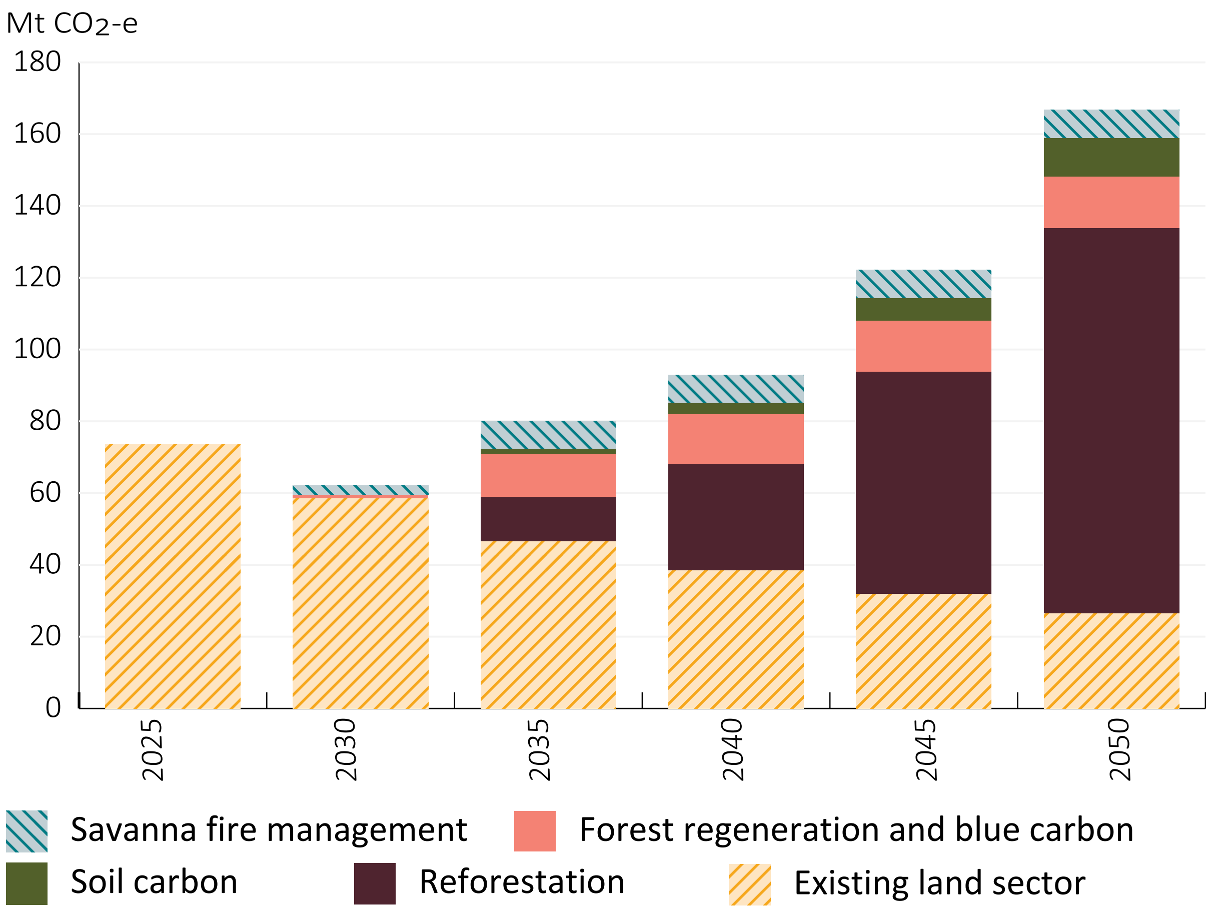
Under the Treasury's Baseline Scenario, residual emissions across the economy (excluding land use, land-use change and forestry) are projected to be 167 Mt CO_2-e in 2050, down from 504 Mt CO_2-e in 2025 (Figure 6). Therefore, carbon removals play a crucial role in balancing these emissions so Australia achieves its 2050 net zero goal. In the near term, reductions in land-based sequestration reflect moderating growth in carbon stores after a strong La Niña in the early 2020s.

Looking to 2050, land-based sequestration is projected to be the primary form of carbon removal. The majority of this is from increased reforestation, which is typically the most cost-effective and scalable method of sequestration (Figure 9). Other forms of land-based sequestration – including soil carbon, savanna fire management, forest regeneration and blue carbon – are also projected to contribute.

The costs of technology-based approaches to engineered carbon removals, an alternative to land-based sequestration, are currently projected to remain relatively high to 2050. Engineered carbon removals are discussed further in the *Net Zero Plan*.

However, there is considerable uncertainty around the scale of land-based sequestration required to 2050, given uncertainties in abatement technology cost pathways across the economy, analytical and data constraints about the carbon sequestration potential of different land types, and uncertainty about the revenue landowners may need if they wish to repurpose their land.

Figure 9 Projected sources of land-based sequestration under the Baseline Scenario



Note: The 'Existing land sector' category refers to the existing net sink, including emissions reductions and sequestration being generated from existing ACCU projects. The decline in this category reflects the ageing of existing vegetation and the related decline in the ability to sequester carbon. The category does not include the sequestration from new sequestration projects incentivised through the Safeguard Mechanism. The sequestration volumes for reforestation, forest regeneration and blue carbon, soil carbon, and savanna fire management represent new sequestration projects in the Baseline Scenario.
Source: Treasury modelling

An evolving response

The Baseline Scenario modelled by the Treasury illustrates just one pathway for agriculture and the land to 2050. Treasury modelling provides useful insights on the potential cost-effective timing, sequencing and size of sectoral contributions to the economy-wide emissions reduction task.

While scenario-based analysis is a powerful tool in helping inform Australia's net zero pathway, it is not possible to precisely predict how the transition will unfold. The future is uncertain and there are many factors that will shape the pathway over time, including technology breakthroughs, market shifts, domestic and international policy directions, and community responses. By working in partnership, we can build on the foundations outlined in the plan to grow and harness opportunities from the net zero transition (Figure 10).

Figure 10 Opportunities for agriculture and land as Australia approaches net zero

To 2030

- Agriculture and land emissions are largely stable.
- Investments in technology solutions are reducing agriculture emissions longer-term.
- Investments in systems, knowledge and capacity are supporting on-ground action, with incremental electrification underway.

To 2035

- Emissions intensity of agriculture is declining through herd and pasture management, more efficient use of inputs, such as fertiliser, and energy performance improvements.
- Reforestation practices are increasing with incentives supporting wider uptake.

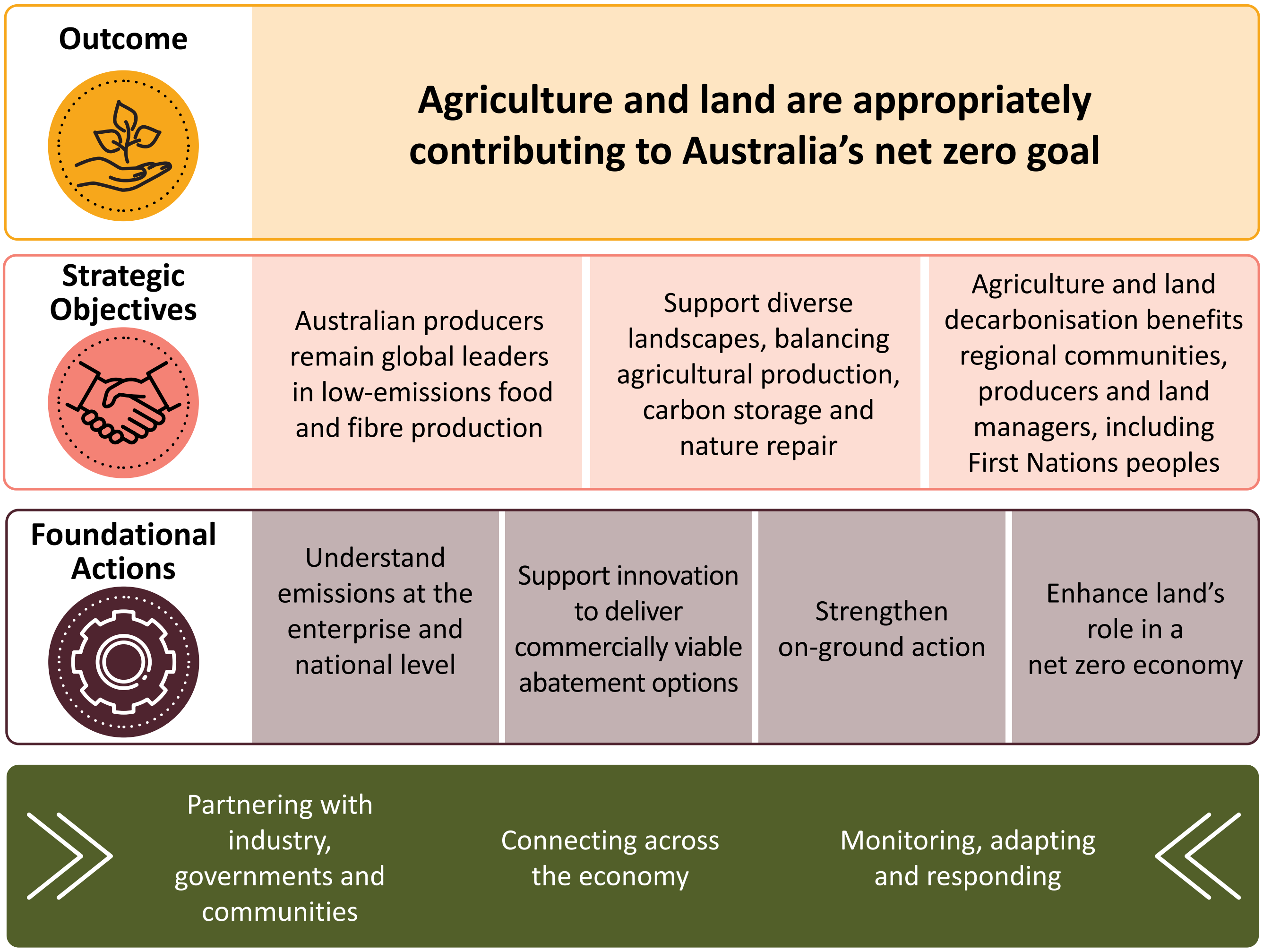
To 2050

- Technologies for agriculture emissions reductions are commercially viable and taken up at scale.
- Market signals, including demand for low emissions intensity products and financial returns for carbon storage and nature repair, are stimulating on-ground action.
- The transition is benefitting local communities, supporting First Nations participation, increasing agricultural productivity, protecting and enhancing our biodiversity and contributing to food security.
- Agriculture and land are appropriately contributing to Australia's net zero goal.

Framework for supporting the sectors' contribution

This plan provides a framework for agriculture and land to make an appropriate contribution to Australia's net zero goal (Figure 11). Extensive consultation highlighted **strategic objectives** that must be achieved alongside this outcome, **foundational actions** needed to guide effort and investment, and guiding principles to support action going forward.

Figure 11 Framework for agriculture and land to contribute to Australia's net zero goal



Three **strategic objectives** must go hand in hand with the sectors' net zero contributions.

First, Australian producers must remain global leaders in low-emissions food and fibre production. Global and regional food demand is growing and Australian exports can support this demand (Hafi et al. 2023; Linehan et al. 2012). It will become increasingly important to decouple food production from emissions as agricultural production increases to 2050, enabling more food to be produced with reduced emissions intensity. Australia will need to continue to demonstrate it is a trusted supplier of sustainable agricultural products to maintain competitive advantage, and support access to premium export markets, global supply chains and finance.

Second, we must support diverse landscapes, balancing agricultural production, carbon storage and nature repair. Growing carbon storage in the land sector to help reach the net zero goal will require balancing multiple priorities. These include maintaining food security, growing agricultural industries, protecting and repairing nature, and safeguarding Indigenous owned, managed, co-managed and special rights lands.

Third, decarbonisation of agriculture and land must benefit regional communities, producers and land managers, including First Nations peoples (Box 6). Much of the transformation required in agriculture and land will occur in regional and remote areas. Decarbonisation strategies must deliver real benefits to the people and communities of these regions, in line with the guiding principles of the Australian Government's Regional Investment Framework.

Four **foundational areas for action** will form the basis for coordinated action, enabling the sectors to achieve multiple objectives:

1. understand emissions at the enterprise and national level
2. support innovation to deliver commercially viable abatement options
3. strengthen on-ground action
4. enhance the role of Australia's land in a net zero economy.

These foundational actions are supported by **a commitment to partnership, strong connections across the economy** and **ongoing processes for monitoring, adapting and responding**. Achieving the objectives identified will require sustained and expanded effort and action from industry, government, the private sector and individuals. This framework aligns with the principles and five decarbonisation actions outlined in the *Net Zero Plan*.

Box 6 Contributing to Closing the Gap priority reforms and targets

First Nations peoples have deep-rooted knowledge in caring for Country and are leaders in sustainable land management. Initiatives to progress decarbonisation should be driven by genuine partnership with, and the provision of adequate resourcing to, First Nations partners and stakeholders.

Aligning agriculture and land emissions reduction policy to the National Agreement on Closing the Gap is vital to improving outcomes for First Nations peoples and communities. The National Agreement is built around Priority Reforms and socioeconomic targets including a distinctive cultural relationship with land and waters, shared decision-making, increased inclusion in employment, education and training, strong economic participation, and development of Aboriginal and Torres Strait Islander peoples and their communities.

This plan outlines ongoing opportunities to assist progress towards Closing the Gap, including:

- integration of First Nations knowledge into abatement solutions through a two-way learning and knowledge exchange through the Zero Net Emissions Agriculture Cooperative Research Centre
- tailored resources for First Nations peoples to increase access to culturally appropriate information through the Carbon Farming Outreach Program
- engagement of First Nations communities in carbon farming, including through savanna fire management projects and the Nature Repair Market.

Decarbonisation efforts across government, industry and communities must continue to share benefits and reduce the disproportional impacts of climate change on First Nations peoples (ACS 2025).

4 Foundational actions

Action 1 Understand emissions at the enterprise and national level

For producers and land managers, understanding the GHG emissions profile of their business or activities is a fundamental first step to managing them. 'Knowing your number' allows producers and land managers to build a more connected picture of their production, energy and land management emissions in a way that can inform ongoing business decisions. It can facilitate a deeper understanding of business inputs, outputs and therefore costs, further informing on-farm decision-making.

The Australian Government is already responding to calls for more standardised approaches to GHG accounting by prioritising improvements in emissions accounting at the national level through to the farm level. In the 2024–25 Budget, the Government committed to:

- improving the quality and consistency of GHG emissions accounting methods and tools by developing voluntary emissions estimation and reporting standards and incorporating the standards into new or existing GHG emissions calculators (Box 7)
- improving the National Greenhouse Accounts (NGA) methods and data, to better reflect regional differences and mitigation actions, and making these more accessible so that GHG calculators can stay up to date.

These investments are aimed at delivering the trust in emissions calculators that producers have been calling for. In addition, the upgrades to the NGA will better enable recognition of producers' and land managers' efforts to reduce emissions and will unlock reporting of emerging low-emissions technologies and practices. In time, this will help incentivise adoption of emerging opportunities at the business level.

The Government's investment needs to be supported with strong action across industry to work with producers to engage with available tools and better understand their farm emissions profile. This is a role for industry groups, Rural Research and Development Corporations (RDCs) and supply chains. Many have taken initial steps, but there is a need to scale this up significantly to deliver long-term outcomes for the industry.

Box 7 Improving emissions accounting on farm

As part of the Improving Consistency of On-farm Emissions Estimates program, Agricultural Innovation Australia has been awarded a grant of $6.4 million (GST exclusive) over 3 years to June 2028, in partnership with the Zero Net Emissions Agriculture Cooperative Research Centre, to help improve the consistency of farm-level GHG emissions calculators.

This grant will make it easier for third-party accounting tool and calculator providers to align with the voluntary emissions estimation and reporting standards. It will fund free access to an application programming interface and open-source calculator code until June 2028. This foundational investment will provide greater consistency and trust in GHG estimates, and support producers as they seek to understand and reduce their on-farm emissions.

Role of supply chains

Global and domestic supply chains and financial institutions are stepping up efforts to measure and manage their emissions (Figure 12). These efforts are being driven by voluntary commitments including net zero targets and sustainability linked finance, and mandatory reporting requirements such as climate-related financial disclosure (CRFD) regimes.

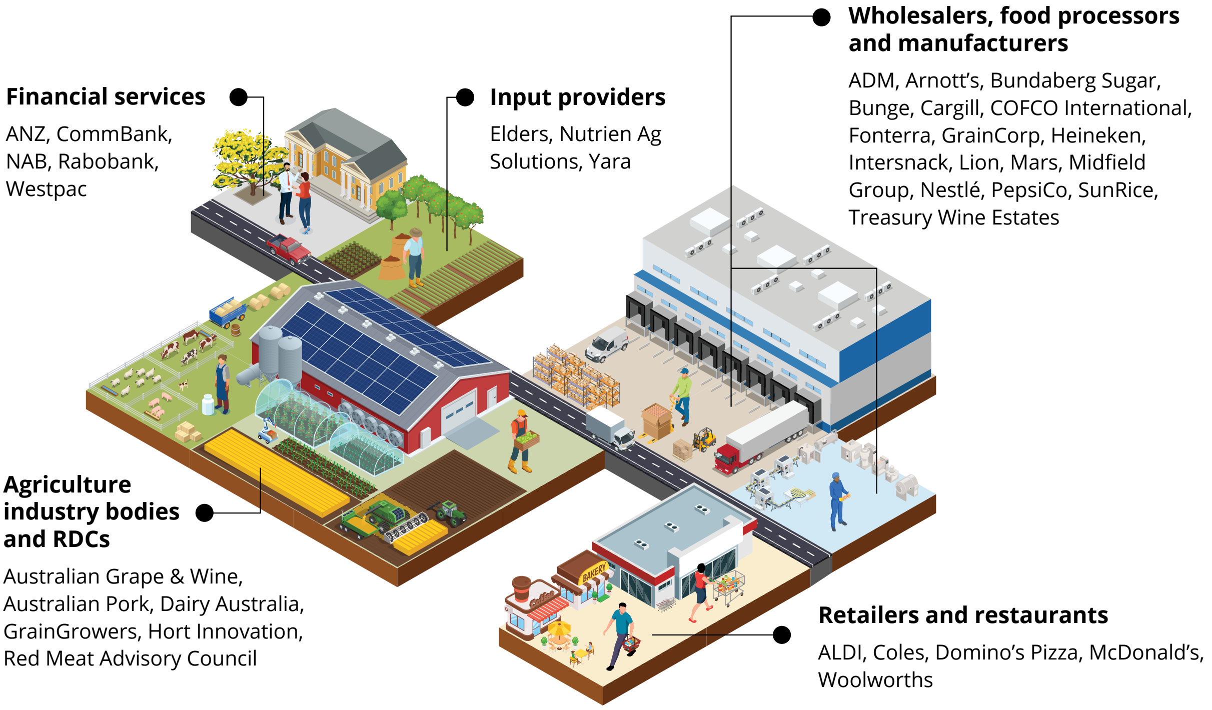
Under Australia's CRFD regime, reporting entities are not required to collect primary data from producers in their supply chain to comply. The *AASB S2 Climate-related Disclosures Standard* (2024) includes a presumption that Scope 3 emissions – that is the emissions that occur upstream or downstream in a company's supply chain – can be reliably estimated using industry averages and secondary data. However, companies with voluntary climate commitments may be more likely to request farm-level data, particularly from larger agribusinesses, so they can monitor performance and improvements in their Scope 3 emissions over time. Climate reporting can be integrated with voluntary nature-related disclosures where relevant.

Many supply chain businesses are already encouraging producers to participate in programs that develop and share emissions data, or providing extension programs that encourage producers to manage their emissions. Producers who know their emissions profile will be able to engage more influentially with organisations in the supply chain and banks.

Looking ahead, there will be increasing benefits to producers and supply chains from developing more integrated and streamlined approaches to GHG accounting and reporting. Improved data sharing arrangements, including greater clarity on what should be measured, can enable producers to be recognised and rewarded for emissions reduction and land management actions that lower the emissions of food and fibre across the supply chain.

Similarly, efforts to improve emissions intensity metrics and implement insetting would help producers to promote their low-emissions credentials and gain recognition for their contributions to net zero. Aligning indicators of success at the business level with the needs of the supply chain will support greater climate action and cooperation, while enabling emissions reduction efforts to remain within the agrifood supply chain. Achieving this will require ongoing stewardship across the supply chain – necessitating coordination and partnership from governments, peak industry bodies and diverse private sector organisations. The Australian Agricultural Sustainability Framework, led by the National Farmers' Federation with support from the Australian Government, is one example of this approach.

Figure 12 Examples of organisations with Scope 3 emissions reduction targets or other climate-related ambitions



Note: Non-exhaustive list intended to illustrate the current breadth of ambitions

Key Australian Government investments

$28.7 million over 10 years from 2024 to 2034 to improve GHG accounting in the agriculture and land sectors at the national through to the farm level.

Action 2 Support innovation to deliver commercially viable abatement options

The agriculture and land sectors involve biological systems that have unique emissions reduction challenges and opportunities. A suite of existing and emerging technologies and practices will be required to improve emissions outcomes (Figure 13).

There are currently limited options for deep reductions in agriculture emissions. However, there is the potential for options to be stacked together to deliver steady reductions in emissions and there are promising prospective technologies. Greater uptake of a combination of existing practices can support efficiency gains, and technological advances in precision agriculture will help fine tune the management of herds, pastures and inputs. Key emissions reduction technologies include feed additives for livestock, and enhanced efficiency fertilisers (for example, slow-release and nitrification inhibiting fertilisers) in the cropping industry, although further development is needed to see uptake at scale (CCA 2024).

In contrast, approaches to increasing carbon stored in the land are relatively mature and there is significant potential for enhancing carbon storage (CCA 2024). Practices that increase carbon storage in the land are well established, but more can be done to increase integration into agricultural businesses and the landscape.

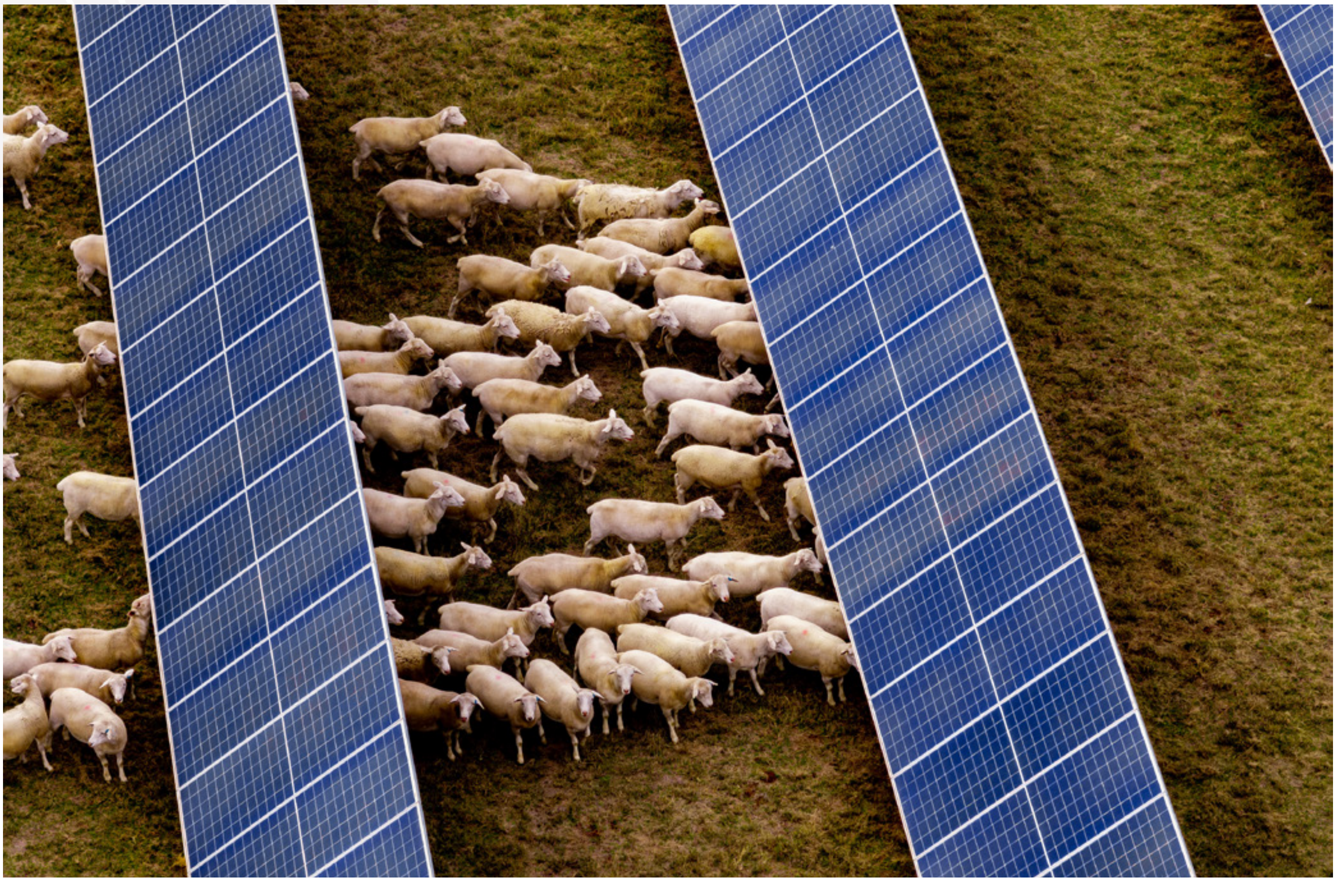


Figure 13 Technologies and practices supporting emissions reduction

Emissions source	2023–24 emissions	Ready to be scaled up	Emerging or under development
Enteric fermentation	58 Mt CO_2-e	Herd management Pasture management Feed additives	Low methane genetics Methane vaccine
Manure management	8 Mt CO_2-e	Management practices (e.g. covered anaerobic ponds, anaerobic digesters)	
Agricultural soils	10 Mt CO_2-e	Precision agriculture Enhanced efficiency fertilisers Improved fertiliser use efficiency	
Energy use	8 Mt CO_2-e	Small-scale renewables Electrification and improved on-farm energy performance	Low carbon liquid fuels Agriculture battery-electric vehicles
Land sector	-74 Mt CO_2-e	Environmental plantings Plantation forestry Farm forestry Savanna fire management Managing lands to increase soil carbon (e.g. pasture improvements)	Blue carbon Biochar

Barriers

Product readiness	Business capacity	Market	Regulatory
Costs Efficacy Productivity improvements Supply	Farm system fit Farm business profitability Practical implementation Skills and capability	Import requirements Social licence Low-emissions premiums Finance availability	Safety (e.g. food safety, human health, animal welfare) Environmental impacts

Focusing on research, development and investment

Research and development (R&D) will be fundamental to increasing the availability of effective and commercially viable technologies and practices needed to achieve deeper cuts in emissions in the agriculture and land sectors. R&D can help scale up emerging technologies and drive the innovation of new solutions. Substantial uplift in R&D will be needed across the innovation system to open up new opportunities for on-ground adoption and practice change.

A key focus for R&D should be the development of tools and information to help producers and land managers evaluate and compare the emissions and productivity outcomes of different practices. Evaluating the bundling of multiple emissions interventions will be important, given the lack of 'silver-bullet' technologies that can achieve large cuts in emissions. The implications of stacking technologies, including for business management, productivity, agronomy, and the natural environment, must also be considered (Bilotto et al. 2025).

The Zero Net Emissions Agriculture Cooperative Research Centre (ZNE-Ag CRC), which commenced in July 2024, represents a significant and ambitious step up in Australia's R&D effort (Box 8). The ZNE-Ag CRC has secured funding from its 70 partners across industry, government, RDCs, the research sector, First Nations groups and small-medium sized enterprises. This includes the Australian Government's investment of $87 million over 10 years to establish the ZNE-Ag CRC, to which it has added a further $4.4 million investment to support the Department of Agriculture, Fisheries and Forestry becoming a formal partner. As partners in the ZNE-Ag CRC, both the Australian Government and state and territory governments are working to improve the linkage between science and policy over the next decade.

Box 8 Zero Net Emissions Agriculture CRC primary research programs

The Zero Net Emissions Agriculture CRC has four research programs:

- **Low-emissions plant solutions:** Developing solutions to reduce emissions across broadacre, horticultural and livestock systems, including the use of enhanced efficiency fertilisers, legumes and in-setting options, as well as reducing emissions in cattle and sheep via the delivery of new low-emissions pasture and forage systems.
- **Towards methane-free cattle and sheep:** Providing the technology and quantification required to transition livestock production to a low-methane emission future.
- **Whole-farm mixed enterprise systems analysis:** Integrating the science emerging from the CRC to provide farmers with the guidelines, resources, metrics, and benchmarking tools required for a profitable transition to Australia's net zero economy.
- **Delivering value from net zero:** Developing renewable energy and circular economy solutions that create profitable opportunities for agribusinesses and rural communities. Improving supply chain management and enhancing access to key export markets.

The commitment to the ZNE-Ag CRC builds on existing Australian Government investments in emissions mitigation. Examples include the Methane Emissions Reduction in Livestock program, support for commercialising the methane-inhibiting Australian red seaweed *Asparagopsis*, the National Soil Carbon Innovation Challenge, and Australian Forest and Wood Innovations.

Critically, there is also a significant collective investment made into agricultural innovation through the RDCs. In 2024–25, the RDCs received over $1 billion through industry levies for R&D (and marketing) and government matching funding for eligible research, development and extension activities. Analysis undertaken by the Council of Rural Research and Development Corporations (2024) found that the RDCs invested $384 million in emissions reduction efforts over the 3 years to 30 June 2024, including projects to leverage opportunities in energy efficiency, natural capital and systems innovation.

Looking forward, there are significant opportunities to increase investment and improve collaboration and coordination on R&D across industry, RDCs, CSIRO, universities, governments and with international partners. Industry groups play a leadership role in providing guidance for RDC investment, communicating producer needs to government and researchers, and facilitating partnerships. A proactive approach to investing in emissions mitigation technologies and practices will deliver gains for producers in the medium to long term. There are also opportunities through increased collaboration to elevate First Nations voices in the sector and drive Indigenous economic inclusion. Increased transparency and communication of R&D strategies and outcomes across different entities will help make the best use of collective investments. Aligning with circular economy principles can also optimise outcomes (Box 9).

Box 9 Circular economy

Enhancing Australia's circular economy will assist with decarbonising the agriculture and land sectors. A more circular economy lowers energy demand and associated emissions by retaining existing goods and materials for longer. Many practices that producers already undertake align closely with the principles of the circular economy and reduce emissions, such as using resources efficiently, reducing waste and regenerating nature. Increasing the circularity of agricultural production can further support emissions reduction efforts.

The Australian Government has developed Australia's Circular Economy Framework, with the goal of doubling the circularity rate by 2035. The framework identifies opportunities and priorities for driving the circular economy transformation across four key sectors, one of which is food and agriculture.

The ZNE-Ag CRC will also have a focus on circular economy solutions that create profitable opportunities for agribusinesses and rural communities.

Innovation also requires significant private investment. Capital markets in Australia and globally are increasingly interested in investing in climate mitigation – not just to develop technologies but also for the take-up of new practices on farms and other land. Coordinated support from both the public and private sectors is critical, including providing incentives such as access to green finance.

The Australian Government is taking a range of actions to help attract and grow private investment for the transition to the net zero economy. The priority actions in the Government's Sustainable Finance Roadmap will support investors to identify new green investment opportunities. The Government has a range of specialist investment vehicles that will help to leverage the private sector's support for the commercialisation, adoption and demonstration of innovative solutions (Box 10).

Key Australian Government investments

$87 million over 10 years from 2024 to 2034 to establish the ZNE-Ag CRC, leveraging 2–3 times that amount in partner cash and in-kind contributions.

$4.4 million over 10 years from 2024 to 2034 for the Department of Agriculture, Fisheries and Forestry to become a formal partner in the ZNE-Ag CRC.

$29 million over 6 years from 2021 to 2027 to support research and development of methane-reducing livestock feed solutions through the Methane Emissions Reduction in Livestock program.

Box 10 Leveraging private investment and incentivising adoption

Strategic public sector investment can help share risks with the private sector of commercialising and deploying new technologies, and accelerate investment and adoption. The Government's specialist investment vehicles are providing concessional debt, equity and in some cases grants to crowd in and de-risk private capital to support net zero aligned investment.

The Government is supporting the growth, resilience and sustainability of Australia's agriculture sector, with an additional $1 billion in new loan funding through the Regional Investment Corporation. This funding broadens the Corporation's loan scope to include assistance for improving climate resilience, boosting sector productivity, and supporting agriculture to be part of Australia's net zero transition. This funding will ensure farmers can continue to access concessional lending to improve their long-term resilience and profitability – and brings total support for the agriculture sector through RIC loans to over $5 billion.

The Clean Energy Finance Corporation has also made several large investments in the agriculture and land sectors, including a $100 million partnership with NAB to support discounted interest rates for farmers on a range of emission reduction activities.

There are a range of other investment opportunities through specialist investment vehicles that can accelerate innovation and on-ground action. This includes an emerging role for the National Reconstruction Fund Corporation, which identifies agriculture, fisheries and forestry as a priority area for investment. The *Net Zero Plan* further discusses actions the Government is taking to support private investment for decarbonisation.

Action 3 Strengthen on-ground action

People and communities are at the heart of agriculture and the land's role in the net zero transition. The sectors' contributions to the net zero goal will ultimately be driven by the capacity and actions of producers and land managers across Australia.

A successful transition to the net zero economy will require trusted information and the expertise of a broad network of trusted advisers. Industry, governments and the private sector have a role to play in providing trusted climate information, noting producers access advice from a range of sources including independent consultants, agronomists, grower groups, government extension providers, research institutions and RDCs. Climate-related extension and outreach is a focus for state and territory governments in working with the agriculture and land sectors to help them reduce emissions and build resilience (for example, see case study in Box 11).

The Australian Government's Carbon Farming Outreach Program (CFOP) is already supporting producers and land managers, including First Nations peoples, to understand their emissions and make informed decisions to manage them over time. The Government has committed an additional $27.8 million to expand CFOP. This builds on $17.5 million provided for trusted and independent advisers, and extends the program to 2028. This additional investment will increase access to trusted advice on emissions management and carbon farming by providing additional training to advisers and establishing a knowledge bank of centralised information. Producers and land managers will also have access to commodity-specific information, helping them make informed decisions about technologies and practices that best suit their enterprise.

The Australian Government expects to see this investment complemented by strong action across industry groups, which can be trusted sources of advice and can provide industry, commodity and regionally nuanced information.

The Natural Heritage Trust (NHT) is the Australian Government's key investment platform for achieving environmental protection, sustainable agriculture and natural resource management outcomes. The NHT's Climate-Smart Agriculture Program commits $302.1 million over 5 years to build capacity and knowledge, and accelerate the uptake of sustainable practices in agriculture. The program supports producers and land managers to adopt practices for sustainable natural resource management, emissions reduction and climate resilience. As part of this investment, $153.4 million in dedicated funding is provided to regional natural resource management organisations, recognising their vital role in achieving on-ground outcomes.

Formal education and training will also need to evolve over time so that the agriculture and land workforces have the skills they need to engage with the net zero economy. Building this capability is a collective challenge across governments, industry and education and training systems. A study by Jobs and Skills Australia found that climate change and net zero is producing significant economic shifts with a range of workforce skills required to support new production and land-use practices (JSA 2025). Skills Insight, the agribusiness Jobs and Skills Council, is responding to future needs through workforce planning and strategies. Alongside its research programs, the ZNE-Ag CRC will create a national education and training program offering a suite of short, applied courses and its demonstration sites will provide a hub for sector-wide outreach and engagement.

Changing workforce needs provide an opportunity to increase the participation of underrepresented groups in the agricultural industry, including women, young people and First Nations peoples. Supporting a safe, diverse and inclusive agricultural workforce will ensure the sector benefits from the full range of talents available in the net zero transition. This will also be critical to meeting skills shortages while unlocking innovation and driving productivity.

Key Australian Government investments

$27.8 million over 4 years from 2024 to 2028 to expand the Carbon Farming Outreach Program.

$302.1 million over 5 years from 2023 to 2028 through the Climate-Smart Agriculture Program to support trials, on-farm demonstrations and practices that address priorities for sustainable agriculture.

Box 11 Improving energy performance

Addressing emissions from energy use provides an opportunity to deliver a small but important contribution to the decarbonisation of the agriculture and land sectors. Energy use can represent a large proportion of emissions for certain sub-sectors including intensive animal operations, such as poultry, irrigated cropping, horticulture and land-based aquaculture.

There are many actions the sectors can already undertake to reduce these emissions. There are a growing number of cheaper renewable energy technologies and energy performance improvements related to energy efficiency, electrification and demand flexibility that are available to reduce emissions from energy consumption. For example, converting diesel-powered water pumps to electric solar-powered pumps can deliver energy efficiency gains and achieve cost savings within a few years, while helping to reduce emissions. Also, incorporating sources of energy storage can aid in demand flexibility, for example, by using stored energy generated from solar photovoltaic systems for pumping and irrigation at night.

Energy audits and tailored advice are valuable in demonstrating the emissions benefits and cost savings that can result from producers and land managers improving the energy performance of their activities.

Electrifying wherever possible, complemented by other energy performance improvements, storage and use of renewable energy, provides a pathway to decarbonise energy use in agriculture, fisheries and forestry. In the long term this will depend on the electrification of heavy machinery and vehicles and the availability of cost-effective low carbon liquid fuels. These outcomes are broadly supported by policies in other sector plans.

Case study: The electrification of a New South Wales sheep dairy provided multiple benefits

Cressida and Michael Cains' sheep dairy and cheesery in Robertson, New South Wales previously experienced energy supply issues, such as power outages and an insecure supply of liquified petroleum gas (LPG) to the farm. Their farm, Pecora Dairy, was supported as a pilot under the NSW Department of Primary Industries and Regional Development's Energy Efficiency Solutions project to demonstrate on-farm energy efficiency improvements (NSW DPI 2024).

The Cains installed a solar photovoltaic and battery system allowing the site's LPG boiler to be replaced by a new heat pump powered by renewable electricity. Energy costs fell by two-thirds and LPG is no longer needed. Broader benefits included reduced food waste due to the reliable energy supply and stronger sustainability credentials through reduced carbon emissions.

'*Electrifying our dairy has been transformative, we've cut energy costs, improved reliability and reduced our carbon footprint, all while strengthening the long-term sustainability of our farm and business.*' Pecora Dairy

Image: Cressida Cains

Action 4 Enhance land's role in a net zero economy

In the last 30 years Australia's land sector has shifted from being a large source of emissions to being a large sink of emissions. As Australia transitions to net zero, this sink will need to be protected and considerably enhanced. There is a strong expectation from stakeholders and the community that this will be achieved while also delivering wider benefits for agricultural production, regional communities, First Nations peoples and nature.

Opportunities to scale up carbon storage

Protecting and enhancing carbon storage while also supporting diverse land uses, such as agricultural production and nature repair, will require action, engagement, cooperation and investment across all levels of government and the private sector.

Producers are already delivering tangible carbon storage and biodiversity outcomes through practices such as rotational grazing, planting shelterbelts, and fencing off and revegetating riparian areas. In some areas, there are also opportunities to invest in on-farm forestry. All of these can be taken up more widely in a way that builds carbon stores, enhances sustainability, and adds to farm productivity and income diversification.

Australia's forests also provide carbon storage and biodiversity outcomes. Forests cover 17% of Australia's land area, comprising 132 million hectares of native forest and 2 million hectares of commercial plantations and other forest types (MIG & NFISC 2024). The forestry industry will continue to play a key role in supporting Australia's climate ambitions, through carbon storage and provision of wood products that displace carbon intensive construction materials and plastics.

Expansion of plantation forestry will enhance the industry's contribution to net zero. However, there are challenges. The Australian Government is supporting expansion of the plantation forest estate by providing $73.8 million over 4 years from 2023–24 through the Support Plantation Establishment program. This program aims to increase future plantation forest resources available for processing while also contributing to Australia's emissions reduction targets.

Coastal blue carbon ecosystems (mangroves, tidal marshes and seagrasses) are widely recognised for their ability to capture and store large amounts of carbon. Investors are increasingly attracted to opportunities to enhance these systems but work is required to address challenges to scaling up the number of blue carbon projects. Through its Blue Carbon Conservation, Restoration and Accounting Program, the Government has supported projects to restore coastal blue carbon ecosystems. These projects have benefits for habitats and coastal protection, as well as reducing emissions and storing carbon.

Leveraging carbon and environmental markets

The Australian Carbon Credit Unit (ACCU) Scheme is a key mechanism for incentivising emissions reductions and carbon storage. The ACCU Scheme is already enabling producers and land managers to earn carbon credits for certain activities. Of the 168 million ACCU credits generated under the Scheme as at 30 June 2025, 65% were from methods related to vegetation (mainly reforestation), savanna burning and agriculture (CER 2025). The Government has already invested more than $1 billion in purchasing ACCUs to stimulate and build the market. The Government is considering its future role as a direct purchaser of abatement in light of Safeguard Mechanism reforms and the evolving role of the ACCU Scheme. ACCU purchasing can provide a flexible and scalable mechanism to drive abatement to help meet Australia's emission reduction goals. Going forward, the reformed Safeguard Mechanism will increasingly drive demand for ACCUs from private buyers.

The Government has implemented a proponent-led method development process for the ACCU Scheme, as recommended by the 2022 Independent Review of ACCUs (Chubb et al. 2022). This approach enables stakeholders to suggest new methods or changes to existing methods. Over time, this process will provide new opportunities to incentivise emissions reductions and carbon storage where it meets the requirements of the scheme.

In addition to the proponent-led process, the Government is progressing the development of the Integrated Farm and Land Management (IFLM) method and two new savanna fire management methods. The IFLM method will enable producers and land managers to implement multiple carbon storage activities on a single property, without having to register multiple ACCU Scheme projects. The Government is developing the IFLM method in a co-design consultation approach with stakeholders.

The Indigenous Estate comprises 536 million hectares, equating to 70% of Australia's land area, and includes land over which Indigenous peoples and communities have ownership, management or co-management, and other special rights (ABARES 2024). First Nations-led land management projects under the ACCU Scheme, such as savanna fire management, reforestation and native forest regeneration projects, can increase carbon stores while fostering employment, training, economic opportunities and the transfer of traditional knowledge (CCA 2023). For example, First Nations land managers in northern Australia are reintroducing traditional strategic early dry season savanna fire management practices. These practices improve ecosystem resilience by supporting mosaic vegetation patterns, stimulating grass regrowth and inhibiting woody weeds. At the same time, these practices reduce emissions and support carbon storage by lessening the size, intensity and frequency of fires.

The emergence of new environmental markets such as Australia's Nature Repair Market is further incentivising emissions reductions alongside important biodiversity outcomes (Box 12). The Nature Repair Market operates alongside the ACCU Scheme, with both schemes administered by the Clean Energy Regulator. This alignment is intended to make it easier for land managers to participate in and benefit from both schemes, whilst helping to achieve Australia's broader net zero and nature goals. Additional income from biodiversity outcomes can help increase the financial viability of carbon projects, especially on marginal land, and contribute to landscape resilience.

The ACCU Scheme and Nature Repair Market are also explored in the *Net Zero Plan*.

Image credit:DCCEEW

Box 12 Supporting carbon and nature outcomes through the Nature Repair Market

Landholders are interested in optimising use of their land to provide sustainable outcomes. Through the Nature Repair Market landholders can undertake projects to deliver both biodiversity and carbon outcomes, and generate income.

The first Nature Repair Market method, the Replanting Native Forest and Woodland Ecosystems method, focuses on revegetation in historically cleared regions. The method is designed to allow biodiversity projects alongside ACCU projects on the same parcel of land. The landholder can earn both a biodiversity certificate and ACCUs where they meet requirements.

There is strong landholder interest in this approach. The Government's Carbon + Biodiversity Pilots under the Agriculture Biodiversity Stewardship Package demonstrate how carbon and biodiversity projects can be successfully integrated within a farm business. Pilot projects show how landholders can maximise opportunities to achieve multiple outcomes on their land.

There are currently 46 pilot projects across Australia, most of which are on small privately-owned farms. These projects cover over 1,600 hectares of biodiverse plantings and participants are planting over 760,000 native trees and shrubs. These plantings are expected to sequester an estimated 350,000 tonnes of carbon dioxide over the 25-year Carbon + Biodiversity permanence period.

Protecting existing carbon stores

Protecting and enhancing carbon stores in natural landscapes will contribute to Australia's net zero goal while providing essential ecosystem services, including clean air and water, habitat, soil fertility and pollination. The Australian Government is working to expand protected and conserved areas, deliver biodiversity conservation and restoration programs, and enhance broader natural resource management approaches. States and territories are also changing how they manage their native forest estates to support emissions, nature and other goals.

Australia is committed to halting and reversing biodiversity loss. Expanding protected and conserved areas and restoring priority degraded areas will help meet Australia's targets under the Global Biodiversity Framework. Through the Australian Bushland Program, the Government will provide $250 million over 5 years from 2025–26 to help meet Australia's target to protect and conserve 30% of Australia's land by 2030 (30 by 30). The program will support partnerships with state and territory governments, expand Indigenous Protected Areas, invest in Nature Repair Market projects, and leverage stakeholder partnerships to protect properties with high biodiversity value. The program complements existing Government funding, including the $231.5 million Indigenous Protected Areas Program and the $25 million Protecting Important Biodiversity Areas Program.

State and territory governments, alongside the Australian Government, play an important role in ensuring relevant land clearing regulations are operating effectively to conserve biodiversity, protect existing carbon stores and prevent illegal land clearing. The Australian Government is currently piloting an enhanced vegetation change monitoring program through the National Vegetation Monitoring System. The system will better monitor vegetation change and assist in identifying illegal land clearing in Australia to enable early intervention.

Land use in the transition

Agriculture and land will support diverse forms of decarbonisation required for the net zero transition across the economy. This will often involve new uses of land, which can generate alternative revenue streams for landholders. Examples include increasing carbon storage (mainly through reforestation), hosting renewable energy generation and transmission infrastructure and producing feedstocks for low carbon liquid fuels (LCLFs) (Box 13). Integrating these activities into regional landscapes, including agricultural production systems, can attract investment, create new employment opportunities and support diversified and more resilient local economies. Appropriate planning and coordination will be needed to reduce transitional risks, balance different land uses and support benefits for communities.

The renewable energy transition will require new infrastructure across regional Australia. Initial analyses suggest that while some renewable energy infrastructure will be located on or alongside agricultural land, overlap with agricultural land may be minimal (CEC 2025; NSW Agriculture Commissioner 2022). Hosting renewable energy infrastructure on farm can provide a more climate-resilient income source while continuing agricultural production, for example, through agrivoltaics. However, there are concerns in some regional communities about agricultural land being removed from production for renewable energy. The *Net Zero Plan* and the *Electricity* and *Energy Sector Plan* discuss the actions the Australian Government is taking to build community support for the transition.

There are also broader concerns from communities about the potential for land sector abatement to drive large-scale land-use change. Moving forwards, land management planning and community engagement will be critical, including genuine, ongoing engagement with First Nations peoples. This needs to be underpinned by information and transparency around how land is used and how land use is changing. The *Net Zero Plan* explores this further. Ultimately, decisions about how land is used will largely be made by individual landholders in line with their own interests and motivations.

All levels of government must take action in their sphere of responsibility. State and territory governments will continue to work with local governments and communities to ensure land is used in a way that aligns with social and community goals. Local governments are responsible for land-use planning, zoning and approvals in their jurisdictions, and will continue to play an important role in community capacity building, advocacy and facilitating on-ground action. The Australian Government maintains the regulatory and policy frameworks that govern the ACCU Scheme and Nature Repair Market. The *Carbon Credits (Carbon Farming Initiative) Act 2011* has a strong framework for assessing and managing potential adverse impacts including for land use, such as legally requiring the Minister to consider adverse social, environmental or economic impacts when making ACCU Scheme methods and detailed consent requirements before area-based projects can be credited. Projects under the ACCU Scheme are also required to consider consistency with regional natural resource management plans during development and are not exempt from compliance with state and territory laws, which is important for having the legal right to carry out each project. Legislative rules also exclude classes of projects which could have material adverse impacts, including on land use for agricultural production, water access or biodiversity.

Box 13 Production of low carbon liquid fuel feedstocks contributes to net zero

Agriculture can contribute to decarbonisation across the economy by producing feedstocks for LCLFs and low carbon gases. These fossil fuel alternatives present an opportunity to decarbonise hard-to-electrify energy demands, including aviation, maritime (including fishing vessels), heavy transport and some industrial processes. LCLFs are a critical technology in the *Transport and Infrastructure Net Zero Roadmap and Action Plan* and the *Electricity and Energy Sector Plan*.

The production of LCLFs will rely heavily upon biogenic feedstocks from the agriculture and forestry industries. The use of non-edible, 'second-generation' feedstocks –such as crop and forest residues and dedicated energy crops – could allow producers to extract additional value from otherwise under-utilised resources.

Australian producers are already producing significant quantities of LCLF feedstock for export and refinement into biofuels overseas. There is also a pipeline of 11 LCLF projects using biogenic feedstocks under development in Australia (CEFC 2025).

To help establish a LCLF industry, the Government is delivering $250 million in grant funding to be provided through the Australian Renewable Energy Agency as part of the Future Made in Australia Innovation Fund. This funding will seek to accelerate the development and deployment of a domestic LCLF supply chain, including nascent production technologies and feedstock sources. To ensure public investment such as this benefits communities during the net zero transition, the *Future Made in Australia Act 2024* requires consideration of the community benefit principles.

To further build a supply chain for Australian LCLFs, the Australian Government will invest $1.1 billion in a new Cleaner Fuels Program. This will help stimulate private investment in Australia's first onshore LCLF refineries, backing local innovators, making fuel supply more resilient and bridging the price gap for early adopters. The Government will engage with industry on how to make sure Australian liquid fuel users have a fair chance to capture the emissions reduction potential unlocked by low emission Australian fuels.

The Government has committed to developing a National Bioenergy Feedstock Strategy, to strategically examine the potential to grow a feedstock industry in a way that maximises opportunities for producers and supports emissions reductions, without compromising food and fibre security. The work will be progressed alongside the development of a National Food Security Strategy to ensure a coordinated approach.

Key Australian Government investments

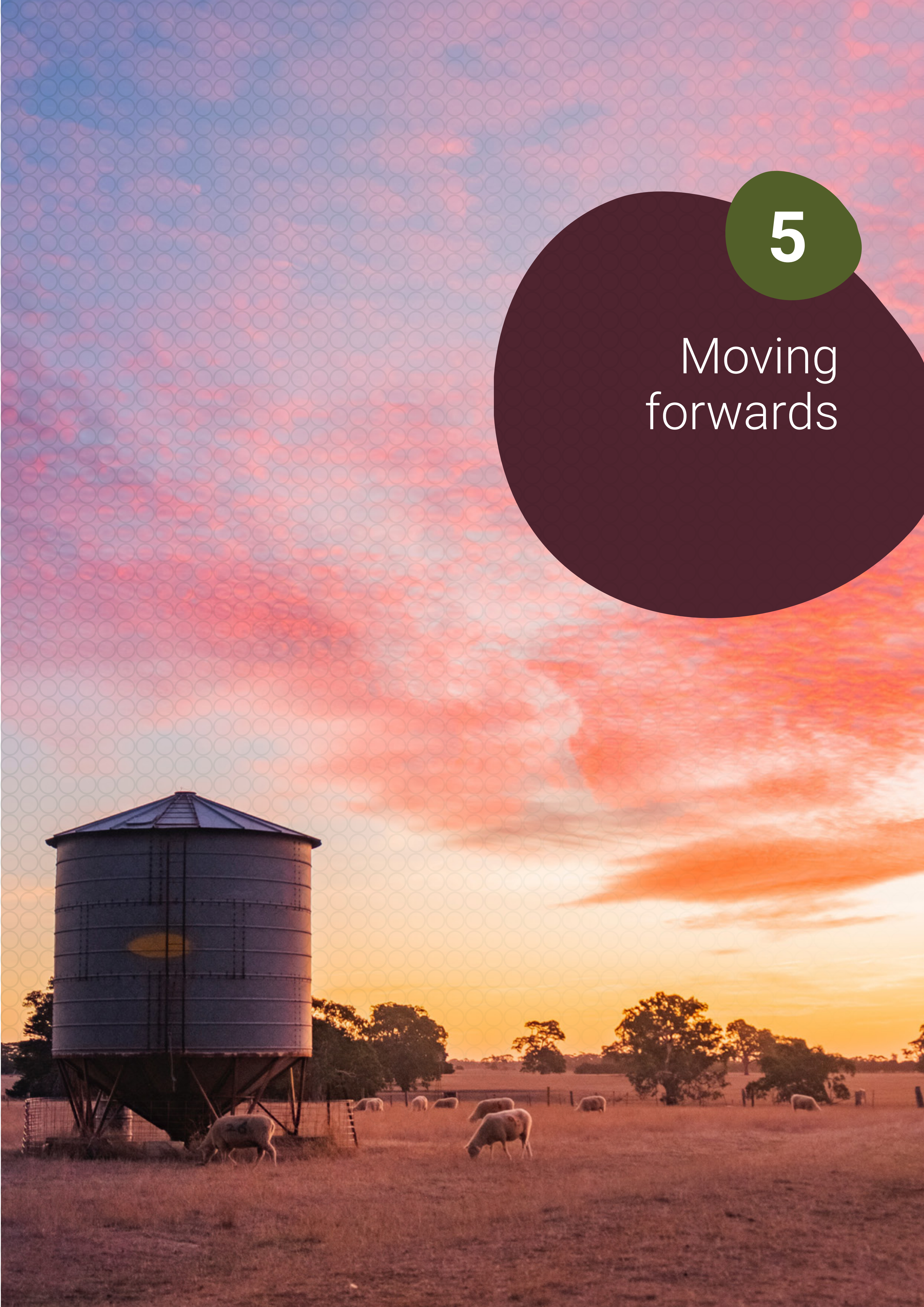
$73.8 million over 4 years from 2023 to 2027 for the Support Plantation Establishment program, which is helping to expand the wood production estate.

$66.1 million over 5 years from 2023 to 2028 to deliver essential reforms to the ACCU Scheme, including implementing a new proponent-led method development process and supporting First Nations groups to participate in up-front consent processes for ACCU Scheme projects.

$250 million over 5 years from 2025 to 2030 for the Australian Bushland Program.

5

Moving forwards



The plan has set out a range of foundational responses to prepare agriculture and land to play an important part in Australia's low-emissions economy. The extensive collaboration and analysis that has informed its development is only the beginning. We can all play a role in enabling agriculture and land to appropriately contribute to Australia's net zero goal.

Foundational actions identified in the plan have been designed to ensure engagement with industry and other stakeholders is embedded in implementation. Industry will need to continue with strong efforts towards decarbonisation, building on the many examples of industry leadership towards Australia's net zero goal. Ongoing partnerships will be necessary not only to achieve the goals of this plan, but to identify opportunities for further ambition as we chart a course to 2050.

All states and territories have set a target of net zero emissions by 2050 or earlier, and several have already established emissions reduction plans for agriculture and land (Box 14). Ongoing coordination and collaboration between federal, state and territory governments is critical to maximise Australia's chances of achieving our collective goals.

Ministerial forums between the Australian Government and state and territory governments for agriculture, environment, forestry, fisheries, energy and climate change are already in place to guide collaboration as we move forward. Commitments such as the National Statement on Climate Change and Agriculture, and the National Statement on First Nations in Agriculture, Fisheries and Forestry currently under development, highlight the shared ambitions of governments.

Box 14 Examples of state and territory government emissions reduction commitments and strategies

New South Wales: The Primary Industries Productivity and Abatement program is a key element of the state's *Net Zero Plan Stage 1: 2020–2030*. The program is further detailed in the NSW government's publication, Growing NSW's primary industries and land sector in a low carbon world.

Victoria: The 2021 to 2025 Agriculture sector emissions reduction pledge ensures farmers are preparing to achieve emissions reductions towards 2030. The Land use, land use change and forestry sector emissions reduction pledge aims to help protect and add to existing sources of natural carbon storage.

Queensland: The Queensland Low Emissions Agriculture Roadmap 2022–2032 provides a framework to achieve a low-emissions agriculture sector by reducing production-based emissions and increasing carbon farming.

Western Australia: The 2023 Sectoral Emissions Reduction Strategy for Western Australia includes pathways for the agriculture and land sectors.

South Australia: South Australia's Net Zero Strategy 2024–2030 guides the state's net zero emissions future and includes policy priorities for agriculture and land use.

Tasmania: Tasmania's first legislated Emissions Reduction and Resilience Plans for agriculture, and land use, land-use change and forestry from 2024–29 outline pathways to reduce emissions and build resilience.

Australian Capital Territory: The goals and actions in the ACT Climate Change Strategy 2019–25 include protecting local species and habitats, sequestering carbon in the landscape and encouraging sustainable and resilient farming.

Northern Territory: The 2020 Northern Territory Climate Change Response: Towards 2050 outlines opportunities to grow the carbon farming industry and the government's actions to respond to climate risks faced by the agriculture, horticulture, fisheries and biosecurity industries.

Addressing emissions from agriculture and land is a global challenge and advances are being made in other countries that can be leveraged to further support emissions reduction goals. Australia is a strong contributor to global alliances, initiatives and efforts, and like-minded countries, including Canada and New Zealand, have reached out to Australia to undertake joint work to support decarbonisation in agriculture. Australia must continue to display leadership and collaboration, and contribute to the international agenda on climate-smart agricultural production and market access requirements.

The *Net Zero Plan* outlines Australia's framework to ensure Australia remains on track to reach net zero emissions, through the *Climate Change Act 2022*. This framework supports transparency and accountability. It also provides a clear cycle for reviewing and improving climate policies over time, including the outcomes and actions outlined in the framework for supporting the agriculture and land sectors' contributions to Australia's net zero goal.

Many industry organisations are also already undertaking monitoring and reporting. Industry has growing data and reporting capabilities, with some industry bodies already reporting annually against climate change related indicators as part of their sustainability frameworks. It is critical that there is continued leadership shown by industry and supported by government where appropriate.

Through ongoing reporting and monitoring, new opportunities for strengthened action will be identified to support greater emissions reductions. As was the case for this plan, the engagement and contributions of the sectors will be fundamental to this process.

Everyone has a role to play

Governments

All levels of government must play their part in supporting a fair and orderly transition across the economy. Strong coordination and collaboration domestically, and also internationally, will provide the necessary guidance and direction to 2050 and beyond. Ensuring appropriate enablers are in place and smoothing barriers to decarbonisation will be critical to support everyone to play their role.

The research community

Research and development will play a crucial role in creating a suite of commercially viable abatement technologies and practices that enable decarbonisation across agriculture and land. Strong collaboration across the research community, together with the private sector and our international partners, will maximise investments and optimise outcomes.

Credit: Joshua Smith

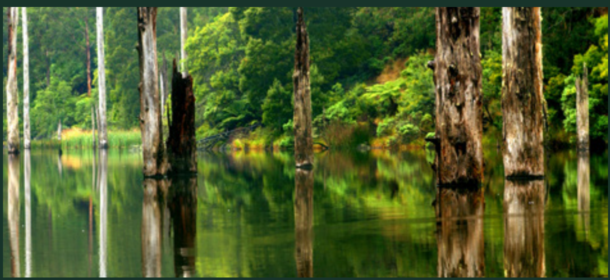
Industry and the private sector

The agricultural industry and private sector actors, including banks and supply chain organisations, have shown leadership on sustainability and emissions reductions. These organisations are establishing sustainability frameworks, setting their own climate goals and working with stakeholders to achieve shared objectives. Continued action will be critical for encouraging best practice, establishing strategic partnerships and guiding ambition.

Producers and land managers

Producers and land managers are at the heart of decarbonising the agriculture and land sectors. Their production decisions, investments and stewardship will drive emissions reductions and increases in carbon stores.

Though efforts of producers and land managers are critical, they are not acting alone. With the support of industry groups, communities, researchers and governments, action taken on the ground will contribute to our collective goals.



First Nations peoples

As the traditional custodians and knowledge-holders of the land and waters of Australia, First Nations peoples must be involved in, and benefit from, efforts to decarbonise the agriculture and land sectors. As significant land managers, co-managers, custodians and owners, First Nations peoples are at the forefront of engaging with the intersecting challenges of climate change, biodiversity loss and economic development.

Glossary

Term	Definition
abatement	The removal of one or more greenhouse gases from the atmosphere; or the avoidance of emissions of one or more greenhouse gases.
agriculture sector	Emissions from agriculture and associated management activities, which fall under the agriculture sector in the National Greenhouse Accounts, and emissions from agriculture, fisheries and forestry electricity and fuel use.
agrivoltaics	The use of land for both agriculture and solar photovoltaic energy generation.
Australian Carbon Credit Unit (ACCU)	Represents one tonne of carbon dioxide equivalent stored or avoided from a registered ACCU Scheme project.
carbon dioxide equivalent (CO_2-e)	A description of, for given amounts of greenhouse gases, the amount of carbon dioxide that would have the same global warming potential over a specified time period.
carbon storage	Carbon stored in carbon pools, such as plants and soils.
CFOP	Carbon Farming Outreach Program
circular economy	An economic model that promotes sustainable and efficient use of resources by recovering, retaining or adding to their value.
CRFD	Climate-related financial disclosures
CSIRO	Commonwealth Scientific and Industrial Research Organisation
decarbonisation	Removal or reduction of greenhouse gas emissions from or emitted to the atmosphere.
direct air capture and storage	A range of processes that separate and remove carbon dioxide from the atmosphere, storing the captured carbon dioxide underground in geological formations.
electrification	The replacement of other energy sources, such as liquid fuels, with electricity.
emissions intensity	A measure of the amount of emissions associated with a unit of output– for example, emissions per tonne of grain produced, or per head of cattle.
energy performance	Covers the broad management of energy demand, including energy efficiency, demand flexibility (or load shifting), and electrification and fuel switching.
enteric fermentation	The process in ruminant animals by which microbes in the digestive tract, or rumen, decompose and ferment food, producing methane as a by-product.
farm forestry	Establishing or managing trees on agricultural land for wood production.
feedstock	A type of renewable biomass, such as agricultural crops and forest residues, that is converted into a renewable fuel.
greenhouse gas (GHG)	Gases that trap heat in the earth's atmosphere. Carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4) are examples of greenhouse gases.
IFLM	Integrated Farm and Land Management
Indigenous Estate	Areas of land over which First Nations peoples and communities have ownership, management or other special legal rights.
insetting	Reducing emissions or storing carbon within an operation, and counting the emissions reductions or carbon storage towards the operation's total emissions.

Term	Definition
IPCC	Intergovernmental Panel on Climate Change
land manager	Someone who oversees the maintenance, use, development, protection or rehabilitation of public or private land.
land sector	The land uses and the land management activities which fall within the 'land use, land-use change and forestry' sector of the National Greenhouse Accounts.
low carbon liquid fuel (LCLF)	Liquid fuels with lower lifecycle emissions than conventional fossil fuels. LCLFs can be sustainably produced from biomass, waste materials and/or green hydrogen.
LPG	Liquid petroleum gas
NGA	Australia's National Greenhouse Accounts
net zero	Greenhouse gas emissions produced are balanced with emissions removed from the atmosphere.
NHT	Natural Heritage Trust
producer	Includes farmers, graziers, pastoralists, foresters and fishers.
R&D	Research and development
RDC	Rural Research and Development Corporation
reforestation	The restoration of previously forested land back to forest.
Scope 3 emissions	All indirect greenhouse gas emissions that occur upstream and downstream in a company's supply chain as a result of what it buys, sells or finances, excluding emissions from electricity production (Scope 2 emissions).
sink	Removes more carbon from the atmosphere than is released.
supply chain	The network of all the individuals, organisations, resources, activities, processes and technologies involved in the creation and sale of a product.
ZNE-Ag CRC	Zero Net Emissions Agriculture Cooperative Research Centre

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Australian Government

Built Environment Sector Plan

Treasury and Department of Climate Change, Energy, the Environment and Water

September 2025

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In the spirit of reconciliation, the Treasury acknowledges the Traditional Custodians of country throughout Australia and their connections to land, sea and community. We pay our respect to their Elders past and present and extend that respect to all Aboriginal and Torres Strait Islander peoples.

Ministerial foreword

Our built environment – homes, workplaces and spaces for community gathering – is at the centre of our lives. Its decarbonisation presents an opportunity to reduce greenhouse gas emissions, and ensure buildings are resilient to a changing climate.

Tried-and-true technologies are already in place to improve our building stock. Accelerating the uptake of these technologies will enable more Australians to save on their energy bills and improve their wellbeing. Innovative construction methods can help unlock further benefits and deliver the quality and quantity of new homes Australia needs now and into the future.

The Built Environment Sector Plan is an Australian Government strategy that provides emissions reduction pathways for the sector, to 2050. Together, the Net Zero Plan and six sector plans (the Plans) articulate Government priorities and ways to reduce greenhouse gas emissions and support ongoing and new investment in low-emissions and renewable activities. The 2035 target and the Plans draw on independent expert advice from the Climate Change Authority, as well as CSIRO, and in-house analysis from Treasury and across government.

Delivering new homes and buildings that are energy efficient and climate resilient across our built environment will create new, highly skilled trades, services, manufacturing and construction jobs. It will be essential to promote these employment and training pathways to ensure that all Australians can access the opportunities that the net zero transition brings.

In achieving these goals, we need to grasp opportunities and ensure no Australian is left behind. Currently, Australians on lower incomes or those renting, are more likely to live in homes that are energy inefficient – meaning higher bills, uncomfortable temperatures, and in the worst case, health problems. A fair and equitable journey to net zero will ensure that savings, wellbeing and health benefits are available to everyone.

Our net zero ambitions, along with the National Housing Accord target to deliver 1.2 million well located homes by June 2029, will help to deliver new homes and buildings that are more energy efficient and with a lower emissions impact. The Built Environment Sector Plan sets out a phased and scalable approach to upgrading existing stock while still delivering new supply.

The Built Environment Sector Plan also adopts a holistic approach to emissions reduction in the built environment. In most cases, solutions are already technically proven, and many have good return on investment.

To realise a fair and equitable transition, the Australian Government will work in partnership with industry and with governments at all levels. A significant work program is underway and will be reviewed and enhanced over the coming years. Together, we will reach net zero by 2050.

The Hon Clare O'Neil MP

Minister for Housing, Minister for Homelessness and Minister for Cities

The Hon Chris Bowen MP

Minister for Climate Change and Energy

Contents

Summary

The Australian Government is committed to achieving our 2035 target of 62–70% below 2005 levels and net zero by 2050, creating new opportunities for businesses, households and workers across Australia.

The Built Environment Sector Plan (BESP) is one of six sector plans (Figure 1) under the Australian Government's Net Zero Plan, which charts Australia's pathway to net zero by 2050. The Net Zero Plan outlines five priority areas for action: decarbonising and expanding the electricity network, electrification wherever possible, switching to low–carbon fuels, technology innovation and carbon removals.

The six sector plans provide a more granular analysis of Australia's emissions reduction opportunities. They outline how each sector contributes to Australia's transition to net zero and the priority areas for action.

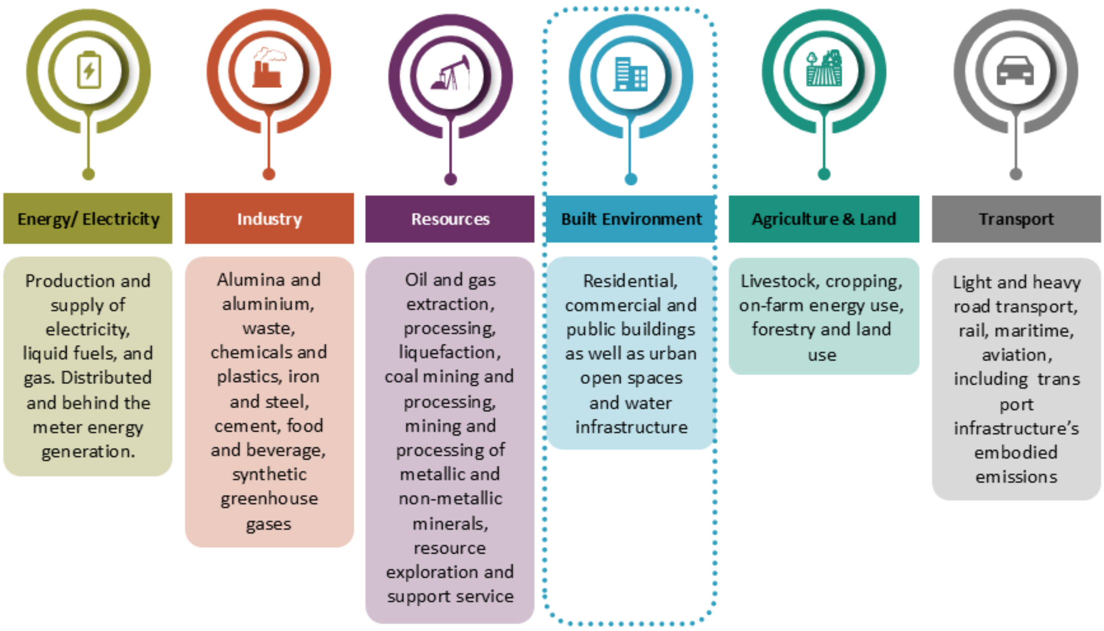


Figure 1 – Scope of sector plans

Our built environment comprises more than 11 million residential buildings and 1 million non-residential buildings, as well as parks, open urban spaces and water infrastructure.

Greenhouse gas emissions from the built environment sector contribute to around 5% of Australia's direct emissions (Scope 1 emissions), primarily from gas used in buildings for heating, cooking, hot water, and hydrofluorocarbon (HFC) emissions connected to air-conditioning and refrigeration equipment. A small number of direct emissions come from fuel used in construction machinery.

The built environment sector is intrinsically linked to the electricity and energy sector and is responsible for 48% of the emissions arising from electricity generation (Scope 2 emissions). The electricity and energy sector is the largest source of emissions – approximately 34% – of annual national direct emissions.

Indirect emissions (Scope 3 emissions) are also derived from building materials and referred to as embodied carbon. Industry and government are developing systems for measuring the embodied carbon within the built environment, including in the manufacture of steel, concrete and other essential building materials. Scope 1 emissions from materials manufactured in Australia are addressed under the Industrial Sector Plan.

The BESP adopts a holistic approach to emissions reduction in the built environment. It focuses on how to reduce Scope 1, 2 and 3 emissions and considers how to support a fair and equitable transition to net zero to realise the benefits of this transition to households, communities and businesses throughout Australia.

Minimising the use of gas in existing buildings and phasing down HFCs has the greatest potential to impact Scope 1 emissions. Technology is already commercially available; however, the upfront cost to replacing gas with electrical appliances can be a significant financial concern for many households and businesses. Government has an important role to play in ensuring policy settings promote public and private investment, and that these investments are coordinated across all levels of government.

Through the BESP, the Australian Government is setting the long–term strategic intent of this transition to ensure Australia's homes and businesses – and the people occupying them – can benefit from the transition to net zero.

Most of Australia's current building stock will still be in use in 2050. This means that achieving net zero will require millions of homeowners, businesses and building occupants to seize opportunities to electrify, improve energy performance, and install new appliances and equipment. Building upgrades deliver long–term benefits through lower operating costs, increased thermal comfort and improved health outcomes for building owners and occupiers. These decisions will happen in parallel with housing shortages, cost-of-living pressures, pressure on industry and the need to increase resilience in a changing climate.

It is important that the built environment transition is fair and equitable. For example, low-income owner-occupiers face disproportionate upfront cost barriers to retrofitting their home, and renters have limited ability to alter their rental property.[1] Public and social housing includes some of the lowest energy performing homes in Australia and tenants often face challenges in improving their homes' energy performance and thermal comfort. Similarly, First Nations people have a lower rate of home ownership (41% compared to 66% of all households[2]) and thus are more likely to rent and be impacted, while remote communities face additional costs due to distance and labour shortages.

A mix of policies will be needed to overcome these barriers and drive action. The Australian Government is working closely with state and territory governments, through a range of fora including the Building Minister's Meeting and the work of the Australian Building Codes Board (ABCB). A strong foundation of programs and projects are in place providing the building blocks for future initiatives (see Chapter 4). This includes the Social Housing Energy Performance Initiative

1 Australian Bureau of Statistics, Australia: Aboriginal and Torres Strait Islander population summary, Australian Government, 1 July 2022, accessed 11 August 2025; Australian Bureau of Statistics, Housing: Census, Australian Government, 28 June 2022, accessed 11 August 2025.

2 Australian Bureau of Statistics, *Australia: Aboriginal and Torres Strait Islander population summary*, Australian Government, 1 July 2022, accessed 11 August 2025; Australian Bureau of Statistics, *Housing: Census*, Australian Government, 28 June 2022, accessed 11 August 2025.

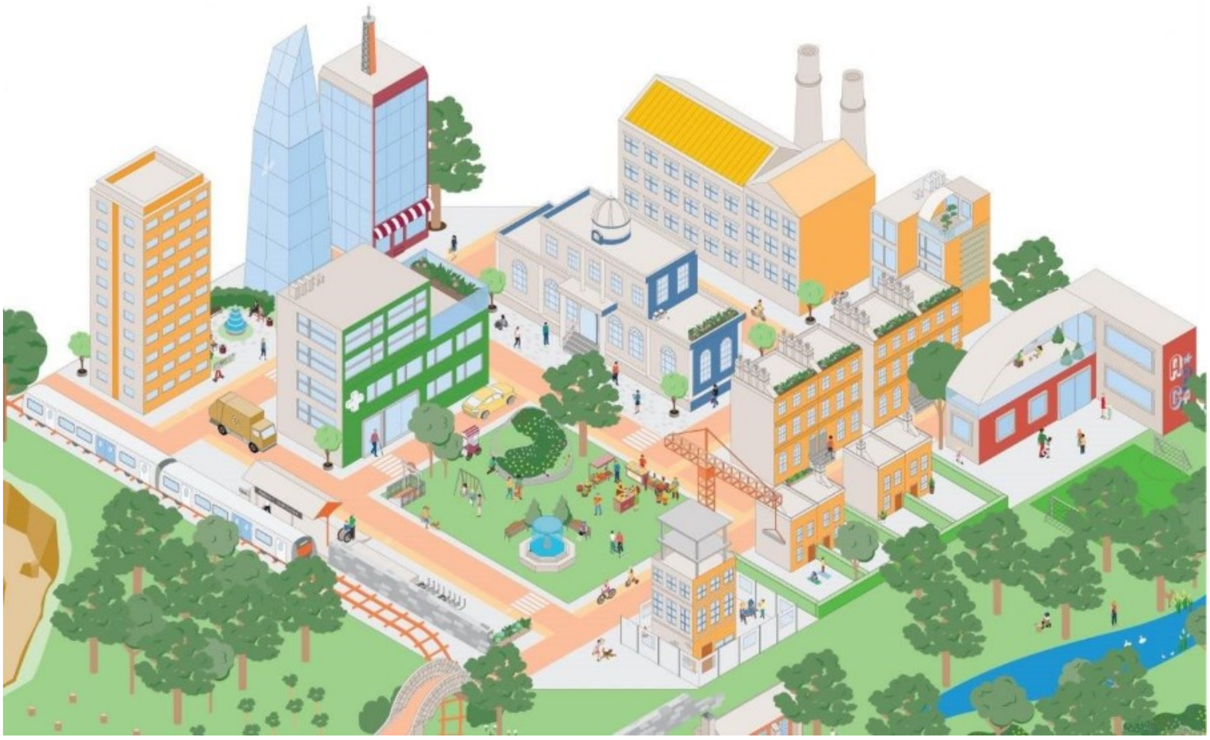
which is providing crucial energy performance upgrades to more than 100,000 social housing properties across Australia to ensure lasting benefits. These programs and projects will be progressively reviewed and adapted.

A phased and scaled approach will be important to provide industry with the best opportunity to grow and train the skilled workforce needed to transition existing stock while still delivering new supply – working towards meeting the National Housing Accord target of 1.2 million new homes.

Development of the BESP has been informed by stakeholder engagement, including ministerial level forums, industry and consumer meetings and one-on-one engagements.

Independent expert advice from the Climate Change Authority and in–house analysis from across government has informed the path forward. This includes insights from Australia's Net Zero Transformation: Treasury Modelling and Analysis and supplementary energy market modelling conducted by the Department of Climate Change, Energy, the Environment and Water.

The work of the Energy and Climate Change Ministerial Council, advancing the Update to the Trajectory for Low Energy Buildings, has also been integral.



Introduction

Australia's built environment comprises more than 11 million residential buildings and 1 million non–residential buildings. It includes parks, open urban spaces, water infrastructure, and buildings with high levels of electricity consumption, such as data centres (for more details refer to the Energy and Electricity Sector Plan).

Residential buildings (our existing homes) are the largest share of the built environment, making them the biggest abatement opportunity through electrifying and improving the energy efficiency of existing residential building stock.

Reducing emissions across the Australian economy and environment is critical to mitigating and adapting to the impacts of climate change. The Government's net zero target and transition pathways provide a predictable and stable path for Australian households, communities and businesses to realise the opportunities and benefits of this transition.

Our homes are important spaces for our health and happiness, and are the largest value asset many Australians may own. The Australian Government recognises the importance of secure and affordable housing for all Australians, which is why the Government set an ambitious target of an additional 1.2 million homes by mid–2029.

Occupants and owners can retrofit technology to upgrade their home's electrification and energy performance. This technology is commercially available and has long–term benefits for occupants and owners. Scale and cost are the biggest barriers stopping people from upgrading the electric and energy performance of their homes. Other barriers include:

- insufficient knowledge
- lack of time to consider electrification and energy performance upgrades
- behavioral biases
- lack of agency
- complexity with ownership structures (for example, split incentives between landlords and tenants or joint decision-making in strata properties).

The cost to electrify commercial buildings can also be high (anywhere between $100,000 and $5 million[3]). There are specific barriers including uncertain returns on investment, long payback periods and technical constraints such as insufficient space in service areas for heat pumps.

For these reasons, actions under the BESP seek to achieve the following key outcomes:

- A low-emissions and low-energy built environment to support Australia's emissions reduction targets.
- A built environment that is fit for purpose, liveable, provides thermal comfort and is resilient to a changing climate.
- A fair and equitable built environment transition where no one is left behind.

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3 Climate Change Authority, *Sector Pathways Review*, Australian Government, 2024, page 147.

Table 1 – Outcomes and supporting objectives of the Built Environment Sector Plan

Outcomes	Supporting objectives
Emissions reduction	A low-emissions and low-energy built environment to support Australia's targets.
	• **Electrification** of existing and new buildings (Scope 1). • **Phasing down hydrofluorocarbons (HFCs)** used in refrigeration and air conditioning, by 2036 (Scope 1). • **Flexible electricity demand** in existing and new buildings to support the transition to variable renewable generation in the electricity sector (Scope 2). • **Solar and coordinated energy storage** with continued solar uptake, paired with choices for batteries, bidirectional integration of electric vehicles and other consumer energy resources (Scope 2). • **Retrofitting existing buildings** to improve thermal performance and efficiency of appliances with capacity for further upgrades as conditions change (Scope 2). • **Increasing material efficiency and/or use of lower emissions materials** to reduce embodied carbon in new building construction and existing building retrofits (Scope 3).
Climate resilience and liveability	A built environment that is fit for purpose, liveable, provides thermal comfort and is resilient to a changing climate.
	• Residential, commercial and public buildings are designed and constructed to ensure **improved resilience of buildings and their occupants to climate-related hazards** expected during their life. • **Retrofitting** existing residential, commercial and public buildings to improve resilience and thermal comfort with capacity for further upgrades as conditions change. • Public urban spaces including parks and gardens are designed and managed to **ensure climate change resilience**. • **Climate-ready planning** through urban design, building location and orientation.
Fair and equitable transition	A fair and equitable built environment transition where no one is left behind.
	• **Support for lower income and disadvantaged households and businesses** (including tenants, culturally and linguistically diverse cohorts, and those in remote communities) to electrify and undertake upgrades to their home to improve energy performance. • There is a **holistic and inclusive approach to decarbonising the built environment** where the needs, interests and resources of all social groups are integrated equally into policy and decision making. • **First Nations cultural values** are considered in decision making about places and processes.

Chapter 1. Benefits of taking action

The transition to net zero presents a range of opportunities and substantial benefits to Australia's households, communities and businesses.

Benefits for households

As Australia transitions to net zero, and our electricity grid reduces reliance on emissions intensive fuels such as coal, households can play an important part in our electrified future.

Energy costs are a significant proportion of household spending. Households spend around 5% of their disposable income on energy, on average. This proportion more than doubles to 11% for households in the bottom 20% of incomes.[4] Electrification technologies can significantly reduce these costs (Figure 2). Electric appliances typically reduce energy costs as they are more efficient than fossil fuel alternatives.

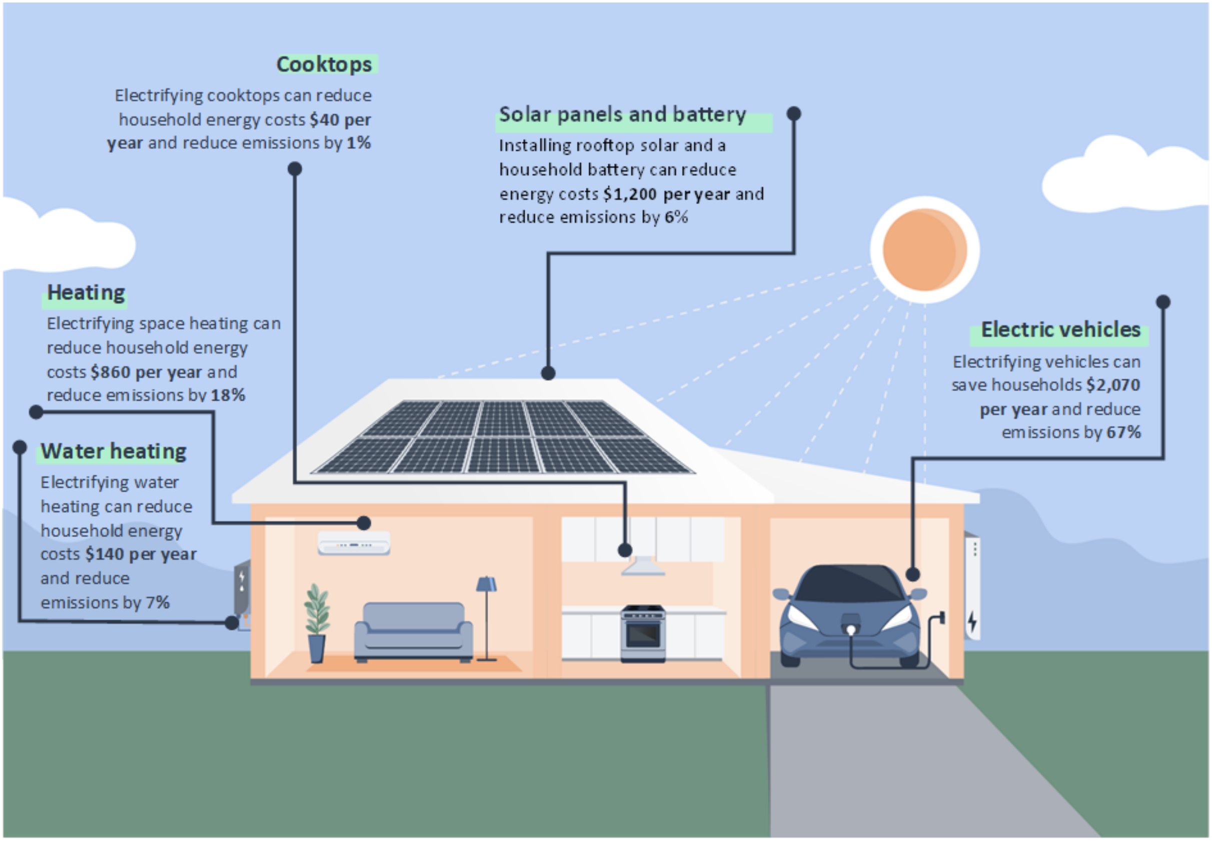

Figure 2 – Treasury (2025) Australia's net zero transformation: Treasury modelling and analysis, Treasury, accessed 16 September 2025.

Note: Annualised real costs from 2030 to 2050, including upfront, financing and ongoing costs. Assumes a typical two-to-three-person household with two vehicles, average consumption for home heating, cooking and hot water, and purchases a 10.6kW solar system and 10kWh battery. For more detail, see 'Australia's Net Zero Transformation: Treasury Modelling and Analysis'.

4 Treasury analysis of 2015–16 ABS Household Expenditure Survey of spending on power and vehicle fuel.

Households can electrify household appliances, such as cooktops, hot water systems, space heating and vehicles and they can reduce costs further by installing rooftop solar and home batteries.

Electric appliances can have higher upfront costs. However, lower ongoing running costs can result in cost-savings for households over time. The Australian Government's Household Energy Upgrades Fund and Cheaper Home Batteries Program, as well as programs run by state and territory governments, can help households get started by offsetting upfront costs. The Nationwide House Energy Rating Scheme (NatHERS), which previously provided ratings for new homes and is now being expanded to include existing homes, gives information to help households identify cost-effective upgrades and choose better performing homes. Banks can use the ratings to verify green finance for upgrades, assisting them to lend capital to Australians to overcome upfront costs.

Cheaper Home Batteries Program

The Government is rolling out the Cheaper Home Batteries Program to help more people install batteries.

Australian households, businesses and community organisations can get a discount of around 30% on the upfront cost of installing small–scale battery systems (5 kWh to 100 kWh). Since 1 July, Australians have installed over 55,000 batteries which represents over 1GWh of extra battery storage capacity.

This program is helping consumers reduce electricity bills at the same time as reducing broader system costs. This will support Australians to make the most of cheap and clean solar power, storing it for later use, while reducing peak demand and creating a more stable electricity grid.

Homes with highly energy efficient thermal shells (well insulated walls and roofs) need less energy to keep warm or to cool, resulting in lower energy bills and better resilience to heatwaves and cold temperatures. Research by Climateworks Centre found that quick-fix thermal upgrades packaged with fully electrified appliances would deliver a positive benefit–cost ratio for most Australian households. These upgrades, combined with rooftop solar, would provide annual net savings on average of between $909 and $1,578 from the first year.

Electrification and improved thermal performance can improve occupants' health. Pollutants from gas cooking and heating appliances are linked to higher rates of childhood asthma. Exposure to gas stove emissions is associated with over 12% of the total asthma burden in children aged 14 years or under.[5] Extreme temperatures increase the risk of heart problems and exacerbate existing health conditions.[6]

Renewable electricity generation, storage and electrification can also increase energy security, particularly for households in rural and remote areas. By reducing reliance on grid infrastructure and

5 LD Knibbs, S Woldeyohannes, GB Marks, & CT Cowie, 'Damp housing, gas stoves, and the burden of childhood asthma in Australia'. *Medical Journal of Australia*, 2018, 208(7):299–302. doi:10.5694/mja17.00469

6 S Hundessa et al, 'Global and regional cardiovascular mortality attributable to nonoptimal temperatures over time'. *Journal of the American College of Cardiologists*, 2024, 83(23):2276–2287. doi:10.1016/j.jacc.2024.03.425

transported fossil fuels, such as diesel and bottled gas, homes are more resilient when isolated due to natural disasters and extreme weather events. Where solar panels and a battery are used (in isolation or in connection to the grid) homes are also shielded from fluctuations in electricity prices.

Benefits for the community

Electrification and energy–efficiency upgrades can also benefit communities, not just individual households.

High thermally performing buildings can deliver widespread community health benefits on a regular basis and during heatwaves, reducing stress on the healthcare system. Temperature control is vital for occupant wellbeing and alleviating associated healthcare and economic impacts.[7]

The Victorian Healthy Homes Program found that thermal shell upgrades and energy efficiency measures resulted in significant health improvements for vulnerable, elderly occupants. The benefits included healthcare cost savings alongside physical health and quality of life improvements. The savings to the healthcare system were estimated to be $887 per person over the winter period.[8] Similarly, a home insulation subsidy in New Zealand was associated with reduced hospitalisations, particularly for respiratory disease, asthma, and ischaemic heart disease in older adults.[9]

Improving energy efficiency and enabling load shifting, helps reduce peak electricity demand, reducing the scale of investment needed to maintain and enhance our electricity grid. This is discussed in the Electricity and Energy Sector Plan

Benefits for business

The transition to net zero presents a range of opportunities and benefits for Australian businesses. This includes opportunities to improve the energy performance of the premises they lease or own, and the opportunities that come with increased consumer demand for higher energy performance technologies. Electrification and energy performance upgrades can include installation of solar and batteries, increased insulation, installation of energy efficient lighting, upgraded heating, ventilation and air conditioning systems, and the installation of building management systems (used to automate a wide range of building elements such as temperature control, ventilation, lifts, doors, sound systems and lighting).

Energy bills can make up a significant proportion of ongoing business costs. Therefore, opportunities to reduce and manage these costs through upgrades and electrification can be effective cost saving initiatives. By tracking energy consumption, building managers and occupants have a greater ability to control their energy use and determine which upgrades are needed. Other stakeholders, including customers, investors and banks are also increasingly seeking trusted, benchmarked and verified

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7 Race for 2030 Cooperative Research Centre, *Enhancing home thermal efficiency*, Race for 2030 CRC, 2023, accessed August 2024, page 78.

8 Climateworks, *Climate-ready homes: building the case for a renovation wave in Australia*, Climateworks website, November 2023, last accessed 11 August 2025, page 29.

9 C Fyfe et al, 'Association between home insulation and hospital admission rates: retrospective cohort study using linked data from a national intervention programme', BMJ, 2020, 371(m4571):n.p. doi: 10.1136/bmj.m4571

information about the energy performance of buildings to inform their decisions. Through the use of tools developed by the National Australian Building Energy Rating System (NABERS) program, participants have achieved an average of 30–40% less energy use over a 10-year period.[10] The range of NABERS tools will be expanded by the Government to ensure a broader range of commercial buildings can understand and act to reduce their energy consumption and costs.

As well as saving money, businesses that electrify and improve their facilities' energy performance can enhance the asset value and its marketability to prospective buyers or tenants who value sustainability and thermal comfort. Additionally, electrification eliminates the indoor air pollution associated with gas appliances and removes the risk of gas leaks and fires, presenting work health and safety benefits.

10 NABERS (National Australian Built Environment Rating System), *What is NABERS?*, Australian Government, n.d., last accessed 13 August 2025.

Chapter 2. Emissions from the Built Environment

This plan focuses on how to reduce Scope 1, 2 and 3 emissions. The sources of these within the built environment are outlined below.

Scope 1 emissions

Scope 1 emissions are the ‘direct’ emissions released into the atmosphere as a direct result of an activity. When considering these emissions in the built environment, this refers to the direct emissions from fuel sources used within our houses and businesses, such as natural gas, diesel, wood and the release of hydrofluorocarbons, or HFCs.

In 2024, the built environment accounted for 22 million tonnes of carbon dioxide equivalent ($MtCO_2$-e) or 5% of scope 1 national emissions. Residential buildings account for 13 $MtCO_2$-e (3% of national emissions) and commercial and public buildings account for 9 $MtCO_2$-e (2% of national emissions).[11]

11 Department of Climate Change, Energy, the Environment and Water, *National Greenhouse Gas Inventory Quarterly Update: December 2024*, Australian Government, 30 May 2025, last accessed 14 August 2025.

Table 2 – Sources of scope 1 emissions from the built environment

Natural gas use	• In 2024 around 5 million homes were connected to the gas network accounting for 17% of total gas consumed in Australia.[12] • The 2021 Residential Baseline Study found that approximately 57% of gas use in homes was used for space heating, 36% water heating, 6% cooking and 2% for other uses.[13] • Non-residential buildings used 40 PJ of gas in 2020.[14] This was approximately 15% of non -residential building energy consumption.[15]
Hydrofluorocarbons	• HFCs are a group of synthetic greenhouse gases with global warming potential many times higher than carbon dioxide. • HFCs are commonly used as refrigerants in commercial and domestic refrigeration and air conditioning equipment. • Together, residential and commercial refrigeration and stationary air–conditioning constitute 32% of the built environment's Scope 1 emissions.[16] Emissions primarily occur through leakage during installation, operation, maintenance, end of life decommissioning and disposal of equipment.
Diesel	• Diesel is used in machinery for construction purposes. It powers more than 75% of heavy construction equipment.[17] It is also used for backup generation in hospitals and commercial buildings where avoiding interruptions to power is vital. • Many small and remote communities rely on diesel generators, either in individual buildings or as part of a micro–grid. • Emissions from the combustion of diesel are a very low percentage of total built environment sector emissions. Abatement actions are addressed in the Transport Sector Plan and Electricity and Energy Sector Plan.
Wood	• Wood heating provided approximately 6% of residential energy in Australia in 2019, primarily for space heating.[18] • Abatement of emissions from wood is addressed by state and territory governments.
Water infrastructure	• Emissions from water infrastructure contribute a small amount to emissions in the built environment. • Emissions from wastewater treatment are covered under the Industry Sector Plan.

12 Wood, T., Reeve, A., and Suckling, E. (2023), *Getting off gas: Why, how, and who should pay?*, Grattan Institute

13 Monash Climate Change Communication Research Hub, *Switching on: benefits of household electrification in Australia*, Monash University, 2023, page 5. [Note: Due to rounding, percentages do not sum to 100%.]

14 Strategy. Policy. Research. *Commercial building baseline study 2022: final report*, Department of Climate Change, Energy, the Environment and Water, 2022, last accessed 13 August 2025.

15 Strategy. Policy. Research. *National totals and by climate zone – Commercial Building Baseline Study 2022*, Department of Climate Change, Energy, the Environment and Water, 2022, last accessed 13 August 2025. [Total energy use considered as total of gas and electricity use.]

16 Climate Change Authority, *Sector pathways review* (Built environment chapter), Australian Government, 1 July 2024, page 5.

17 Department of Climate Change, Energy, the Environment and Water, *Construction*, Australian Government, n.d., last accessed 13 August 2025.

18 Energy Rating, *2021 Residential Baseline Study for Australia and New Zealand for 2000 to 2040*, Australian Government, 11 November 2022, last accessed 13 August 2025. (Table 4 in 2021 RBS_OutputTablesV1.9.2-AU)

Scope 2 emissions

Scope 2 emissions are the ‘indirect’ emissions such as the emissions from the offsite production of electricity used to power homes and businesses.[19]

In 2024 the built environment contributed 73Mt CO_2-e or 48% of Australia’s Scope 2 emissions. Residential buildings account for 39 Mt CO_2-e and commercial and public buildings account for 34 Mt CO_2-e .[20]

The decarbonisation of the electricity system will greatly reduce the built environment’s Scope 2 emissions, and this is addressed in detail in the Electricity and Energy Sector Plan.

Scope 3 emissions

Scope 3 emissions are the indirect emissions in the supply chain and are often referred to as ‘embodied carbon.’ Embodied carbon represents the sum of the greenhouse gas emissions associated with materials and construction processes through the lifecycle of a building, (including material extraction, transportation, manufacturing, construction, use, replacement, demolition and end of life). These emissions are ‘locked in’ by the decisions made during the planning, design, procurement, delivery and maintenance of new construction projects.[21]

The term ‘upfront embodied carbon’ refers to the emissions generated during the material production and building construction phases of the building’s life. Infrastructure Australia has estimated that the upfront embodied carbon of Australia’s construction pipeline for building and infrastructure from 2022–23 to 2026–27 will be responsible for producing between 37–64 Mt CO_2-e per year. Upfront embodied carbon in commercial buildings can be calculated using the NABERS Embodied Carbon rating tool.

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19 Scope 2 emissions are the ‘indirect’ emissions such as the emissions from the offsite production of electricity used to power homes and businesses. In 2024 the built environment contributed 73Mt CO.

20 Department of Climate Change, Energy, the Environment and Water, *National Greenhouse Gas Inventory Quarterly Update: December 2024*, Australian Government, 30 May 2025.

21 Infrastructure Australia, *Embodied carbon projections for Australian infrastructure and buildings*, Australian Government, 15 July 2025, page 20.

Chapter 3. Pathway to 2050

This chapter provides an overview of the main actions underpinning the built environment sector's net zero transition to 2050.

Australia's emissions pathway

Economic modelling and analysis by the Australian Treasury explores three plausible scenarios for Australia's transition to net zero by 2050. This work informed the development of the Government's Net Zero Plan and sector plans. The modelling and analysis includes potential economy-wide and sector-specific emissions reductions pathways. The Baseline Scenario – in which Australia efficiently builds on existing climate policies and trends to achieve its net zero targets – is referenced in this chapter.

While scenario-based analysis is a powerful tool in helping inform Australia's net zero pathway, it is not possible to precisely predict how the transition will unfold. The future is uncertain and there are many factors that will influence the net zero transition, including changes in technology, global dynamics and community responses.

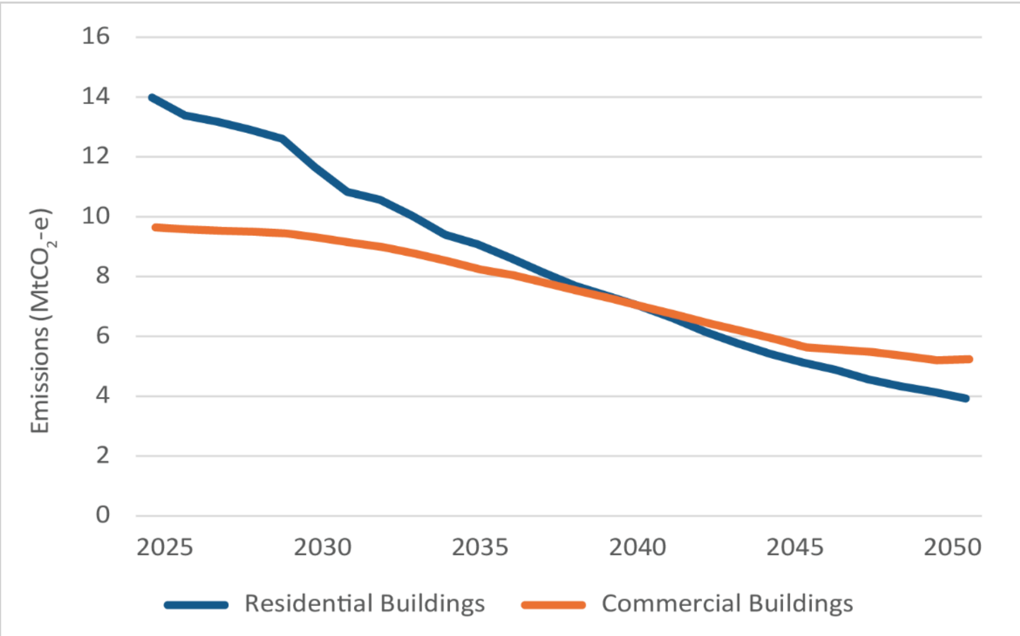

Figure 3 – Scope 1 emissions in the Built Environment sector, Baseline Scenario

Source: Treasury (2025) *Australia's net zero transformation: Treasury modelling and analysis*, Treasury, accessed 16 September 2025.

The Treasury's Baseline Scenario illustrates how the Built Environment sector could efficiently contribute to whole of economy net zero by 2050 across both Scope 1 and 2 emissions.

Scope 1 emissions in the Built Environment sector are projected to fall to 9 Mt CO2-e in 2050.

Much of this reduction in direct emissions is driven by electrification of the residential sector. The projected impact of electrification is substantial, driven by the prospect of energy bill reductions and other household motivations. However, electrification alone will not reduce all emissions. By 2050, there are projected to be 4 Mt CO2-e of remaining emissions by households.

Emissions from commercial buildings are projected to decline by 4 Mt CO2-e to 2050, driven by the electrification of commercial heating and cooling, some fuel-switching in construction machinery, and efficiency improvements. The Commercial Building Disclosure Program improves the energy efficiency of Australia's large office buildings by requiring the disclosure of energy ratings and emissions information. Expanding Commercial Buildings Disclosure to a wider range of buildings will contribute to this decline in emissions.

Improvements to residential and commercial energy efficiency due to electrification and greater thermal performance means total energy usage in the built environment sector is expected to remain relatively stable to 2050. At the same time, the emissions intensity of the sector decreases substantially by 2050.

Growing renewable penetration to 2050 reduces the built environment's Scope 2 emissions relative to today and enables its electrification.

Electrify, where possible

Reducing direct (Scope 1) emissions will rely on switching energy use from fossil fuels (such as gas and diesel) to electricity. Electrification is a simple way to decarbonise buildings, and the cost of technologies is expected to fall as adoption and innovation grows. Electrification of equipment and appliances in existing building stock is the largest opportunity to reduce Scope 1 emissions from the sector. Pairing electrification with energy efficiency, renewables and demand flexibility measures will help reduce strain on the electricity generation sector and increase savings for building occupants.

Supporting the transition away from gas as a fuel source for space and water heating is important. The 2021 Residential Baseline Study found that approximately 57% of gas use in homes was for space heating and 36% water heating, while only 6% was used for cooking.[22] It is estimated that currently 125,000 gas hot water systems are replaced with electric systems annually.[23] In non-residential buildings, gas makes up 15% of the sector's energy use.[24]

Supporting electrification with an orderly transition away from natural gas as a fuel source forms a key part of this plan and aligns with the Future Gas Strategy, which aims to support decarbonisation across the economy and meet our long-term emissions targets while seeing gas supply shift to higher-value, non-substitutable uses.

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22 Monash Climate Change Communication Research Hub, *Switching on: benefits of household electrification in Australia*, Monash University, 2023, page 5. [Percentages do not add to 100% due to rounding.]

23 Climate Change Authority, *Sector pathways review* (Built environment chapter), Australian Government, 1 July 2024, page 7.

24 Strategy. Policy. Research. *National totals and by climate zone – Commercial Building Baseline Study 2022*, Department of Climate Change, Energy, the Environment and Water, 2022, last accessed 13 August 2025. Total energy use considered as total of gas and electricity use.

Increase energy efficiency

At the same time as electrifying buildings, it is vital to improve their energy efficiency, and the energy efficiency of the appliances and equipment used within them. Upgrading buildings to improve their thermal performance and choosing the right combination of efficient "smart" appliances and efficient equipment to support demand flexibility will maximise benefits to households and businesses. In turn, this will reduce Scope 2 emissions from our houses and businesses. Efforts to enhance energy efficiency of buildings and reduce overall demand on the electricity sector can also reduce demand for electricity and current and new generation sources.

Energy rating and standards programs provide critical information and signals to households and businesses to improve energy efficiency and reduce costs. Expanding these proven programs in the residential and commercial built environment supports the market to choose and invest in improved energy efficiency.

The Greenhouse and Energy Minimum Standards (GEMS) program is the government's primary tool for regulating the energy efficiency of appliances and equipment to ensure that Australian consumers have access to a range of efficient appliances and energy efficiency information to support their purchasing decisions.

Improve design and decarbonise materials

Embodied carbon (Scope 3) is primarily produced in the manufacture of building materials such as cement and steel.[25] Buildings are one of the largest sources of embodied carbon. Improving building design, reducing construction waste, moving to low emissions materials and adopting circular economy principles can reduce embodied emissions. Steps taken now can help generate future demand for low emission materials.

Urban planning and precinct design can also play an important role in decarbonising the built environment, as highlighted in the National Urban Policy[26] which provides a framework for creating sustainable and resilient urban environments. Effective planning includes orienting buildings and developments to maximise energy performance, comfort and climate resilience. Providing tree canopies and careful selection of roof and road treatments can help address the urban heat island effect. Smart planning and design can also support reduced energy consumption. With good design less air-conditioning is needed to manage summer heat and winter sun is used to warm buildings during the cooler months of the year.

Harness low emissions technology

As detailed in the Energy and Electricity Sector Plan, households are already investing in solar systems, batteries, and other energy management solutions. Over time, this means that households and businesses will play a more active role in both generating and storing electricity. What was once a

25 Materials and Embodied Carbon Leaders Alliance Working Group 5c – Aluminium (WG5c), *Low emissions aluminium: the challenges and opportunities for advancing Australia's low carbon future*, Materials and Embodied Carbon Leaders Alliance, 2022, page 5.

26 Infrastructure Australia, *National Urban Policy*, Australian Government, 29 November 2024.

relatively straightforward, one-directional market where large generators supplied electricity to consumers, is evolving into a decentralised model that supports two-way power flows.

This transformation is being led by the uptake of consumer energy resources (CER) – such as rooftop solar panels, electric vehicles and home battery storage – which enable households, industries and businesses to generate, store and manage their own electricity. Complementary services like virtual power plants, aggregation services, bidirectional charging and home energy management systems can further empower consumers to optimise their energy use and benefit from the transition to net zero.

As CER deployment accelerates and innovative technologies are developed, the electricity system is becoming more dynamic, with a greater number of participants and increasingly blurred lines between supply and demand. While this creates a more complex system, it also unlocks opportunities to reduce overall system costs and deliver better value to consumers.

Virtual power plants (VPPs) are starting to aggregate solar and battery installations into larger systems, trading energy between them and the grid, and maximising the system benefits that these resources can provide.[27] Batteries and VPPs can help reduce grid demand and reduce the need for new investment in electricity generation sources.[28]

Opportunities to use emerging technologies like Artificial Intelligence (AI) and robotics in the design, construction and demolition of buildings, including through prefabricated and modular construction methods, can help reduce emissions in the construction phase, reducing waste and embodied emissions. AI also has the potential to deliver significant benefits for our electricity systems by optimising energy usage, supporting grid stability through predictive maintenance, and better integrating renewable energy by improving predictions of supply and demand.

Phase out hydrofluorocarbons (HFCs)

The built environment sector also includes emissions from sources with a high global warming potential, such as HFCs used in refrigeration, air conditioning and some hot water systems.

A global phase-down of HFC production and imports was agreed under the Montreal Protocol on Substances that Deplete the Ozone Layer in 2016. The global phase down of 85% of HFCs will reduce HFC emissions equivalent to up to 72 billion tonnes of carbon dioxide (CO_2) by 2050. This is the equivalent of well over one year of total global greenhouse gas emissions.[29]

Australia's phase-down of imports of HFCs is underway, with importers required to hold licences for all imports of bulk HFCs from 1 January 2018. The phase down uses an annual import quota to reduce use of new HFCs by 85% from baseline by 2036, leading to reduced emissions over time as low or

27 Australian Energy Market Operator, *Integrated System Plan*, AEMO, 26 June 2024, last accessed 11 August 2025, page 50.

28 Australian Energy Marker Operator, *Integrated System Plan*, AEMO, 26 June 2024, last accessed 11 August 2025, page 51.

29 Department of Climate Change, Energy, the Environment and Water, *Montreal Protocol on Substances that Deplete the Ozone Layer*, Australian Government, 26 September 2024, last accessed 11 August 2025.

lower global warming alternatives replace HFCs.[30] Bulk imports of HFCs are capped at around 2 Mt CO_2-e from 2036.[31]

Strategies to support proper maintenance, installation and decommissioning of equipment using refrigerants can reduce these emissions. Since 1993, product stewardship arrangements for refrigerants, including HFCs, have led to the recovery of more than 10 million kilograms of refrigerant gases. This is equivalent to avoiding 18.5 million tonnes of carbon dioxide emissions and preserving millions of tonnes of stratospheric ozone.[32]

30 Department of Climate Change, Energy, the Environment and Water, *HFC import quota*, Australian Government, 2024, last accessed 11 August 2025.

31 Department of Climate Change, Energy, the Environment and Water, *Australia's HFC phase-down – key information*, Australian Government, 3 October 2021, last accessed 11 August 2025.

32 Refrigerant Reclaim Australia, *About RRA*, RRA, n.d., last accessed 11 August 2025.

Chapter 4. Foundational actions

This section sets out Australian Government actions underway.

Accelerate electrification and increase energy performance

Energy performance (electrification or fuel switching, energy efficiency and demand management) will play a key role in the built environment sector reducing greenhouse gas emissions. Energy performance provides an opportunity to manage the scale of increased national demand for electricity, especially during periods of peak demand and provides an important opportunity for households and businesses to reduce energy bills. A significant number of initiatives are underway including:

- The **National Energy Performance Strategy** which was announced on 5 April 2024 and is the Australian Government's approach to improving energy performance across the economy. The National Energy Performance Strategy includes 47 actions supporting energy efficiency, electrification and demand flexibility. Funding for actions under the National Energy Performance Strategy includes:
  - The $1 billion Household Energy Upgrades Fund providing discounted consumer finance products to help households upgrade the energy performance of their homes.
  - $800 million in Australian Government funding for the $1.1 billion Social Housing Energy Performance Initiative in partnership with all states and territories.
  - The $100 million Community Energy Upgrades Fund providing grants to support local councils, which own and operate many public sporting, community and cultural facilities, to make their facilities more energy efficient, cut their emissions and reduce their energy bills.
- The **Small-Scale Renewable Energy Scheme** which encourages investment in small scale renewable energy. It provides incentives to households and businesses to install systems like rooftop solar, solar batteries, solar water heaters and air sourced heat pumps.
- The **Cheaper Home Batteries Program** under the Small-Scale Renewable Energy Scheme which is expected to support over one million new battery installations by 2030.
- The **Sustainable Finance Strategy** which has been developed in close coordination with financial regulators and other key stakeholders. It supports Australia's pathway to net zero by providing a framework to reduce barriers for investment into sustainable activities. The strategy included development of a sustainable finance taxonomy (classification system), which will be relevant for capital raising activities including bank lending.
- The **Australian Government's Green Treasury Bonds Program** which enables investors to back projects that progress Australia's transformation to net zero and support environmental objectives, including through investment in low-carbon construction and the circular economy.
- **Australian Public Service Net Zero in Government Operations Strategy** is expanding minimum energy performance standards for government purchases of services, including higher standards for offices and introducing standards for data centres, warehouses, hotel accommodation and consideration of embodied carbon in new construction.

Ensuring a fair and equitable transition

The Australian Government is committed to ensuring fair and equitable access to the benefits of the transition to net zero for all Australians, and that consideration is given to vulnerable consumers, small business and community organisations. Benefits can include improved health, amenity, resilience and financial benefits.

As consumers choose to transition away from natural gas it is important that low income and disadvantaged Australians are not left paying costly supply charges for a network supporting a dwindling consumer base. The cost of staying connected to the gas network will grow in the absence of targeted action as network costs are spread across a smaller group of consumers. Electrification and energy performance upgrades require upfront capital, which low -income cohorts are often unable to access. Hence, action to lower carbon emissions needs to be carefully managed to address social and economic inequalities. Disadvantaged cohorts that will be considered include:

- **Low-income owner occupiers**: 55% of households in the bottom two income quintiles with a mortgage spend more than 30% of their income on housing, a sign of financial stress. [33]
- **Private renters:** There are 2.4 million private rental properties in Australia,[34] with more than 270,000 tenanted by people on the lowest 20% of income.[35] Women are overrepresented in low-income and renter households and as heads of single-parent households, facing disproportionate hardship with rising energy costs.
- **People living in social housing:** There are 452,000 social housing dwellings in Australia. This encompasses people living in either public or community housing. The majority (298,000) of these dwellings are public housing.[36] The remainder are a combination of First Nations housing, Community Housing Provider managed First Nations houses, and Community Housing Provider managed social housing.
- **Older Australians** and **people with disability** are particularly vulnerable to extreme weather and may require additional adjustments to their home. Additionally, we need to ensure that changes intended to improve outcomes for net zero and resilience do not have unintended negative consequences.

33 Australian Institute of Health and Welfare, *Housing affordability*, Australian Government, 15 July 2025, last accessed 11 August 2025.

34 Australian Institute of Health and Welfare, *Home ownership and housing tenure*, Australian Government, 15 July 2025, last accessed 11 August 2025.

35 Australian Council of Social Services, *Funding and financing energy performance and climate-resilient retrofits for low-income housing*, Analysis & Policy Observatory, January 2024, page 24.

36 Australian Institute of Health and Welfare, *Housing assistance in Australia: social housing dwellings*, Australian Government, 24 June 2025, last accessed 11 August 2025.

- **People living in regional and remote areas** may face higher costs for building and renovating homes, making energy efficiency upgrades more expensive. While solar power and batteries can improve energy security and reduce reliance on gas and diesel,[37] installation can be difficult and expensive.[38]
- **First Nations households and individuals may** have unique needs. First Nations people are more likely to be part of other disadvantaged cohorts, such as renters.[39] Remote Indigenous communities in Australia are among the most energy insecure in the world,[40] and remote communities often experience high rates of unreliable and unaffordable energy supply.[41]

To support a more fair and equitable transition, the Australian Government is investing $800 million in the expanded **Social Housing Energy Performance Initiative** in partnership with all state and territory governments, to deliver energy performance upgrades to over 100,000 social housing properties by 2028–29. The initiative is supporting social housing tenants, including those in First Nations housing in some jurisdictions, to benefit from solar systems, batteries, efficient electric appliances, and insulation. This will provide tenants with sustained savings on energy bills, and improved comfort and health. Upgrades are currently being rolled out across Australia, including to First Nations housing in regional and remote communities.

The **First Nations Clean Energy Strategy** (the Strategy) was released on 6 December 2024 and aims to maximise the enormous, nation-wide potential for First Nations peoples to benefit from the clean energy transformation. Priority actions identified in the Strategy will underpin progress on outcomes of the National Partnership Agreement on Closing the Gap through self-determined participation in large project development, business development and project ownership, energy efficient housing and access to reliable and affordable clean energy at the household level.

The $70 million **First Nations Clean Energy Program** will support implementation of the Strategy and fund design and delivery of the program to empower and enable First Nations peoples' leadership and participation in the clean energy transformation.

The **Community Energy Upgrades Fund Program** will provide $100 million in matched competitive grant funding for energy efficiency and electrification upgrades to deliver reduced energy bills and emissions for local government owned and/or operated facilities.

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37 Clean Energy Regulator, *Solar power for remote Indigenous communities*, Australian Government, 23 March 2024, last accessed 7 August 2025.

38 M Nixon & E Dobson, '*Remote outback communities go solar to protect food during wet season*', ABC News, 30 January 2025, last accessed 11 August 2025.

39 Australian Bureau of Statistics, *Australia: Aboriginal and Torres Strait Islander population summary*, Australian Government, 1 July 2022, last accessed 11 August 2025; Australian Bureau of Statistics, *Housing: Census*, Australian Government, 28 June 2022, last accessed 11 August 2025.

40 Department of Prime Minister and Cabinet, *First Nations communities to have their say on the energy transition* [media release], 14 November 2023, last accessed 11 August 2025.

41 S Quilty, NF Jupurrurla, RS Bailie & RL Gruen, 'Climate, housing, energy and Indigenous health: a call to action', *Medical Journal of Australia*, 2022, 217(1):9–12.

Support consumers to make informed decisions

Ensuring the public has easy access to credible, accessible information to make confident choices and suitable investments is critical for emissions reductions. For communities and people who identify as culturally and linguistically diverse, providing easily understandable information on the opportunities and processes to upgrade is paramount to promoting uptake. Improvements in measurement, reporting and disclosure for building emissions and performance will also improve the data necessary for financiers and investors to have confidence in the sustainability credentials of building projects and meet requirements under sustainable finance frameworks.

Current Australian Government initiatives include:

- The **Nationwide House Energy Rating Scheme** (NatHERS), which provides new and existing homes with a home energy rating of 0 to 100 based on the energy expected to be used by the home, as well as a thermal performance rating from 0 to 10 stars based on the home's heating and cooling needs. Previously available for new homes only, the Government is rolling out NatHERS to existing homes to provide critical information to help consumers choose better performing homes and make cost-effective upgrades.
- The **National Australian Built Environment Rating System (NABERS)** which rates commercial buildings from 0 to 6 stars across a range of commercial buildings types and the Government is investing in the National Australian Built Environment Rating System (NABERS) for non-residential buildings.
- **NABERS Embodied Carbon** rating tool which enables eligible new buildings and partial rebuilds to measure, verify, and compare their upfront embodied carbon with similar buildings. The tool provides a certified measure of carbon intensity, incorporating material, transport and construction emissions.
- The **Commercial Building Disclosure Program**, which requires office buildings over 1000m2 to obtain and disclose their NABERS energy rating and tenancy lighting assessment when offered for sale or lease. The Government is expanding the Commercial Building Disclosure (CBD) program to more commercial building types beyond office buildings.
- **Greenhouse and Energy Minimum Standards** which help consumers purchase efficient appliances with an energy star rating. Appliance standards have improved over time due to minimum energy performance standards for appliances and equipment required under the *Greenhouse and Energy Minimum Standards Act 2012*.
- **CSIRO's RapidRate™**, an artificial intelligence tool developed to provide a quick estimate of the NatHERS energy ratings of established homes.

Continue collaboration with states and territories

Each level of government holds different responsibilities regarding building construction, urban planning, electrification, energy performance and material efficiency. Under the Australian Constitution, states and territories are responsible for the regulation of building and planning activities and are primarily responsible for the mechanisms that encourage households and small and medium businesses to switch from gas to electricity.

The Australian Government works with state, territory and local governments through a range of forums on the development and delivery of initiatives outlined in their strategic plans. These include:

- The **Energy and Climate Change Ministerial Council** who are delivering outcomes in line with the Update to the Trajectory for Low Energy Buildings, with a goal to achieve a net zero emissions building sector by 2050, while lowering costs for households and businesses and improving building thermal comfort for all Australians. It provides strategic direction for collaboration between the state, territory and Australian governments to progress energy efficient, low emissions, sustainable and forward-thinking long-term buildings policy.
- The **National Consumer Energy Resources Roadmap** which is working to broaden consumers' access to consumer energy resources including solar, batteries, electric vehicle chargers, water heaters and air conditioners.
- The **Building Ministers' Meeting** who are responsible for the **National Construction Code** which sets minimum energy efficiency standards for buildings. These are then given legal effect through state and territory regulations.
- The **Planning Ministers' Meeting** who are working together to progress nationally significant planning reforms. These include planning reforms to facilitate more and well-located housing; national principles to embed natural disaster and climate risk considerations in land use planning decisions and progressing the National Urban Policy.
- Launched in November 2024, the **Australian Government's National Urban Policy** provides a coordination framework to ensure all levels of government effectively work together. The Policy includes a shared vision for sustainable urban growth, developed jointly with state and territory governments and in consultation with the Australian Local Government Association.

Support materials efficiency

Using material resources more efficiently, and encouraging the use of low emissions products, is an important method for reducing emissions across all sectors. Applying circular economy principles is a way of managing resources that focuses on using materials more efficiently and reducing waste. Many businesses are already moving toward a circular economy for economic reasons, and because it aligns with emerging consumer preferences. This includes using products and materials made from recycled content, replacing single-use products with reusable options, offering repair and reuse services and reducing waste.

The Australian Government is supporting these actions through implementing **Australia's Circular Economy Framework** to accelerate Australia's transition to a circular economy. The framework will help encourage more efficient and productive use of our resources with its goal of doubling Australia's circularity by 2035.

The framework identifies the built environment as one of the four priority sectors for the circular economy transformation as there is great potential for application of circularity practices. Early design decisions – such as using prefabricated, modular, flexible layouts and designing for longevity, reuse, decommissioning and repair – can dramatically lower the need for new resources, cut emissions and reduce waste. By retaining existing goods, assets and materials for longer, not only is the embodied carbon of a building reduced – but so is the need for new extraction and processing activities and their associated impact.

The following circular economy strategies are pathways to reduce emissions:

- prioritising refurbishment and adaptive re-use over demolition
- designing for modularity and disassembly
- designing for longevity
- inclusion of recycled content and diversion of waste from landfill
- using waste heat from one facility, such as a data centre, to heat another, such as an office or swimming pool.

The **NABERS Embodied Carbon** rating tool, developed in collaboration with states and territories, enables the consistent measurement of emissions arising from the construction of commercial buildings. The 0 to 6 star rating encourages building owners to choose low carbon materials, improve building design, recycle, reduce construction waste and adapt existing structures where possible. In June 2024 Building Ministers agreed to include a voluntary pathway in the 2025 update of the National Construction Code for commercial buildings to measure and report on embodied carbon using the NABERS method.

Innovate to expand emissions reduction

Investment in innovative research and industry development is helping the built environment sector reduce emissions. The Australian Government is partnering with other levels of government, research institutions and private enterprises to develop and implement new technologies and systems. Innovation in the sector is relatively low, as highlighted by the recent Productivity Commission report on residential construction productivity. To build more homes and reduce emissions, construction innovation and productivity needs to grow. Initiatives underway include:

- **Modern methods of construction,** such as prefabricated and modular construction have many benefits, such as increased speed of delivery, efficient use of materials and reduced waste. There are also benefits to regional and remote Australia, where on-site building costs are up to double those in metropolitan areas.[42]

  Australian Government initiatives include:

  – $49.3 million over 2 years from 2025–26 to partner with states and territories to support the prefabricated and modular construction projects.

  – development of a voluntary manufacturers' certification scheme to support regulatory compliance.

  – $120 million committed in National Competition Policy funding for states to support regulatory neutrality between modern methods of construction and traditional buildings.

- The Australian Government has also committed $14.5 million to support Mineral Carbonation International to produce low carbon building materials using carbon dioxide captured from hard to abate industries, through the Carbon Capture Technologies Program.

42 Nous Group, *Efficient system costs of remote Indigenous housing*, National Indigenous Australians Agency, 2017, page 20.

- **Cooperative Research Centre** initiatives:
  - Building 4.0 Cooperative Research Centre – $28 million to develop an internationally competitive, dynamic and thriving Australian advanced manufacturing sector, delivering better buildings at lower cost and the human capacity to lead the future industry.
  - SmartCrete Cooperative Research Centre and La Trobe University – $21 million to develop a Low Carbon Concrete Centre, accelerating the decarbonisation of concrete and improving confidence in low-carbon concrete-based products.
- **Australian Renewable Energy Agency** initiatives:
  - $59.1 million to support low emissions steel, iron and renewable hydrogen research, development and commercialisation projects.
  - $750 million of the Future Made in Australia Innovation Fund, administered through the Australian Renewable Energy Agency, to support innovative green metal projects including iron, steel, alumina and aluminium.[43]
- Low or no cost loans from the **Clean Energy Finance Corporation** such as their $100 million commitment to Wesfarmers to support renewable energy upgrades and energy storage solutions across Bunnings and Officeworks sites.

Create a resilient built environment

Efforts are underway to ensure the impacts of climate change are managed. Emissions reduction policies will help reduce impacts, but they cannot eliminate them, and the impacts of a changing climate will disproportionately affect vulnerable and disadvantaged Australians. Impacts such as flooding, bushfires, heat stress, extreme rainfall events, storms and hail, coastal erosion and intensified cyclones, will be experienced more acutely across Australia.

The **National Climate Risk Assessment (NCRA)** and **National Adaptation Plan (NAP)** are complemented by the transition pathway outlined in the Net Zero Plan and Sector Plans (including the BESP). The NCRA provides the first comprehensive government-led assessment of the risks Australia faces because of climate change. The NAP establishes a framework for adapting to the risks identified within the NCRA.

The NCRA identified that there are critical risks to essential infrastructure and the built environment in Australia. The impacts of climate change on this sector will present risks to supply chains that are necessary for the distribution of goods and services, Australia's labour markets, capital and trade. Critical infrastructure (e.g. transport, energy and telecommunications infrastructure) is vulnerable to most climate hazards including but not limited to bushfires, heatwaves, extreme wind and flooding. All these hazards are projected to increase in frequency and/or severity with increasing global warming.

43 Australian Renewable Energy Agency, *Future Made in Australia Innovation Fund*, ARENA, 2024, last accessed 11 August 2025.

Adapting the built environment to be resilient to climate change impacts provides an opportunity to support broader environmental and social co-benefits. For example, Improving the thermal comfort and energy performance of Australia's building stock is critical to supporting the health and wellbeing of at-risk individuals and communities.

There is significant work already underway across all levels of government and the private sector to improve the resilience of the built environment including initiatives already covered such as NatHERS, the Updated Trajectory for Low Energy Buildings and the National Energy Performance Strategy. To boost action, in June 2024, Building Ministers agreed to include climate resilience as a specific objective of the Australian Building Codes Board. This will give the Australian Building Codes Board a clear mandate to develop future National Construction Code requirements that reduce the impact of natural hazards on housing and other critical community facilities.

Chapter 5. Moving forward

A phased and scalable approach

As mentioned, the technology to support the transition to net zero is already available, and this is already being taken up and incentivised by industry, consumers and governments at all levels. Supporting a transition to net zero in the built environment requires a phased and scaled approach to ensure we can transition existing stock while still delivering new supply – and meet the National Housing Accord target of 1.2 million new homes over the next five years.

Objectives	2025–2030: Accelerate upgrades	2030–2035: Continuing action	2035–2050: Realising our net zero ambition
A low-emissions and low-energy built environment to support Australia's targets.	• Energy efficiency upgrades and electrification are supported with clear, accessible, information, standards and programs. • Continued expansion of ratings and disclosure for buildings and appliances. • Frameworks to reduce embodied carbon are established. • Modern methods of construction are supported through R&D. • Policies to reduce refrigerant emissions (HFCs) implemented. • Appliance and equipment efficiency and demand flexibility is improved.	• Households and businesses have the information they need. • Consumer energy resources support grid stability. • Continued development of standards for existing homes and commercial buildings. • Support minimum energy performance standards for commercial buildings Continuing to improve appliance and • Continuing to improve appliance and equipment efficiency standards, and demand flexibility, as new technologies come online. • Continuing work to reduce refrigerant emissions and embodied carbon.	• All energy users that can, have electrified. • The electricity grid is supported by homes and businesses. • Standards for new buildings and appliances improve as new technologies come online. • Refrigerant emissions reduced and HFC phase down completed in 2036. • Embodied carbon is minimised.
A built environment that is fit for purpose, liveable, provides thermal comfort and is resilient to a changing climate	• Work with states and territories to improve urban planning. • Implement the National Adaptation Plan. • Ensure decision makers have the information they need to consider climate risks.	• Continue to accelerate and mainstream adaptation action across all levels of government, business and households.	• The built environment is liveable, fair, equitable, productive, innovative, sustainable and resilient as outlined in Australia's National Urban Policy.

A fair and equitable built environment transition where no one is left behind.	• Energy performance upgrades for social housing are delivered to benefit vulnerable cohorts. • A nationally consistent framework for rental energy efficiency standards is available to jurisdictions that choose to implement it.	• Ongoing updates to the framework for nationally consistent energy efficiency standards for rental properties for jurisdictions that choose to implement. • Continue work with state and territory support for vulnerable households.	• All households benefit from improved energy performance and lower energy costs.

Future Direction

The Australian Government will expand several existing programs that have successfully led decarbonisation covering commercial and residential buildings, as well as appliances to continue to drive towards net zero. These include:

- NatHERS for existing homes implementation
- Expansion of Commercial Buildings Disclosure
- Expansion of the National Australian Built Environment Rating System (NABERS)
- Greenhouse and Energy Minimum Standards (GEMS) modernisation.

These are existing programs that will be expanded, significantly reducing implementation risk and building on the Government's track record of delivery success.

Expanding the Commercial Building Disclosure (CBD) Program

Trusted energy ratings, minimum performance standards and strong disclosure regulations are critical to establishing the right policy settings for further industry and private sector investment and action in the built environment. The CBD Program improves the energy efficiency of Australia's large office buildings by requiring the disclosure of energy ratings and emissions information. The Government will invest around $10 million to expand the existing CBD Program, which currently only covers office buildings, to consider most commercial building types by 2035 in accordance with the Commercial Building Disclosure Roadmap. The Roadmap will be published by Government as a first step to provide industry with a clear pathway for the program's expansion.

Accelerating and investing in the National Australian Built Environment Rating System (NABERS)

The Government will invest around $10 million to expand NABERS to prepare the commercial buildings sector for expansion of the CBD Program by developing new tools and providing discounted NABERS ratings, maximising its effectiveness. Australia's NABERS rating tools for commercial buildings are seen as world leading, with their focus on the actual energy performance of buildings. NABERS will work with sectors in scope for expansion of CBD to improve voluntary disclosure rates in the run up to mandatory disclosure, incentivising building owners to seek ratings and ensuring assessor capacity leads sector expansion. The development and refinement of NABERS tools will also enable NABERS and its partners to deliver useful products for industry in areas such as energy flexibility and embodied carbon.

Greenhouse and Energy Minimum Standards (GEMS)

The *Greenhouse and Energy Minimum Standards Act 2012* (GEMS Act) and program is the primary driver for improving the energy performance of the appliances we use in our homes, buildings and industry. Sending the right signals about the value of efficient, electric appliances, enabled for demand flexibility, gives consumers the information they need to make informed choices and take pressure off their bills. The Government will invest around $16 million to modernise the GEMS Act and update the program so the Government can ensure the Act is fit-for-purpose now and into the future, this will reduce emissions and deliver real bill savings by regulating a greater range of more efficient products and equipment across residential, commercial and industrial sectors.

Expanding Nationwide House Energy Rating Scheme (NatHERS) to existing homes

In July 2025, the Government released stage 1 of the expansion of the Nationwide House Energy Rating Scheme (NatHERS) to existing homes. The Government will invest around $33 million to continue and scale-up the roll out of NatHERS ratings for existing homes. This will provide ratings and upgrade information for more households across Australia, to better inform decisions on how to cut energy bills, reduce emissions and improve their home's resilience and comfort.

Previously, NatHERS was used for new home designs and major renovations – with more than 90% of new builds using NatHERS to demonstrate compliance with the energy efficiency requirements of the National Construction Code. NatHERS ratings consider the energy efficiency of the building, as well as its major fixed appliances and any on-site solar or batteries.

There are expected to be a range of other users of NatHERS for existing homes ratings:

- Banks may use the ratings to verify green loans, helping them access green capital markets to lend money for home upgrades. This will make more finance available to Australians and drive energy performance improvements in existing housing stock.
- Governments may use the ratings to underpin and target home energy upgrade programs, and in time, state and territory governments may use the ratings for home energy rating disclosure schemes at the point of sale or lease.
- Various businesses will benefit from new business opportunities, jobs and professional development to meet the demand for skills, services and products to rate and improve energy performance.

Investing in these trusted and effective programs will deliver emissions and energy savings in the built environment for households, communities and businesses.

Furthering Community Energy Upgrades – Game On: Teaming up for climate action

Building on the success of the Community Energy Upgrades Fund, the Government will provide $50 million to deliver energy performance upgrades for community sports clubs to climate-proof community sports facilities, promote inclusive climate action and harness the potential of sport as a vehicle to engage everyday Australians in the energy transition.

Sport provides a powerful opportunity to engage millions of Australians in positive action to address climate change. Energy upgrades will unlock savings that can be directed back to grassroots sport. Upgrades include installing solar and batteries, electrification, energy efficiency upgrades and lighting, and climate adaptation improvements.

Monitoring progress

The *Climate Change Act 2022* sets up a strong framework to ensure Australia remains on track to reach net zero emissions. It requires the Minister for Climate Change and Energy to report progress through an Annual Climate Change Statement to Parliament, including progress towards emissions targets, and whether current policies are effective. This regular reporting ensures transparency and accountability. It also creates a clear cycle for reviewing and improving climate policies over time.

The BESP outlines a range of measures to reduce greenhouse gas emissions and their success will depend on all levels of government, the community and industry working together. Progress will be reviewed by the Australian Government and state and territory governments through the Building Ministers Meeting, Planning Ministers Meeting and Energy and Climate Change Ministerial Council which provide important fora for collaboration.

Continued stakeholder engagement will also be key to achieving the BESP's goals and to identify and grasp new opportunities. A range of stakeholder consultation and vehicles for input will be rolled out over the life of the plan.

Delivering on the objectives of net zero sector plans will be assessed by the Climate Change Authority in its five yearly review of Australia's progress against emissions reduction targets. Key metrics of success will include declining emissions, increasing electrification rates and use of low-carbon fuels, and improvements in Australia's energy performance. Further metrics will be developed to support a fair and equitable transition.

Acronyms and Glossary

Acronyms

Term	Definition
ABCB	Australian Building Codes Board
BESP	Built Environment Sector Plan (this document)
CEFC	Clean Energy Finance Corporation
CER	Consumer energy resources
CO2	Carbon dioxide
CO2-e	Carbon Dioxide equivalent is a standard unit used to compare the emissions of different greenhouse gases based upon their global warming potential in terms of the equivalent amount of carbon dioxide emissions.
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEEW	Department of Climate Change, Energy, the Environment and Water
HFCs	Hydrofluorocarbons
kW	Kilowatt
Mt CO2e	Million tonnes of carbon dioxide equivalent
NABERS	National Australian Built Environment Rating System
NatHERS	Nationwide House Energy Rating Scheme
NAP	National Adaptation Plan
NCRA	National Climate Risk Assessment
NEM	National Electricity Market
PJ	Petajoule (One petajoule is 1015 joules (1 million billion) or 278 gigawatt hours).
R&D	Research and development
t	Tonne
TWh	Terawatt hour

Glossary

Term	Definition
Abatement	A reduction in atmospheric greenhouse gases through emissions avoidance or removal of carbon from the atmosphere.
Decarbonise	To stop or reduce carbon gases, especially carbon dioxide, being released into the atmosphere as the result of a process, like the burning of fossil fuels.
Electrification	Switching from energy sources, such as liquid fuels or gas, to electricity.
Greenhouse gases	Any gas (natural or produced by human activities) that absorbs infrared radiation in the atmosphere, leading to warming effects. Greenhouse gases include carbon dioxide, methane and nitrous oxide.
Net zero emissions	The sum of anthropogenic greenhouse gas emissions to the atmosphere and anthropogenic removals of greenhouse gases from the atmosphere.

Australian Government

Industry Sector Plan

September 2025

Department of Industry, Science and Resources
Department of Climate Change, Energy, the Environment and Water

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Acknowledgement of Country

We acknowledge the Traditional Owners of Country throughout Australia and recognise their continuing connection to land, waters and culture. We pay our respects to their Elders past and present.

Contents

Ministerial foreword

As the world economy decarbonises, the Albanese Labor Government is focused on backing a revitalised manufacturing sector in a more productive, more resilient, and more diversified Australian economy, consistent with a Future Made in Australia.

Australia has all the critical and strategic mineral resources that the future global industrial economy requires, vast wind and solar resources, the advantages of our geography and a skilled and resilient workforce. The challenges of a changing geostrategic landscape and the global shift to lower emissions require an ambitious plan to back Australian industry.

The Industry Sector Plan sets a path to net zero emissions for Australia’s industrial and waste sectors in a way that leverages Australia’s advantages, recognises the challenges, and drives international competitiveness.

Some parts of existing industry will reduce emissions by using less carbon-intensive energy sources. For some sectors electrification will be key, allowing them to take advantage of cheap electricity from wind and solar backed by batteries. Hard-to-abate sectors, like those requiring high heat or chemicals manufacturing firms, will continue to use natural gas where production processes require. For some of these sectors a move to green hydrogen, when it is affordable, will be possible. Investments to improve energy efficiency and change production processes will also drive emissions down. There is also significant opportunity to kickstart new industries like green iron, which take advantage of Australia’s resources and energy endowments.

A decade of underinvestment in the energy grid has left Australia’s industrial sector vulnerable. Despite being a leading global exporter of LNG, Australia’s energy system, and in turn industry, is exposed to international gas price shocks. A lack of energy policy certainty through 22 discarded energy policies prior to 2022 has seen corporate underinvestment in new and emerging technologies, including renewable energy infrastructure and new production processes. While it is an imperative to reduce carbon emissions to ensure we mitigate the worst impacts of climate change, it does not mean the pathway will be linear or without challenges.

This plan recognises the significant challenges Australian industry faces and will continue to face as it decarbonises. For some sectors, abatement technology either does not exist or is too expensive, and all industry is dealing with pressures on the cost of energy. Effective policy and joint effort between governments, industry and unions will be vital to ensuring we meet these challenges in the national interest.

The government is undertaking major structural reform to address the energy market pressures. The Gas Market Review, led by Minister Bowen and Minister King, which builds on the Future Gas Strategy, is examining long-term policy settings for Australia’s gas markets to drive affordable and secure gas and investment. The National Electricity Market wholesale market settings review, led by Minister Bowen, will unlock long term investment in Australia’s national energy grid to ensure affordability and reliability. Minister Watt has committed to reforming environmental approvals, which will help renewable generation and transmission projects get built sooner, while protecting Australia’s unique and invaluable environment.

In tandem, the Albanese Labor Government is making the most significant pro-manufacturing investment in Australian industry in the nation's history. This includes the Net Zero Fund, a new $5 billion sub-fund of the National Reconstruction Fund (NRF), that will draw from and refocus existing NRF capital. It will support major investments by large industrial facilities in decarbonisation and energy efficiency, and scale up manufacturing low emissions technologies. The remaining $10 billion of the NRF's capital will continue to drive investment in Australian firms to diversify and transform the nation's industrial base. In addition, the $22.7 billion Future Made in Australia agenda is further supported by the $1 billion in the new Green Iron Investment Fund to help Whyalla and other local manufacturers make iron using low or zero emissions energy.

In a changing global environment, we have the collective responsibility to ensure Australian industry remains competitive and is a critical contributor to Australia's economic future. A vibrant industrial and manufacturing sector is critical to creating and protecting good jobs in our regions and outer suburbs. The Albanese Labor Government is seized of this opportunity – backing Australian industry as a critical contributor to communities, workers, our economy and sense of national pride.

The Hon Tim Ayres
Minister for Industry and Science

The Hon Chris Bowen
Minister for Climate Change and Energy

Executive summary

As part of the Paris Agreement, Australia has legislated climate action goals in the Climate Change Act 2022, committing Australia to achieve net zero emissions by 2050. The Industry Sector Plan sets out pathways for the Australian industrial and waste sectors to meaningfully reduce direct greenhouse emissions and help businesses transition to net zero.

Australia's industrial sector is vital to the nation's economic strength and resilience. It now faces a pivotal transformation amid the global push towards net zero emissions. Traditionally reliant on fossil fuels, the sector must adapt to remain competitive. The transition away from fossil fuel use will be complex, requiring industries and government to work together to navigate evolving energy systems, competition for technology and changing markets. Adapting to address these challenges is fundamentally in Australia's economic interest, bringing new growth opportunities and supporting competitiveness in a decarbonising global economy. Decarbonising industry is also necessary to meet domestic climate commitments of 62–70% emissions reductions below 2005 levels by 2035 and net zero by 2050.

Securing and strengthening our existing industrial capability and seizing emerging opportunities in the clean economy will be vital to our Future Made in Australia. Capitalising on our advantages will revitalise our industrial base and ensure Australia remains globally competitive, while contributing meaningfully to the national net zero target. Australia has what is necessary to make this transition: abundant minerals and renewable energy resources, infrastructure, an experienced workforce and a world class research and innovation sector.

The Industry Sector Plan provides an overview of the pathway for how Australia's industry and waste sectors will contribute to meeting the 2030, 2035 and 2050 emissions targets. We created the plan using targeted and ongoing stakeholder engagement, which gave us important insights on opportunities for technology development.

The Industry Sector Plan has 3 principles:

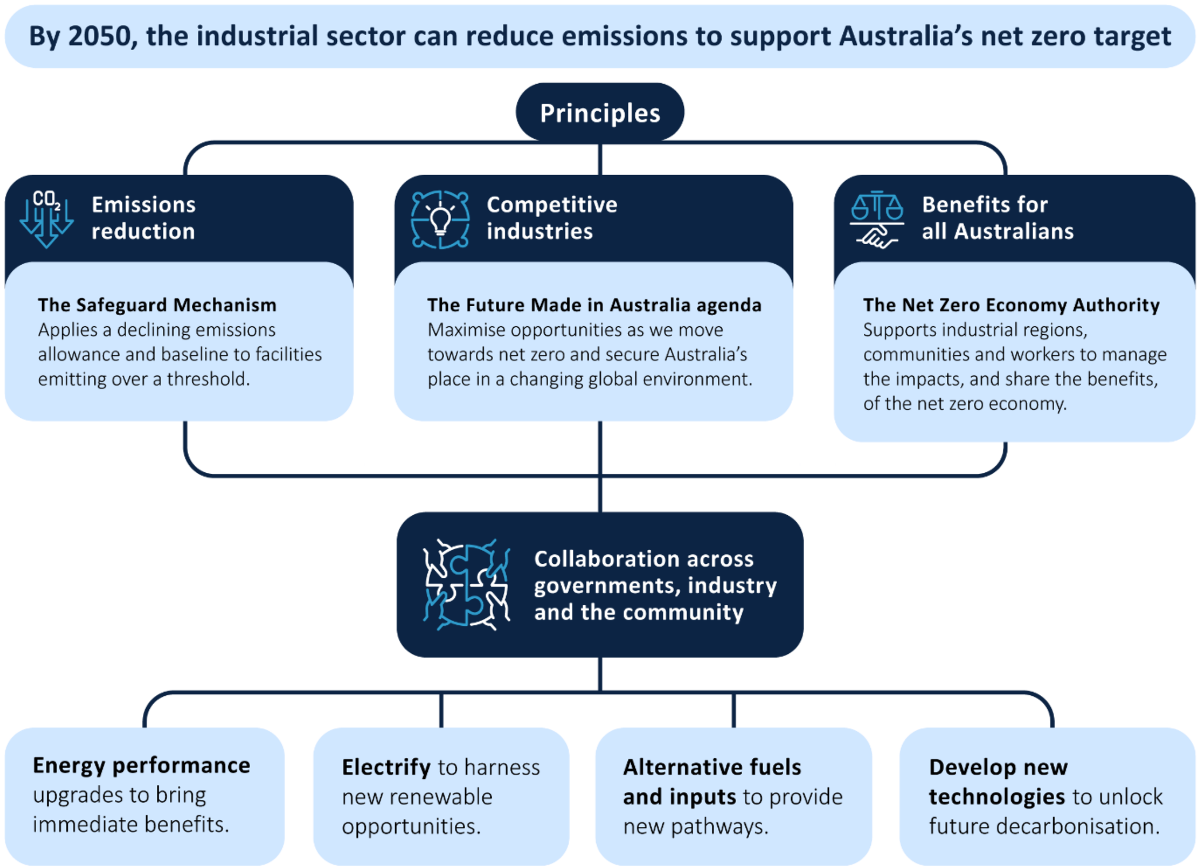
- meaningfully reduce emissions
- maintain and grow competitive industries
- deliver a just and equitable transition.

These principles lean on existing measures including the Safeguard Mechanism, the Future Made in Australia agenda and the Net Zero Economy Authority.

The Industry Sector Plan sets out a clear pathway towards net zero for industries. Optimising energy use through energy efficiency and demand flexibility upgrades will immediately help reduce industrial emissions. Electrifying many industrial processes is a critical next step, allowing businesses to reduce emissions by using renewable electricity. For processes that are unable to electrify now, scaled-up alternative fuels and inputs like hydrogen and bioresources will become available. Finally, coordinated efforts from Australia's world leading researchers, innovators, businesses and government will work to bridge technology gaps in sectors that rely on hard-to-abate, high-heat processes. Natural gas usage may still be required for sectors where no other alternatives exist, though abatement is possible through carbon management technologies.

The Australian Government acknowledges industry transition will take time and will need to align with the rollout of renewables and technology development. Heavy industries face compounding challenges that require coordinated efforts from governments and businesses to solve. Many of Australia’s manufacturing and heavy industry hubs are also foundational parts of local economies and communities. We need to carefully consider the social and regional aspects of the industrial net zero transition to ensure it is both equitable and effective. Community engagement and investment in regional workforces, including retraining and education, will win social license for decarbonising Australian industry. Delivering tangible benefits to Australian industry from decarbonisation will also increase community support.

Successfully decarbonising Australia’s industry and waste sectors will significantly benefit the nation, if we can coordinate, manage and balance the process’s ambition and feasibility. This Industry Sector Plan shows how public, private and community stakeholders can work together to reach net zero.



To 2030 Deploy existing opportunities and planning	• Safeguard Mechanism to drive abatement for large industrial emitters. • Accelerate deployment of commercial abatement technologies and grow industry knowledge and awareness to build momentum • Plan and begin action on the key enablers required for net zero
To 2035 Widespread adoption of existing technologies and commercialise new technologies	• Widespread deployment of commercially available net zero technologies such as energy performance upgrades and electrification. • Heavy industries expected to deploy technologies at scale, enabled by the buildout of the renewable grid and driven by the Safeguard Mechanism. • Trials and commercialisation of new technologies, and the scale up of enablers and alternative inputs such as hydrogen and alternative fuels to progress at pace
To 2050 Net zero and new market opportunities	• Significant emissions abatement from across all industry supported by the successful delivery of key enablers and technology developments. • Growth of new industry opportunities in green metals, green chemicals, clean energy manufacturing and other areas of comparative advantage. • Safeguard Mechanism drives abatement to net zero which may include use of carbon management technologies for residual industrial emissions.

Figure 1: Industry Sector Plan overview

Introduction

Australia's industrial sector is more than just a producer of goods – it is a foundation for national economic health, international competitiveness and long-term sustainability. Its growth supports jobs, drives exports and underpins infrastructure, making it essential to Australia's prosperity. The world is undergoing the biggest and fastest economic transformation since the industrial revolution. Australia must use its strengths to develop competitive, diverse, higher-value industrial businesses.

The Industry Sector Plan covers 9 subsectors that represent Australia's manufacturing and waste sectors:

- alumina and aluminium manufacturing
- waste and resource recovery
- iron and steel manufacturing
- chemicals and plastics manufacturing
- cement and concrete production
- food and beverages manufacturing
- manufacturing and additional industries
- pulp, paper and paperboard manufacturing
- other metals refining and smelting.

Appendix B contains overviews of each subsector.

This plan highlights areas of greatest opportunity and need for decarbonisation. It also discusses those that the economy's transition to net zero will affect the most.

The plan primarily focuses on the decarbonisation of scope 1 (direct) emissions from industrial and waste sectors. Figure 2 shows the 9 industrial subsectors' scope 1 emissions.

In 2024, the 9 industrial subsectors contributed 62 million tonnes of CO2-equivalent emissions, or 14% of Australia's net emissions.

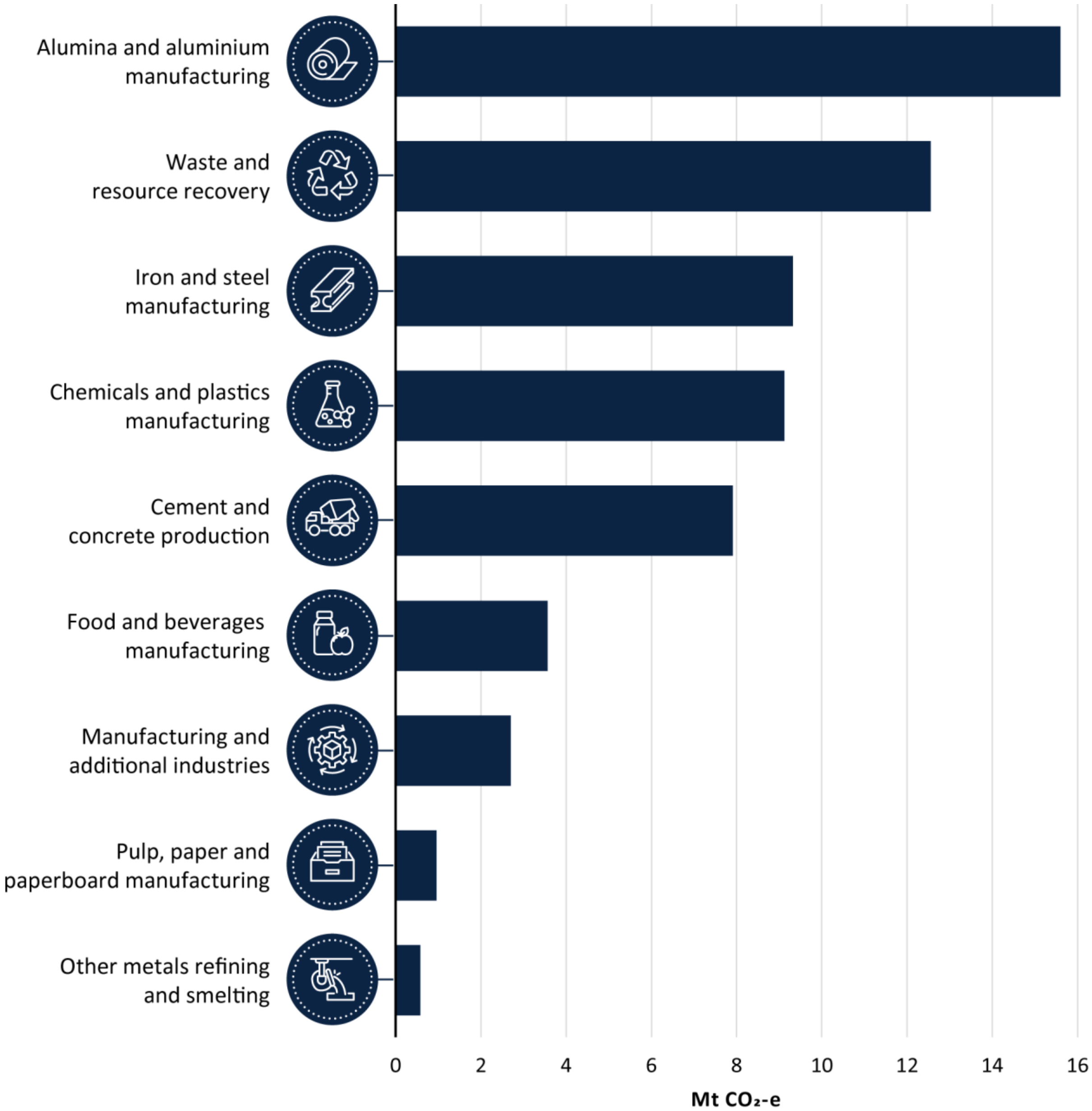


Figure 2: The 9 subsectors covered within the Industry Sector Plan and their associated scope 1 emissions in 2024 (in Mt CO2-e). 'Manufacturing and additional industries' include those in glassmaking, battery and clean energy technologies, and data centres (see Appendix B). The Industry Sector Plan refers to these 9 subsectors.

These 9 subsectors represent 120,000 Australian businesses that generated $205.8 billion in gross value added (GVA), the equivalent of 7.7% of GDP, in 2023–24. Australia's industrial sector provides over one million jobs, which is approximately 8% of Australia's total employment.

Australia's industrial sector represents 14% of the economy's scope 1 emissions (DCCEEW, 2025a). Of the 9 industrial subsectors, 5 represent almost 90% of industrial scope 1 emissions:

- alumina and aluminium
- waste and resources recovery
- iron and steel
- chemicals and plastics
- cement and concrete production.

Industrial facilities, particularly alumina and aluminium, steelworks and datacentres, are also large electricity and energy users.

Key activities that contribute to scope 1 emissions from industry include:

- Process heating emissions from the combustion of gas, coal and oil to create heat and energy for industrial activities. For example, alumina, steel and food and beverage manufacturing burn these fuels to generate heat for calciners, furnaces and boilers.
- Industrial processes that produce greenhouse gases because of the feedstock and reactions needed for their production. Traditional cement, iron and ammonia production rely on chemical reactions that produce greenhouse gases.
- Decomposing organic materials producing methane emissions that can escape into the atmosphere, such as from sewage, landfill and industrial wastewater.

The Australian Government has committed over $22.7 billion towards a Future Made in Australia. This agenda aims to maximise the economic and industrial benefits of the global net zero transition and secure Australia's position in the global landscape. The Industry Sector Plan is part of this effort.

We developed this plan through targeted engagement. We heard how many Australian industrial businesses, including large and export-focused businesses and forward-looking small and medium-sized businesses, are already taking steps towards net zero. This plan also uses findings from concurrent consultation processes including the Climate Change Authority 2024 Sector Pathways Review and the DISR Green Metals Consultation Paper.

In the immediate term, Australian industry is facing multiple significant challenges transitioning to net zero. These include global market disruptions driving volatile energy prices, limited opportunities to electrify in some sectors, aging infrastructure and intensifying competition in global markets. Sectors such as smelting, cement, glass, and ammonia production are particularly challenging to decarbonise. As Australia pursues the Future Made in Australia agenda and seeks to grow its manufacturing base, we must address these transitional pressures. This will ensure our long-term energy security, industrial competitiveness and economic resilience.

The most critical challenges are to efficiently deliver and use gas and electricity as industries move towards net zero, accelerate the rollout of renewable electricity and fill technology gaps for certain high heat industrial processes. Maintaining industrial competitiveness and capabilities during the transition period is equally important to set us up to achieve our net zero and Future Made in Australia ambitions. Alongside this plan, the Net Zero Plan and the Electricity and Energy Sector Plan explore these challenges and how industry and governments are addressing them.

Achieving the industrial net zero transition will be complex. It will need careful regional planning, a skills ready workforce and reliable and affordable access to renewable energy. It will also need significant capital investment. But decarbonising Australia's industrial sector presents opportunities that will benefit communities and the broader economy. The Industry Sector Plan sets out a way for community, government and industry to work together to achieve these opportunities: to reduce emissions, develop new export opportunities and promote economic growth.

The Net Zero Industry Sector Plan sets out a pathway around 3 principles:

Emissions reduction

An industrial sector that supports Australia's national trajectory to net zero by 2050 and meaningfully contributing to the 2035 target of 62–70% below 2005 levels emissions reduction.

Competitive industries

A competitive, diverse and higher value industrial sector supported by affordable energy to capitalise on Australia's comparative advantages.

Benefits for all Australians

Fit-for-purpose industry policies to ensure a just and equitable transition for our regions, businesses and workers.

The industrial decarbonisation opportunity

Emerging clean energy industries such as green metals and batteries will shape the future of global trade. By decarbonising the industrial sector, Australia has the opportunity to become an integral part of the global net zero economy.

Major economies such as the EU, UK and others are introducing carbon border adjustment mechanisms which will favour suppliers with low and zero-emission goods. The plan for industrial net zero transition includes investing in clean production methods like green metals (iron, steel, alumina and aluminium) and renewable hydrogen. As we transition to net zero, Australian industry will have the opportunity not only to maintain market access but to secure new trade opportunities. Our transition gives us the chance to become a global leader in clean industrial exports and contribute to global and regional decarbonisation efforts.

Green metals are a central component of the Future Made in Australia agenda. Conventional production of steel and aluminium is highly emissions intensive, particularly for iron and steel, which contribute to 8% of all global emissions (IEA, 2023a). The global and domestic energy transition will need significant quantities of green metals. Studies have suggested that Australia's green metals opportunity can be worth tens to hundreds of billions by mid-century (TSI, 2025; Grattan, 2020; Accenture, 2023). Australia is well placed to become a competitive producer of green metals. By investing in local production and using our natural and renewable resources, skills, and world class research, we can play a pivotal role in decarbonising global metals supply chains.

Decarbonisation also enhances Australia's industrial resilience and global reputation. It can encourage innovation, attract investment and create new jobs in emerging sectors such as clean technology and renewable energy. By embracing net zero, Australian industry not only reduces emissions but also builds a more modern, competitive and productive economy.

Upgrading to energy-efficient technologies, automating systems and adopting cleaner production methods can improve productivity by streamlining operations, reducing waste and improving efficiency. Transitioning to renewable energy and diversified energy sources can reduce exposure to global fossil fuel price shocks and disruptions. These improvements can make industrial processes and operations more agile and resilient in the face of economic risks. Industries also face risks arising from climate change though there are opportunities to strengthen industry adaptation and resilience as explored under the National Climate Risk Assessment and the National Adaptation Plan. Australian industry can strengthen its ability to adapt, compete and thrive in a rapidly changing global landscape.

Pathway to 2050

Economic modelling and analysis by Treasury explores 3 scenarios of Australia's transition to net zero by 2050 (Treasury, 2025). This work informed the Australian Government's Net Zero Plan and sector plans and includes potential economy-wide and sector-specific emissions reductions pathways. Treasury modelling provides useful insights on the potential cost-effective timing, sequencing and size of sectoral contributions to the economy-wide emissions reduction task. The Treasury modelling and analysis serves as part of the evidence base for potential decarbonisation pathways for the Industrial sector.

In this section, we refer to the Baseline Scenario, in which Australia efficiently builds on existing climate policies and trends to achieve its net zero targets. The Treasury's Baseline Scenario illustrates a cost-effective pathway for the industrial sector to contribute to reaching Australia's net zero goal.

Treasury's Baseline Scenario projects that emissions from Australia's industrial and waste sector will reduce from 61 Mt CO2-e in 2025 to 32 Mt CO2-e in 2050. Investments in abatement technologies are expected to be a significant driver for this emissions reduction. These technologies include electrification and adoption of less emissions-intensive production processes, which are projected to reduce emissions intensities across the sector by 72% by 2050. Emissions from waste remain a small but persistent source of emissions. Abatement through methods such as landfill gas capture is expected to reduce emissions in the sector by 2.5 Mt CO2-e by 2050.

This modelling projects that Australia will be able to maintain (and in some cases, expand) its existing industrial capabilities. However, the decarbonisation of Australian industries will not be straight forward. Navigating a pathway to net zero will need careful coordination and planning between governments and the private sector. Treasury's Baseline Scenario presents a case where we have successfully achieved this transformation.

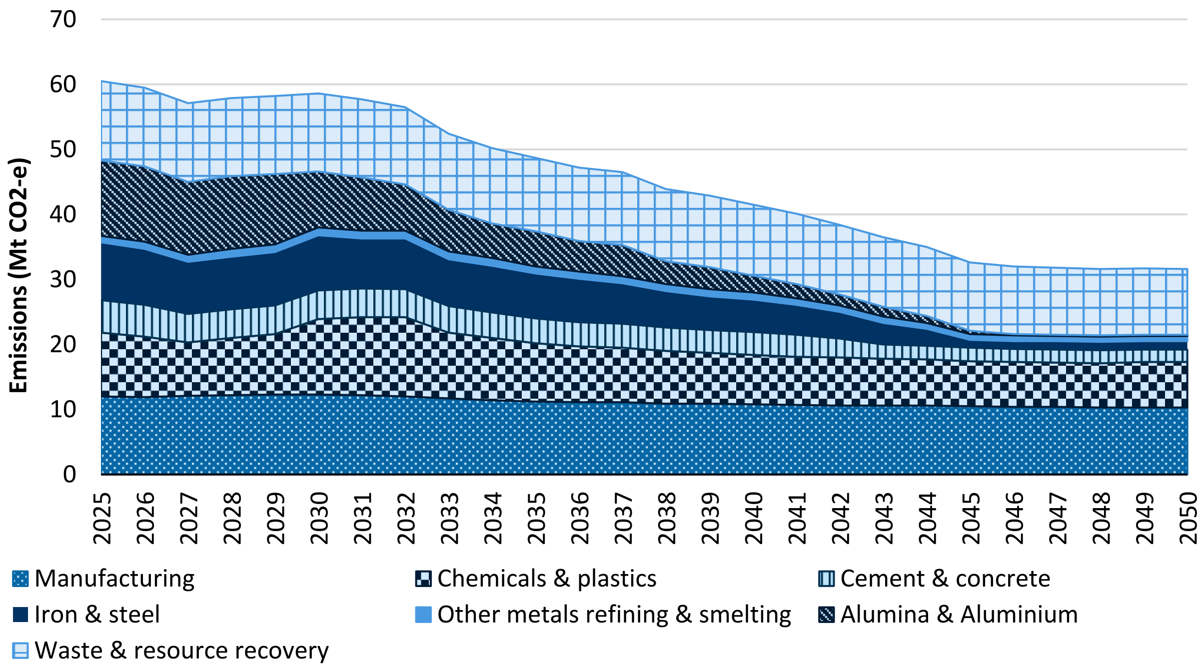


Figure 3: Projected scope 1 emissions for the industrial subsectors Baseline Scenario. Note that manufacturing in this figure includes the subsectors: food and beverage, pulp, paper and paperboard, and manufacturing & additional industries. Source: Treasury modelling (Treasury, 2025).

Treasury's modelling suggests that the industrial pathway to net zero at 2050 could occur in the following phases:

Near term (to 2030): Emissions reductions will largely come from facilities covered by the Safeguard Mechanism deploying commercially available abatement options such as energy efficiency upgrades, electrification where possible, fuel switching from coal to gas and use of alternative fuels. Support measures such as those from the Powering the Regions Fund can help these reductions in emissions intensity.

Medium term (to 2035): The Future Made in Australia agenda supports the iron, steel and alumina sectors to adopt cleaner manufacturing processes as the necessary technologies become available. This transition depends on having access to the necessary renewables and grid infrastructure. It will also rely on scaling up alternative feedstocks such as hydrogen and alternative fuels (see the Electricity and Energy Sector Plan for details). The Safeguard Mechanism will continue driving down emissions for large facilities. Other industrial subsectors will also continue their transition towards net zero, gradually adopting electrification and other abatement technologies as they become commercial and competitive.

Longer term (to 2050): Targeted intervention, including through the Safeguard Mechanism and Future Made in Australia agenda, can potentially reduce emissions from the ammonia, iron and steel, and alumina and aluminium sectors to 5 Mt CO_2-e of emissions, down from 25 Mt CO_2-e in 2025. Overall industry emissions are projected to decline, though residual emissions remain at 2050. Natural gas usage for the industrial sector is likely to decline but will remain part of the energy mix. Gas will continue to play a role in high heat industrial uses, as a feedstock for industrial products and for sectors where it is difficult to fully decarbonise due to technology limitations. As alternative fuels and technologies scale up and become competitive, these users can transition through options such as renewable electricity and hydrogen. Where natural gas remains in use, carbon management technologies will be a potential abatement option.

While scenario-based analysis is a powerful tool in helping inform Australia's net zero pathway, it is not possible to precisely predict the transition. The future is uncertain, and many factors will influence the net zero transition, including changes in technology, global dynamics and community responses.

Actions we can take now

The Australian Government has set an ambitious and achievable emissions reduction target for Australia of 62–70% below 2005 levels in 2035. A strong foundation of Commonwealth policies and initiatives encouraging decarbonisation across the economy will underpin emissions reduction in the industry and waste sectors. These initiatives provide the direction, funding and market mechanisms that support the transition to low-emissions technologies and practices.

Complementing this, state and territory governments play a critical role in reducing emissions through regionally-tailored regulatory settings, planning systems and infrastructure development. Together, all governments can coordinate to support meaningful progress towards reducing industrial emissions while ensuring the continued growth and resilience of our industrial base.

The industry and waste sector can meaningfully contribute to Australia's 2035 target and in many instances can act now. For industrial facilities that use low heat processes, immediate decarbonisation opportunities include using commercial technologies such as heat pumps and electric boilers where there is access to electricity, as well as improving energy performance. Others will need to use new technologies or alternative feedstocks and supply chains.

The Safeguard Mechanism is driving momentum

The Safeguard Mechanism gives industry the clearest and most direct signal to reduce emissions in line with Australia's climate targets. It applies a declining emissions baseline to facilities emitting more than 100,000 tonnes of CO2-e a year and covers approximately 56% of industrial sector scope 1 emissions. The Safeguard Mechanism supports long-term investment certainty and operational planning as well as encourages investment in commercially viable abatement technologies and alternative inputs. See the Net Zero Plan for more information on the Safeguard Mechanism.

The Safeguard Mechanism will continue to be the main framework for industry facilities to adopt decarbonisation technologies, particularly for heavy industrial facilities. The 2023–24 Safeguard Data Insights from the Clean Energy Regulator shows that Safeguard facilities are already reducing their emissions, abating 2.7 Mt CO2-e in the first year of operations of the reformed scheme (CER, 2025a). The Safeguard Mechanism can incentivise the uptake of technologies in the near to medium term. These include electric boilers for alumina refining, alternative fuels for cement production, tertiary abatement catalysts for chemicals and improvements to blast furnaces for ironmaking.

Capitalising on Australia's opportunities

The Australian Government is creating a positive investment environment through A Future Made in Australia. This environment lets industry, government and investors share the risks and rewards of investing in clean, low-emissions industries such as green metals production and battery manufacturing. To support the net zero transformation of existing industries and the growth of new industries, the Australian Government has announced over $22.7 billion to promote industrial development where Australia has comparative advantages. This positions Australian industry to compete in a global net zero economy.

A Future Made in Australia is underpinned by a robust National Interest Framework which will ensure significant public investments incentivise private investment at scale. Government support is in 2 streams:

- The Net Zero Transformation Stream for industries that will make a significant contribution to the net zero transition and are expected to have an enduring comparative advantage.
- The Economic Resilience and Security Stream for industries that are necessary for domestic economic resilience and require the encouragement of public funding.

To unlock this opportunity, the Australian Government has introduced several funding initiatives:

- Green Iron Investment Fund: A $1 billion fund to support early movers in establishing commercial-scale green iron facilities that use lower emissions technologies such as direct reduction using gas or hydrogen. Up to $500 million of this fund will be used the help support the Whyalla transformation.
- Green Aluminium Production Credit: A $2 billion initiative to support aluminium smelters to transition further to renewable electricity, helping position Australian aluminium as some of the greenest in the world.
- Future Made in Australia Innovation Fund: A $1.5 billion fund that includes $750 million to support the new technologies needed for green metals through pilot and demonstration projects, and early-stage development.
- Battery Breakthrough Initiative: A $500 million fund to strengthen economic resilience and critical battery manufacturing capabilities, particularly those for high-value battery products in Australia's areas of competitive advantage.
- Green Metals Innovation Network: A $10 million network run by the CSIRO in collaboration with the Heavy Industry Low-carbon Transition Cooperative Research Centre, which brings together research, government and industry to address key technical and economic challenges for green metals.

The Australian Government is also funding co-contributions to capital investment and providing attractive financing options through initiatives to support decarbonisation and low-emissions technologies. The $15 billion National Reconstruction Fund (NRF) finances investments in priority areas like renewables and low emissions technologies to support early-stage startups, growth-stage companies and mature businesses. The Net Zero Fund will be a new $5 billion sub-fund of the NRF to support major investments by large industrial facilities in decarbonisation and energy efficiency, and scale up manufacturing low emissions technologies. The Net Zero Fund will buttress and modernise domestic industrial capability. The funds will be drawn from existing NRF capital and will be a refocusing of the NRF's priorities. The Powering the Regions Fund will continue to support a range of decarbonisation investments in Australian industry through:

- the $600 million Safeguard Transformation Stream (STS)
- the $400 million Industrial Transformation Stream (ITS)
- the $400 million Critical Inputs to Clean Energy Industries (CICEI) programs.

The STS and ITS will open new rounds soon. The Australian Government will continue to consider the needs, resourcing and priorities of the fund over time in light of program priorities, the Net Zero Plan and this sector plan.

The Clean Energy Finance Corporation's Rewiring the Nation program further supports industrial decarbonisation through electrification and renewables. Rewiring the Nation provides low-cost finance to expand, modernise and connect renewables to Australia's electricity grid – particularly transmission lines and renewable energy zones. This enhanced grid infrastructure allows large-scale renewable energy generation to reach industrial centres, supporting the shift towards renewable electricity. The Capacity Investment Scheme provides a long-term revenue-underwriting framework that lowers investor risk for new renewable generation and firming resources (like battery storage). The National Electricity Market wholesale market settings review will further help to deliver reliable, competitively priced and secure electricity services. Together, these initiatives allow industries to electrify processes, reduce exposure to volatile fuel markets and adopt renewables at scale – making meaningful, practical industrial decarbonisation achievable. Some important technologies that these measures can enable include deployment of heat pumps and electric boilers.

The Future Gas Strategy and National Hydrogen Strategy are vital pillars to Australia's industrial decarbonisation by supporting the scale up and adoption of alternative fuels and inputs. The Future Gas Strategy outlines how gas can support the transition towards renewable energy, especially where electrification is not yet viable. Consistent with Future Gas Strategy, the Gas Market Review will examine existing government policies and ensure sufficient gas supply in the longer term. Switching from coal to gas is also an important transition step for industries to reduce their emissions before alternative lower emission inputs and technologies become available.

Renewable hydrogen is critical to industrial decarbonisation for key subsectors. The National Hydrogen Strategy will guide Australia's production, use and export of hydrogen. The Australian Government's Hydrogen Headstart program and Hydrogen Production Tax Incentive helps catalyse renewable hydrogen and clean energy industries. These strategies and supporting measures are particularly important for industries that require renewable hydrogen such as green iron and green ammonia production.

Green industries that are supported by the Future Made in Australia investments help deliver a stronger Australian economy. As the global economy decarbonises, existing Australian fossil fuel exports will decline. Clean industries could offset the loss of fossil fuel export revenue. In Treasury's Renewable Exports Upside Scenario, export revenue from green commodity sectors is projected to reach $178 billion in 2050, provided there is effective coordination, strong ambition and steady technological progress.

States and territories

Australian governments are increasingly aligning their efforts to coordinate industrial decarbonisation, recognising the need to reduce emissions from hard to abate sectors while maintaining economic competitiveness. All governments are working together to develop and deploy low-emissions technologies, including renewable hydrogen, carbon capture and storage, and electrification of industrial processes. This coordination is critical to ensuring regulatory consistency, supporting shared infrastructure investments and planning the industry transition across jurisdictions.

Australian states and territories are actively developing and implementing strategies, legislation and roadmaps to reduce emissions and support the industrial transition. The state and territory governments are working in close alignment with Australia's ambitious and achievable target of net zero by 2050. All governments are collaboratively advancing Australia's industrial decarbonisation through the National Transformation Principles. These underscore a shared commitment to a fair and inclusive transition, emphasising place-based approaches, First Nations partnerships and regional economic diversification. This collaboration is exemplified through the National Energy Transformation Partnership, the Capacity Investment Scheme and Renewable Energy Transformation Agreements.

Pathways to decarbonisation

Immediate decarbonisation opportunities are available for industrial facilities that use low heat processes. These facilities can use commercially available technologies such as heat pumps and electric boilers and optimise their energy efficiency. Industrial sub-sectors that use high heat will be on a slower decarbonisation trajectory. They will need new technologies or alternative feedstocks and supply chains to support their transition (Climate Change Authority, 2024). The 4 key areas of decarbonisation focus are:

1. Optimise energy use now to reduce costs

Energy performance upgrades to optimise energy use across the economy could achieve more than 13% of the emissions reductions needed to achieve net zero by 2050 (ANZ; EEC, 2024). It is particularly important for the industrial sectors (DCCEEW, 2024a) and is the first logical step in the decarbonisation pathway for all business in the 9 sub-sectors. Energy performance upgrades will deliver immediate benefits, are deployable now, and will help reduce the cost of future upgrades (IEA, 2025a).

Energy performance is also a pathway to modernise Australian businesses, improving competitiveness and productivity while reducing emissions (even in hard-to-abate sectors). Energy efficiency upgrades that use less energy to do the same job, is an ideal first step in the decarbonisation of industrial processes and can achieve immediate reductions in emissions and energy costs. For example:

- The use of heat recovery or thermal energy storage to reduce the amount of gas needed for process heat and to reduce emissions. Thermal energy storage systems can also help businesses better harness renewables and solar to further reduce operational costs (CSIRO, 2023).
- Upgrading old equipment such as pumps, refrigeration and hot water systems to improve efficiency. In addition to being more efficient, upgraded equipment typically operates more quickly, with more capacity for optimisation through the incorporation of digitisation and AI technologies. For example, a new air compressor helped a paint maker reduce electricity use by 23% (ANZ; EEC, 2024).
- Deploying smart technologies to help monitor and optimise manufacturing processes and energy use.

Many of these energy efficiency measures can be deployed now using commercial technologies that do not require costly whole of plant upgrades. Studies have shown that energy efficiency can deliver an average 11% per annum in energy savings, with some having a payback period of under one year (IEA, 2025b). The $56.7 million Energy Efficiency Grants for Small and Medium Sized Enterprises program supports businesses to upgrade or replace inefficient equipment and implement other energy efficiency activities. The program assists businesses lower their energy use and improve their energy efficiency.

Industries can also optimise energy through demand flexibility to better harness times of peak renewable generation where cost of electricity is low. Demand flexibility is discussed in further detail in the 'Enabling the Transition' section below as well as in the Electricity and Energy Sector Plan, but in summary, demand flexibility for industry includes:

- Adjusting processes to take advantage of time of use tariffs e.g. minimise production when renewable generation is low and maximise production when renewable generation is high.
- Use of energy storage such as batteries or electric thermal energy storage to load shift and reduce industrial demand on the grid in times of low renewable generation.

Box 1: Orora Glass – World leading efficiency for its glass furnace

Orora is a provider of packaging solutions for the beverage industry, including glass bottles and aluminium cans. As part of its sustainability actions, Orora has recently commenced operation of its upgraded oxyfuel furnace for its wine glass furnace at its site in Gawler, South Australia. This upgrade was supported by federal grant funding under the Modern Manufacturing Initiative and moves the Orora glass furnace into the 10% most energy efficient furnaces worldwide (Orora, 2025).
By removing nitrogen and heating a mix of oxygen and natural gas, the new oxyfuel furnace is reducing emissions from CO2 by 25% and nitrogen oxides by up to 80%, all while enabling a furnace energy reduction of up to 30%.

Enabling upgrades to optimise energy use

Many industry sector businesses do not understand where, when, and how they use energy. Improving business awareness of their energy use is therefore a crucial first step to help them to identify where they need to focus investment to optimise energy use. Business can gain insights about their energy use through monitoring or metering systems or by engaging an energy auditor to help inform their upgrade opportunities. The Australian Government is investing in the development of the National Energy Performance Strategy, which will provide a long-term framework to coordinate and accelerate actions to improve energy performance. This includes assisting businesses and industry overcome barriers to energy performance, including a lack of awareness of benefits and lack of in-house skills.

For demand flexibility, some industries are already actively participating, often through agreements with retailers. However, widespread demand flexibility from industry is currently limited by financial risk, high set-up and operational costs, and lack of revenue certainty (Nelson, Conboy, Hancock, & Hirschhorn, 2025). These issues make it difficult for businesses to assess their opportunities to engage and invest accordingly. The National Electricity Market Wholesale Market Settings Review panel is looking to investigate solutions to address these barriers and encourage more demand flexibility participation.

2. Electrify processes where possible

Electrification, which replaces processes that use fossil fuels with electric equivalents that can be powered by renewable energy, is a primary pathway for decarbonisation for industries. There are electrification opportunities across a range of subsectors, including in food and beverage manufacturing, green alumina and green steel production. Electrification of industrial processes also helps reduce gas use in the electrified industry sectors, freeing up gas supplies for industries that do not yet have viable alternatives. Promising electrification technologies include:

- Heat pumps to replace gas heating for low temperature processes in food & beverages. Heat pumps use electricity and refrigerants to more efficiently deliver heat and can be over 4 times more efficient than traditional gas boilers (DCCEEW, 2023).
- Electric boilers to replace coal and gas boilers, particularly for alumina digestion which is a significant source of industrial emissions. Electric boilers likely need to be coupled with low-cost renewable energy to be economically viable (Deloitte; ARENA, 2022).
- Electric Smelting Furnace (ESF) for example in Pilbara ironmaking. This electrification technology helps remove impurities and will enable green steelmaking using Australian Pilbara ore. It is currently in pilot phase (BlueScope, 2024) (Fortescue Metals, 2025).

While electrification may require higher up-front capital costs, they can provide operational benefits including improved energy efficiency, better ability to integrate digital technologies, and productivity improvements. Electrification technologies can also take advantage of on-site solar or battery assets to reduce the need to purchase electricity from the grid, helping to reduce energy costs and mitigate potential grid capacity limitations or other constraints. For example, heat pumps typically have higher capital costs than the gas-fired boilers they replace, but they are highly efficient and can deliver operational cost savings for a potential payback period of under 3 years if implemented appropriately (A2EP, 2022). See Box 2 below.

Box 2: 3 Ravens Brewery – Benefits from electrification

3 Ravens is a craft Brewery located in the northern suburbs of Melbourne that has moved to 100% electric operations. In 2020, they installed a cool roof and 74 kW of solar PV, this saved energy and improved temperature management. In 2023, they partnered with Regenerate Engineering and A2EP to improve efficiency and minimise waste (3 Ravens, 2025). A CO2 chiller heat pump was also installed, supported by funding from the Australian Renewable Energy Agency (ARENA) and can operate in different modes depending on the heating or cooling required (Future Heat, 2023). A thermal battery and upgraded distribution systems were also added. Because of these electrification upgrades, 3 Ravens now produce 84.78% of their own electricity, and can brew 4 times more beer without increasing energy use (3 Ravens, 2025).

Enabling electrification

Reliable access to appropriately priced, firmed renewable energy is needed to underpin industrial decarbonisation, and electricity supply will need to double or triple from current levels by 2050 to meet demand and enable uptake of electrification technologies (Climate Change Authority, 2024).

Significant private investment from networks and renewable developers will also be crucial as governments will not be able to deliver the grid transformation alone. The Electricity and Energy Sector Plan outlines a framework to deliver sufficient renewables to support industrial decarbonisation (further detail in the ‘Enabling the transition’ section). The Powering the Regions Industrial Transformation Stream supports a range of industrial decarbonisation solutions relating to electrification, energy efficiency, low emissions processing and fuel switching.

3. Switch to alternative fuels and inputs

Industrial facilities can also consider adopting alternative fuels and inputs such as low carbon fuels, renewable gases, and other alternative inputs which can reduce emissions when other electrification options are not viable, such as in chemical production, ironmaking, and cement production. Many alternative fuels and inputs are key drivers for new economic opportunities. For example, the production of renewable hydrogen, supported by the Future Made in Australia agenda, is a key input to produce green iron and green ammonia, both of which are significant future clean export opportunities. Increased adoption of circular economy practices and the sustainable use of bioresources represent other areas of opportunity and innovation. A selection of alternative fuels and inputs are highlighted in Table 1.

The use of alternative inputs such as the adoption of inert anodes in aluminium smelting or a switch to lower global warming potential refrigerants, will also be needed to reduce emissions from synthetic greenhouse gases. Abatement options for synthetic greenhouse gases are examined in further detail under the Net Zero Plan and the Built Environment Sector Plan.

Table 1: Alternative fuels and inputs, their applications, and actions to support their deployment

Alternative fuel/input	Applications	Current actions and future steps
Natural gas Natural gas can replace coal as a transition fuel in some applications to reduce emissions intensity, though it will not be able to eliminate emissions.	Substitute for coal to deliver process heat (alumina, cement, etc.), replace coal as a reducing agent for ironmaking (gas-based DRI)	Gas market tightness is likely to impact gas supply and prices. The Future Gas Strategy outlines the Australian Government’s plan for managing these challenges and the current Gas Market Review will identify improvements to ensure sufficient gas supply in the longer term.
Hydrogen Hydrogen can be produced using renewable electricity and can be a clean alternative to gas and coal	Feedstock (ammonia), chemical reactant (direct reduced iron), fuel source for high temperature applications (alumina calcination)	The National Hydrogen Strategy 2024 provides the framework to position Australia as a global hydrogen leader. The Hydrogen Production Tax Incentive and the Hydrogen Headstart program are helping to increase availability and affordability of hydrogen as the industry scales. The Australian Government has also invested more than $500 million to support and co-fund common infrastructure investments and the formation of hydrogen hubs in regional Australia. Hydrogen is a key priority of the Future Made in Australia agenda, and in decarbonising many industries.
Bioresources Bio-derived fuels and inputs from agricultural waste, forestry residue, and waste-water treatment that can substitute fossil fuels	Process heat (biogas, biomass, biomethane), electricity generation (bagasse), feedstocks (biomethane for chemicals)	The cost and sustainability of bioresources can vary. Access and distance to bioresources are key factors. Bioresources are enablers for the sector plans. ARENA released Australia’s Bioenergy Roadmap in 2021, which highlights the potential for Bioenergy in Australia. Modelling shows that bioenergy has the potential to provide up to 20% of Australia’s total energy consumption by the 2050s. (Enea, Deloitte, ARENA, 2021)

Alternative fuel/input	Applications	Current actions and future steps
Circular Economy Resource recovery and reuse at end-of-life to turn waste materials into manufacturing inputs	Material recycling (scrap metals, plastic waste), waste recovery (mineral carbonation), process heat (biogas from waste treatment)	Supply chains and regulations for circular economy activities can take time to develop but Australia is progressing its circular economy transition through embedding principles into programs and policies. Australia's Circular Economy Framework provides the blueprint for prioritising national action through supporting material recovery and domestic reprocessing across industrial sectors. The Government has committed to doubling Australia's circularity by 2035, which is anticipated to reduce greenhouse gas emissions by 14% in the same timeframe.
Low carbon building materials Additives and alternatives to building materials that traditionally have high emissions	Supplementary cementitious materials (blast furnace slag to substitute clinker), new materials (geopolymers)	Only certain cement types can be used in concrete under the relevant Australian standard for concrete. This inhibits the uptake of lower emission technologies in Australian cement production and use. Updates in Australian Standards and regulations and promoting market adoption will help increase the use of low carbon building materials.

Box 3. Alternative industrial process heat option through concentrated solar thermal

Mars Petcare in Wodonga, Victoria, has installed a $39.3 million Solar Thermal Plant with the aid of a $17.2 million grant from ARENA. The 18-megawatt Parabolic Trough Concentrated Solar Thermal (CST) plant will provide up to 10 hours of thermal energy storage for cooking pet food (Mars, 2024). The project is expected to reduce their total natural gas consumption by over 50%, leading to an annual carbon reduction of up to 4,000 tons (ARENA, 2025). The CST plant uses mirrors to concentrate sunlight to produce thermal energy, the heat is then captured and stored and can be dispatched on demand for a wide range of industrial process heat applications.
CST combines with electrical thermal energy storage (eTES) systems to displace gas for steam-based manufacturing processes.

4. Invest in technology opportunities to support the transition

All subsectors have technology opportunities that are deployable now, though additional technologies are required for most subsectors to reach net zero. This is especially the case for hard to abate industrial processes due to high process temperature requirements and complex production processes. New technologies and innovations will be important for subsectors such as iron and steel, aluminium and alumina, cement and chemicals. Some potential decarbonisation technologies by subsector are listed in Table 2.

Table 2: Potential deployment timeframes for a selection of emissions reduction opportunities in each subsector in the near, medium and long term. Technology pathways will vary by facility.

Subsector	Near term (by 2030)	Medium term (by 2035)	Longer term (by 2050)
Alumina and aluminium	• Double digestion	• Thermal energy storage • High temperature heat pumps • Electric boilers • Mechanical vapour recompression • Steam recovery	• Electric/Hydrogen calcination • Inert anodes
Cement and concrete production	• Alternative fuels • Supplementary cementitious materials	• Design and concrete innovation • Geopolymers	• Electrification of high temperature thermal processes* • Carbon management tech
Chemicals and plastics	• Tertiary abatement catalysts • Waste heat recovery • Introduce renewable hydrogen for ammonia	• Biotechnology*	• Zero emissions renewable hydrogen feedstocks
Food and beverages	• Food waste avoidance • Electric/biomass/biogas boilers • Heat pumps	• High temperature heat pumps • Further electrification	• Continued adoption
Iron and steel	• Electric Arc Furnace • Gas-based DRI • Blast-furnace partial mitigation • Increase scrap steel use • Alternate feedstocks (biochar)	• Beneficiation and pelletisation • Electric Smelting Furnace • Hydrogen/gas mix DRI	• Hydrogen-based DRI • Hydrogen plasma smelting* • Molten Oxide Electrolysis* • Flash ironmaking*
Manufacturing	• Process optimisation • Alternative fuels	• Continued adoption of process optimisation and alternative fuels	• Technologies currently in early stages of development
Metals refining and smelting	• Energy and materials efficiency	• Electric smelters	• Technologies currently in early stages of development

Subsector	Near term (by 2030)	Medium term (by 2035)	Longer term (by 2050)
Pulp, paper and paperboard	• Bioresources • Electric boilers	• See common opportunities	• Continued adoption
Waste and resource recovery	• Gas capture and use • Diversion of organic waste	• Biogas and biomethane production • Biotechnology	• Continued adoption
Common opportunities	• Circular economy • Energy performance • Onsite renewables • Use of lower GWP refrigerants • Process optimisation • Material substitution	• Further electrification • Electric thermal energy storage (e-TES) • Further development of new low GWP alternatives • Optimisation via AI	• Alternative fuels, including hydrogen • Carbon management tech • Technologies currently in early stages of development

*Potential breakthrough technologies that are in earlier stages of development

Research and development and technology innovation

Australia is an established global leader in world-class research and science excellence. There are a range of measures to support the development of technologies and innovations required to help industries reach net zero.

Commonwealth agencies such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO) play a vital role in accelerating the development of technologies and innovation. This includes work from the CSIRO energy mission to lead the development of technologies and knowledge creation that drive low-cost electrification and decarbonisation of our major industries and exports. CSIRO's research infrastructure is critical in this role, providing world class facilities to deliver on Australia's science ambitions and support collaboration across research, industry and community sectors.

Australian Government programs funded through ARENA offer critical support towards industrial decarbonisation research, development, commercialisation and uptake. To support the net zero transition, the $1.5 billion Future Made in Australia Innovation Fund provides grant funding to support pre-commercial innovation, demonstration and deployment of renewable energy and low emission technologies across green metals, clean energy technology manufacturing and low carbon liquid fuels. The $40 million National Industrial Transformation Program supports industrial decarbonisation projects targeting investment in electrification, fuel switching or energy efficiency, or critical enabling infrastructure. Support ranges from feasibility stage projects through to demonstration and deployment stage projects.

Innovation and commercialisation are major levers to increase the commercial success of SMEs through differentiation and competitiveness. Research from the Industry Innovation and Science Australia showed medium-sized businesses have the highest rate of innovation-active businesses (at 71%) among Australian businesses, higher than large businesses (IISA, 2023). The Research and

Development Tax Incentive encourages companies to innovate by offsetting some of the costs of eligible R&D activities, which could include research and development focussed on decarbonisation of industrial processes. Up until 2023–24, over $7.5 billion of R&D expenditure was claimed under the Research and Development Tax Incentive by green metals related projects. The Australian Government's cooperative research centres (CRCs) foster high quality research partnerships between industry and research organisations to support the competitiveness, productivity, and sustainability of Australian industries. The Heavy Industry Low-carbon Transition (HILT) CRC is focussed on de-risking and accelerating the technology pathways to transition steel, iron, alumina and cement industries.

The Australian Government is also supporting the growth of enabling capabilities such as artificial intelligence (AI) and quantum technologies to enhance our ability to collect, collate, and analyse vast amounts of data. These digital insights can support the transition to green practices through improved energy utilisation, process optimisation and smart decision-making to boost productivity. Biotechnologies can also play a role, providing biobased substitute feedstocks for fossil fuels, see Box 4. These enabling capabilities have been identified as a priority area under the National Reconstruction Fund and is further supported through the National AI Capability Plan and the National Quantum Strategy.

The Strategic Examination of Research and Development builds on this to deliver an effective R&D system and increase the benefits of science, research and innovation for Australia. This includes getting more value from research investments, growing business investments in R&D, and leveraging our scientific strengths to address national priorities.

Box 4. Innovative biotechnology solutions to reduce emissions and plastics waste

Samsara Eco and Uluu are 2 Australian companies offering innovative biotechnology solutions to reduce the carbon intensity of plastic production by keeping materials in use for as long as possible (Samsara Eco, 2025; Uluu, 2024). Uluu produces biodegradable plastics derived from seaweed. Samsara Eco has developed novel enzymes to infinitely recycle plastics at scale.
Both manufacturing processes have a low carbon footprint as they rely on renewable resources and use lower temperatures compared to traditional methods. This results in reduced emissions through circular processes.

Enabling the transition

Industrial decarbonisation is not just a technical challenge; it is a complex transformation that demands focused attention on a range of key enablers. This includes tailored regional transition planning, securing social licence to operate, a skilled and adaptable workforce, reliable and affordable access to renewable energy, and sustained innovation in technology.

Our regions can be the driving force

The industrial net zero transition will have a profound impact on regional Australia, where much of the country's industrial activity takes place (see Figure 4). The heavy industry regions of Australia today were largely developed decades ago in response to proximity to large fossil fuel-based energy sources. As these industrial regions transition, it is important that industrial decarbonisation deliver real benefits to the people and communities of the regions in line with the guiding principles of the Australian Government's Regional Investment Framework.

Industrial transformation can create significant opportunities for regional revitalisation and economic diversification. Investing in modern onshore metal processing capabilities, for example, supports essential services within industrial ecosystems by connecting mines to end users of refined metals, leverages existing local resources and infrastructure and enables vertically integrated supply chains to make onshore manufacturing more resilient. These regional connections and supply chains are also important enablers for the decarbonisation of industries, particularly those that require alternative inputs such as bioresources (including biogas, biomethane and biochar), circular economy, and alternative fuels (see Table 1).

Existing industrial regions not only contain the smelters, refineries and facilities for a net zero economy and regional livelihoods, they also have the critical skilled workforce, land availability, local supply chains, and much of the required infrastructure including ports, rail and housing to attract new investments and projects such as green metals. Growing new industries and retaining our regional industrial capability and the communities and ecosystem that they provide for will be critical for Australia's industrial transformation and long-term economic resilience.

Future industries such as green metals may also require the development of new industrial regions. These locations will be dependent on the availability of renewable energy, nearby mineral/ore reserves, access to infrastructure, and future trade and industry opportunities, and community support for local industry development. With the right planning, enabling infrastructure and skills development, regional areas can play a pivotal role in Australia's net zero economy, ensuring the benefits of decarbonisation and emerging industries are widely shared and that communities traditionally reliant on emissions-intensive industries are not left behind. This consideration for communities is an important part of the Future Made in Australia agenda, as highlighted by the Community Benefit Principles to guide policy making and investment decisions.

The industrial transition will also cause significant changes to the local industrial infrastructure and business practices of large employers and will require community buy-in. Social licence and ongoing community support can be compromised through poor practices, leading to potential community backlash. Practices such as early and inclusive community consultation, benefits sharing, and job upskilling can maintain and increase social licence. As industries decarbonise, regional economies and their communities and workers will also face opportunities as well as risks. For example, communities that have traditionally relied on fossil-fuel based industries will also need a coordinated approach to retraining and reskilling the local workforce.

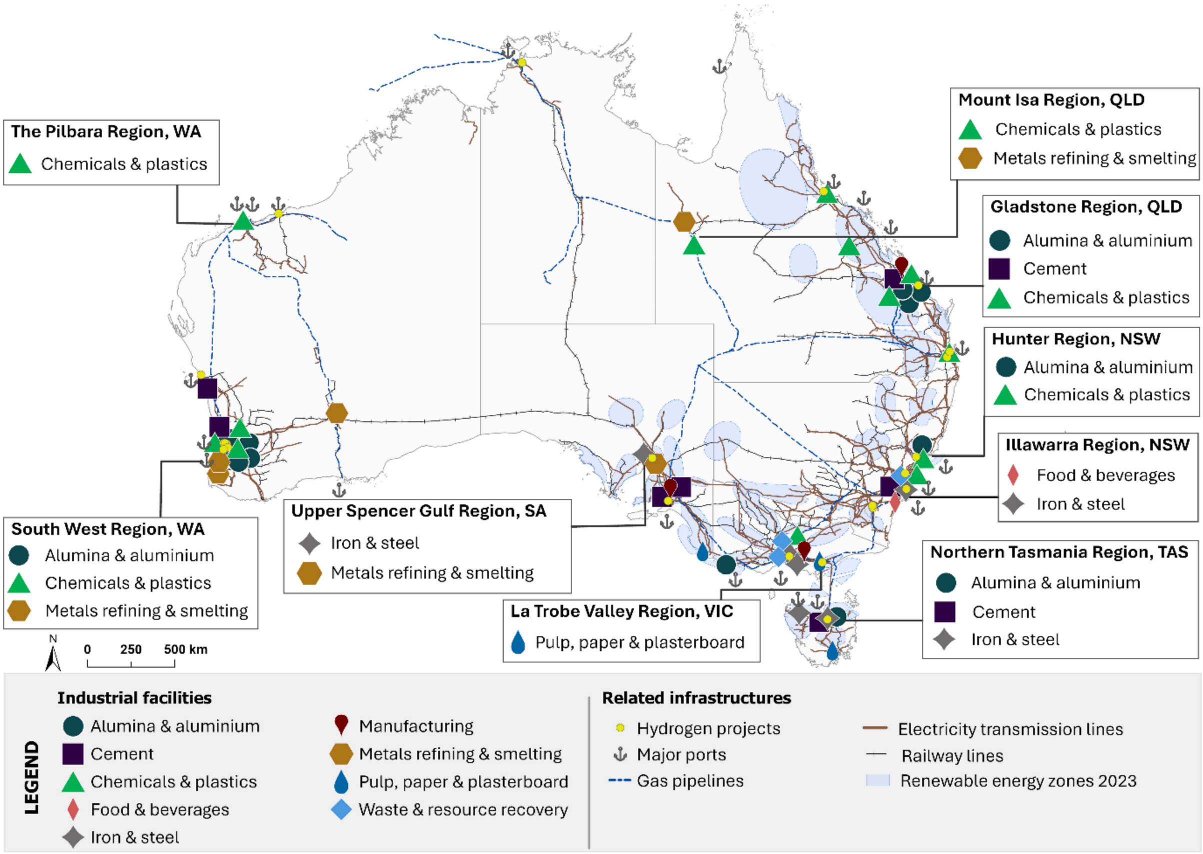


Figure 4: Key industrial facilities co-located in regional areas with relevant infrastructure. This map is intended to be a high-level representation only. DISR created this map based on data from the Clean Energy Regulator (CER), Geoscience Australia (GA) and Australian Energy Market Operator (AEMO).

Net Zero Economy Authority

The Net Zero Economy Authority (the Authority) is shaping a better future for industrial regions, communities and workers in the net zero economy. As key industrial regions transition away from fossil fuels, the Authority will help support regions, communities and workers to manage the impacts, and share in the benefits, of the net zero economy. This is supported by the Community Benefit Principles under Future Made in Australia.

The Authority is working closely with the regions that will be most affected by Australia's transition to a net zero economy. This includes helping workers in coal and gas facilities affected by the transition to prepare for and find new well paid, safe and secure jobs, supporting affected communities to prosper through economic development and investment and being a trusted and influential voice to build understanding of, and shape policy on, the regional net zero transition. Current focus regions for the Authority include Collie, Central Queensland, the Hunter, Latrobe, Pilbara and Upper Spencer Gulf. The Authority is working with communities, including First Nations communities, state and local government, other federal government agencies, regional bodies, unions, businesses and individuals across these regions.

Box 5: The Central Queensland region

Central Queensland is an economic powerhouse, underpinned by manufacturing and mining industries. It is one of the most emissions-intensive places in Australia, accounting for around 14% of national scope 1 emissions.

The emissions intensive industries in Central Queensland include alumina and aluminium production, coal mining, Liquified Natural Gas (LNG), cement, ammonia and other chemical manufacturing. These have been the backbone of the regional economy and transitioning these sectors to clean energy will be critical to Australia's net zero target. While the shift to net zero presents challenges, Central Queensland is well positioned to become a global hub for green metals, critical minerals, biofuels, and potentially defence-related manufacturing, creating new industries and high-quality jobs for local communities.

With a strong legacy of international trade and industry, supported by its world-class deepwater port, Central Queensland is a strategic hub for investment. Progress is underway with a strong pipeline of renewable projects complemented by new industrial developments. This includes Alpha HPA's delivery of Australia's first high-purity alumina processing facility, and Rio Tinto's agreement to power its Boyne aluminium smelter in Gladstone with renewable energy sources from projects across the region.

Workforce and skills

To support the net zero transition, building a skilled workforce for advanced manufacturing is crucial for Australia's economic growth and prosperity. Key areas of focus include attracting young people to manufacturing careers, diversifying the workforce, reskilling existing workers, and modernising training so it is relevant and up to date. In line with findings from Jobs and Skills Australia, considerations in skills, location, timing and preferences will need to be made to deliver targeted, localised and individualised supports to drive successful outcomes for workers and their communities (Jobs and Skills Australia, 2025).

As new technologies are developed and adopted, new skills and specialised training will be required to design, install, operate and maintain future systems. Vocational education and training (VET) system reforms will help deliver an adaptable, skilled workforce resilient to the structural changes of the net zero transition and support micro-credentials in the training system to deliver in-time training to meet emerging and urgent skills needs. Peak bodies, such as A2EP and the Energy Efficiency Council, will be helpful in delivering trusted advice to build industry awareness on the skills necessary to support a specialised implementation workforce. In addition, through the Australian Government's Green Metals Innovation Network, the CSIRO in collaboration with HILT CRC will identify pathways to support a strong Australian metals workforce.

The Clean Energy Capacity Study found that Australia 'can't grow the workforce at the pace and scale required if large groups of the population are excluded, including women, First Nations people, people with disability, and recent migrants whose skills' potential are underutilised.' (Jobs and Skills Australia, 2023). Creating conditions in the industrial sector that support increased participation from women and other underrepresented groups would help address workforce shortages, in alignment with the Australian Government's ambitions in Working for Women: a Strategy for Gender Equality. State-led programs such as, Victoria's 'Making it Equal' and Queensland's Women in Manufacturing, alongside federal reforms for fair hiring practices, pay transparency, and more inclusive workplaces will be an important aspect of this effort.

First Nations communities to share in the benefits of industrial net zero

Australia's net zero transformation presents a unique opportunity to deepen our engagement with First Nations communities through partnerships that are built on respect, shared value and long-term benefit. As industries transition to cleaner energy and technologies, many projects and their enabling infrastructure (e.g. renewable energy, hydrogen developments) will be located on land with Native Title, rights and interests.

Industrial decarbonisation can empower First Nations communities as key partners in Australia's clean energy future. Working in partnership with First Nations communities, especially during the planning stage, and by creating pathways for employment, training and business participation, industrial decarbonisation can support cultural heritage and economic empowerment.

Meaningful collaboration with First Nations communities is necessary for industries, helping to develop trust with their local communities, avoid costly delays and build new opportunities. The First Nations Clean Energy Strategy can provide a helpful guide to support benefits for First Nations Australians. Engaging collaboratively to achieve positive outcomes for local communities, including First Nations communities is one of the Community Benefit Principles under Future Made in Australia.

Industrial transition will rely on grid infrastructure and access to renewable energy

As industrial facilities such as aluminium smelters, alumina refineries and food and beverage manufacturers increasingly prepare to shift to renewable energy, they require tailored grid infrastructure and renewable investments to support their net zero operations. This includes transmission and distribution grid upgrades, as well as access to the necessary renewable generation and firming. Depending on the location of facilities and the nearby existing grid infrastructure, industries may consider partial or completely off-grid solutions to be a cost-effective method for accessing renewable energy. However, off-grid solutions present their own complications and costs, including the need for sufficient access to land for renewable developments. Most existing industrial facilities will still likely require tailored on-grid connections to support their decarbonisation pathways.

Investment in industrial decarbonisation will require coordinated regional infrastructure planning to deliver renewable energy and firming to industry users. Recent developments such as Rio Tinto's multiple power purchase agreements, comprising 2.7 GW of wind and solar for their assets in Gladstone, show a potential way forward (Rio Tinto, 2025). These agreements will help repower Rio Tinto's industrial facilities with renewables, including the Boyne aluminium smelter, Yarwun alumina refinery and the QAL alumina refinery. Use of offtake agreements can help de-risk investments for industrial decarbonisation, drive large renewable investment, and help negotiate affordable electricity prices. Proactive grid planning from grid bodies such as AEMO, state and federal governments, and network providers to consider industry specific needs will help to reduce the chance of costly delays. Reforming regulatory processes for approvals for renewables and transmission infrastructure will also be key enablers for the renewable rollout.

Industry is an active player in the grid

Continued grid transition and increased share of variable renewables will need to be balanced with demand flexibility from all areas of the economy, including industry. Industry will need to consider options for reducing energy demand when demand and supply balance is tight (e.g. load-shedding), increasing industrial demand when there is excess renewable supply (e.g. load-taking) and providing other grid stability services to help deliver a cost effective system. This industrial demand flexibility is also discussed in the Electricity and Energy Sector Plan and can help optimise grid infrastructure, minimising the delivered cost of renewable electricity and supporting industries to remain competitive.

The Reliability and Emergency Reserve Trader (RERT) process presents an example of demand flexibility arrangements. The RERT is a mechanism for AEMO to maintain reliability by calling on large industrial users such as aluminium smelters (with the necessary assets) to voluntarily reduce their electricity demand during times of tight demand and supply balance to support grid stability. In turn these participating facilities are compensated for these services (AEMO, 2024). While providing these grid services is not a core business for industrial facilities, the RERT represents an example of how industry can play a more active role in the grid while receiving an additional source of revenue. Additional opportunities for demand flexibility are being assessed as part of the National Electricity Market Wholesale Market Settings Review.

Other tools to support demand flexibility include energy performance upgrades and onsite (behind-the-meter) generation and storage. Demand flexibility via onsite energy storage assets (batteries, hot water storage, thermal energy storage etc.) can be particularly useful by providing business with ways to store and use energy independently from the grid for short periods of time. These tools provide opportunities for a more active participation in the grid, such as load shifting and energy arbitrage, providing benefits to both industry and the wider grid.

To encourage the widespread uptake of industrial demand flexibility, the cost and benefits of industrial participation will need to be carefully balanced. Trials such as AGL's Dynamic Pricing Load Flex Trial are currently underway to better understand this balance and is complemented by new market mechanisms and intermediaries such as storage brokers.

Market demand will help de-risk investments

Market demand for lower-emission products will bring confidence for business and enable them to invest in industrial decarbonisation efforts. This is particularly important for industries with low margins such as cement, steel, aluminium and chemicals where significant capital is required for decarbonisation. Strong demand drivers, either through government procurement, regulatory requirements, consumer demand or business commitments to net zero, will help de-risk critical investments such as new boilers, kilns, furnaces etc. needed for net zero.

Work is already underway on this, including through Materials and Embodied Carbon Leaders' Alliance (MECLA), helping to reduce the embodied carbon in the building and construction industry. This helps support the adoption of lower emission products from the steel, cement, aluminium and other construction material subsectors. Additional opportunities are highlighted in other sector plans, many of which rely on inputs from the industrial sector. the built environment sector Plan and Transport Sector Plan have strong linkages to the steel and cement subsectors for the buildout of new buildings and infrastructure. Other opportunities include lower emission explosives and fertilisers from chemical manufacturers for the Resources and Agricultural and Land Use Sector Plans. Local content policies that encourage use of low emission products also help build momentum in markets, supporting the scale up of manufacturing capability and unlocking advantages from economies of scale.

International market demand for lower emission and green products is also growing and is one of the key drivers for investment and opportunities under the Future Made in Australia agenda. Global demand for green commodities is expanding, driven by government policies such as Europe's Carbon Border Adjustment Mechanism, as well as net zero commitments from businesses around the world. Successfully attracting this international market demand to Australian producers and investments will be key to unlocking a Future Made in Australia and its economic opportunities around green metals and other clean exports. Measures including the Investor Front Door, the Guarantee of Origin scheme, the Sustainable Finance Roadmap and Sustainable Finance Taxonomy are already underway to help streamline global and domestic investments (see also Chapter 10 of the NZP 'Attracting investment to achieve net zero').

Towards net zero

Industrial transition will occur in phases due to complexity and evolving nature of low-emissions technology. A phased transition allows industries to adapt over time while ensuring that investments align with technological readiness, cost-effectiveness and emissions reduction potential. This approach will vary depending on the subsector, balancing ambition with practical implementation, to help industry maintain competitiveness while progressing towards net zero.

Phase 1: Deploy existing opportunities and planning (near term 2025–30)

Focusing on developing industry knowledge and deployment of existing commercial abatement technologies, subsectors such as food and beverages, and pulp, paper and paperboard will likely be early movers. Overall abatement may be minor but can build momentum within industry.

The Safeguard Mechanism will be an important driver for large industrial emitters. To ensure they are appropriately calibrated, the Australian Government will review Safeguard Mechanism policy settings in 2026–27. As part of the review, the Climate Change Authority (CCA) will advise the Australian Government on the extent to which on-site abatement is being driven by the reforms, and whether any additional incentives are required.

Australia's Carbon Leakage Review was undertaken as part of the 2023 Safeguard Mechanism reforms to assess potential carbon leakage risks and develop policy options to address carbon leakage. Findings from the review found that current Safeguard Mechanism settings are effective at mitigating carbon leakage risk in the short to medium term, but settings for some sectors may need to be augmented with additional measures over time. The Australian Government will release the report from the Review to continue discussions on recommendations with impacted industries and will give further consideration to the issues and whether to implement a border carbon adjustment in the 2026–27 review of the Safeguard Mechanism.

Energy performance upgrades, increasing use of circular economy, switching from coal to gas, and electrification where commercial solutions exist are likely pathways during this time. For industrial abatement to continue at pace, planning for key enablers including grid infrastructure, R&D, skills, and regional coordination will need to be begin in Phase 1.

Phase 2: Widespread adoption of existing technologies and commercialise new tech (medium term 2030–35)

Building on progress from Phase 1, industrial transition will focus on the widespread deployment of commercially available net zero technologies and broader deployment of circular economy practices. Widespread adoption of electrification, energy performance upgrades and other alternative inputs is anticipated for low heat processes such as food and beverage manufacturing. Heavy industries are also expected to deploy commercial technologies such as electric boilers at scale, enabled by the buildout of the renewable grid.

Trials and commercialisation of new technologies are also anticipated ahead of the next phase of decarbonisation. Scale up and build out of the necessary infrastructure, supply chains and workforce for alternative inputs such as hydrogen and bioresources are also likely to begin progressing at pace.

Phase 3: Net zero and new market opportunities (longer term 2035–50)

Significant emissions abatement from across industry is anticipated, particularly for hard-to-abate processes such as high temperature heating in alumina calciners. Much of this would be driven by the technology developments and innovations occurring today. Alternative inputs such as hydrogen and bioresources are also likely at sufficient scale and cost to enable widespread industrial adoption.

This period will also likely see the growth of new industry opportunities in green metals, green chemicals and other areas of comparative advantage. New breakthrough technologies may also be commercialised and deployed during this time and circular economy practices will be widely integrated.

The Climate Change Act 2022 sets up a strong framework to ensure Australia remains on track to reach net zero emissions. It requires the Minister for Climate Change and Energy to report progress through an Annual Climate Change Statement to Parliament, including progress towards emissions targets, and whether current policies are effective. This regular reporting ensures transparency and accountability. It also creates a clear cycle for reviewing and improving climate policies over time.

Together with advice from the Climate Change Authority, the Net Zero Plan and corresponding sector plans will guide the decarbonisation trajectory of industry and the broader economy. Through ongoing monitoring and review, new opportunities for action will be identified. Continued engagement and contribution of stakeholders is fundamental to this process.

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Glossary

Term	Definition
AI	Artificial intelligence
ARENA	Australian Renewable Energy Agency (ARENA). ARENA is a statutory authority that provides research, development and deployment grant funding to improve the affordability and increase the supply of renewable energy in Australia.
Biotechnologies	Biotechnologies harness cellular and biomolecular processes to improve our health, wellbeing, economy and environment. This includes engineering cells that recycle plastics and microorganisms to recover metals from ores
CO2	Carbon dioxide
CO2-e	Carbon dioxide equivalent
CRC	Co-operative Research Centre
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DISR	Department of Industry, Science and Resources
DRI	Direct reduced iron
GDP	Gross Domestic Product
GVA	Gross Value Added
GWP	Global warming potential
Mt	Million tonnes
NGERS	National Greenhouse and Energy Reporting Scheme
NZEA	Net Zero Economy Authority
R&D	Research and development
Scope 1, 2 and 3	Scope 1 emissions refer to greenhouse gas emissions released into the atmosphere as a direct result of the activities at a facility Scope 2 emissions are those released in the process of producing the electricity which is generated externally and imported in to power a facility, Scope 3 emissions are other indirect emissions which occur outside the boundary of a facility. Typically, these occur are upstream or downstream of the facility. (CER, 2025b)
SME	Small-to-medium enterprise (non-employing and businesses with 1–19 or 20–199 employees)

Appendix A: Historical emissions

Emission trends to date, and the projections on status quo

Since 2005, the industrial subsectors direct emissions have decreased slightly (Figure A1). Some of the declines can be attributed to the global financial crisis, particularly in the immediate years following 2007 (House of Representatives, 2009). Other declines in emissions are likely a result of improvements in efficiency as well as the closure of industrial facilities over this period.

Emissions have otherwise remained mostly flat, reflecting a stable period of industrial activity. More recent disruptions triggered by the invasion of Ukraine and the accompanying gas price increases are partly responsible for the decreases in emissions in the years 2022 to 2024.

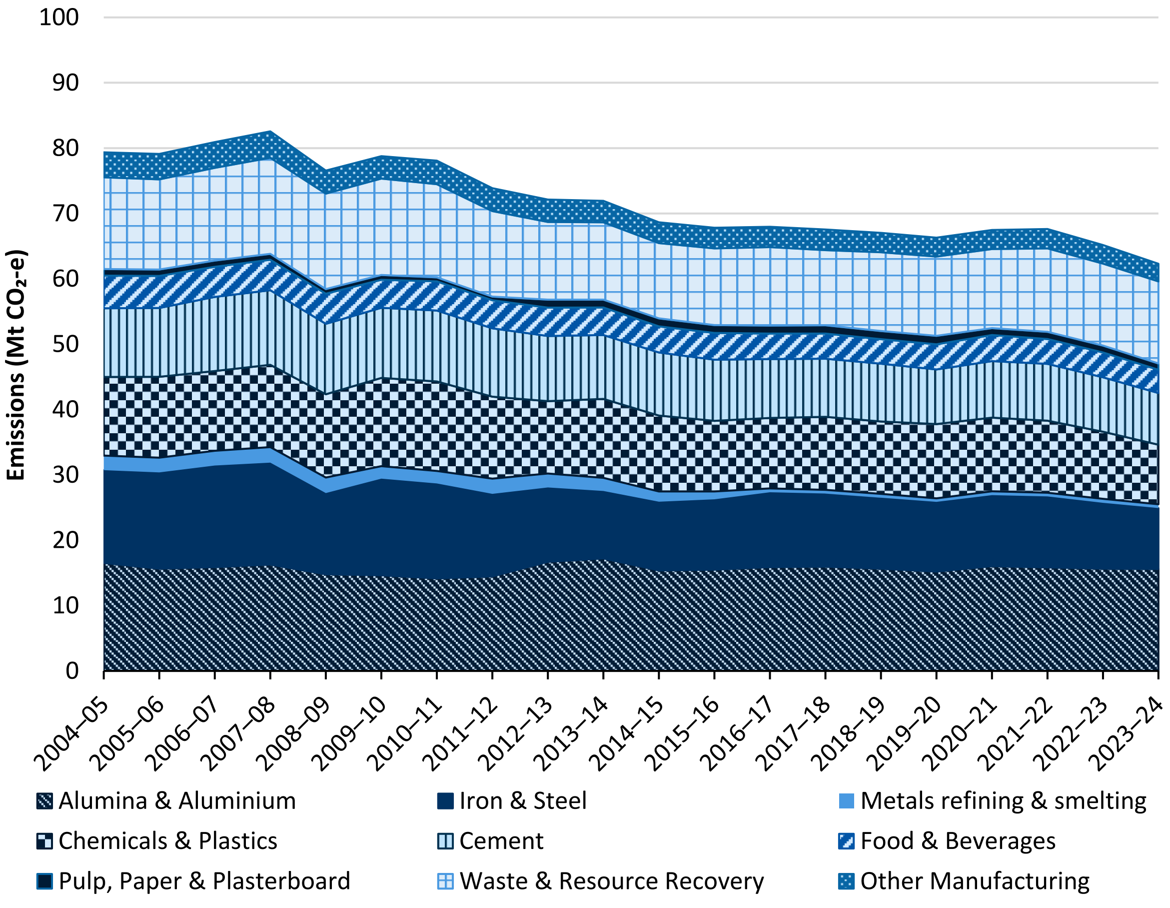

Figure A1. Historic scope 1 emissions of the Industry Sector Plan by subsector from 2005–2024. The emissions estimates are based on national emissions reported in the Quarterly Update of Australia's National Greenhouse Gas Inventory, December 2024 (DCCEEW, 2025a).

Appendix B: Summary of the Industry Sector Plan subsectors

Aluminium and alumina

Economic context

Number of businesses*	GVA (% of GDP) *	Exports ($m) *	Number of jobs
1,699	0.2%	14,811	26,900

* FY2024

- Australia is globally competitive in alumina and aluminium production, and Australia is unique in having the entire aluminium supply chain, from bauxite mining to finished products.
- Aluminium has a wide range of uses across the economy, including in the automotive and construction industries.

Emissions profile

Scope 1 emissions (% whole-of-economy)*	Safeguard facilities	Safeguard facility emissions (% whole-of-economy)*	Safeguard proportion of scope 1 subsector emissions
3.5%	10	3.4%	96%

* % of Australia's emissions, FY2023-24 (DCCEEW, 2025a; DISR, 2025)

- Emissions are primarily from Australia's 5 alumina refineries and 4 aluminium smelters. Remaining businesses are aluminium fabrication operations with minimal direct emissions.

Alumina

Alumina production generates emissions primarily from 2 processes: firstly digestion, using the Bayer process, which is energy and heat intensive (138–255°C) and secondly calcination, which uses high temperatures around 1,000°C to produce the final alumina product. Conventional technologies use coal and gas to produce the energy and heat required (Deloitte; ARENA, 2022).

Low emissions alumina production technologies are being developed, including Australian projects at various stages of development (links below):

- Yarwun Hydrogen Calcination Pilot Demonstration Program
- Alcoa Renewable Powered Electric Calcination Pilot.
- Alumina refineries' next-generation transition (AlumiNEXT™) Project

The choice of technology suitable can be facility and ore specific, with multiple pathways to net zero for Australia's alumina industry.

Aluminium

Aluminium's scope 1 emissions are predominantly from the production and use of carbon anodes in the aluminium electrolysis process, resulting in small amounts of perfluorocarbon (PFC) emissions, which is a very potent type of greenhouse gas. Most scope 1 emissions will be abated through substituting carbon anodes with inert anodes, likely available in Australia some time after 2035. Provision of firmed renewable electricity is required prior to adopting inert anodes, as they likely have a higher demand for electricity than conventional carbon anodes and would otherwise result in higher emissions (NRDC, 2023).

Recycling aluminium does not produce PFCs and uses significantly less electricity, also reducing scope 2 emissions. The small scale of Australia's scrap recycling industry results in 95% of Australia's scrap aluminium being exported for recycling (Australian Aluminium Council, 2024). Domestic recycling is limited by the scale of downstream manufacturing of primary aluminium in Australia beyond the extrusion industry

Aluminium facilities are by far the largest consumers of electricity within the industrial sector and economy more broadly. Addressing alumina and aluminium's scope 2 emissions by switching to firmed renewable electricity would make a significant contribution to achieving Australia's net zero ambitions. Traditionally, aluminium production has been sited close to electricity generation and port access.

The alumina and aluminium industry require a coordinated buildout of low-cost and firmed renewables and (potentially) access to affordable renewable hydrogen at scale to fully decarbonise. In Canada and Europe, the sector has located facilities close to historically located hydroelectricity to provide firmed low-cost power at scale, which has enabled zero emissions aluminium production.

Cement and concrete production

Economic context

Number of businesses*	GVA (% of GDP) *	Exports ($m) *	Number of jobs
1,638	0.2	2,051	15,300

* FY2024

- Other products produced in the sector include bricks, pavers, and precast concrete components. Large scale railway, road and wind farm developments consume large quantities of cement, lime, and concrete products.
- At present the industry is highly trade exposed, and domestic demand is met through a mixture of onshore manufacture of clinker and imports from overseas suppliers.

Emissions profile

Scope 1 emissions (% whole-of-economy)	Safeguard facilities*	Safeguard facility emissions (% whole-of-economy)	Safeguard proportion of scope 1 subsector emissions
1.8%	7	1.2%	66%

* % of Australia's emissions, FY2023-24 (DCCEEW, 2025a; DISR, 2025)

- Emissions are primarily from integrated cement, clinker and lime facilities, with some emissions from brick manufacturing.

Most emissions associated with cement and concrete production are due to clinker and lime production from limestone, which is a high temperature (approximately 1,450°C) process that currently requires gas, coal, or other high carbon intensity fuels. The industry is also a large user of refuse-derived fuels, including biomass, which diverts emissions from landfill. In addition, the process is inherently carbon emitting regardless of heat source due to the chemical reaction (calcination) involving limestone (Cement Industry Federation, 2023).

Most opportunities to address scope 1 emissions in this sector rely on using less carbon intensive fuels for calcination and substituting some clinker with supplementary cementitious materials in cement and concrete production. Addressing the inherent process emissions from calcination of limestone remains a global challenge for the industry.

Several cement and concrete suppliers (including those manufacturing clinker in Australia) have started to offer lower-carbon products to the market, but some of these products require changes to the application of standards and specifications to enter more widespread use. As noted in the Built Environment Sector Plan, reducing cement and concrete use where possible, or specifying the use of lower-carbon cement and concrete, can greatly reduce the embodied carbon of new construction over time.

Fully net zero alternatives that can displace standard cement are yet to be discovered; however, there are lower emissions alternatives available such as circular economy opportunities to improve materials efficiencies, using supplementary cementitious materials (SCMs) and geopolymers as substitutes for clinker in concrete, and using renewable hydrogen for process heat in cement kilns. Bio-based SCMs may also play a role, as biological compounds can grant unique properties to cement from a sustainable source. Only certain cement types can be used in concrete under the relevant Australian standard for concrete to ensure it meets strength and other design criteria (Verein Deutscher Zementwerke, 2021). This is a key issue inhibiting the uptake of lower emission technologies in Australian cement production and use.

Chemicals and plastics manufacturing

Economic context

Number of businesses*	GVA (% of GDP) *	Exports ($m) *	Number of jobs
6,369	0.8	11,751	77,900

* FY2024

- Chemicals and plastics are critical enablers of almost every value chain across the economy, including mining, agriculture, construction, infrastructure, manufacturing, food, textiles, and healthcare. The chemicals and plastics industry includes base material manufacture, compounders, manufacturers, and recyclers.

Emissions profile

Scope 1 emissions (% whole-of-economy)*	Safeguard facilities	Safeguard facility emissions (% whole-of-economy)	Safeguard proportion of scope 1 subsector emissions
2.0%	11	1%	51%

* % of Australia's emissions, FY2023-24 (DCCEEW, 2025a; DISR, 2025)

- Emissions primarily come from ammonia production, process heat generation and nitric acid production with smaller portions from onsite electricity generation and the production of titanium dioxide.

Chemicals and plastics processes rely on fossil fuels as both an energy source and feedstock. About half the scope 1 emissions from chemical manufacturing are from the use of natural gas. Two-thirds of this are from using natural gas as an input into the production of other chemicals such as ammonia and nitric acid for use in explosives and fertilisers.

Opportunities for decarbonisation include integrating renewables and affordable renewable hydrogen and carbon feedstock at scale, efficiencies, and industrial symbiosis through industrial precincts.

Currently, hydrogen is produced and used within the chemicals and plastics manufacturing sector, for example as a precursor to ammonia (for explosives and fertilisers), and in plastics materials and solvents. Chemicals manufacturers making hydrogen and ammonia for industrial purposes are well placed to produce them to use as energy carriers in the energy sector, for transportation fuels, and for export.

Virgin plastic production is an inherently carbon intensive process given the use of fossil fuels as feedstock and the energy used to create plastics. Australia is well placed to increase plastics circularity through product design improvements, greater use of recycled and bio-feedstocks, and improved and advanced recycling technologies. This will help the sector to reduce the reliance on virgin fossil fuel plastic resins in the future.

Opportunities to produce lower emission products include:

- Coated fertilisers from ammonia that result in lower emissions when used in agriculture
- Insulation and other energy efficiency solutions for homes and the built environment
- Lightweight, energy-saving materials for vehicles and transport such as plastic panelling, foams and carbon fibre materials (ICCA, 2020).

Food and beverage manufacturing

Economic context

Number of businesses*	GVA (% of GDP) *	Exports ($m) *	Number of jobs
15,414	1.3	38,345	235,100

* FY2024

- Australia is a net exporter of food products and has a global reputation for safe, clean food. The food and beverages manufacturing sector is diverse, itself encompassing multiple industries, and has many SMEs.
- Meat processing, grain milling, and cereal product manufacturing are the 3 highest emitting industries within this subsector and account for 64% of its total emissions.

Emissions profile

Scope 1 emissions (% whole-of-economy)	Safeguard facilities*	Safeguard facility emissions (% whole-of-economy)	Safeguard proportion of scope 1 subsector emissions
0.8%	1	0.1%	11%

* % of Australia's emissions, FY2023-24 (DCCEEW, 2025a; DISR, 2025)

- Emissions are spread across a wide variety of businesses. Emissions are largely from using fossil fuel for low to medium temperature processes, and from synthetic greenhouse gas refrigerants.

Due to the perishability of many food and beverage products, and food safety requirements, the sector is reliant on maintaining robust cold-chain and refrigeration systems for processing, storage, and transport of foodstuffs. This highlights the importance of energy and transport reliability and the security that grid power provides.

Sustainability is already a significant focus for food and beverage businesses and consumers, with a decarbonised food supply chain expected to be a competitive necessity in the future for both export and domestic suppliers. Major supermarket retailers already require food and beverage suppliers to demonstrate decarbonisation commitments in line with retailers' own aspirational net zero targets.

Opportunities to decarbonise include optimising energy consumption, process heat generation and recapture, reuse of materials (including waste-to-energy), upgrading to more energy efficient equipment and processes, and electrification. Alternative technologies are currently available to address many of these processes. Synthetic greenhouse gas refrigerants used for process heating and cooling can be replaced with lower global warming potential alternatives to reduce scope 1 emissions. Biogas energy is an increasingly important energy source and an alternative to grid gas in regions with reliable waste streams. Sustained high-energy input costs will drive uptake of alternative energy technologies and electrification.

The decarbonisation challenges for the food and beverages subsector are primarily economic, including barriers to investment, market demand, and tight margins. The subsector is also slow to share data on successful transition projects to quantify results and awareness of technology solutions, to build broader industry confidence.

Achieving decarbonisation requires greater awareness across the sector and demonstration of available low-emissions technologies. Almost 90% of businesses within the food and beverages subsector are SMEs that are not captured within existing emissions reporting measures such as the National Greenhouse and Energy Reporting scheme (NGERs).

Food waste accounts for 3% of Australia's emissions and costs our economy $36.6 billion each year. The amount of land we use to grow wasted food covers over 25 million hectares – a landmass bigger than the state of Victoria. Working across the supply chain to minimise food wastage will also significantly reduce emissions. (DCCEEW, 2024b).

Iron and steel manufacturing

Economic context

Number of businesses*	GVA (% of GDP) *	Exports ($m) *	Number of jobs
16,745	0.7	4,899	98,200

* FY2024

- Iron and steel manufacturing provides key inputs for the construction, defence, transport, infrastructure, and renewables industries, and is important for sovereign capability. It is a trade exposed industry and faces competition from Asian steelmakers.

Emissions profile

Scope 1 emissions (% whole-of-economy)	Safeguard facilities*	Safeguard facility emissions (% whole-of-economy)	Safeguard proportion of scope 1 subsector emissions
2.1%	6	1.7%	82%

* % of Australia's emissions, FY2023-24 (DCCEEW, 2025a; DISR, 2025)

- Emissions are primarily from integrated iron and steel works using iron ore and coking coal (~70% of emissions) to make primary steel, and electric furnaces using electricity from the grid and scrap steel.

Primary (or virgin) iron and steel are currently made in Australia through an integrated process, from Australian iron ore (hematite and magnetite ores) and various sources of metallurgical (coking) coal. The first stage of the process uses a BF for ironmaking, reaching over (>1,200°C), and the second stage converts the hot liquid iron into steel through a basic oxygen furnace (BOF) (>1,500°C). Australian operators also use smaller scale EAFs, primarily for scrap recycling. Decarbonising primary iron and steelmaking requires alternative heat processes and material inputs, such as renewable hydrogen, to provide heat and the chemistry required to make iron and steel (Australian Industry Energy Transitions Initiative, 2023).

There are 2 main types of Australian iron ore used for steelmaking: hematite and magnetite.

- Hematite iron ore, also known as Pilbara iron ore, is well suited to conventional BF-BOF steelmaking which can easily remove impurities and is overwhelmingly Australia's main iron ore export. Hematite ore is currently used at BlueScope's Port Kembla Steelworks. Improvement in the processes for using hematite in decarbonisation technologies requires further research.
- Magnetite iron ore is better suited to decarbonisation technologies. This is due to its magnetitic qualities, which enable it to be more easily concentrated, lifting its iron content to the level required for use in decarbonisation technology pathways such as DRI. Production of iron from magnetite is well proven and underway in Australia, notably through the Port Latta plant in Tasmania (Grange Resources, 2023). Technology pathways to concentrate magnetite for use in conventional steelmaking are also suitable for zero emission steelmaking pathways.

Near zero emissions primary steel production has been proven internationally in Sweden, achieved through significant public and private investment in the research, development, and demonstration of its HYBRIT technology (Hybrit, 2023). Following this success, Stegra in Sweden is preparing to produce green steel with about 95% less greenhouse gas emissions than conventionally produced steel (Stegra, 2025). The quality of primary steel made using decarbonisation pathways is the same as that from conventional technologies. Industry is investigating the Australian applicability of HYBRIT technology, H2 Green Steel, and similar processes.

Steelmaking using scrap steel does not require high temperatures or carbon-based inputs like coking coal or natural gas, as the iron has already been turned into steel, making it an attractive input that can lower costs. For every tonne of scrap used for steel production, 1.5 tonnes of carbon dioxide emissions can be avoided (World Steel Association, 2021). Increasing the use of scrap steel offers a pathway for immediate reductions in emissions. Scrap is the main input to Australia's electric arc furnaces to produce steel, which can be powered by 100% firmed renewable electricity, when combined with energy storage. About 26% of Australian steel is produced via the EAF process (Australian Steel Institute, 2023).

Steel mills typically source domestic scrap metal within a 200km radius of the mill due to high transport costs (KPMG, 2023). The majority of Australia's scrap metal processing capacity is far from where the materials will be received, though supply chains for material management are developing in response (CSIRO, 2024). Opportunities for Australia to further use scrap steel will be explored, noting there can be some limitations due to the presence of other metals in the scrap. For example, copper cannot be readily separated and its presence in scrap affects the quality of steel produced (Nicholas & Basirat, 2022).

Australian research is underway through:

- HILT CRC with key industry stakeholders to explore suitable technology pathways
- ARENA funding to Calix to support demonstration of its Zero Emissions Steel Technology – ZESTY
- NeoSmelt project, a joint venture with BlueScope, BHP, Rio Tinto, Woodside Energy and Mitsui Iron Ore Development, supported by ARENA funding to produce green iron from Pilbara ores
- CSIRO pre-feasibility study around a common user pilot facility for low emissions ironmaking.
- Fortescue's Green Iron Metal Project at Christmas Creek to use green hydrogen to convert iron ore into sponge iron.

Transitioning to net zero is fundamentally disrupting the global iron and steel industry. Many decarbonisation technologies would decouple iron making from steel making processes. This could see ironmaking becoming positioned close to locations that are rich in renewables resources and able to competitively produce renewable hydrogen, with decarbonised iron exported to steel making locations.

Manufacturing and additional industries

Economic context

Number of businesses*	GVA (% of GDP) *	Exports ($m) *	Number of jobs
72,207	4.1	71,756	598,600

* FY2024

- Manufacturing and additional industries includes glass manufacturing, battery production, clean technologies, data centres and other digital technologies, and excludes industries captured under the other 8 subsectors in this document.

Emissions profile

Scope 1 emissions (% whole-of-economy)	Safeguard facilities*	Safeguard facility emissions (% whole-of-economy)	Safeguard proportion of scope 1 subsector emissions
0.6%	3	0.1%	34%

* % of Australia's emissions, FY2023-24 (DCCEEW, 2025a; DISR, 2025)

- Scope 1 emissions are concentrated within large glass and magnesia businesses.

Glass manufacturing

Glass making is the primary source of emissions within the manufacturing and additional industries subsector, due to its reliance on high heat processes (>1,600°C) requiring the use of fossil fuels to melt sand into glass. No alternative low emissions technologies or alternative heat sources have been identified to date. While the use of hydrogen is being explored, this is at very early stages. It is not yet clear that hydrogen will provide the relevant chemical properties to produce the quality of glass products needed by industry.

Glass is also a key input into improving energy efficiency and thermal comfort in buildings, key to the Built Environment Sector Plan. Maintaining sovereign capabilities in glass manufacturing is important for security of supply to the building and construction sector.

Battery manufacturing and clean energy technologies

Demand for products and materials to enable the economy to transition to net zero is expected to grow. Australian manufacturing is well placed to provide the infrastructure, equipment and technology needed for this transition. This includes solar panels, on and offshore wind, lower-carbon construction, and energy storage systems and electrified heavy machinery.

On 28 March 2024, the Australian Government announced it will invest $1 billion in the new Solar Sunshot program to accelerate the development of Australia's solar manufacturing industry, catalyse clean energy industries, and help Australia connect to new global supply chains (ARENA, 2024).

Batteries are a critical technology underpinning Australia's long-term energy security and pathway to net zero. Australian made batteries can help meet long-term demand for stationary energy storage and support the Australian Government's decarbonisation commitments. The global battery demand is expected to increase by 18-fold over the next decade (Accenture, 2023). Strengthening Australia's battery manufacturing capabilities would support firming electricity supply for those industries requiring reliable supply.

Data centres

Australia has over 200 data centres, primarily located in and around the major capital cities Sydney, Melbourne, Brisbane, Perth, Canberra and Adelaide (Data Centre Map, 2024). Data Centres are large electricity and energy users, predominantly required for cooling (Noble, Atherton, & Berry, 2023) and to ensure uninterrupted electricity supply of their operations, that are used to support a range of digital technologies used across the economy and by households.

In 2022–23, diesel generators (60.5%) and refrigerant gases (39.4%) were the main source of scope 1 emissions from data centres. Diesel generators are typically used intermittently, to ensure their uninterruptable electricity supply needs can be met. Most emissions from data centres are scope 2 from electricity use from the grid.

Demand for data centres is expected to grow due to increasing use of digital technologies such as Artificial Intelligence, cloud services, the internet of things and blockchain. AEMO projects that data centre electricity demand will rise from a current 4 TWh to around 12 TWh in 2029–30.

Reducing emissions will be driven by improving efficiency of its cooling systems and electricity use, and low emission substitutes for backup electricity supply.

Data centre owners and operators are increasingly employing innovative technologies and design elements themselves to reduce emissions and maximise energy efficiency, particularly in newly built centres. There are significant opportunities to improve energy efficiency and reduce emissions particularly in existing older data centres.

Rooftop solar photovoltaic (PV) panel recycling

With one of the highest rates of rooftop solar PV users in the world, there will be a rapid growth in PV waste in Australia in the coming years when systems come to end of life or require replacement. Emissions reductions can be achieved through the efficient collection, transportation and treatment of PV waste, as well as the recovery of critical minerals to be reused in manufacturing new PV panels.

The main barriers to solar panel recycling are costs, purity of extracted materials, environmental impacts of recycling processes and access to information on solar panel recycling facilities.

A 2024 Australian Centre of Advanced Photovoltaics (ACAP) study has suggested that cumulative PV waste in Australia could reach 2–3 Mt by 2050. End-of-life solar panels are a source of valuable critical materials such as silver, copper, and high purity silicon, glass, and aluminium which can be utilised in the manufacture of new modules. The ACAP study suggests that in 5 years, end-of-life silver and aluminium from PV panels could supply 30% of future PV demand, 50% in 15 years, escalating to 100% in 25 years. The appropriate recycling and reuse of PV waste could significantly reduce emissions through lowering demand for new raw materials. The Australian Government and industry groups have been working on a number of proposals to enhance recycling and product stewardship for solar panels.

Other metals refining and smelting

Economic context

Number of businesses*	GVA (% of GDP) *	Exports ($m) *	Number of jobs
296	0.1	43,600	13,100

* FY2024

- These metals are key inputs in the development and manufacture of renewable energy infrastructure, particularly for battery storge, hydrogen electrolysers and solar panels.

Emissions profile

Scope 1 emissions (% whole-of-economy)	Safeguard facilities*	Safeguard facility emissions (% whole-of-economy)	Safeguard proportion of scope 1 subsector emissions
0.1%	3	0.1%	91%

* % of Australia's emissions, FY2023-24 (DISR, 2025; DCCEEW, 2025b) Note: Safeguard facility emissions for Metal Smelting and Refining are calculated as a percentage of NGER emissions.

- Emissions are concentrated within a small number of large businesses. Remaining businesses with the sector are mostly fabrication operations.

The metals refining and smelting sector uses multiple processing operations and techniques, metals captured under this subsector for the Industry Sector Plan includes copper, zinc, lead, gold and silver. These can differ even within a metal type and will require process specific decarbonisation solutions. Reducing emissions from metals refining and smelting will rely on the development of alternative high heat processes and the electrification of existing facilities. Given that some of facilities are aged, there is an opportunity for renewed investment to encourage the adoption of new approaches towards net zero production.

R&D is needed to explore alternative methods and processed to displace or reduce carbon-based inputs where possible, as reactants for metals refining and smelting.

Pulp, paper and paperboard manufacturing

Economic context

Number of businesses*	GVA (% of GDP) *	Exports ($m) *	Number of jobs
660	0.1	1,143	18,500

* FY2024

- The industry provides the materials needed for packaging, office supplies, and many household products.
- Australia's pulp and paper industry is characterised by price volatility set by global markets, making it significantly trade exposed with thin cost margins.

Emissions profile

Scope 1 emissions (% whole-of-economy)	Safeguard facilities*	Safeguard facility emissions (% whole-of-economy)	Safeguard proportion of scope 1 subsector emissions
0.2%	3	0.1%	53%

* % of Australia's emissions, FY2023-24 (DCCEEW, 2025a; DISR, 2025)

- Heating and drying processes account for most emissions in pulp and paper manufacturing.
- Facilities with emissions below the NGERs threshold include stationery and printing businesses.

Digitisation of the economy has resulted in slowing demand for paper products from key markets (i.e., newspaper and print media), which has been somewhat offset by rising demand from online retailers requiring paperboard packaging products. Upstream, the sector is also affected by supply challenges, such as lack of plantation investment and state bans on native timber harvesting.

The industry is energy and water intensive, using low and medium heat processes for drying pulp into paper and paperboard products. According to the IEA (IEA, 2023b), drying accounts for 70% of the energy use in the sector. A key challenge is gaining access to available capital to retrofit existing systems, and to affordable renewable electricity at scale.

Pulp and paper decarbonisation will rely on optimising energy consumption, using bioenergy, adopting alternative process heat technologies, electrification, and more efficiency in waste and recycling management across the supply chain. Many of these technologies are currently commercially available.

Waste and resource recovery

Economic context

Number of businesses*	GVA (% of GDP) *	Exports ($m) *	Number of jobs
5,745	0.3	n/a	47,800

* FY2024

- The sector is dominated by large companies that provide collection services and operate (and often own) waste and recycling infrastructure. It includes both public and private operators.
- The sector is currently experiencing rapid growth in recycling and processing operation in Australia supported through recent state and federal government funding programs.

Emissions profile

Scope 1 emissions (% whole-of-economy)	Safeguard facilities*	Safeguard facility emissions (% whole-of-economy)	Safeguard proportion of scope 1 subsector emissions
2.8%	3	0.1%	3%

* % of Australia's emissions, FY2023-24 (DCCEEW, 2025a; DISR, 2025)

- Emissions from waste and resource recovery are primarily from organic matter going to landfill, which escape as fugitive emissions. Facilities with emissions below the NGERs threshold include regional and small landfills. Reporting on landfill managed by local government is also not mandatory.

The waste and resource recovery sector is a key enabler for the circular economy and provides an essential service to the Australian community. The sector is responsible for collecting, transporting, recycling, treating, and disposing of materials. Businesses are diverse in size and location and often operate with thin margins. Service providers have little control over inputs, and there is very little tolerance for disruption to the essential services these businesses provide. These features complicate the sector's net zero transition.

Various technologies are available to avoid, reduce and capture emissions from the waste and resource recovery sector. As most of the sector's emissions come from decomposing organics in landfills, approaches that divert organics for alternative treatments will have a high impact.

Importantly, our net zero transition provides significant opportunities to create new markets for waste and resource recovery companies. Consumer preferences for more sustainable products, including products that can be repaired, reused, repurposed and recycled, mean end of life solutions for products are becoming increasingly important.

There is an opportunity to divert materials to higher value products, such as bioenergy and biogas, as well as reusing and recycling construction materials, in partnership with the Transport and Built Environment Sector Plans. The ACCU scheme plays an important role incentivising emission reductions in this sector.

Australian Government

Resources Sector Plan

September 2025

Department of Industry, Science and Resources
Department of Climate Change, Energy, the Environment and Water

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Acknowledgement of Country

We acknowledge the Traditional Owners of Country throughout Australia and recognise their continuing connection to land, waters and culture. We pay our respects to their Elders past and present.

Cover: Map image courtesy Geoscience Australia

Foreword

Australia's resources sector is the engine room of the economy, underpinning jobs, investment and energy security.

As we tackle the global challenge of climate change, the Australian resources sector will play a pivotal role in global emissions reduction. The road to net zero runs through the resources sector, and to support that we will work with industry to deliver one of the world's lowest emissions mining sectors.

This Resources Sector Plan demonstrates how reducing the emissions as well as emissions intensity of the resources sector will be a vital contributor to Australia's net zero future, and its role as a global partner in supplying the materials required for this transition.

We have a clear plan and credible pathway for the long-term transformation of the sector, which has shown tremendous capacity to adapt and innovate, backed by a skilled workforce and world class institutions.

Australia's reputation as a reliable and trusted trade and investment partner will be bolstered, not just by securing the region's energy future, but by helping shape it.

Australia's resources and our critical minerals will be essential for global efforts in delivering greater renewable energy. In this process, we will be building a more sustainable, prosperous future for Australia and the world.

Our plan reflects our commitment to an ambitious and credible transition pathway, while seizing economic opportunities that will benefit all Australians.

Together, our dynamic industry and world-class researchers can build a thriving, low-emissions resources sector that works in partnership with communities and continues to deliver for Australia and the world.

The Hon Madeleine King MP
Minister for Resources
Minister for Northern Australia

The Hon Chris Bowen
Minister for Climate Change and Energy

Contents

Executive summary

Australia is a resource-rich country. The global drive towards net zero requires the production of critical minerals and metals for renewable energy and new clean and advanced technologies, and as an economy we stand to benefit.

The Resources Sector Plan outlines a pathway for Australia to continue thriving as a global exporter of resources commodities, underpinned by a set of enduring comparative advantages that support ongoing prosperity.

The nation's rich endowment of minerals and resources provides a strong foundation for production of and innovation in low emissions and clean energy embedded products. Our low sovereign risk and stable political environment have fostered sustained investment confidence. Coupled with secure trade routes and our strategic proximity to fast-growing Indo-Pacific markets, Australia maintains a well-earned reputation as a reliable and trusted exporter of energy and resources.

This plan gives an overview of the sector, emissions profile and credible abatement pathways, anchored by the Safeguard Mechanism.

To fully realise the economic and strategic potential of its natural resources, Australia must build sovereign capability in decarbonised minerals extraction and processing, as market demand for low emissions and clean energy embedded products continues to rise.

The Future Made in Australia agenda will support this new capability to strengthen global supply chains and position Australia as a reliable, value-adding export partner in low emissions commodities. New trade in critical minerals will complement existing trade in energy commodities, to ensure energy security for both domestic and international markets.

The government recognises that emissions reduction efforts are changing the way the resources sector operates. Emissions reduction in Australia's resources sector will be shaped by a mixture of evolving global commodity demand, the adoption of low emissions technology and breakthroughs in technological innovation. The Safeguard Mechanism covers 87% of the resources sector's emissions and 64% of the facilities covered by the SGM are resources operations. This places most of the sector's emissions on a predictable trajectory to net zero by 2050 and encourages emissions reductions, achievable through electrification, methane abatement and switching to low-carbon fuels where available.

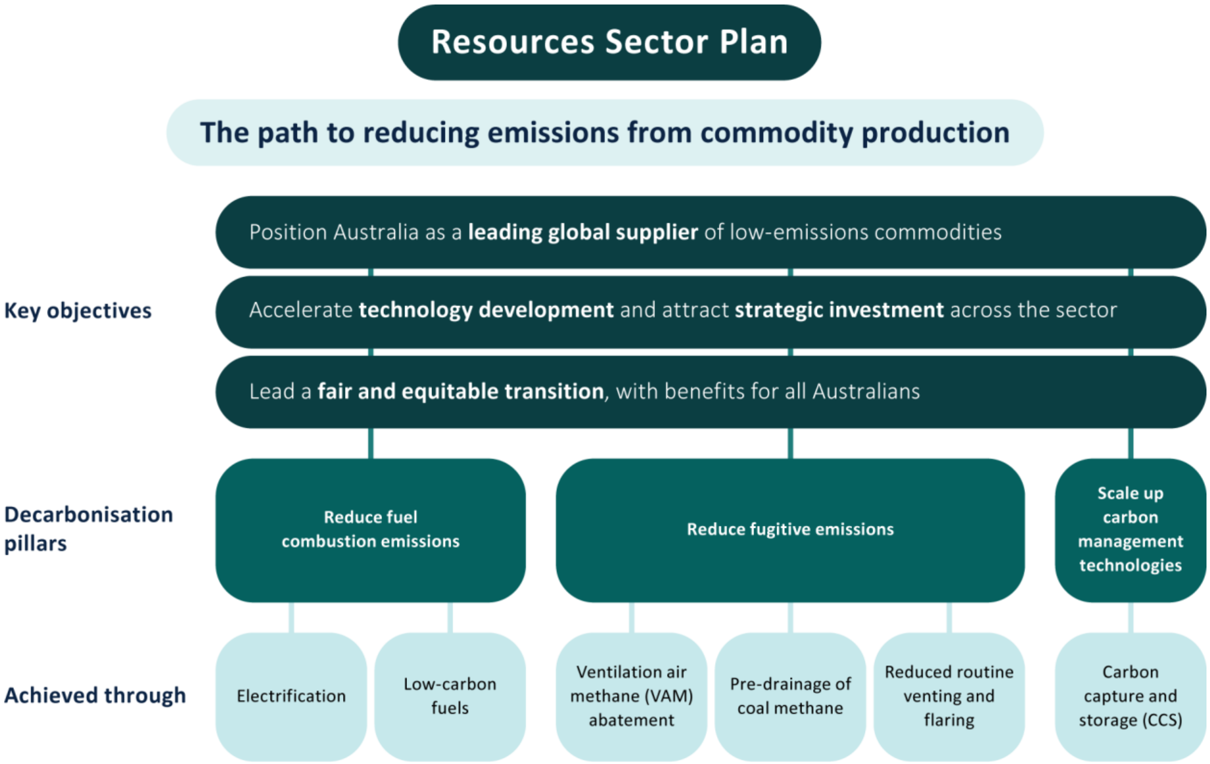
Net zero scenarios, including those set out in Treasury's modelling report, project a decline in gas trade due to a global shift to clean energy. However, gas will remain critical for energy security and it is an important transition fuel to reach net zero. The role of gas will change over time, with some sectors electrifying. Other areas of our economy and those of our trading partners, like large industrial users, power generation, and electricity firming and peaking support will still require gas over the medium to long-term. We anticipate gas use to support a growing minerals processing industry and to achieve emissions reductions amongst industrial coal users until renewable energy alternatives, like hydrogen or biomethane, are commercially available at scale. Government policy is encouraging a reduction in emissions from gas production and use, while the government's Future Made in Australia investments will help to make low-carbon alternatives like hydrogen competitive.

New technology developments and carbon management solutions will also be critical to achieve net zero. Many companies are leading the way by trialling equipment that reduces diesel consumption, minimising venting and flaring, developing their own new carbon capture technology, investing in multi-billion-dollar carbon capture and storage projects, looking at opportunities to adopt circular economy principles or investing in expanded renewable energy generation. Methane abatement technologies are an important focus for coal and gas extraction industries, with ventilation air methane abatement technology particularly important for underground coal mines, along with technology enhancements in the detection and measurement of methane emissions.

The resources sector is working on lowering its emissions intensity because demand is growing for lower emissions commodities and having a credible pathway to net zero is key to the sector's social licence. Communities affected by the transition must be supported to participate in the net zero economy. This will require inclusive planning and decision-making processes that reflect community needs, with potential to share in the benefits.

The Resources Sector Plan includes insights from consultation with a wide range of stakeholders, identifies opportunities for technology development and highlights cross-cutting considerations that must be taken into account when developing new policies. Together, the 6 sector plans and Australia's overarching Net Zero Plan harness the nation's comparative advantages to unlock the economic opportunities of the transition to net zero.

Resources Sector Plan at a glance



To 2030	• Reduced routine venting and flaring from oil and gas facilities • New resources facilities designed for electric power, and improved energy efficiency where technically and commercially feasible • Demonstration and commercialisation of electrified haulage and equipment • Demonstration of coal VAM abatement technology in Australian mines • Expansion of Carbon Capture Storage (CCS)
To 2035	• Increased electrification and energy performance across the sector • Deployment of heavy electric vehicles and equipment, with greater penetration of low-carbon liquid fuels and renewable energy in remote regions • Scale-up of coal VAM abatement technology in Australian mines • Greater use of methane pre-drainage in coal mines • Adoption of low-carbon fuels (liquid and gaseous) where electrification is not feasible • Use of CCS continues to grow
To 2050	• Widespread use of VAM abatement and pre-drainage technologies for coal mines • Continued use of low-carbon fuels • Continued use of CCS

Figure 1 – Resources Sector Plan at a glance

Introduction

Australia's resources sector significantly adds to the nation's prosperity and standard of living. It accounts for around two-thirds of Australia's total merchandise exports and is the largest industry for foreign direct investment (DISR 2025). The resources sector accounts for 22% of national emissions and must contribute to emissions reductions (DCCEEW 2025a). The sector is a major employer, predominantly across regional or remote locations, and is an important employer of First Nations people.

Australia is a world leader in the export of natural resources and energy commodities. Into the future, global demand for these commodities will shift, with forecast declines in traditional energy commodities in response to investment, technology advancement and policy settings. However, Australia aspires to be a leading exporter of the energy and mineral resources that will be crucial for the global energy transition.

Australia's continued success as a reliable exporter will depend on its ability to scale up production of the critical minerals and low-emissions commodities required for the global transition towards renewables. These exports will be key to the nation's sustained prosperity, with new opportunities emerging in critical minerals, rare earths and green metals, supported by the Future Made in Australia agenda.

The Resources Sector Plan and overarching Net Zero Plan provide policy certainty to support an uplift in investment and innovation for a successful transition. This will make sure the sector remains competitive, resilient and central to global decarbonisation.

The Resources Sector Plan: the path to a thriving sector in a net zero world

The Resources Sector Plan (RSP) is one of 6 sector plans underpinning the Australian Government's Net Zero Plan. Australia has legislated greenhouse gas emissions reduction targets of 43% below 2005 levels by 2030 and net zero by 2050. The government has just announced an emissions reduction target of 62–70% below 2005 levels for 2035. The Net Zero Plan identifies 5 priority decarbonisation actions to reduce key emissions sources across the economy:

1) Decarbonise and expand the electricity network
2) Electrify activities wherever possible and improve energy performance and materials efficiency
3) Switch to low-carbon fuels
4) Innovate to expand emissions reduction solutions
5) Scale up carbon removals to balance residual emissions

The RSP supports the Net Zero Plan and demonstrates how reducing the emissions as well as emissions intensity of the resources sector will be a vital contributor to Australia's net zero future, and its role as a global partner in supplying the materials required for this transition.

The plan builds on Australia's reputation as an attractive trade and investment destination. It outlines Australia's potential to become a reliable supplier of critical minerals, clean energy embedded products and clean energy commodities to international partners, to support their own paths to net zero.

The RSP considers the opportunities the transition presents to Australian businesses, workers and communities. It has been developed by harnessing the expertise of the Climate Change Authority (CCA), the Treasury, Geoscience Australia and the Commonwealth Scientific Industrial Research Organisation (CSIRO). It has also been informed by the analysis and sector knowledge of the Department of Industry, Science and Resources. Importantly, it has been informed by widespread engagement with a large cross-section of stakeholders.

Insights from stakeholder engagement

New technology developments and carbon management solutions will also be critical to achieve net zero. Many companies are leading the way by trialling equipment that reduces diesel consumption, minimising venting and flaring, developing their own new carbon capture technology, investing in multi-billion-dollar carbon capture and storage projects, looking at opportunities to adopt circular economy principles or investing in expanded renewable energy generation. Methane abatement technologies are an important focus for coal and gas extraction industries, with ventilation air methane abatement technology particularly important for underground coal mines, along with technology enhancements in the detection and measurement of methane emissions.

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The Resources Sector Plan includes insights from consultation with a wide range of stakeholders, opportunities for technology development and highlights cross-cutting considerations that must be taken into account when developing new policies. The accessibility of energy, whether in the form of electricity or low-carbon liquid fuels, has been a recurring theme. Together, the 6 sector plans and Australia's overarching Net Zero Plan harness the nation's comparative advantages to unlock the economic opportunities of the transition to net zero.

Scope of the Resources Sector Plan

The resources sector covers exploration and production of minerals, oil and gas, and coal resources. The sector also covers mine closure, decommissioning and rehabilitation.

Production

Production includes resource extraction and, depending on the commodity, any additional on-site processing as well as limited minerals processing. The RSP focuses on the production activities in its 3 major sub-sectors: minerals, oil and gas, and coal resources.

Mineral resources

Australia has a rich minerals endowment. In 2023, Australia ranked as top global producer for aluminium ore (bauxite), iron ore and rutile, as well as lithium which is important for battery storage technologies. Australia also hosts the largest share of economic demonstrated resources for gold, iron ore, lead, rutile, uranium, vanadium, zinc and zircon (GA 2024b). These are currently mined predominantly across Queensland, Western Australia and Victoria (GA 2022).

The government designates lists of critical minerals and strategic materials, that are essential to the global transition towards net zero. These resources support a range of strategic industrial applications. During 2023, Australia was a top 5 producer of 7 critical minerals and 2 strategic materials (GA 2024b). Australia is a world leader in reserves of key critical minerals. Under the Future Made in Australia agenda, this sub-sector will expand with the growth of critical mineral concentration and refining capability.

Oil and gas

In 2022, three-quarters of Australia's natural gas resources were produced from conventional sources, and the remaining quarter from coal seam gas sources (GA 2024f). Conventional gas can be found both onshore and offshore (CSIRO 2021) and is often co-located with liquid hydrocarbons such as crude oil, condensate and liquefied petroleum gas (GA 2024a). Comparatively, unconventional gas is the collective term for gas accumulations such as coal seam, tight and shale gas. Unconventional gas resources are currently being produced and developed in onshore basins in Australia (CSIRO 2021).

The majority of Australia's conventional gas is produced offshore in Western Australia, with approximately 93% of Australia's conventional gas resources located on the North West Shelf, offshore Western Australia. In 2022, the majority of Australia's coal seam gas was sourced onshore from the Bowen and Surat basins in Queensland. Australia also has onshore coal seam gas reserves and contingent resources in New South Wales, while pilot projects for a significant shale gas resource are currently being appraised in the Northern Territory (GA 2024f).

Over recent decades, the geographic profile of gas supply has evolved, with newer developments increasingly located in regions further from major demand centres. This shift has introduced additional transport and infrastructure requirements, which may have implications for supply costs and system planning.

Liquefied natural gas (LNG) can be produced using either conventional or unconventional gas. Australia is a leading exporter of LNG and accounted for a fifth of the global LNG trade in 2023–24 (DISR 2025). Australian gas supports our standard of living and energy security, currently providing over a quarter of our energy needs. It is needed for high-heat industrial processes and as a critical feedstock for the manufacturing industry. Australian LNG exports support and sustain millions of households and businesses across Asia and will be pivotal to the ongoing energy security of the region for decades to come.

Australia produces a small amount of crude oil, condensate and liquefied petroleum gas (LPG), predominantly in Western Australia (GA 2023b).

Coal

Most of Australia's coal production is black coal (GA 2023a). Its primarily used for 2 major applications:

- metallurgical coal, used in steelmaking
- thermal coal, used for electricity generation (GA 2024e).

In 2023, Australia had the world's largest share of metallurgical coal exports (46%), and the second-largest share of thermal coal exports (19%) (DISR 2025). Black coal is mined in several Australian states, with Queensland and New South Wales having the largest reserves (GA 2024d).

Australia's coal exports are currently largely directed to key Asian markets, including Japan, India, China, South Korea, Taiwan and Vietnam (DISR 2025). These long-standing trade relationships support regional energy security and reflect Australia's role as a reliable trading partner.

Mine closure, decommissioning and site rehabilitation

Essential to successful modern resource extraction is stewardship of the natural environment and care for country through responsible mine closure, decommissioning and rehabilitation practices.

In the context of onshore activities, this can include removing hazardous materials, stabilising structures and land restoration, with a view at supporting post-mining land use (CSIRO 2023b).

Decommissioning is the final stage in the production lifecycle. As facilities reach the end of their productive life, the leftover infrastructure must be stripped apart and removed. The offshore oil and gas industry will spend an estimated $60 billion to decommission offshore oil and gas infrastructure over the next 5 decades.

Effective rehabilitation not only reduces environmental impacts, but also contributes to improved social licence, stronger economic output for the local area, and emissions abatement from carbon sequestration achieved through land-based restoration.

An Australian decommissioning and rehabilitation industry can support Australia's move to net zero. It can support growth of domestic industrial capabilities, like recycling, which will assist in the transition. A decommissioning and rehabilitation industry will also play a key role in the continued protection of our environment by ensuring Australia continues to meet the robust environmental standards under Australian and international law.

Exploration and other mine support services

Exploration and mine support services are also part of the resources sector. These additional activities include exploration, drilling operations, mine site preparation, mine site closure operations, as well as mine rehabilitation and remediation. Together, these activities generate 1% of overall resources sector emissions (DCCEEW 2025a).

Resources sector emissions: an overview

The resources sector generated about 22% of all scope 1 emissions in Australia in 2023–24 (DCCEEW 2025a).

Scope 1 emissions are direct greenhouse gas emissions released into the atmosphere as a direct result of the activities at a facility. The RSP focuses on scope 1 emissions, as they are under the control of resources facilities.

Scope 2 emissions are indirect, for example emissions generated from an external electricity grid to provide the electricity to power a resources facility. Scope 2 emissions for the resources sector will be addressed through the outcomes of the Electricity and Energy Sector Plan.

Reducing the sector's contribution to national emissions while continuing to supply essential commodities to the global decarbonisation challenge, is key to achieving Australia's climate targets for 2030, 2035 and 2050. A breakdown of scope 1 emissions in 2023–24 by sub-sector is seen in Figure 2 below.

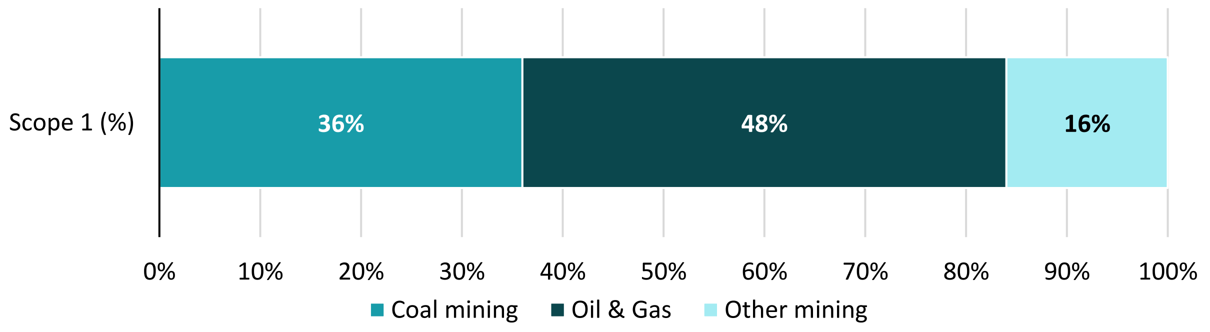

Figure 2 – Resources sector emissions, 2023–24 by sub-sector (%)

Source: *Data from* Australia's National Greenhouse Gas Inventory December 2024*,* DCCEEW*.*

Another way to consider emissions in the sector is in relation to its source. Emissions within the resources sector can be classified as being:

- **Fuel combustion emissions** which are emissions produced to power vehicles and equipment on extraction sites. The major sources of fuel combustion emissions in the sector are from diesel used in internal combustion engines (on-site vehicles and equipment) and remote power generators. They also include natural gas used in stationary energy generators in places like gas liquefaction and processing facilities.
- **Fugitive emissions** are released to the atmosphere during exploration, extraction, production and processing of energy commodities. Fugitive emissions typically arise from leaks, venting and flaring, and the release of gases from geological formations, such as methane escaping from coal seams during mining.

A breakdown of scope 1 emissions by type in 2023–24 is seen in Figure 3 below.

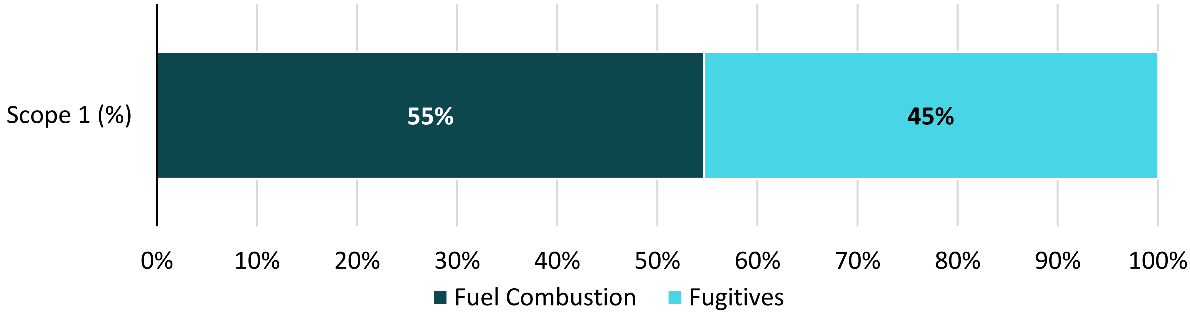

Figure 3 – Resources sector emissions, 2023–24 by emissions type (%)

Source: *Data from* Australia's National Greenhouse Gas Inventory December 2024*,* DCCEEW*.*

Emissions by sub-sector

Production of energy commodities is the greatest source of greenhouse gas emissions in the sector, followed by production of minerals. [1]

Minerals

On-site equipment and vehicles (e.g. drills, haul trucks, excavators and auxiliary equipment), powered by diesel, cause most fuel combustion emissions in minerals production.

While operating practices across the minerals sector are broadly similar, the scale of emissions from iron ore operations is significantly higher due to the sheer volume of production, especially when compared to Australia's existing strategic materials and critical minerals outputs (DISR 2025).

The minerals sub-sector is currently developing capacity for further processing, which can be energy intensive. The emissions activity from new processing activities will be partially offset by improved energy performance, which includes electrification and integration of renewable energy generation.

Fugitive emissions within the sub-sector are minimal, for example gas leaks and gases released from chemical reactions.

Oil and gas

The bulk of fuel combustion emissions in the oil and gas sub-sector come from liquefying gas into LNG (using turbines, compressors, and other specialised equipment, commonly known as 'LNG trains'), and from gas to power on-site equipment during extraction activities (Advisian 2022).

Venting and flaring of natural gas and its by-products also contribute to emissions in the gas value chain. Gas reservoirs often contain embedded carbon dioxide, which must be stripped during processing, because it cannot be liquefied or transported alongside saleable gas. The stripped carbon

[1] Note: Carbon dioxide and methane are the 2 largest sources of greenhouse gas emissions in Australia. Sector emissions of nitrous oxide and other greenhouse gases reportable under the United Nations Framework Convention on Climate Change and Paris Agreement comprised approximately 0.5 Mt CO_2-e in 2023–24.

dioxide is either discharged or 'vented' into the atmosphere (as fugitive emissions), or captured and reinjected underground for permanent geological storage via carbon capture and storage (CCS).

Flaring involves igniting the released hydrocarbons and process by-products, converting methane to mostly carbon dioxide, which has a lower global warming potential than methane. Venting and flaring can be undertaken for safety, operational and economic reasons.

Coal

Fuel combustion emissions in coal mining are typically produced through diesel and petrol consumption in heavy mining equipment (e.g. for drilling, hauling and blasting), as well as during gas flaring activities, and gas used for on-site energy generation (CER 2024).

Fugitive emissions in coal mining are predominantly methane (95%) (CCA 2024b). These emissions are the result of the fracturing of gas-bearing strata when coal is extracted (CER 2024).

Underground coal mines generate 60% of fugitive emissions in the sub-sector, with most methane released as ventilation air methane (VAM). Open-cut mines also contribute, though typically at lower concentrations (DCCEEW 2025a).

The resources sector pathway to net zero

Economic modelling and analysis by the Treasury explores plausible scenarios of Australia's transition to net zero by 2050. This work informs the development of the Australian Government's Net Zero Plan and sector plans and includes potential economy-wide and sector-specific emissions reductions pathways. The RSP considers the Baseline Scenario, in which Australia efficiently builds on existing climate policies and trends.

Under the Baseline Scenario:

- Through to 2050, Australia's commodity exports are expected to shift from hydrocarbon energy commodities towards minerals and resources essential for global decarbonisation.
- Emissions from Australia's resources sector are projected to reduce from 94 Mt CO_2-e in 2025 to 19 Mt CO_2-e in 2050. In 2050, emissions from the resources sector are projected to make up 12% of economy-wide gross emissions.

To achieve the necessary reduction in emissions while supporting energy security and increasing output through to 2050, operations in the sector will focus on lowering emissions intensity (Treasury 2025). This is especially the case for energy commodities and emissions-intensive mining activities that will continue to play a role in the transition.

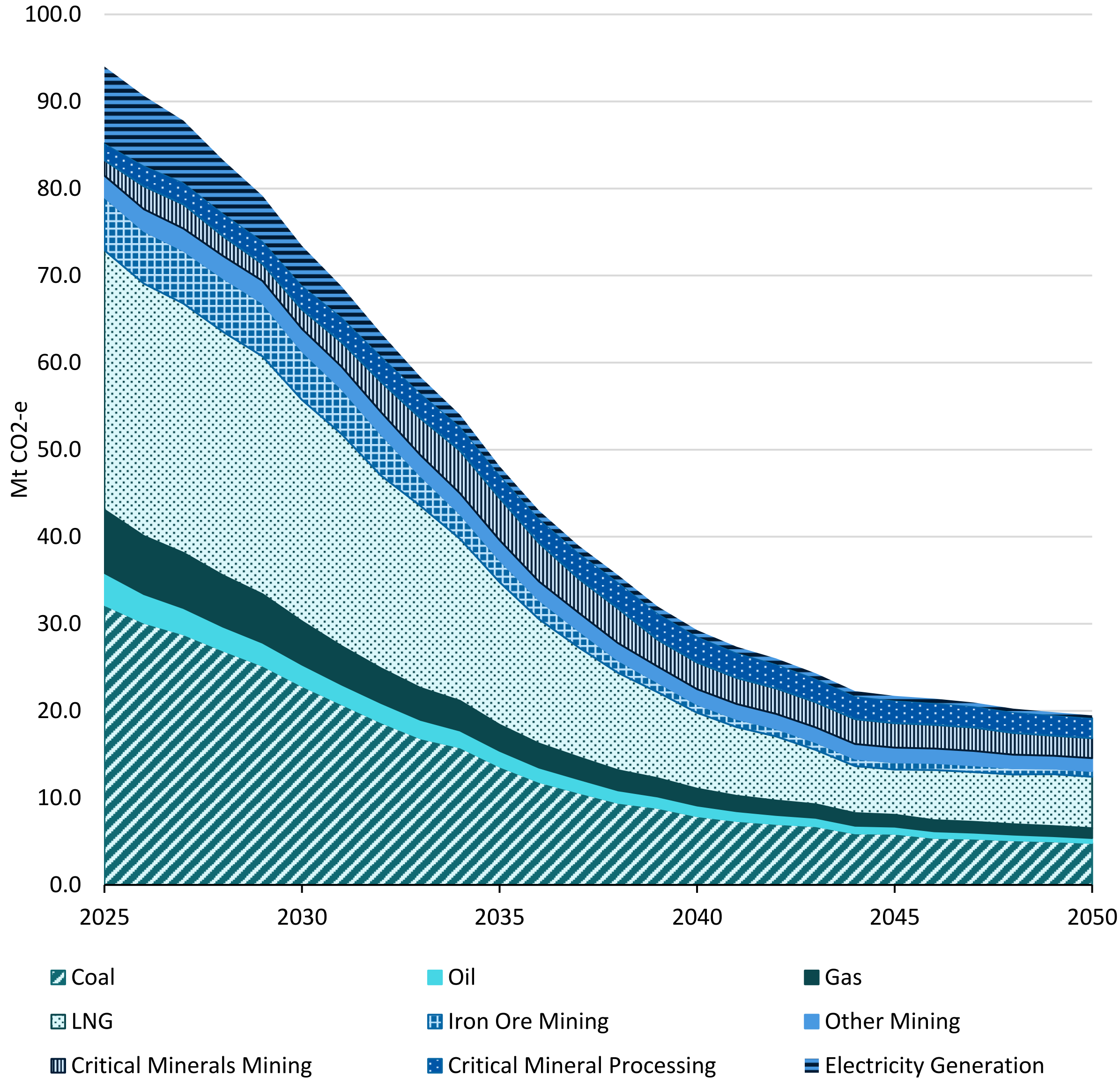

Figure 4 – Resources sector emissions projections to 2050, by commodity group under the Baseline Scenario.[2]

Source: Modelling report: Treasury (2025) *Australia's net zero transformation: Treasury modelling and analysis*, Treasury, accessed September 2025.

These declines are broadly consistent with technology pathways advice from the CCA. Government sees a credible pathway with a structural shift to production of the energy and mineral resources that will be crucial for the global energy transition, which leads to a reduction in emissions (CCA 2024a).

While scenario-based analysis is a powerful tool in helping inform Australia's net zero pathway, it is not possible to precisely predict how the transition will unfold. The future is uncertain and many factors will influence the net zero transition, including changes in technology, global dynamics and community responses.

[2] Note: In a stacked area chart, emissions are represented cumulatively. Values should be interpreted as the magnitude within each visible area, not from the baseline of the chart. *'Electricity Generation'* covers emissions from off-grid electricity generation in industries covered by the Resources Sector Plan.

Australia's energy commodities

The global shift toward clean energy and the production of clean energy-intensive commodities is expected to reduce demand for coal and gas. As a result, demand for Australia's emissions-intensive exports such as coal and LNG is projected to decline (IEA 2023b).

However, some large industrial users will continue to require gas as for several decades, and gas production will continue to maintain energy security in Australia and the region (AEMO 2024). The International Energy Agency (IEA) suggests that between 2025 and 2050, global demand for coal is projected to decrease by 71%, LNG by 40%, and oil by 42%. Despite these global projections, there will be an ongoing need for some Australian metallurgical coal and gas in 2050, and beyond. This supports investment in further development and deployment of technologies to abate emissions in these sub-sectors.

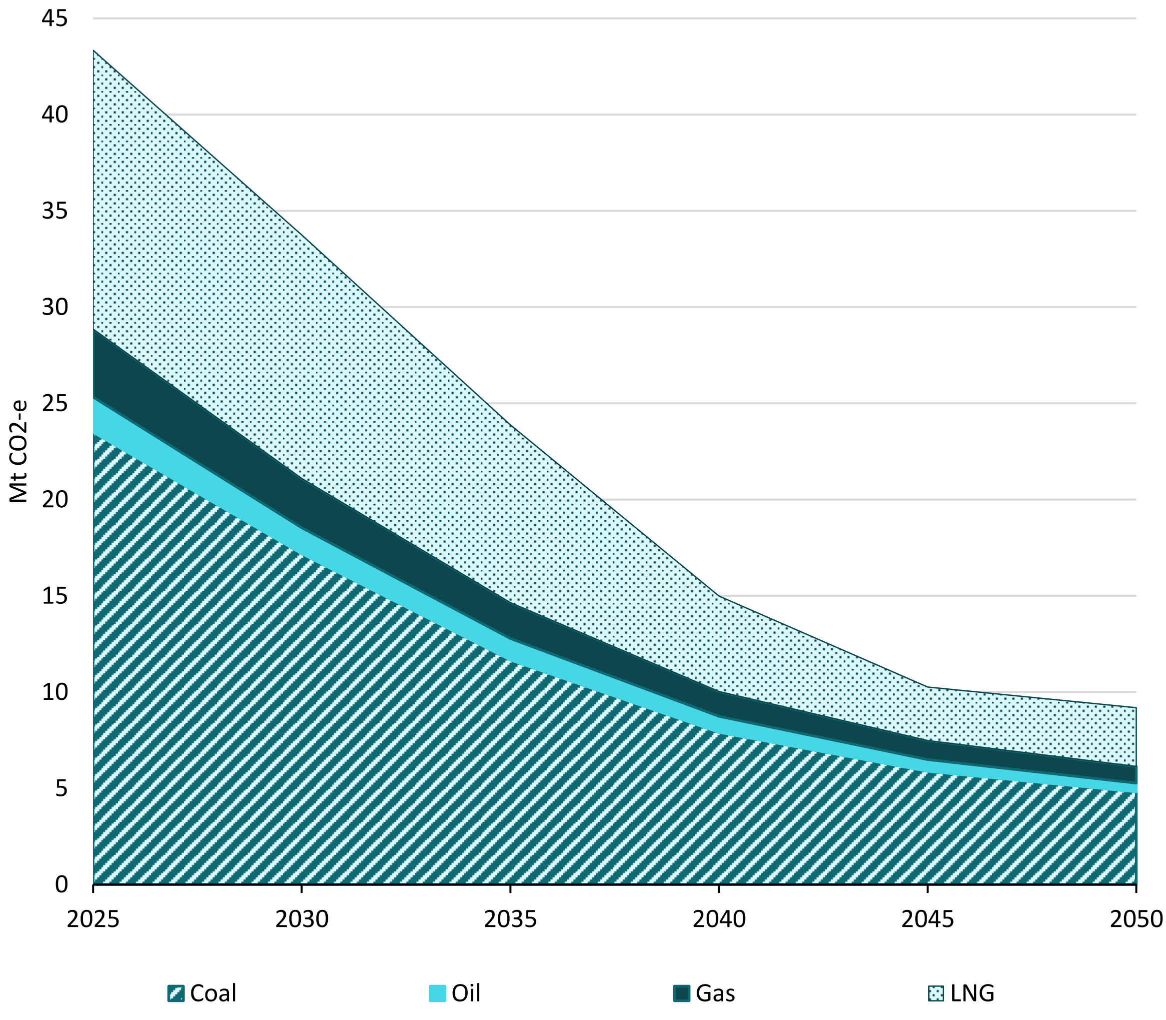

Figure 5 – Resources sector fugitive emissions projections to 2050, by commodity under the Baseline Scenario[3]

Source: Modelling report: Treasury (2025) *Australia's net zero transformation: Treasury modelling and analysis*, Treasury, accessed September 2025.

[3] Note: In a stacked area chart, emissions are represented cumulatively. Values should be interpreted as the magnitude within each visible area, not from the baseline of the chart.

Australian minerals needed for the global transition to net zero

Australia's rich endowment in minerals and metals positions us to be a leading enabler in the global transition to net zero. This creates significant economic opportunities and potential to grow the overall output of Australia's resources sector while reducing global emissions.

Global demand for the mineral commodities needed to support the net zero transition – especially critical minerals – is projected to increase rapidly. Under the International Energy Agency's Announced Pledges Scenario, demand for lithium grows around sixfold from today to 2040 while graphite demand almost triples and demand for nickel and cobalt almost doubles. Rare earth elements also grow strongly, increasing around 65% by 2040. Copper demand is projected to grow by more than 30% over the same period (IEA 2024).

While volume is expected to increase, emissions are projected to be offset by key steps taken within industry to decarbonise. This means the overall sector's emissions will decline as Australia becomes a leading supporter of global decarbonisation (Advisian 2022).

Australia's mineral resources will support the development of technologies that shape daily and industrial life in a net zero economy. Examples of demand drivers include:

- Electric vehicles (lithium, graphite and rare earth elements)
- Wind turbines (magnets from rare earths)
- Home and grid-scale energy storage (lithium and graphite)
- Rooftop and utility-scale solar systems (high purity silica)
- Low-emissions transport infrastructure (aluminium, silicon and rare earth elements)
- Low-emissions manufacturing systems (copper, nickel, cobalt, aluminium)

Australia is well positioned to meet this growing demand, with globally significant reserves of key minerals and metals, and a policy environment that supports expansion of supply capacity.

The Future Made in Australia agenda is accelerating investment in critical minerals processing and refining, including through initiatives such as the Critical Minerals Production Tax Incentive and finance options such as the Critical Minerals Facility, managed by Export Finance Australia. These are designed to mobilise private capital and build sovereign capability in strategic supply chains.

Practical actions to reduce emissions in the sector

The Australian resources sector has and will continue to capitalise on new technologies, systems and approaches to managing its own emissions. The pathway to net zero will be enabled by 3 trends:

- reducing fuel combustion emissions
- reducing fugitive emissions
- scaling up carbon management technologies.

Reducing fuel combustion emissions

Energy efficiency | Demand flexibility | Electrification or fuel switching

Reducing fuel combustion emissions is a key priority for the resources sector, given the scale of diesel and gas use across extraction and processing activities. Electrification and fuel switching are credible pathways for many companies, including through the adoption of low-carbon fuels such as renewable diesel and other low-carbon liquid fuels where renewable infrastructure is not available. Energy performance will underpin emissions reductions at the lowest cost within the sector (DCCEEW 2024d).[4]

The sector will pursue innovative technologies to improve energy performance, focusing on efficiency in extraction and processing, precision in resource mapping, and operational optimisation (MCA 2017). These improvements will help reduce emissions, energy usage and operating costs.

Electrifying vehicles and equipment across resources facilities will significantly reduce diesel consumption, which currently accounts for most energy use on-site (in 2020–2021, 95% for mine sites) (Advisian 2022). Electrification enables the sector to leverage firmed renewable energy capacity, including within major grids across Australia. The sheer scale and distance of some on-site operations, such as train and large vehicle haulage across expansive mine sites, presents a substantial technical and logistical challenge. Analysis from research and stakeholder engagement suggests that electrified haulage options are rapidly improving, with broader uptake expected over the next

[4] Note: Energy performance is the broad management of energy demand, including energy efficiency, electrification or fuel switching and demand flexibility.

decade. This trajectory reflects the sequencing challenges posed by existing asset lifecycles and the infrastructure requirements necessary to support electrification.

Given many resources facilities are located in remote locations with limited grid access, off-grid solutions may offer a practical and effective decarbonisation pathway in many cases. The sector is currently collaborating with technology and service providers to accelerate innovation and deployment of electrified solutions.

Operators are increasingly partnering with energy providers and independent power producers to deploy off-grid systems powered by renewables. As renewable energy capacity at remote sites becomes more resilient and efficient, mining operations will be able to deploy electrified vehicles and equipment at scale.

Other operations (in particular, but not exclusively, offshore facilities) are unable to develop on-site renewable generation or connect to larger electricity grids due to location, cost associated with transmission or environmental constraints. In these cases, facilities will need to meet any applicable decarbonisation requirements by pursuing the most economically viable options available to them.

While long-distance freight emissions and electricity transmission infrastructure fall outside the scope of this plan, they are critical enablers of the transition and are addressed in the Transport and Electricity and Energy Sector Plans respectively.

Low-carbon fuels will offer an alternative to diesel and natural gas, particularly where electrification is not feasible, such as in remote areas where transmission infrastructure is too expensive to deploy. These fuels are a valuable decarbonisation option, with examples including biodiesel, renewable diesel, ammonia-based fuels and hydrogen.

The Australian Government is taking steps to accelerate the growth of domestically produced, cost-competitive low-carbon fuels under the Future Made in Australia agenda. To build a supply chain for Australian low carbon liquid fuels, the Australian Government will invest $1.1 billion in a new Cleaner Fuels Program. This will help stimulate private investment in Australia's first onshore low carbon liquid fuel refineries, backing local innovators, making fuel supply more resilient and bridging the price gap for early adopters. The government will engage with industry on how to make sure Australian liquid fuel users have a fair chance to capture the emissions reduction potential unlocked by low-emission Australian fuels. More detail can be found in the Net Zero Plan and Electricity and Energy Sector Plan.

Gas as a chemical feedstock to manufacturing processes cannot be electrified and will require direct substitution. Altering the feedstock used in a process is not straightforward, as chemical processes are typically fully integrated into the facility. This means investment in new infrastructure and supply chains will be required. Transition is likely to require a change to the whole operation rather than a gradual change to the facility. Such changes involve significant capital outlays and require extensive testing and planning.

Treasury's Baseline Scenario indicates that in 2050, fuel combustion emissions in the sector will reduce to around 20% of what they are in 2025, as seen in Figure 6 below.

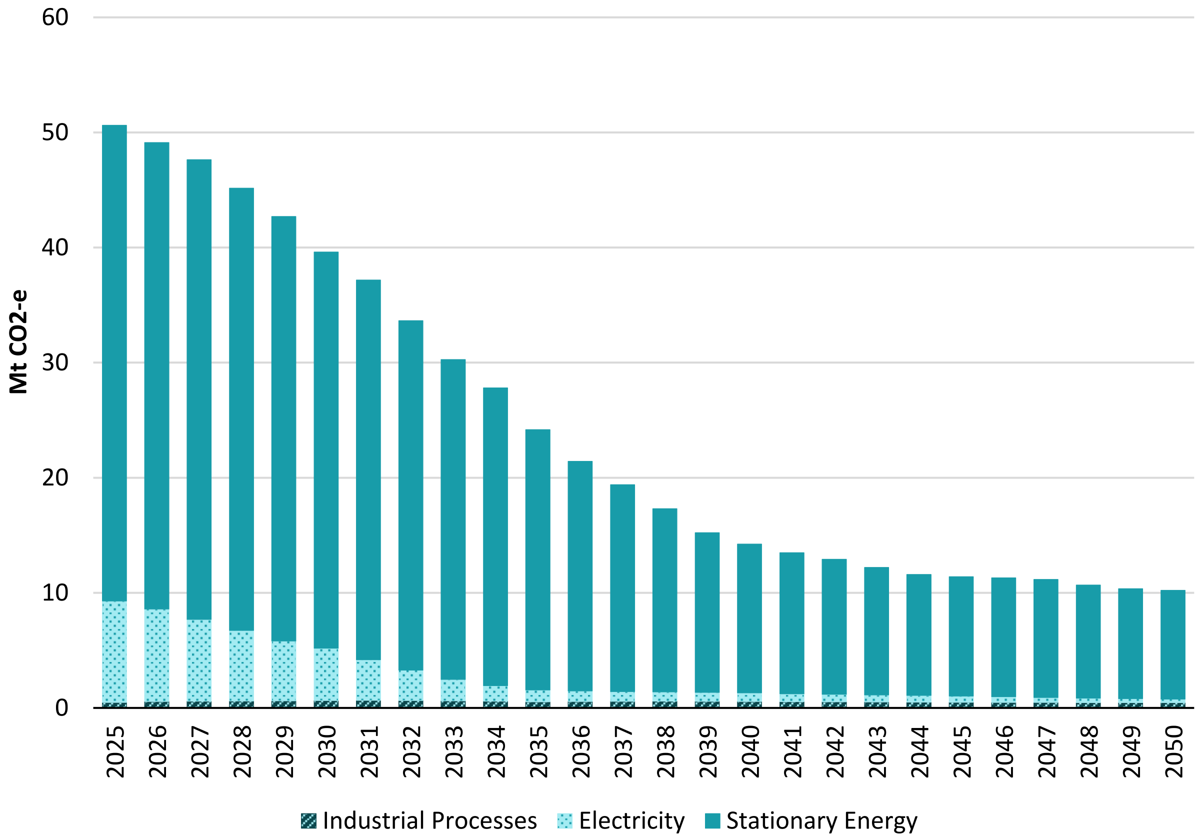

Figure 6 – Total sector fuel combustion emissions projections to 2050, by UNFCCC category under the Baseline Scenario

Source: Modelling report: Treasury (2025) *Australia's net zero transformation: Treasury modelling and analysis*, Treasury, accessed September 2025.

Reducing fugitive emissions

Pre-drainage

VAM abatement

Reduced routine venting and flaring

Leak detection and repair

Fugitive emissions remain one of the most complex and critical challenges in the resources sector's pathway to net zero. Each tonne of methane released has the same warming effect as 28 tonnes of carbon dioxide over 100 years (IPCC 2014). Australia is a signatory to the Global Methane Pledge and is committed to reducing methane emissions across energy commodities production.

New approaches to estimating fugitive methane emissions by combining atmospheric detection of methane with modelling and other analysis involving aerial imaging (top-down approaches) are being developed. The Australian Government has appointed an expert panel to examine these new approaches and advise whether they could enhance Australia's estimation of fugitive methane emissions (DCCEEW 2025b). Better detection and measurement of methane is also important to addressing methane emissions, such as through leak detection and repair.

The sector is also taking steps to reduce its methane emissions. During the 28th Conference of Parties (COP28), 50 global oil and gas companies (including some operating in Australia) committed to net zero operations by 2050 and ending routine flaring by 2030 under the Oil & Gas Decarbonisation Charter.

As energy production continues, reducing fugitive emissions from the coal and gas sub-sectors can make a significant difference in the pathway to net zero. In the coal sub-sector, 95% of fugitive emissions are made up of methane. In contrast, oil and gas operations tend to release more carbon dioxide, with 68% of fugitive emissions from oil and gas extraction being carbon dioxide in 2024 (DCCEEW 2024b).[5]

Coal

Abating coal mine methane is a major opportunity to reduce fugitive emissions in the coal sub-sector, with underground mines responsible for the majority of production-related methane (CSIRO 2025a). Most of these emissions come from ventilation air methane (VAM), which is currently difficult to mitigate due to low and variable methane concentrations and complexity in meeting safety requirements (NSW Resources 2025).

The government is actively supporting a VAM abatement project using regenerative thermal oxidation technology under the Powering the Regions Fund. This project is intended to demonstrate that the abatement of VAM emissions for underground gassy mines safely is possible, providing a replicable pathway for many underground gassy mines to materially reduce their emissions (GrantConnect 2024).

The sector is exploring other approaches such as pre-mining drainage for open-cut mines (CCA 2024a), and new ways of safely oxidising methane (CSIRO 2025b).

The Australian Government will continue to work closely with state governments and their agencies on coal mine methane abatement, particularly to help ensure new technologies, such as for VAM, can be safely and efficiently deployed. State government agencies also regulate coal mines, including in relation to the implementation of abatement technologies for waste coal mine gas.

Oil and gas

Fugitive emissions in the oil and gas sub-sector can be reduced by minimising or eliminating venting and flaring. Technologies to reduce the incidence or intensity of venting and flaring include process and infrastructure optimisation, gas and vapour recovery and utilisation, and use of flaring instead of venting when gas capture is not commercially viable.

The Future Gas Strategy committed to reducing and, where possible, eliminating venting and flaring of gas, unless required for safety purposes. A consultation process occurred in March 2025 and offshore policy and regulatory settings are being assessed, to implement this commitment. The

[5] Note: DISR data processed by National Inventory Systems and International Reporting Branch of DCCEEW and the Analysis and Insights Division at DISR.

Australian Government will continue to work with state and territory governments on their equivalent regulatory regimes.

Leak detection and repair and monitoring programs can also contribute to emissions reduction in the oil and gas sub-sector while maximising gas outputs for energy production. Spectral gas imaging is widely used to detect leaks, and continuous monitoring devices will be increasingly used to allow for rapid detection and rectification of leaks (IEA 2023a). Innovative robotics and remote operations can also lead to more safe and cost-effective leak detection and remediation. The oil and gas industry should continue to pursue and invest in innovative solutions to minimise emissions from leaks, alongside regulatory approaches.

Scaling up carbon management technologies

Carbon management refers to a suite of technologies and processes that help to remove, reduce or reuse carbon dioxide and other gases. The most applicable for the resources sector is carbon capture and storage (CCS).

Other carbon dioxide removal technologies continue to be a focus for development through the CSIRO, brought together through the CarbonLock Program (CSIRO 2024). Technologies applicable to the resources sector such as enhanced mineralisation from tailings are actively being developed in partnership with industry, for example a pilot carbon mineralisation project using mine tailings at BHP’s Mount Keith Nickel West Mine in Western Australia (Austrade 2024).

Carbon capture and storage

Australia has several comparative advantages when it comes to CCS. Our geology, landmass, existing regulatory frameworks, existing infrastructure and expertise, and potential for cheap, renewable energy resources all offer opportunities for domestic and international transport and storage of CO_2 (CSIRO 2023a).

CCS can address industrial and point-source emissions that cannot otherwise be avoided.
CCS projects can reduce emissions from resources sector activities by capturing and storing reservoir carbon dioxide that would otherwise be emitted during gas production.

Australia is home to one of the largest CCS facilities in the world (Gorgon, at Barrow Island, off the coast in Western Australia). Another large-scale CCS project has recently been commissioned (Moomba, in South Australia) and a third project has just been granted major project status (Bonaparte, in the Northern Territory).

According to the International Energy Agency, CCS as well as carbon, capture and use (CCU) could be responsible for abating around 20% of global emissions required to reach net zero by 2050 (IEA 2021). While the IEA notes that progress on CCS has been slower than needed to meet this ambition and there have been technical challenges to overcome with these significant engineering projects, the scale of the opportunity remains significant. CCS is used in almost every model pathway assessed by the IPCC that reaches net zero emissions – including in pathways which assume a high uptake of renewables. Australia is therefore well placed to capitalise on the scale-up of this technology, widely recognised as essential to reach net zero.

The government's role in the development of CCS is focused on the regulatory frameworks to facilitate its deployment, such as the Safeguard Mechanism, and offshore regulatory framework for its safe operation. Emissions accounting and verification is also assessed under the National Greenhouse and Energy Reporting Scheme. Offshore CCS activities are regulated under several pieces of Commonwealth legislation including the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* and the *Environment Protection (Sea Dumping) Act 1981.*

Offshore CCS opens the door to new trade opportunities, leveraging Australia's geological capacity to enter new international markets for transboundary CO_2 storage. Through the Regional Cooperation Initiative on Carbon Sequestration, the Australian Government is working collaboratively with key regional and partner countries to establish bilateral instruments to facilitate transboundary CCS.

International volumes of CO_2 could generate the economies of scale needed to help reduce the cost of CCS. This would make CCS a more accessible option for Australia's domestic industries while also helping the economies of Australia's trading partners

Table 1 – Large-scale CCS projects in Australia

Project	Capacity	Status
Gorgon	Up to 4 Mtpa (over 100 Mt total)	Stored over 11 Mt since 2019
Moomba	1.7 Mtpa, potential for 20 Mtpa	Stored 1 Mt since September 2024
Bonaparte	Capacity over 10 Mtpa	Major project status, injection to commence around 2030

Mtpa = million tonnes per annum.
Source: (Chevron Corporation 2025), (Santos 2025), (Inpex 2025)

More projects are currently at various stages of development. It is estimated that Australia has approximately 31 Gt of sub-commercial storage capacity and 470 Gt in undiscovered storage resources (GA 2024c).

Framework supporting net zero

Australia's resources sector will undergo a significant transformation towards a net zero economy. This transition benefits from a strong foundation of existing policies, but will require coordinated action across governments, industry and communities. Together, these actions will ensure that proponents contribute to emissions reductions while maintaining energy security and economic resilience.

To guide future policy and investment, the Australian Government will consider core objectives to drive economic transformation, alongside emissions reduction.

- Position Australia as a leading global supplier of low-emissions commodities and commodities needed for the global net zero transition
- Accelerate technology development and attract strategic investment across the resources sector
- Lead a fair and equitable transition, with benefits for all Australians.

These objectives will shape the next phase of the sector's transition and ensure that future actions build on existing momentum.

They complement existing government policies such as the Safeguard Mechanism and the Future Gas Strategy, which encourage the resources sector to reduce emissions. State and territory governments also play a critical role, working alongside the Australian Government to achieve national climate targets. The objectives are also aligned with the Critical Minerals Strategy, which outline the government's ambition to grow the resources sector and provide a secure and diversified supply of critical minerals needed for net zero.

The Safeguard Mechanism

The Safeguard Mechanism (SGM) will play a central role in driving emissions reductions in the resources sector. The scheme applies to most of the sector, with 87% of emissions from the sector covered in 2023–24 (see Figure 7 below). It gives industry, including the resources sector, a clear and enduring incentive to undertake cost-effective emissions reductions.

The SGM sets limits on scope 1 emissions, known as baselines, on industrial facilities emitting more than 100,000 tonnes of CO2-e per year. Baselines will decline predictably and gradually on a trajectory aligned to Australia's 2030 and 2035 emissions reduction targets and net zero by 2050. Over time, declining baselines will provide facilities with increasing incentive to develop and pursue decarbonisation pathways to reach net zero by 2050. The best practice arrangements for new entrants help ensure that the expansion of the resources sector does not compromise the achievement of Australia's emissions reduction targets. These include net zero baselines for new shale gas facilities and for reservoir carbon dioxide emissions from new gas fields.

Where new projects are approved under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), information about their emissions is provided to the Climate Change Authority and Secretary of the Department of Climate Change, Energy, the Environment and Water for assessment of their impacts on the delivery of the Safeguard Mechanism objectives. These objectives include a cumulative emissions budget for the 10 years to 2030, a 100 Mt net emissions target for

2030 and a requirement for gross emissions of all facilities to decline over time (assessed on a 5-year rolling average basis).

The resources sector makes up the majority of facilities covered under the Safeguard Mechanism (64% in 2023–24).

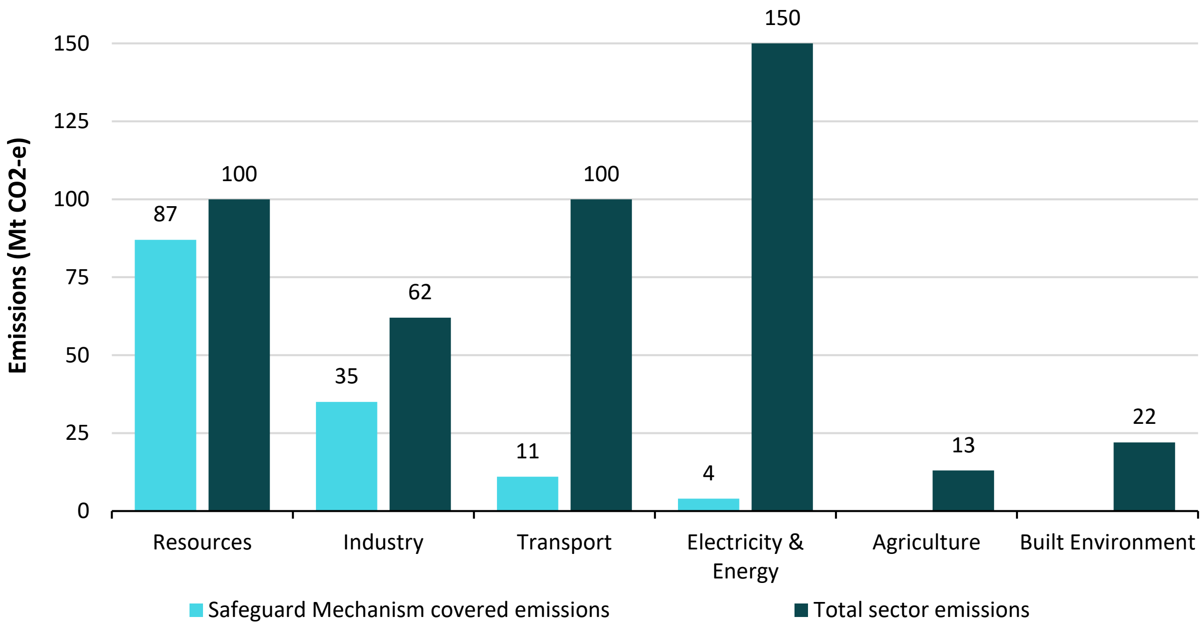

Figure 7 – Safeguard Mechanism emissions coverage by economy sector in 2023–24

Source: Data from Australia's National Greenhouse Gas Inventory – December 2024, DCCEEW; 2023–24 Safeguard Mechanism data, CER.

To ensure the SGM is appropriately calibrated to help Australia reach its emissions reduction targets, including the 2035 target of 62–70% below 2005 levels, the government will conduct a review of the Safeguard Mechanism in 2026-27. In addition to the targets, the Safeguard Mechanism also has a number of legislated outcomes that must continue to be met, including ongoing reduction in total on-site emissions across all facilities and maintaining a material incentive for on-site emissions reductions.

The Future Gas Strategy

The Future Gas Strategy (FGS) is the Australian Government's plan for how gas can support the energy transition to net zero by 2050 and beyond. The FGS outlines guiding principles to underpin government policies and actions as we move towards a net zero economy, and signals the government's commitment to reducing and, where possible, eliminating venting and flaring of gas, unless required for safety purposes.

The FGS also acknowledges the important role geological storage of carbon dioxide through CCS will play to support our region's transition to net zero, by enabling transboundary carbon storage. It also helps ensure that emissions are managed to help achieve net zero, while allowing consumer choice in selecting sources of energy for Australian homes and businesses.

Coordination with state and territory governments

State and territory governments play a key role in the transition, as they each regulate resources activities within their jurisdictions and strive to meet their own climate targets. There is opportunity to work across all levels of government to streamline project approvals, giving proponents more certainty. This would result in increased productivity while striving for a common net zero goal, with benefits shared with local communities. Cooperation on methane abatement, including safe deployment of new technology, is another focus of activity.

Unlocking investment and innovation

To accelerate the transition towards a net zero economy while strengthening Australia's global competitiveness, the government has deployed a diverse array of initiatives to crowd-in private investment and stimulate innovation across the economy, with a direct impact on the resources sector. These include targeted funding programs, tax incentives, and specialist investment vehicles that support emerging industries such as low-carbon fuels and critical minerals processing.

Complementary initiatives like the Capacity Investment Scheme and Australian Renewable Energy Agency (ARENA) are accelerating innovation and renewable electricity uptake across the resources sector. Export Finance Australia's Critical Minerals Facility, the Northern Australia Infrastructure Facility, the Critical Mineral Production Tax Incentive and the newly announced Critical Minerals Strategic Reserve will help unlock investment into the strategic growth of the critical minerals sector. The Safeguard Transformation Stream of the Powering the Regions Fund provides additional support for emissions abatement, including reductions in fugitive emissions in the coal sub-sector. The Industrial Transformation Stream of the Powering the Regions Fund administered by ARENA has also funded a range of resources sector projects, including electrification of mining operations.

These initiatives alongside the Future Made in Australia agenda enable Australia to grow and leverage opportunities in the resources sector towards a net zero economy.

The role of industry and the research and development system

Offsetting is available where on-site abatement is not yet technically or economically viable. Industry recognises that reliance on offsets is not a long-term solution. As policy settings evolve and technology costs fall, a shift toward direct emissions reduction is increasingly economic, underscoring the importance of identifying and investing in commercially viable abatement solutions sooner rather than later.

Industry-led initiatives, often in collaboration with research institutions look to innovate in emissions abatement technologies (ACARP 2025). These have reached various levels of technology readiness, and it is imperative that private investment continues to support these innovations to scale up and commercialise.

Accelerating the commercialisation of low-emissions technologies will rely on continued industry innovation in close collaboration with energy providers, original equipment manufacturers, the mining equipment, technology and services (METS) sector, universities, and private equity. These partnerships are essential to move promising innovations from pilot to scale.

The METS sector plays an important role in decarbonising the resources sector by deploying more energy-efficient machinery as well as electric equipment to replace machinery powered by diesel. It also contributes expertise to optimise processes and plan the transition to low-emissions technology at individual sites.

Links with other sector plans

The Australian Government recognises that not all sectors within the economy will achieve the same rate of decarbonisation at the same time. There are significant dependencies between the different sectors, which need careful coordination and sequencing to meet national targets in a cost-effective way.

The 6 sector plans have been informed by engagement with industry, the community, experts and governments. Collaboration between agencies gives whole-of-government coverage on aspects of mutual interest.

Outcomes from the Electricity and Energy Sector Plan will have a direct impact on the pace of decarbonisation in the resources sector. Expanded electricity networks, with increased capacity to power heavy industries, will enable electrification of resources operations. The availability of low-carbon fuels at a competitive price will reduce reliance on diesel for activities that cannot be electrified.

The resources sector will provide the critical minerals and iron ore required to produce renewable energy, and the gas to firm supply. These are direct enablers of the Electricity and Energy Sector Plan. In addition, iron and other metal ores will be the foundation to produce green metals, contributing to the Industrial Sector Plan. Australia will need to increase production of these resources, which represent an important economic opportunity as they are essential inputs for a decarbonised world.

Enabling the transition

Enabling the resources sector's transition to net zero requires more than emissions reduction. A successful transition will stimulate positive system-wide change.

Workers, financial systems, First Nations partnerships, innovation, and regional resilience, are all integral to the transition. This level of industrial transformation needs inclusive, coordinated, and future-focused action. These considerations shape the conditions for success and ensure the transition is not only technically feasible, but socially and economically sustainable.

Enabling social licence and community benefits

First Nations people and communities

Building and promoting First Nations partnerships is critical to the resources sector's ability to attract the renewable and carbon abatement investment necessary to build the pipeline of projects required to meet net zero by 2050. International demand for critical minerals is expected to increase significantly. Meeting this demand is likely to require access to land subject to Native Title claims or determinations, which calls for respectful engagement and partnership with First Nations communities (DCCEEW 2024c).

All levels of governments are working with First Nations Peoples, communities, organisations and businesses to implement the 2020 National Agreement on Closing the Gap at the national, state and territory, and local levels. This approach acknowledges that First Nations Peoples should determine, drive and own the desired outcomes, alongside government.

A recent study highlights that 57.8% of critical minerals projects that produce 14 key commodities are in areas where First Nations peoples hold negotiation rights (Burton et al. 2024). When Native Title claims are considered, this figure rises to 79.2%, underscoring the importance of early, inclusive and respectful engagement with First Nations communities for a thriving resources sector, and for a successful and equitable net zero transition.

Communities and the transition

Remote and regional communities are uniquely positioned to benefit from Australia's net zero transition, with opportunities to attract investment and diversify local economies. However, realising this potential requires addressing infrastructure gaps, workforce challenges, and social disadvantage.

As the economy decarbonises and transitions away from coal as an energy source, there will be an impact on regional communities. The Net Zero Economy Authority (NZEA) is promoting an orderly and positive economic transformation in Collie (Western Australia), the Hunter Valley (New South Wales), La Trobe (Victoria), Central Queensland and Upper Spencer Gulf (South Australia).

The Australian Government through the Net Zero Economy Authority can help build economic resilience by supporting enabling infrastructure, fostering inclusive workforce participation, and encouraging stronger engagement between industry and communities. National policy settings and market signals must reflect regional needs to ensure these areas share in the long-term prosperity of the transition. The aim is to ensure the transition works to the benefit of communities that have enabled Australia’s high standard of living and reliable power supply for many decades.

More broadly, by signalling a commitment to climate action, the government encourages investment in clean energy and low-carbon technologies to create a positive economic transformation in regional areas, where workers and communities, including First Nations people, can realise and share the benefits of the future net zero economy.

Supporting workers, communities and families through regional workforce transition plans will help to ensure an inclusive and fair transformation, critical for a successful net zero transition.

Workforce, skills and jobs

Decarbonisation will provide employment opportunities, supported by reskilling or upskilling of existing workers to transition into the renewable energy industry. The expansion of a clean energy workforce is integral towards net zero by 2050.

Addressing skills gaps requires a coordinated effort from governments, educational institutions, industry associations and employers to develop comprehensive and accessible education and training programs.

The Australian Government is committed to tackling skills shortages by funding the training system Australia needs, with TAFE at the heart of the system. Universities have a significant role to play, not only in providing graduates but in undertaking the research and development essential for Australia to realise its net zero targets. To achieve decarbonisation through increased energy optimisation and efficiency, it is important to recognise that these are fundamentally productivity challenges.

Increasing the participation of women in the workforce should be advanced as part of a gender responsive approach (KPMG 2018). Women currently make up just 22% of the mining workforce, are overrepresented in lower paid occupations, and the gender pay gap currently sits at 16.6% (WGEA 2024).

The resources sector will need to support the equitable participation of women and other underrepresented groups to secure the skilled workforce that’s needed for net zero, in alignment with the government’s ambitions in *Working for Women: A Strategy for Gender Equality*, to make industries less gender segregated. Greater participation of women across occupations in the resources sector will also support industry scale up to meet supply chain demand and benefit from the increased innovation and productivity that a more gender equal workforce can bring (PM&C 2024).

Unlocking more value out of existing resources

The circular economy presents an opportunity to harness the full value of our resources. Circular practices within the sector will play an essential role in lowering energy demand and associated emissions, by improving resource efficiency. This refers to how efficiently materials are used at all stages of the mining lifecycle.

Australia's mining sector has an ongoing history of repurposing mining byproducts and waste, with initiatives such as Geoscience Australia’s Atlas of Mine Waste helping to identify opportunities to recover critical minerals and reduce environmental impacts (GA 2025).

Utilising mining byproducts and waste, such as tailings, provides an opportunity to alleviate pressures associated with the extraction of virgin materials and reduce Australia's carbon footprint. Moving towards a circular economy is critical from both supply security and environmental perspectives and provides the basis for a sustainable and competitive economy.

Australia's Circular Economy Framework provides the policy blueprint for driving Australia's circular economy transition (DCCEEW 2024a). It includes an overarching goal of doubling circularity by 2035 and sets clear priorities and targets to reduce waste and keep materials in our economy for as long as possible. The framework identifies resources as one of 4 priority sectors that will drive the transition and deliver on our net zero, environment and economic agendas.

Mobilising private capital for sustainable finance

Sustainable finance can support the sector's net zero transformation. It can assist in funding climate mitigation and adaptation efforts, such as through financing more efficient, low-emissions technologies.

The Australian Sustainable Finance Taxonomy provides common definitions for sustainable economic activities, helping to drive private investment and support Australia's path to net zero emissions. The Taxonomy includes key mining and metal activities, particularly those with a role in the transition.

The government will publish best practice transition planning guidance in 2025. The voluntary guidance will complement Australia's climate-related financial disclosures regime and help organisations navigate existing international frameworks and relevant domestic considerations for robust transition planning.

Moving forward to a net zero resources sector

The RSP provides the foundation for the Australian resources sector to make a significant ongoing contribution to reducing the nation's emissions and assisting the domestic, as well as the global supply chain transition to net zero.

Resources decarbonisation will be an ongoing process driven by implementation of emissions reduction and carbon management technologies combined with a structural shift in the type of commodities the world demands. While there is uncertainty in the projected rate of change, there is no doubt on its direction – a low-emissions Australian resources sector supporting net zero globally.

Alongside Australia's Nationally Determined Contributions under the Paris Agreement, with the target of 62–70% reductions by 2035 being the latest, this plan will undergo periodic review to ensure its settings continue to support a credible and coordinated pathway to net zero. While emissions reduction targets have been in place for some time, we are now approaching our first legislated milestone on the path to net zero. Coordinated work between governments, industry, workers and regional communities will be essential to support the sector through this transformation.

The journey to net zero will require sustained effort, innovation and partnership to remain a source of strength and opportunity to deliver for industry, investors, communities, workers and trading partners in a decarbonising world.

Glossary

Term	Definition
AEMO	Australian Energy Market Operator
ARENA	Australian Renewable Energy Agency
CCA	Climate Change Authority
CCS	Carbon capture and storage
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide equivalent
COP	Conference of the Parties (United Nations Climate Change Conference)
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DISR	Department of Industry, Science and Resources
EPBC	*Environment Protection and Biodiversity Conservation Act 1999*
FGS	Future Gas Strategy
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
METS	Mining equipment, technology and services
NZEA	Net Zero Economy Authority
PM&C	Department of the Prime Minister and Cabinet
RSP	Resources Sector Plan
VAM	Ventilation air methane
WGEA	Workplace Gender Equality Agency

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Australian Government

Transport and Infrastructure Net Zero Roadmap and Action Plan

Transport Sector Plan

September 2025

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Acknowledgement of Country

We acknowledge the Traditional Owners of Country throughout Australia and recognise their continuing connection to land, waters and culture. We pay our respects to their Elders past and present.

We thank First Nations people for their continuing custodianship of, and care for, the Country that we live and work within today. It is fitting to reflect on the thousands of generations of traditional knowledge First Nations people hold, and generously share, as we look to decarbonise how we move people and goods across Australia.

We acknowledge the diversity of First Nations cultures, languages and practices across the country and the resilience of First Nations people in keeping these alive. We recognise the importance of listening to local First Nations people and responding to the uniqueness of each place.

We are committed to working in partnership with First Nations people in meeting current and future challenges and achieving opportunities, including through the net zero sector plans.

Contents


TRAMWAY
TRAMS EXCEPTED

Ministers' foreword

Transport shapes our cities and regions. It supports economic and social development and determines how we can engage with the communities around us. Today, the transport sector emits 22% of Australia's annual carbon dioxide equivalent gas emissions. If we do not act, transport emissions are on track to be the largest source of greenhouse gas emissions in Australia by 2030. Ensuring the transport sector is fit for our net zero future is essential.

Decarbonising the transport sector also brings other benefits and opportunities beyond mitigating climate change. This includes consumer savings through electric vehicles that offer savings on lifetime costs; increased fuel security through decreased demand for fossil fuels and the development of a domestic low carbon liquid fuel sector; export opportunities for low carbon transport infrastructure materials and low carbon liquid fuels; health improvements due to reduction in noxious tailpipe emissions and increased use of active transport; and productivity gains from optimising passenger and freight network routes and nationally coordinating infrastructure decarbonisation policies.

The Transport and Infrastructure Net Zero Roadmap and Action Plan is one of 6 sector plans that supports the Government's Net Zero Plan, to ensure Australia maximises the benefits of the global transition to net zero and provides long-term policy certainty to drive investment in low emissions and renewable technologies.

This Roadmap and Action Plan has been informed by feedback, insights and analysis provided through public and industry consultations, as well as the Climate Change Authority's Sector Pathways Review and analysis and modelling from the Treasury. In response to the Transport and Infrastructure Net Zero Consultation Roadmap released in May 2024, we received 284 written submissions, and 28 targeted consultation sessions were held, with engagement from 166 organisations and over 400 participants.

The Roadmap and Action Plan establishes a policy direction that benefits all Australians. It will build on initiatives introduced by the Australian Government to reduce emissions in the transport and infrastructure sectors. These initiatives include: increasing the uptake of electric and more efficient vehicles through the National Electric Vehicle Strategy and an Australian New Vehicle Efficiency Standard; as part of our Future Made in Australia agenda, fast-tracking support for a low carbon liquid fuel industry, with an initial focus on sustainable aviation fuel and renewable diesel to support emissions reduction in the aviation, heavy vehicle, rail and maritime sectors; establishing the Australian Jet Zero Council; developing a Maritime Emissions Reduction National Action Plan; the National Rail Manufacturing Plan and establishing the High Speed Rail Authority; supporting zero emissions travel with the Active Transport Fund; embedding sustainability as a key strategic theme in the Infrastructure Policy Statement; and working with the states and territories through the Infrastructure and Transport Ministers' Meeting to reduce transport and transport infrastructure emissions.

The decarbonisation of Australia's transport system will require significant public and private sector investment in emerging low and zero emissions technology and enabling infrastructure. It will also require collective action between all levels of government, business, industry and the community to ensure a fair and equitable transition.

The Roadmap and Action Plan will enable this investment and collective action by providing a clear strategy to reduce emissions across the transport and transport infrastructure sectors. It covers all transport modes and considers cross-cutting issues including low carbon liquid fuels, freight and supply chains, system wide efficiencies and transport infrastructure. It is robust, ambitious and achievable.

The Hon Catherine King MP

Minister for Infrastructure, Transport, Regional Development and Local Government

The Hon Chris Bowen MP

Minister for Climate Change and Energy

Executive summary

The Australian Government has an ambitious climate agenda, committing to reduce national emissions by 43% on 2005 levels by 2030, 62–70% by 2035 and net zero by 2050, in line with the global goal to keep warming to well below 2°C and efforts to keep it to 1.5°C.

The Net Zero Plan sets out and extends Australia's action on climate change. The Plan helps ensure Australia maximises the benefits of the global transition to net zero and provides long-term policy certainty to drive investment in low emissions and renewable technologies. To support the Plan, the Government has developed six sector plans. These plans cover the following sectors: electricity and energy; industry; resources; the built environment; agriculture and land; and transport.

The Transport and Infrastructure Net Zero Roadmap and Action Plan is the sector plan for transport and transport infrastructure. It covers all transport modes and considers cross cutting issues including low carbon fuels, freight and supply chains, systemwide efficiencies and transport infrastructure.

While the transport sector is critical to our economy, it is also the third largest source of greenhouse gas emissions in Australia, with direct emissions amounting to 22% of Australia's greenhouse gas emissions. With Australia's population and economy expected to grow, transport activity is also expected to continue to increase to 2050. The challenge is to reduce emissions while the sector grows.

Reducing transport emissions will also bring a range of other benefits and opportunities, including consumer savings, enhanced fuel security, health benefits and productivity gains. These co-benefits are outlined in Chapter 1, along with information on how this plan was developed.

Informed by Treasury modelling, Chapters 2 and 3 outline the Roadmap to 2050, including the emissions outlook and the potential decarbonisation pathways for each transport mode and transport infrastructure. Chapter 4 is the Action Plan and sets out the actions the Government is taking to reduce transport emissions. Chapters 5 and 6 explain how the Government will continue to work collaboratively with all levels of government, the community, business, industry and unions to deliver the plan.

Roadmap to 2050

Treasury Baseline Scenario presents an efficient pathway Australia could take to reach its net zero goal. This shows it is technically and economically feasible to achieve deep reductions in transport emissions by 2050.

Electrification and improved energy efficiency will be the primary decarbonisation pathway for light vehicles, such as cars and vans.

The decarbonisation pathway for heavy vehicles is likely to require a range of different technologies, including electrification for buses and rigid trucks, and a mixture of low carbon liquid fuels (LCLFs) for larger vehicles that carry heavier payloads over longer distances.

Rail is generally a lower emissions mode than road transport, so increasing the share of freight moved on rail will reduce emissions, even with existing technologies. The decarbonisation pathway for rail will come from a mix of track electrification, battery electric trains, LCLFs and hydrogen.

For maritime, shipping will require the use of LCLFs and other low carbon alternatives, including hydrogen-derived fuels such as methanol and ammonia, and hydrogen. There will be opportunities for battery electric technology for use in smaller vessels and other domestic maritime applications with shorter voyages.

For aviation, sustainable aviation fuel (SAF) will be the key technology. Other technologies such as battery electric and hydrogen powered aircraft are expected to be used for some short-haul flights in the long term.

Decarbonising transport infrastructure (such as roads, railways, ports and airports) will require national standards for data collection, measurement and reporting of embodied emissions, and increased investment in low and zero carbon construction materials.

Figure 1 (as seen on page 8) outlines the decarbonisation technology pathways for each transport mode and transport infrastructure.

The Action Plan

This plan is guided by five guiding principles: maximise emissions reduction, provide value for money, maximise economic opportunity, be inclusive and equitable and be evidence-based.

The avoid-shift-improve (ASI) framework is used to identify all opportunities for abatement.

There are five key priority actions across our transport systems, modes and enabling inputs in this Roadmap and Action Plan:

1. Invest in enabling low and zero emissions transport infrastructure.
2. Electrify and increase transport's energy performance.
3. Switch to low carbon alternatives (LCLFs) to power transport where electrification is not feasible.
4. Innovate to expand cost competitive transport technology options.
5. Scale up efforts to reduce embodied emissions in transport infrastructure.

Figure 2 provides a summary of these priority actions and the Government's policies to reduce transport emissions.

Enabling the transition

The decarbonisation of Australia's transport system will require significant public and private sector investment in emerging low and zero emissions technology and enabling infrastructure.

Major industry shifts are needed to prepare Australia's workforce to meet the needs of the transition, including improving Vocational Educational Training, improving workforce diversity for those that do not traditionally have high participation rates in the sector (e.g. Aboriginal and Torres Strait Islanders people, women, people with disability) and addressing training opportunities and digital literacy, especially in rural and remote areas.

Collective action is needed between all levels of government, business, industry and the community to reduce transport emissions. Australia will continue to be actively engaged in international fora to reduce emissions and look to establish international partnerships to advance low emission technologies.

Moving forward

The *Climate Change Act 2022* (Cth) sets up a strong framework to ensure Australia remains on track to reach net zero emissions. It requires the Minister for Climate Change and Energy to report progress through an Annual Climate Change Statement to Parliament, outlining progress towards emissions targets, and whether current policies are effective.

The Transport Sector Plan is one of 6 sector plans underpinning the Net Zero Plan

Energy/ Electricity

Energy performance; and the supply of electricity, liquid fuels, and gas

Industry

Alumina and aluminium, cement and concrete, chemicals and plastics, food and beverages, iron and steel, manufacturing and additional industries, other metals refining and smelting, pulp, paper and paperboard, waste and resource recovery

Resources

Oil and gas extraction, processing, liquefaction, coal mining and processing, mining and processing of metallic and non-metallic minerals, resource exploration and support services

Built Environment

Residential, commercial and public buildings as well as urban open spaces and water infrastructure

Agriculture and Land

Livestock, cropping, on-farm energy use, fisheries, forestry and land use

Transport

Light and heavy road transport, rail, maritime, aviation, including transport infrastructure's embodied emissions

Figure 1: Transport and Infrastructure Net Zero Roadmap: a timeline of transport decarbonisation technology pathways

<table>
<tr><th></th><th>2025–2030</th><th>2030–2035</th><th>2035–2050</th></tr>
<tr><td rowspan="3">Light vehicles</td><td>EVs become increasingly affordable</td><td>Continued improvements in EV technologies</td><td>Fossil fuels only used in very specific circumstances</td></tr>
<tr><td>Ongoing investment in EV charging infrastructure</td><td colspan="2">Widespread charging infrastructure across Australia</td></tr>
<tr><td>Bidirectional charging scales up</td><td colspan="2">Bidirectional charging and vehicle-to-grid are widespread</td></tr>
<tr><td rowspan="2">Heavy vehicles</td><td>Electrification of buses and smaller trucks, supported by more charging infrastructure</td><td>Charging infrastructure scales up. Battery electric and hydrogen fuel-cell adoption accelerates</td><td>Battery electric and hydrogen fuel-cell mass market adoption and efficiency improvements</td></tr>
<tr><td>Demonstrated use of LCLFs</td><td>LCLFs continue to support longer distance, heavier vehicles</td><td>LCLFs where battery electric and hydrogen fuel-cell are not feasible</td></tr>
<tr><td rowspan="3">Rail</td><td>Battery electric trials</td><td rowspan="2">Battery electric and hydrogen fuel-cell deployed</td><td rowspan="2">Mass market adoption of battery electric and hydrogen fuel-cell technologies</td></tr>
<tr><td>Hydrogen fuel-cell trials</td></tr>
<tr><td>Demonstrated use of LCLFs</td><td colspan="2">LCLFs support long distance, hard to electrify cases</td></tr>
<tr><td rowspan="2">Maritime</td><td>Battery electric and hybrid for some short-range vessels</td><td>Short range battery electric vessels deployed</td><td>Short-range battery electric vessels adoption and efficiency improvements</td></tr>
<tr><td>Hydrogen and hydrogen-derived fuels demonstration</td><td>Emerging use of hydrogen and hydrogen-derived fuels for long range vessels</td><td>Hydrogen and hydrogen-derived fuels for majority of long-range vessels</td></tr>
<tr><td rowspan="2">Aviation</td><td>Battery electric and hydrogen fuel-cell technology development for small aircraft</td><td>Battery electric and hydrogen fuel-cell demonstrations for short range flights</td><td>Battery electric and hydrogen fuel-cell for some short to medium-range flights</td></tr>
<tr><td>Blended SAF uptake increases</td><td>Deployment of SAFs for short, medium and long-haul flights</td><td>SAFs for majority of medium and long-haul flights</td></tr>
<tr><td rowspan="4">Transport Infrastructure</td><td rowspan="2">Increased availability of low emissions and recycled materials with verified emissions profiles</td><td>Low and zero carbon materials are prioritised by industry</td><td>Low and zero carbon materials used by default</td></tr>
<tr><td>Widespread use of low and zero carbon materials and modular components</td><td>Circularity of components considered at all project life stages</td></tr>
<tr><td>Optimisation of intermodal freight infrastructure</td><td colspan="2">Increased low and zero carbon options to transport goods</td></tr>
<tr><td>Continued investment in active and public transport infrastructure</td><td colspan="2">Sustained investment and increasing use of active and public transport infrastructure</td></tr>
</table>

2025–2030 2030–2035 2035–2050

- The technology requires development
- Demonstrate scale and commercial viability
- Deploy commercially ready technology
- Used in limited, tailored applications

Figure 2: Transport and Infrastructure Net Zero Action Plan

Guiding principles

Maximise emissions reduction (using avoid-shift-improve framework), value for money, maximise economic opportunity, inclusive and equitable, evidence based.

Priority Action 1: Invest in enabling low and zero emissions transport infrastructure (avoid and shift)

Achieving low and zero emissions transport infrastructure (roads and bridges, rail, ports and airports) will require rethinking our transport networks and systems to decarbonise how we move people and goods across our large and geographically diverse country.

1.1 Invest in transport infrastructure projects that support sustainable and decarbonised transport systems

Key initiatives: Infrastructure Policy Statement; Infrastructure Investment Program; Active Transport Fund; High Speed Rail; Inland Rail; National Freight and Supply Chain Strategy; Investments in intermodal hubs.

1.2 Support the path to net zero in the planning and development of urban areas

Key initiatives: National Urban Policy; National Urban Freight Planning Principles.

1.3 Develop place-based solutions to drive transport sustainability and decarbonisation at a local level

Key initiatives: Regional Investment Framework.

1.4 Embed resilience to current and future climate change

Key initiatives: National Climate Risk Assessment; National Adaptation Plan; National Freight and Supply Chain Strategy; Infrastructure Policy Statement.

Priority Action 2: Electrify and increase transport's energy performance (shift and improve)

Electrification and energy efficiency will be the primary decarbonisation pathway for much of the transport sector, especially light vehicles.

2.1 Maintain, review and improve regulatory frameworks to drive emissions down

Key initiatives: New Vehicle Efficiency Standard; Safeguard Mechanism.

2.2 Increase the supply of affordable and accessible EVs

Key initiatives: National Electric Vehicle Strategy; Australian Design Rule (ADR) Harmonisation Review; Reforms to heavy vehicle mass limits; Safer Freight Vehicles package.

2.3 Encourage increased uptake of more efficient vehicles, supported by energy performance improvements

Key initiatives: Driving the Nation Program; Electric Car Discount; Green car fleet loans; Green Vehicle Guide; ev.gov.au

2.4 Support the efficient rollout of electric vehicle charging infrastructure

Key initiatives: Driving the Nation Fund; Guides to help multi-residence (strata) buildings become 'EV ready'; National Roadmap for Bidirectional EV Charging; Minimum operating standards for EV charging infrastructure; $40 million to accelerate rollout of kerbside and fast charging.

2.5 Enhance the operations of ports, railways and airports to advance decarbonisation

Key initiatives:

- Rail: National Rail Action Plan; Inland Rail; High Speed Rail; National Rail Manufacturing Plan.
- Maritime: Maritime Emissions Reduction National Action Plan.
- Aviation: Aviation White Paper; Airports Regulation 2024; Regional Airports Program.

Priority Action 3: Switch to low carbon alternatives to power transport where electrification is not feasible (improve)

To support the transport sector's net zero pathways, low carbon alternatives such as low carbon liquid fuel (LCLF), including sustainable aviation fuel (SAF) and renewable diesel, and hydrogen, will be important to decarbonise hard-to-electrify transport modes, including heavy vehicles, rail, maritime and aviation.

3.1 Establish frameworks to verify and track the emissions intensity and production methods of LCLFs

Key initiatives: Guarantee of Origin scheme; Fuel Quality Standards (Paraffinic Diesel) Determination 2025.

3.2 Fast track support for a domestic LCLF industry, with an initial focus on SAF and renewable diesel

Key initiatives: Future Made in Australia agenda; Sustainable Aviation Fuel Funding Initiative; Australian Jet Zero Council; $1.1 billion Cleaner Fuels Program.

3.3 Support the development of renewable hydrogen

Key initiatives: National Hydrogen Strategy; Hydrogen Production Tax Incentive; Hydrogen Headstart.

Priority Action 4: Innovate to expand cost competitive transport technology options (avoid, shift and improve)

To support the transport sector's net zero pathways, developing strategic approaches through innovation, commercialisation, pilot and demonstration projects will expand cost competitive technology options and ensure Australia is an important part of the global net zero economy.

4.1 Provide financial assistance and knowledge sharing to support improvements in the competitiveness and supply of renewable energy and the uptake of energy efficiency and electrification

Key initiatives: Future Made in Australia Innovation Fund; Driving the Nation Fund; Clean Energy Innovation Fund (CEFC); Cooperative Research Centres (CRC); Australian Renewable Energy Agency (ARENA); National Reconstruction Fund; National Battery Strategy.

4.2 Develop nationally coordinated and consistent approaches to the rollout of new transport technologies

Key initiatives: National Electric Vehicle Strategy; Aviation White Paper; National Rail Action Plan; Maritime Emissions Reduction National Action Plan; Advanced Air Mobility Strategy; National Road Transport Technology Strategy; 2024–27 National Connected and Automated Vehicle Action Plan.

Priority Action 5: Scale up efforts to reduce embodied emissions in transport infrastructure (shift and improve)

Embodied emissions are expected to form a major and increasing proportion of infrastructure-related emissions as the electricity grid transitions to decarbonised sources and operational emissions decline.

5.1 Develop end-to-end carbon management policy and guidance, beginning with a nationally consistent approach to measuring embodied carbon in infrastructure projects

Key initiatives: National Carbon Values for use in cost benefit analyses; Embodied Carbon Measurement for Infrastructure: Technical Guidance; National Sustainable Procurement in Infrastructure Guideline; National Embodied Carbon Databook.

5.2 Accelerate the commercialisation of low and zero emission construction materials

Key initiatives: Future Made in Australia Innovation Fund; Low Carbon Concrete Centre; Low emissions steel, iron and renewable hydrogen research.

5.3 Mandatory requirements on companies for reporting, assessment and emissions reduction

Key initiatives: Safeguard Mechanism; Mandatory climate-related financial disclosures.

5.4 Support infrastructure decarbonisation capability in private and public sectors, including the development of resources, training and guidance

Key initiatives: ITMM infrastructure decarbonisation capability building program and central knowledge hub.


2P
1P

1 Introduction

Transport connects Australians to each other and to the rest of the world. It is critical to our economy and wellbeing. It is also the third largest source of greenhouse gas emissions in Australia, amounting to 22% of national emissions in 2024. As the Transport Sector Plan, this Roadmap and Action Plan provides a clear strategy to reduce emissions across transport and transport infrastructure to contribute to economy-wide net zero by 2050.

1. Introduction

Key points

- The Australian Government has set ambitious targets to reduce emissions by 43% on 2005 levels by 2030, 62–70% below 2005 levels by 2035 and net zero by 2050 in line with the global goal to keep warming to well below 2°C and pursue efforts to keep it to 1.5°C.
- The Australian Government's Net Zero Plan sets how Australia can transition to net zero emissions by 2050, and the steps the Australian Government is taking to achieve this.
- The six sector plans provide further detail on the pathways, opportunities for abatement and policy directions for each sector.
- The Transport and Infrastructure Net Zero Roadmap and Action Plan is the sector plan for the transport and transport infrastructure sectors. It provides a clear strategy to reduce emissions across the transport sector. It covers all transport modes and considers cross cutting issues including low carbon liquid fuels, freight and supply chains, systemwide efficiencies and transport infrastructure.

In 2022, the Australian Government legislated its commitment to reduce economy-wide net greenhouse gas emissions to 43% below 2005 levels by 2030, and to net zero by 2050. 'Net zero emissions' refers to achieving an overall balance between greenhouse gas emissions produced and greenhouse gas emissions taken out of the atmosphere. Across the economy, Australia's emissions were 447 million tonnes of carbon dioxide equivalent gases (Mt CO_2-e) in 2023–24.[1]

The Australian Government's Net Zero Plan sets out and extends Australia's action on climate change. The Net Zero Plan will guide our transition to net zero greenhouse gas emissions by 2050, and the 2035 Target of a reduction of 62–70% below 2005 levels. The Plan helps ensure Australia maximises the benefits of the global transition to net zero and provides long-term policy certainty to drive investment in low emissions and renewable technologies.

To support the Net Zero Plan, the Australian Government has developed six sector plans. These plans cover electricity and energy; industry; resources; the built environment; agriculture and land; and transport. This is the Transport Sector Plan.

How the transport sector can contribute to achieving net zero

While the transport sector is critical to our economy, it is also the third largest source of greenhouse gas emissions in Australia, with direct emissions amounting to 22% of Australia's greenhouse gas emissions.[2] With Australia's population and economy projected to grow, transport activity is also expected to continue to increase to 2050. The challenge is to reduce emissions while the sector grows.

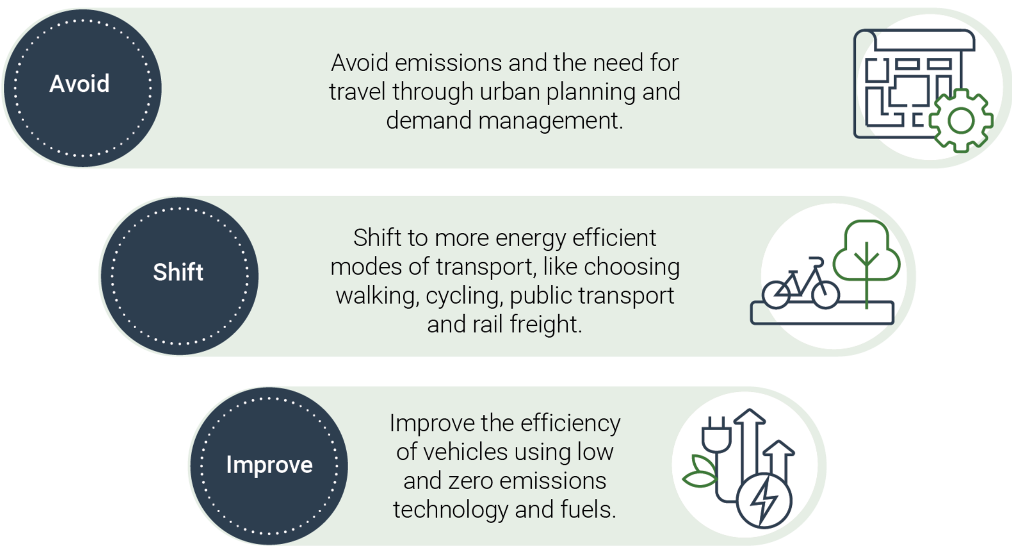
Box 1: The size and significance of transport in Australia[3]

- 4.6% of Australia's Gross Domestic Product was accounted for by Australia's transport, postal and warehousing industry in 2023–24.
- Total employment across transport, postal and warehousing industry was 705,000 persons in 2023–24.
- In 2023–24, there were an estimated 249.0 billion tonne kilometres of freight moved by road, 447.9 billion tonne kilometres of freight moved by rail, 88.3 billion tonne kilometres of freight moved by coastal shipping and 0.2 billion tonne kilometres moved by air freight.
- In 2023–24, 162.7 billion passenger kilometres were travelled by car, and 12.3 billion passenger kilometres were travelled on heavy rail networks in Australian capital cities.
- There were 616,361 domestic flights in 2023–24. At the height of the pandemic, domestic flights fell to 326,616, fewer than flight numbers in 1977–78.
- Transport infrastructure engineering construction work done recorded a new all-time high of $51 billion (adjusted by chain volume index) in 2023–24. This accounted for 53 per cent of the value of infrastructure construction work done in Australia (including transport, energy, telecommunications and water).

Opportunities for reducing emissions from the transport sector have been identified through the avoid-shift-improve framework (see **Figure 3**):

- **Avoid** refers to reducing unnecessary vehicle, travel and freight movements. By improving the efficiency of the transport system through integrated land-use planning, improved supply chain logistics, transport demand management and telecommuting, the need for transport and the length of some transport may be reduced or avoided. This includes optimised future net zero supply chains, such as the co-location of sources of renewable energy, hydrogen production and green iron manufacturing.
- **Shift** refers to decarbonising travel by choosing to shift to more sustainable transport modes like active and public transport, or to low emission freight transport modes instead of fossil fuelled vehicles.
- **Improve** refers to improving the technology or efficiency of transport modes, such as through electrification or higher productivity vehicles.

Figure 3: Avoid-shift-improve framework



Through avoiding unnecessary transport, shifting transport to lower emissions modes, and improving the emissions profile of each transport mode and associated infrastructure, the emissions associated with the transport sector can be significantly reduced.

The benefits of taking action

Achieving net zero is essential to support global efforts to minimise the extent of climate change. Decarbonising the transport sector also brings other benefits and opportunities.

Consumer savings: Improving emissions profiles through electrification of light vehicles offers more efficient, affordable and sustainable transport for commuters. Electric vehicles (EVs) cost significantly less to power and maintain than internal combustion engine (ICE) vehicles. This means that, while the upfront cost of electric vehicles is currently typically higher, they offer savings compared to an ICE vehicle over the lifetime of the vehicle, with running cost savings offering an EV owner a reduction in road transport costs of around $1500 per annum compared with an ICE vehicle, averaged over 20 years of ownership.[4]

Additionally, when coupled with home solar and battery systems, EV ownership can offer substantial savings compared to owning an ICE vehicle or using grid energy. As vehicle to grid and bidirectional charging technology develops further, EV owners of vehicles with the appropriate technology enabled will have the potential to lower their electricity bills by using their EV battery to discharge back to the grid at times of peak demand. There is also potential for electricity consumers who do not own an EV to benefit from the shared savings at a system level from EV batteries discharging into the grid. This stored electricity can be leveraged to help manage peak demand, lowering energy prices for all consumers.[5] This will have a real benefit for consumers; for example, reducing light vehicle emissions through the New Vehicle Efficiency Standard (NVES) is estimated to deliver $95 billion in fuel savings to Australia by 2050.[6]

Fuel security: Electrification of the transport sector and uptake of locally produced low carbon liquid fuels (LCLFs) and other fuels such as hydrogen will also reduce Australia's reliance on imported fuels. Australia is heavily reliant on imports of liquid fossil fuels, with 90% of the liquid fuel we use imported directly as refined products or indirectly as crude oil.[7] In 2024, Australia held an average of 28 days of consumption coverage for automotive gasoline, 23 days for diesel oil and 20 days for aviation turbine fuel.[8] Fuel security will be enhanced both by a decrease in demand for fossil fuels, and the development of a domestic LCLF production industry.

Export opportunities: Supporting domestic manufacturers to reduce the emissions intensity of key construction materials used in the transport infrastructure sector, including concrete, cement and steel, will increase the competitiveness of Australian industry in a decarbonising global economy. Increased production of low and zero carbon materials in Australia can open new market opportunities and ensure that exports are not penalised for their emissions impact.

A domestic LCLF production industry would also add value to Australian agricultural products before they are used as feedstocks in the LCLF supply chain or exported.

Health: Options to avoid, shift and improve transport emissions have efficiency and health co-benefits. It is estimated that there are more than 11,105 premature deaths of adults in Australia each year due to vehicle emissions, due to emissions of nitrogen dioxide and a range of fine particulate pollutants.[9] People of lower socioeconomic status are disproportionately exposed to traffic and air pollution and at higher risk of adverse health outcomes;[10] addressing transport emissions therefore has health equity impacts.

Increased investment in active transport infrastructure and corresponding uptake has health, community, social and safety benefits, with cities estimated to receive an almost $5 economic benefit for every $1 of investment.[11] Switching from ICE vehicles to EVs also provide health benefits across the community due to the reduction of air and noise pollution, as does decarbonising freight transport. For example, the introduction of Euro 6d and Euro VI equivalent standards are expected to reduce the burden of disease attributable to noxious emissions from cars, SUVs, light commercial vehicles and heavy vehicles by $13 billion.[12] The NVES is estimated to yield an additional $5.5 billion in health savings benefits by 2050.[13]

Productivity: Decarbonising passenger and freight networks requires optimising routes and shifting to lower emissions, more efficient modes, where transport and energy infrastructure is in place. Strategic investments in infrastructure, such as multi-modal transport hubs, can support mode choice. Government facilitation of the decarbonising of transport infrastructure also offers productivity gains. Working with states and territories to produce nationally aligned infrastructure decarbonisation policies and guidance will reduce operational complexity and encourage innovation in material manufacturing.

Approach to developing this plan

This Roadmap and Action Plan has been informed by feedback, insights and analysis provided through public and industry consultations, as well as the Climate Change Authority's Sector Pathways Review and analysis and modelling from the Treasury. In response to the Transport and Infrastructure Net Zero Consultation Roadmap released in May 2024, the Australian Government received 284 written submissions, and 28 targeted consultation sessions were held, with engagement from 166 organisations and over 400 participants. Stakeholders from across industry, unions and communities broadly confirmed their support for the transport and transport infrastructure decarbonisation technology pathways.

Consultation showed broad support for the technology pathways for decarbonisation of each transport mode as set out in this Roadmap and Action Plan:

- electrification of light vehicles, as a low cost and efficient opportunity to decarbonise the sector as the electric light vehicle market continues to expand
- electrification of heavy vehicles where feasible and the use of LCLFs while electrification and hydrogen technologies develop, and for legacy vehicles
- renewable powered electrified metropolitan rail services, with more research and development required to determine the best decarbonisation pathway for non-electrified sections of the rail network for regional passenger and freight services

- a mix of technologies for maritime, including the use of low emissions fuels (LCLFs, including other fuels such as hydrogen derived fuels, and hydrogen) and battery electric small vessels
- in aviation, the use of sustainable aviation fuel (SAF) for medium to long haul aviation, with alternatives like battery electric and hydrogen propulsion aircraft having a role in decarbonising some short haul and regional flights.

There were calls for a range of measures to support the uptake of these technologies, including for:

- consistent national data on freight emissions and support for shifting more freight onto rail
- the removal of regulatory barriers to heavy vehicle decarbonisation and investment in charging infrastructure
- rail network efficiencies and investment in infrastructure
- encouraging low emissions shipping by addressing high certification costs for new low emissions vessel builds, supporting freight mode shift through intermodal terminals, and pursuing Green Shipping Corridors, along with supporting ports with bunkering and charging infrastructure
- both supply- and demand-side measures to drive the scaling-up of the LCLF industry, supported by lifecycle emissions accounting.

Consultation also covered transport infrastructure, showing support for:

- increased investment in active and public transport infrastructure
- guidance on measurement, benchmarking and reducing embodied emissions in transport infrastructure
- national infrastructure procurement guidelines which incorporate sustainability considerations in project assessments
- government support for commercialisation of low and zero emissions materials for transport infrastructure.

End notes

1 Department of Climate Change, Environment, Energy and Water (DCCEEW). *National Greenhouse Gas Inventory Quarterly Update: December 2024*, DCCEEW, Australian Government, 2024.

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2

Emissions outlook

With targeted action transport emissions will significantly reduce by 2050.

2. Emissions outlook

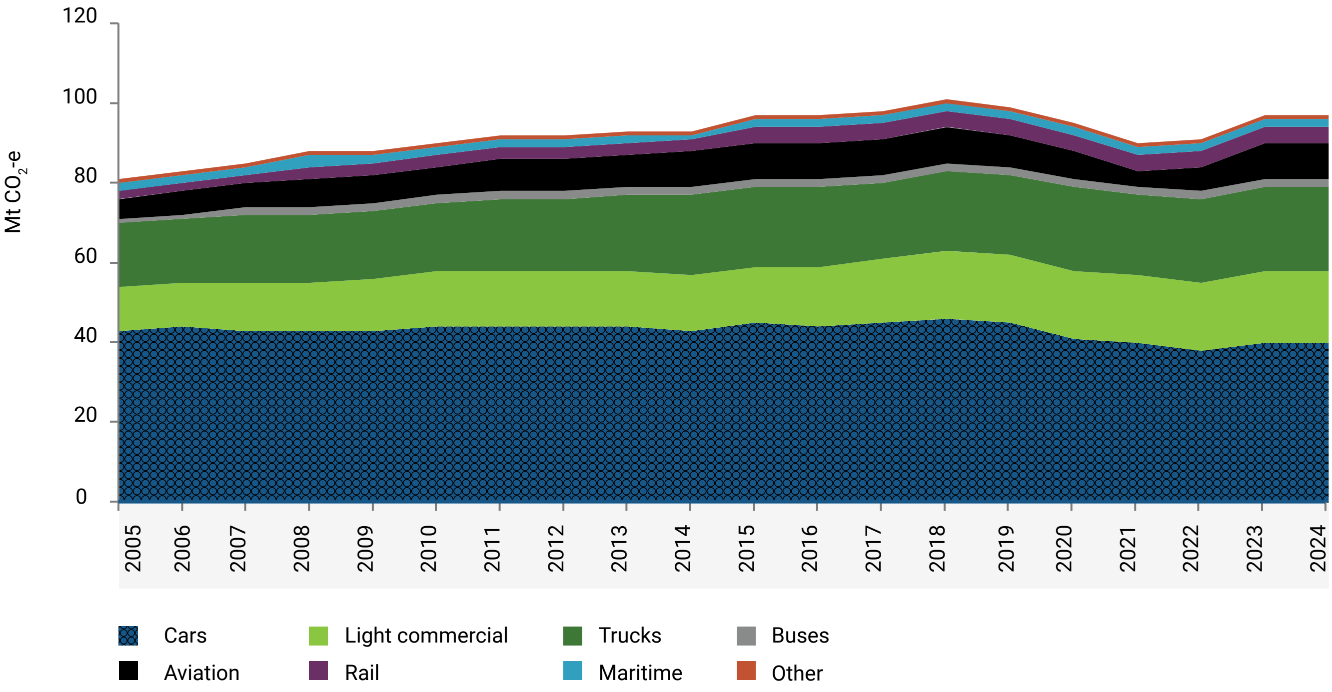
Key points

- Light vehicles (passenger and light commercial) make up 59% of all transport emissions. The switch to lower emitting vehicles facilitated by the New Vehicle Efficiency Standard (NVES) will drive significant abatement in the transport sector.
- The decarbonisation of heavy commercial vehicles, rail, maritime and aviation is expected to progress at a slower pace compared to light vehicles as the technologies are less mature.
- Treasury's modelling of the Baseline Scenario presents an efficient pathway Australia could take to reach its net zero goal. This shows it is technically and economically feasible to achieve deep cuts in transport emissions by 2050.

Transport moves people and goods across our geographically large and diverse nation. The majority of goods are moved by rail and heavy vehicles, and people move largely in cars. Road transport – cars, buses, motorcycles and trucks – is responsible for the majority of transport emissions (at around 83%).[14] Of this, light vehicles (passenger cars and light commercial vehicles) are the single biggest source of emissions, contributing to 59% of Australia's transport emissions.[15] In 2023–24, emissions from domestic aviation were 10% of transport emissions, rail roughly 4% and domestic maritime roughly 2%.[16] **Figure 4** shows the emission trends from 2005 to 2024.

Figure 4: Road vehicles are responsible for the majority of transport emissions

Emission trends from the transport sector



Source: DCCEEW, *Australia's emissions projections 2024*, Australian Government, 2024.

Economic modelling and analysis by the Australian Treasury explores three scenarios of Australia's transition to net zero by 2050. This work has informed the development of the Australian Government's Net Zero Plan and sector plans and includes potential economy-wide and sector-specific emissions reductions pathways. The Baseline Scenario, which presents an efficient pathway Australia could take to reach its net zero goal, is referenced in this plan.

While scenario-based analysis is a powerful tool in helping inform Australia's net zero pathway, it is not possible to precisely predict how the transition will unfold. The future is uncertain and many factors will influence the net zero transition, including changes in technology, global dynamics and community responses.

Treasury modelling indicates it is technically feasible to reduce transport emissions from 100 Mt CO_2-e in 2025 to 36 Mt CO_2-e in 2050. Electrification and improved energy efficiency are projected to play a large role, aided by the implementation of policies such as the NVES. The growth in EV take-up is further enabled by reductions in EV prices, and greater public and private investment in EV charging infrastructure. In Treasury's Baseline Scenario, emissions from passenger transport in 2050 are projected to decrease from 42 Mt CO_2-e to 4 Mt CO_2-e, a 90% reduction between 2025 and 2050.

The decarbonisation of heavy vehicles, rail, maritime and aviation progresses at a slower pace compared to passenger transport in Treasury's Baseline Scenario (see **Figure 5**). In addition to electrification, alternative pathways for these transport modes include the use of low carbon liquid fuels (LCLFs), hydrogen-derived fuels and hydrogen.

By 2050, blending renewable diesel with conventional diesel and sustainable aviation fuel with jet fuel could support the reduction of the emissions associated with these fuels across the entire economy by up to 32 Mt CO_2-e and 5 Mt CO_2-e respectively (see **Figure 6**). As a result, emissions from commercial transport are projected to decline by 45% (to 32 Mt CO_2-e) from 2025 levels.

Figure 5: Emissions for commercial and private transport, Treasury's Baseline Scenario

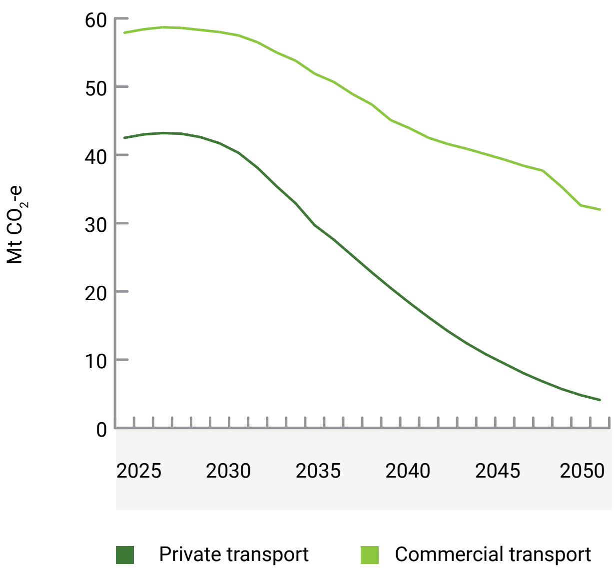
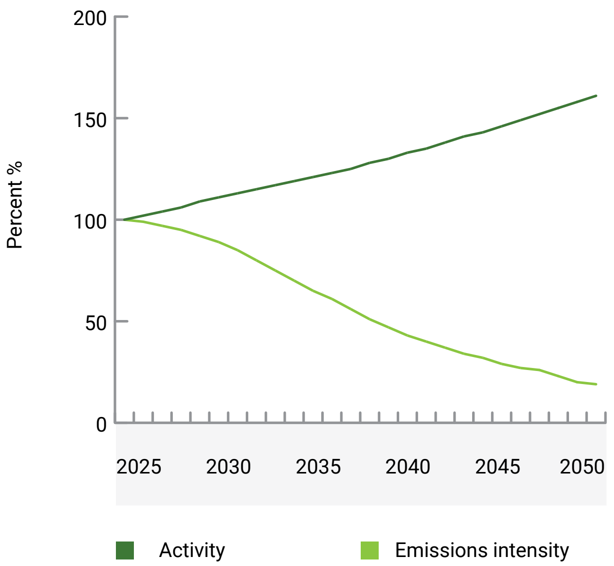


Figure 6: Transport activity and emissions intensity, Treasury's Baseline Scenario



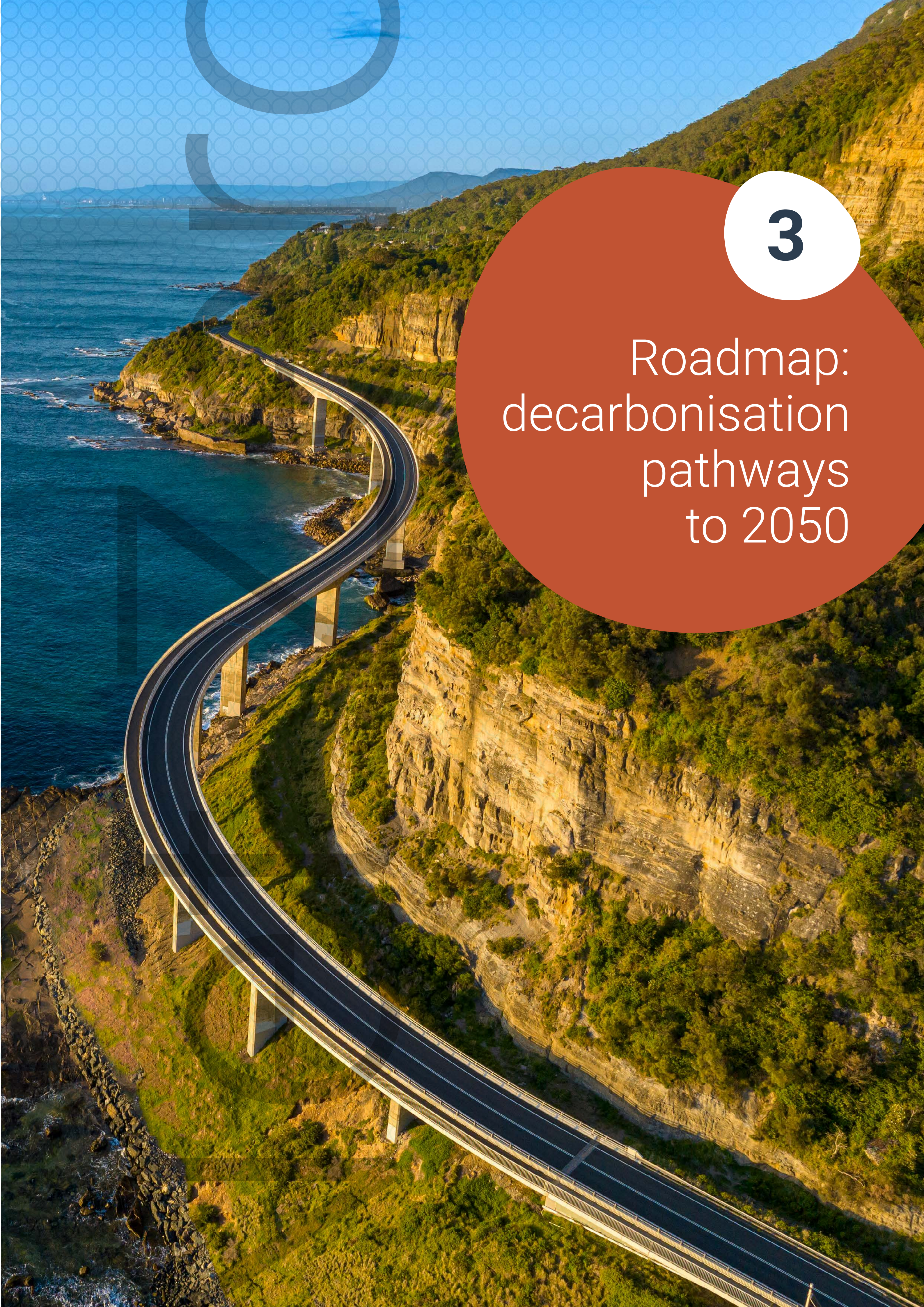
Potential pathways for each transport mode, as well as for transport infrastructure, are set out in detail in the next chapter.

End notes

14 DCCEEW, *Australia's emissions projections 2024*, DCCEEW, Australian Government, 2024.

15 DCCEEW, *Australia's emissions projections 2024*, DCCEEW, Australian Government, 2024.

16 DCCEEW, *Australia's emissions projections 2024*, DCCEEW, Australian Government, 2024.



3

Roadmap: decarbonisation pathways to 2050

The pathways to net zero will be different for each transport mode and will require a mix of technologies, policies and planning, based on evidence, market readiness and science. There are opportunities within each mode to shift to lower emission modes as well as improve the technology or efficiency of that mode. The actions the Australian Government is taking to support these decarbonisation pathways are set out in the next chapter.

3. Roadmap: decarbonisation pathways to 2050

Key points

- Electrification and improved energy efficiency will be the primary decarbonisation pathway for light vehicles, such as cars and vans.
- The decarbonisation pathway for heavy vehicles is likely to require a range of different technologies, including electrification for buses and rigid trucks, and a mixture of low carbon liquid fuels (LCLFs) for larger vehicles that carry heavier payloads over longer distances.
- Rail is generally a lower emissions mode than road transport, so increasing the share of freight moved on rail will help reduce emissions, even with existing technologies. The decarbonisation pathway for rail will come from a mix of track electrification, battery electric trains, LCLFs and other low carbon alternatives, such as hydrogen.
- For maritime, shipping will require the use of LCLFs and other low carbon alternatives including hydrogen-derived fuels, such as methanol and ammonia, and hydrogen.
- For aviation, sustainable aviation fuel (SAF) will be the key technology. Other technologies such as battery electric and hydrogen powered aircraft are likely to be used for some short-haul flights.
- Decarbonising transport infrastructure (such as roads, railways, ports and airports) will require national standards for data collection, measurement and reporting of embodied emissions, and increased investment in low and zero carbon construction materials.

Treasury modelling provides useful insights on the potential cost-effective timing, sequencing and size of sectoral contributions to the economy-wide emissions reduction task. Treasury modelling alongside public and industry consultation have informed the potential decarbonisation pathways outlined in this chapter. The decarbonisation pathways outlined in this chapter have also been guided by the Climate Change Authority's Sector Pathways Review, the CSIRO's report *Pathways to Net Zero: Rapid decarbonisation pathways for Australia*, the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report, analysis of over 130 transport emission reduction strategies from Australia and around the world, as well as public and industry consultation.

In general, the potential transport decarbonisation pathways for each transport mode involve a mix of electrification, LCLFs and alternatives, such as hydrogen-derived fuels or hydrogen, as well as productivity and efficiency improvements. A shift to sustainable, low emissions ways of moving people and goods, will further reduce transport emissions.

Box 2: Low carbon liquid fuels

- Drop in LCLFs, such as renewable diesel and sustainable aviation fuel, allow industry to use their existing fleet while lowering emissions. Drop-in fuels are LCLFs that can be used as a direct replacement for traditional fossil fuels, without the need for any modifications to the existing fuel infrastructure or engine technology. These LCLFs have a role in the decarbonisation of multiple transport modes, including heavy vehicles, rail, maritime, and aviation. See below for further details by transport mode.
- Potential LCLF feedstocks include canola seeds, tallow, sugarcane, municipal solid waste, bagasse, agricultural residues, short rotation trees, hydrogen and captured CO_2.
- LCLFs will be produced from biogenic feedstocks, such as vegetable oils, in the short-term. There is ongoing research and development into producing LCLFs from synthetic feedstocks, such as hydrogen and captured CO_2, in the medium to long term.
- This Roadmap and Action Plan (the Transport Sector Plan) focusses on the use of LCLFs in transport.
- For more detail on the production of LCLFs and hydrogen, see the Energy and Electricity Sector Plan.
- For more detail on the contribution of biogenic feedstocks to the net-zero transition, see the Agriculture and Land Sector Plan.
- More detail on the production of CO_2 for industrial uses, including LCLF production, will be provided in the upcoming Carbon Dioxide Removal (CDR) Roadmap, delivered in partnership with CSIRO.

3.1. Road – light vehicles

The main technology pathway to reduce light vehicle emissions is electrification.

Electric vehicles (EVs) have lower lifecycle emissions than petrol and diesel internal combustion engine (ICE) vehicles. EVs have zero tailpipe emissions, and even considering emissions from electricity generation the tailpipe emissions reductions more than offset the emissions associated with the supply chain and manufacturing phases.

Although EVs will be the primary technology for reducing light vehicle emissions, there are several other technologies that will also contribute to reducing light vehicle emissions:

- **Hybrid and plug-in hybrid vehicles:** Hybrid vehicles are already helping to reduce emissions within the light vehicle fleet. Plug-in hybrids can operate solely on electricity for shorter journeys – typically between 50km and 80km – and can further reduce the need for fossil fuels, especially if recharged with renewable energy. Extended range plug-in hybrids are emerging that provide a bridge towards full electrification of all light vehicle types.
- **Efficiency improvements:** Efficiency improvements in ICE and hybrid vehicles will mean less fuel is consumed, resulting in cost savings to owners and reduced emissions. For EVs, advances in battery technology are likely to result in greater electric range for plug-in hybrid vehicles, while tyres with lower rolling resistance can reduce emissions for all vehicle types.
- **Low carbon liquid fuels (LCLFs):** LCLFs may play a limited role in decarbonising light vehicles, for example in remote areas where there is limited access to charging infrastructure for EVs. For other applications electrification is expected to be the dominant technology.
- **Hydrogen fuel cell electric vehicles (FCEVs):** FCEVs can play a supportive role in decarbonising light vehicles, if hydrogen is produced from renewable energy. Hydrogen has increased range compared to current EVs, however is not currently competitive due to relatively low energy efficiency, the high cost of hydrogen production and the need to establish new refuelling infrastructure.

Voluntary alternatives to using light vehicles, especially greater use of active and public transport and home-based work, will also reduce transport emissions to 2050.

A net zero pathway for light vehicles

EVs are the key net zero pathway for light vehicles. In the short-term, this transition is being supported by incentives for purchasing EVs, along with regulation and consistent national charging standards that support the rollout of EV charging infrastructure. These actions, together with advancements in battery technology, will help ensure EVs are accessible to all Australians.

The NVES is encouraging greater availability and uptake of more efficient ICE vehicles and EVs in the Australian market by introducing progressively more stringent emissions standards for new vehicles over time. The current settings of the NVES, which improve year on year performance to 2029, are forecast to reduce emissions by 321 Mt of CO_2 emissions up to 2050.

The Australian Government is supporting and helping coordinate continued investment, including from the commercial sector, in renewable energy and network grid capacity. As take-up of vehicle-to-grid technology achieves scale, EVs will play an increasing role in consumer energy resources, helping take pressure off the grid.

As the light vehicle fleet continues to electrify, fossil fuel demand will continue to decrease until it is only used in light vehicles in very specific circumstances. Government will have a role to play in ensuring all Australians have opportunities to transition their vehicles, while maintaining transport access.

Figure 7: A net zero pathway for light vehicles

2025–2030

- The New Vehicle Efficiency Standard reduces new light passenger vehicle emissions intensity by over 60% and light commercial vehicles by 49%
- EVs become more affordable and accessible to all Australians
- Investments in charging infrastructure keep up with projected EV uptake
- Early steps to enable uptake of bidirectional charging and vehicle-to-grid capabilities

2030–2035

- Continued improvements in EV technologies and market offerings
- Charging infrastructure expands across the country
- Bi-directional charging and vehicle to grid capabilities start scaling up

2035–2050

- Charging infrastructure, including support for bi-directional charging and vehicle to grid capabilities, becomes widespread
- Fossil fuel demand decreases until it is only used in very specific circumstances

3.2. Road – heavy vehicles

A combination of low emission technologies and fuels will be required to decarbonise heavy vehicles.

A range of technologies and fuels will be required to decarbonise heavy vehicles, depending on payloads and distances:

- **Battery electric vehicles (BEVs):** Battery electric technology is advancing rapidly, both in increased energy density and reduced charging times. Buses and rigid trucks operating in urban areas are already able to utilise this following set routes, as they can recharge frequently at a central location. However, the additional weight of batteries has a significant impact on the total mass of BEVs, especially for trucks that operate over long distances and/or with heavier loads. The impact of this increased mass on road pavements will result in additional road maintenance being required.
- **Low carbon liquid fuels (LCLFs):** Drop-in LCLFs, such as renewable diesel, offer abatement potential and could act as a transition solution as it allows industry to continue using their existing diesel fleet, while lowering emissions. Depending on supply, LCLFs will also likely be used for larger payloads and distances, especially in regional and remote Australia, over the medium to long term.
- **Hydrogen:** Heavy and long-haul transport was identified as a priority sector in the 2024 National Hydrogen Strategy. However, the hydrogen truck market, and associated infrastructure, is currently less advanced than the market for electric trucks, with limited options currently available. This is because of emerging infrastructure required to produce and distribute hydrogen, together with its high costs and lower energy efficiency. As such, hydrogen vehicles, either hydrogen fuel cell vehicles (FCEVs) or hydrogen internal combustion engine (ICE) vehicles, may play a role in road freight transport in the long-term where electrification is less feasible due to charging infrastructure location, capacity and speed, or EV battery range to support heavy freight tasks. Greater volumes of hydrogen are required to cover the same distance, compared to diesel, due to its lower energy density by volume.
- **Battery swapping and range extending technologies:** Battery swapping vehicles are designed for batteries to be quickly removed and replaced, shortening charging times of a BEV. However, the lack of uniform standards for battery design make battery swapping less practical. A range extender is an auxiliary power unit, usually a small ICE engine, that recharges the battery in a BEV when necessary. While neither battery swapping nor range extenders are common in Australia, they have had proven success internationally, including in battery swapping in China. Demonstration projects, applying lessons from overseas could support heavy BEV uptake in regional Australia.
- **Productivity and efficiency improvements:** Higher productivity freight vehicles will move more goods more efficiently, lowering emissions. Additionally, modernising and efficiency improvements in ICE trucks and their components like tyres will mean less fuel is consumed, resulting in cost savings to owners and reduced emissions. Improvements in vehicle productivity and fuel efficiency will contribute to transport decarbonisation in the short- to medium-term but will not result in zero emissions. Optimising distribution networks (e.g. hub and spoke networks) and enhanced route planning can also increase efficiency and reduce last-kilometre transport distances.

A net zero pathway for heavy vehicles

Reflecting the technology development for heavy vehicles, the timeline for uptake of low and zero emissions vehicles will vary depending on the vehicle type and task.

In the short-term, electrification is already feasible and being used for buses, rigid and some articulated trucks (mostly through pilot programs). Roll out of charging infrastructure and establishing consistent national regulatory requirements will support electrification for heavy vehicles, with early opportunities for fixed routes and in metropolitan areas. Demonstration of this is already underway with bus, fire and rubbish truck electrification. Hub and spoke networks that deploy electric last-kilometre solutions can make greater use of these early opportunities. Decarbonisation may not necessarily involve like-for-like replacement of every route in a network.

More research and development will be needed to decarbonise articulated trucks that generally carry heavier loads longer distances. Battery and hydrogen technology innovation for articulated trucks can be progressed in near-term through addressing regulatory barriers and clarifying investment priorities. LCLFs, especially renewable diesel, could be used in conventional articulated trucks engines where electrification is not feasible. In the short-term, increasing the uptake of more efficient, modern and higher productivity freight vehicles will also contribute to emissions reduction.

In the medium-term the transition will accelerate as infrastructure for electric heavy vehicles continues to scale, along with improved technology and decreases in cost. LCLFs and other low carbon fuels such as hydrogen, with certification and accounting frameworks in place to verify emissions reductions, can complement electrification. As Australia's hydrogen industry develops, the targeted use of hydrogen for transport, either through direct use in hydrogen fuel cell vehicles or as a low-carbon feedstock for the production of LCLFs, will complement electrification. The Guarantee of Origin Scheme will be expanded to provide certification and lifecycle emissions accounting frameworks to verify the carbon intensity of LCLFs in addition to hydrogen.

In the long-term, the widespread adoption of battery electric technologies will need to be supported by a national charging network. The use of LCLFs, where BEVS and alternatives such as hydrogen are not feasible, will also reduce emissions.

A shift of some freight transport to rail, where appropriate for the load, will complement improvements in heavy vehicle emissions intensity.

Figure 8: A net zero pathway for heavy vehicles

2025–2030

- Electrification of buses, rigid trucks, rubbish and fire trucks
- Continuing roll out of charging infrastructure for BEVs
- Initial use of LCLFs where electrification is not feasible, such as heavy duty articulated trucks, supported by certification
- Research and development into articulated truck emissions reduction technology
- Increased uptake of higher productivity freight vehicles

2030–2035

- Scale up charging infrastructure
- BEVs and FCEVs will continue to increase in efficiency and decrease in cost
- LCLFs and hydrogen, with certification and accounting frameworks in place to verify emissions reductions, complement electrification of some heavy vehicles

2035–2050

- National charging and refuelling networks
- Widespread use of battery and other zero emission technologies, such as hydrogen
- LCLFs where BEVs and hydrogen are still advancing/not feasible

3.3. Rail

The decarbonisation pathway for rail will involve a mix of track electrification, battery electric trains, LCLFs, including hydrogen-derived fuels and hydrogen.

Electrification of the rail network is a mature and readily available solution. However, electrifying rail track infrastructure is expensive, requiring high traffic volumes and shorter distances for financial viability. As such, the decarbonisation of Australia's rail network will likely require some mix of technologies, including:

- **Track electrification:** Electrified locomotives can take advantage of the increased level of renewable energy in the electricity mix. However, investment in rail electrification is expensive and requires high traffic use for financial viability. Track electrification is likely to be best suited for urban contexts and passenger rail.
- **Battery electric technologies:** Switching from hybrid diesel electric locomotives to battery electric locomotives is a promising solution. Battery electric locomotives can also be deployed to cover gaps between electrified rail segments and to support partial line electrification, lowering infrastructure costs. Although regenerative braking improves efficiency, the range of a battery electric locomotive is currently significantly less than a diesel electric locomotive. The technology has undergone substantial advances over recent years and will continue to develop with trials being conducted internationally and in Australia. Due to the long asset life of locomotives, retrofitting existing diesel locomotives with batteries is less expensive, and aligns with circular economy principles. In addition to battery electric locomotives, battery electric or alternatives such as hydrogen fuel cell electric tenders (additional vehicles carrying the fuel or power needed) could be used.
- **Low carbon liquid fuels (LCLFs):** Drop-in LCLFs, such as renewable diesel, offers medium-term abatement potential, which will allow the industry to use their existing fleet while lowering emissions.
- **Hydrogen and hydrogen-derived fuels:** Low and zero emissions hydrogen and hydrogen derived fuels, especially ammonia could also become viable for rail transport. Hydrogen can be used through fuel cells or combustion. Ammonia is not a drop-in fuel, which means diesel engines need to be retrofitted to be compatible. Greater volumes of hydrogen or ammonia are required to cover the same distance, compared to diesel, due to their lower energy densities by volume.
- **Energy efficiency and network optimisation:** Higher productivity freight networks will move more goods more efficiently, lowering emissions. Additionally, efficiency improvements in diesel locomotives will mean less fuel is consumed, resulting in cost savings to operators and reduced emissions. Improvements in rail productivity and fuel efficiency will contribute to transport decarbonisation in the short- to medium-term but will not result in zero emissions.

Rail is already a low-emissions mode of transport when compared to other modes. Where feasible, increasing the share of freight and passengers moved on rail will also contribute to reducing overall transport emissions.

Current barriers to this mode shift include capacity and reliability constraints on the interstate rail network, regulatory fragmentation and a lack of standards harmonization. Eliminating these barriers will lift rail's competitiveness, facilitating its choice as an effective mode option by end users.

A net zero pathway for rail transport

The decarbonisation of rail transport will require a supply of commercially competitive zero-emission technologies with the necessary enabling infrastructure. A combination of technology improvements and pilot projects in the short-term will help determine the pathway to the medium- and long-term solutions.

Governments will play an important leadership role to test and establish future net zero pathways. Co-design of technology pathways and the enabling infrastructure investments, regulatory requirements and rolling stock standards will be needed. LCLFs, with the necessary certification and accounting frameworks to verify emissions, could start to be used in the short-term where alternative emissions reduction technology is not yet viable, while battery and hydrogen technology trials begin to establish which use-cases they suit best. Investment and regulatory requirements for low and zero emission energy and the required infrastructure should also begin across the rail network in the short-term. Where budgets allow, the Australian Government will take opportunities through the Infrastructure Investment Program (IIP) to invest in passenger rail electrification.

In the medium-term, demand for LCLFs for rail may begin to decrease as battery and alternatives such as hydrogen technology develop. As domestic production capacity of battery and hydrogen technologies grows, the refuelling and charging networks, including hydrogen refuelling infrastructure, will develop.

The long-term net zero future will require a significant reduction in fossil fuels as industry increases efficiency and adopts wide scale use of battery and alternatives such as hydrogen fuel cell technologies, supported by completed charging and refuelling networks.

Figure 9: A net zero pathway for rail

2025–2030

- Investment in passenger rail electrification
- Trials of battery electric and other zero emission technologies such as hydrogen
- Accelerate the build out of low and zero emission charging and refuelling infrastructure
- Initial roll out of LCLFs where electrification is not feasible, supported by certification
- Efficiency and productivity improvements

2030–2035

- Investment in a national charging and refuelling network
- Greater use of battery electric and other zero emission technologies such as hydrogen
- Production and investments in locomotive diesel technologies begin to scale down

2035–2050

- Widespread adoption of battery and other zero emission technologies such as hydrogen for new locomotives

3.4. Maritime

Shipping will require the use of low and zero emission fuels, including hydrogen derived fuels such as methanol and ammonia as well as hydrogen.

As a result of the diversity of the maritime transport sector both in Australia and internationally, a range of decarbonisation technologies are required:

- **Low carbon liquid fuels (LCLFs):** Drop-in LCLFs, such as renewable diesel, offer abatement potential and could act as a transition solution for existing diesel fleets, lowering emissions while other low emissions technologies are taken up.
- **Hydrogen and hydrogen-derived fuels:** Low and zero emissions alternatives such as hydrogen and hydrogen derived fuels, i.e. ammonia, and methanol, will play a role in the decarbonisation of long-distance shipping. Vessels require specialised internal combustion engines or fuel cells to use these fuels. Global production of ships that can run on these fuels is increasing.[17] Greater volumes of hydrogen or ammonia are required to cover the same distance, compared to heavy fuel oil or marine diesel oil, due to their lower energy densities by volume.
- **Battery electric vessels:** Battery electric technology is suited for use in smaller vessels and other domestic maritime applications with shorter voyages. Battery electric technology will be highly limited by vessel size and voyage length, and will need to be matched with appropriate charging infrastructure at ferry terminals and other key locations. E-vessels, such as battery electric boats, sailing yachts, tug boats, ferries and smaller cargo ships, some of which are manufactured in Australia, are already available and in use in other countries. Hybrid electric vessels may be taken up in the short term while battery technology advances to extend the range of battery electric vessels.
- **Operational and efficiency gains:** Improved ship design and optimised vessel operations can increase efficiency and reduce emissions. This can include use of shore power (cold ironing), slow steaming, just-in-time port scheduling, hull optimisation, waste heat recovery, and advanced monitoring systems.
- **Zero emissions ports:** Ports can reduce operational emissions through the electrification of ground vehicles and equipment, including stevedoring machinery. This is in addition to using battery electric service vessels e.g. tugs.

A net zero pathway for maritime transport

To contribute to a net zero pathway, the maritime transport sector will require a combination of technology improvements and pilot projects in the short-term to determine the pathway to the medium- and long-term solutions.

In the short-term, LCLFs may be used in small vessels, as the necessary LCLF certification and accounting frameworks are developed. Newer vessels will continue to incorporate more efficient ship designs. Battery electric boats, sailing yachts, tug boats, ferries and smaller cargo ships will start to be deployed for short range voyages. The International Maritime Organization (IMO) Net Zero Framework is considering the introduction of a new set of GHG reduction measures for international shipping from 2028, including annual fuel intensity targets, a GHG emissions pricing mechanism, and a reward system for sustainable fuel adoption.

In the medium-term, the Australian Government and industry investment priorities and transition milestones will be based on evidence from trials and pilot projects. There will be greater adoption of hydrogen and hydrogen-derived low and zero carbon fuels for long distance shipping as the cost of hydrogen decreases. The use of battery electric power for small vessels (boats, sailing yachts, tug boats, ferries and smaller cargo ships) will also continue to grow. These will be supported by the expansion of refuelling and charging infrastructure, and shore power, connected to a low emissions electricity grid.

In the long-term, long-distance shipping vessels will run on low and zero emission fuels, such as hydrogen and hydrogen-derived fuels. This will be supported by low and zero-emissions port infrastructure and operations. There will be widespread adoption of battery electric boats, sailing yachts, tug boats, ferries and smaller cargo ships.

The Australian Government's Maritime Emissions Reduction National Action Plan (MERNAP) will provide more detail on the maritime decarbonisation pathway.

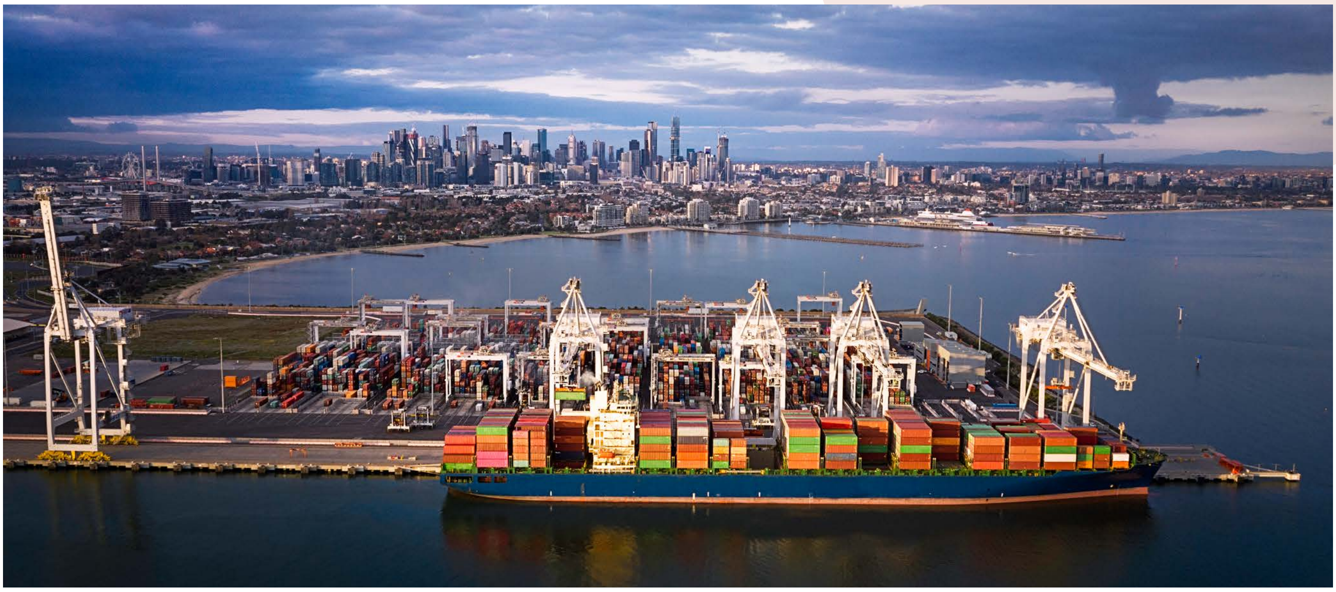


Figure 10: A net zero pathway for maritime

2025–2030

- Pilot and demonstration projects for low and zero carbon propulsion technologies
- International Maritime Organization progresses measures to reduce international shipping emissions
- Some battery electric vessels (battery electric boats, sailing yachts, tug boats, ferries and smaller cargo ships) commence deployment for short voyages
- LCLFs may be used in some small vessels as LCLF certification and accounting frameworks are developed
- Development of operating and safety standards for vessels using hydrogen and hydrogen-derived fuels
- Ongoing improvements in ship design improve efficiency of new vessels

2030–2035

- Short haul battery electric vessels continue to be deployed for short routes, including public transport
- Emerging use of hydrogen-derived fuels and hydrogen for long distance shipping, as hydrogen costs come down
- Increased deployment of charging and refuelling infrastructure at ports
- Expansion of shore power infrastructure and greater decarbonisation of port operations

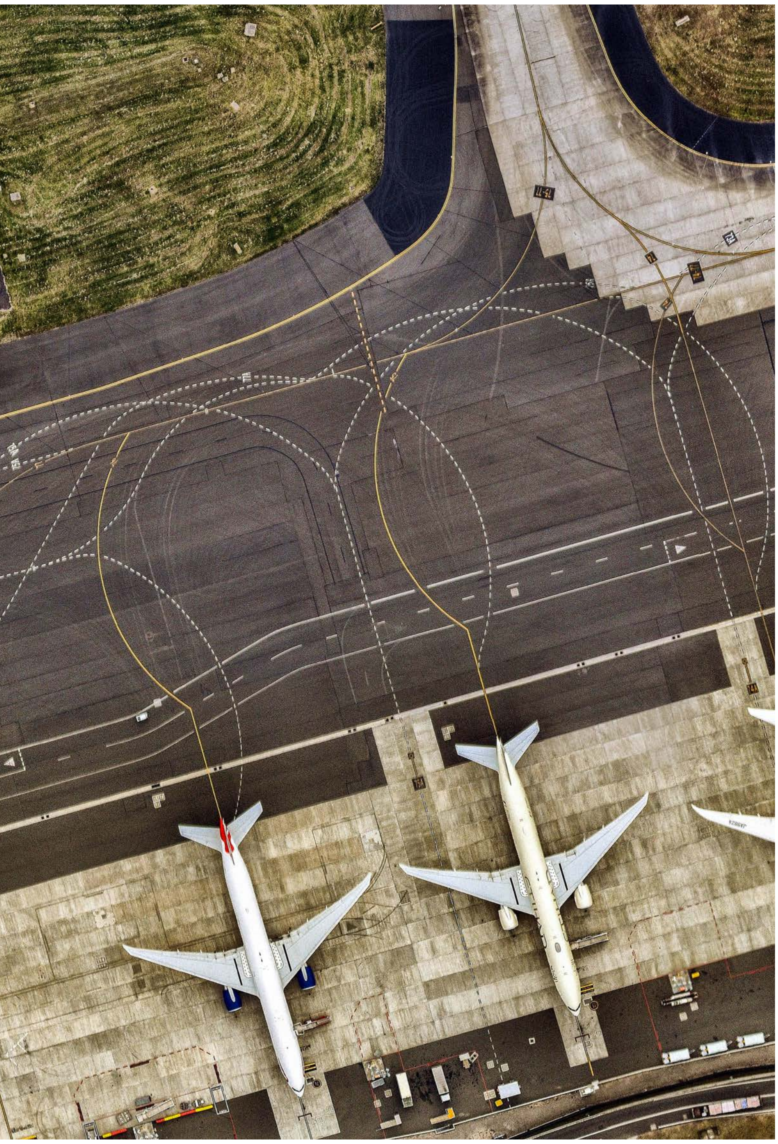
2035–2050

- Widespread adoption of short haul battery electric vessels
- Significant increase in vessels powered by alternatives such as hydrogen-derived fuels and hydrogen for long distance shipping
- Ports broadly support battery recharging and refuelling of hydrogen derived fuels and hydrogen
- Zero emissions port operations widespread

3.5. Aviation

Sustainable aviation fuel is the primary pathway to decarbonise aviation.

Sustainable Aviation Fuel (SAF), a type of LCLF, will be the primary pathway to decarbonise the aviation sector, particularly for medium and long-haul flights. SAF is produced from sustainable feedstocks. It is chemically very similar to traditional fossil jet fuel and can be used in traditional jet engines without modifying them. Depending on the feedstocks, production methods and supply chains used, SAF offers an approximately 20% to 90% reduction in lifecycle emissions compared to traditional jet fuel.[18] Potential feedstocks include canola seeds, tallow, sugar, agricultural and municipal solid waste, bagasse, agricultural residues, short rotation trees and hydrogen.



As a result of the diversity of the aviation transport sector both in Australia and internationally, a range of other decarbonisation technologies have potential:

- **Battery powered aircraft:** Due to range and payload limits, battery propulsion will be restricted to short haul aircraft, which are responsible for only a small percentage of the aviation sector's carbon emissions. In the longer term, battery powered aircraft may help to decarbonise short regional routes in Australia. Advances in battery technology may extend the range of these aircraft, supporting additional use cases.
- **Hydrogen:** Hydrogen propulsion shows some promise for use in medium-haul commercial flights for which battery powered aircraft are not suitable; longer domestic routes with small passenger loads that may not be viable with large aircraft; and in 'general' aviation i.e. private and recreational flying, instruction, and aerial work (agriculture, surveying, photography). Small hydrogen powered aircraft may also be well suited to regional aviation. After 2050, liquid hydrogen combustion may help decarbonise long haul domestic flights, though further testing is required to demonstrate the feasibility of this technology. Hydrogen could also play an increasing role as a feedstock for production of synthetic SAF, but this technology is at an early stage.
- **Advanced Air Mobility:** Advanced Air Mobility (AAM) involves a new generation of battery and/or hydrogen-powered aircraft with vertical take-off and landing capabilities, which can be used to move people and goods. AAM will provide opportunities to decarbonise the aviation sector and reduce surface transport emissions through mode shift.
- **Operational and efficiency gains:** Improvements in engine efficiency and aerodynamics can further improve aircraft fuel efficiency and reduce emissions. Efficient air traffic management can reduce unnecessary time aircraft spent in the air or in taxi, reducing emissions.
- **Zero emissions airports:** Airports can reduce operational emissions through the electrification of ground vehicles and equipment.

Voluntary flight alternatives, where passengers shift to other transport modes, such as High-Speed Rail, and increased use of video-conferencing could slightly reduce demand for domestic flights, lowering emissions.

A net zero pathway for aviation

The net zero pathway for aviation will rely heavily on SAF for medium and long-haul flights through to 2050 due to range and payload constraints of other technologies. Some short haul and regional flights will likely decarbonise through battery and hydrogen powered aircraft as these technologies mature.

In the short-term, SAF will be used with conventional aircraft engine technology, while investment supports battery and hydrogen propulsion development, and airport operations begin to electrify. SAF emissions intensity certification and accounting frameworks will be developed.

In the medium-term, SAF use will continue to grow, supported by increased domestic and international production. SAF production will evolve to include advanced feedstocks and production technologies, such as synthetic SAF produced from hydrogen feedstocks. Small aircraft are expected to begin to adopt hydrogen and battery propulsion technologies. Airport infrastructure will continue to upgrade to reduce operational emissions and provide recharging and hydrogen refuelling infrastructure.

In the long-term, the majority of aviation fuel used in Australia will be SAF, supported by a domestic SAF industry. Battery and hydrogen aircraft will likely be used for an increasing number of short to medium range flights. Airports will support these technologies and continue decarbonising their own operations.

Figure 11: A net zero pathway for aviation

2025–2030

- Nascent SAF uptake
- SAF certification and accounting frameworks are developed
- Battery and hydrogen technology and standards continue to develop with testing and demonstration in small aircraft
- Airport operations begin to electrify

2030–2035

- SAF uptake grows, as SAF costs reduce and production matures
- Small battery and hydrogen aircraft complete demonstration phase
- Incremental efficiency improvements in newer aircraft also reduce emissions
- Airport infrastructure continues to move towards net zero and upgrade to support electric and hydrogen aircraft recharging and refuelling

2035–2050

- SAF continues to reduce in cost and newer SAF technologies continue to commercialise
- Deployment of battery and hydrogen aircraft for some short to medium haul flights
- Australian airports support battery and hydrogen aircraft recharging and refuelling and have low operational emissions

3.6. Transport infrastructure

The net zero pathway for transport infrastructure requires investment in low and zero emissions construction materials supported by the implementation of design and procurement decisions which prioritise decarbonisation.

Embodied emissions from transport infrastructure are estimated to account for approximately 2.3% of Australia's net emissions, which is equivalent to 10% of transport emissions.[19] These emissions are incurred during the manufacture of materials used in transport infrastructure, particularly cement, aluminium, steel and asphalt, as well as during asset construction, operation and decommission. Of these emissions, only a small proportion are scope 1 (direct) emissions for the transport sector, and are limited to emissions from on-site construction. The majority of embodied emissions are attributable as direct emissions in other sectors.

The Industrial Sector Plan covers supply-side measures which support domestic companies to decarbonise material manufacturing such as cement, steel and aluminium. In contrast, this Plan focusses on demand-side measures including the policy and regulatory environment which encourage greater production and utilisation of lower carbon construction materials. This Plan also considers opportunities to reduce emissions through optimised design and procurement, including avoided construction, using recycled materials and other circular economy practices:

- **Low emission construction materials:** In 2023, 'cradle to gate' emissions associated with the manufacturing of materials accounted for 67% of upfront embodied carbon for transport infrastructure.[20] Increased investment in low and zero carbon materials (steel, cement, asphalt and aluminium), including recycled materials, is needed to support the development of low carbon industries and markets.
- **Low emission design and procurement:** Public procurement can create strong, long-term demand signals for innovative materials. Procurement levers, such as purchasing with low emission materials in mind, or designing to circular economy principles (no-build or 'avoided' solutions, better maintenance, and refurbishment, or by using efficient planning, design and building techniques), promote demand-side drivers to incentivise emissions reduction in construction.[21] Analysis by Infrastructure Australia found that up to 23% of upfront carbon from transport infrastructure construction could be abated by 2026–27 using like-for-like decarbonisation strategies. Achieving net zero aligned infrastructure by 2050 will require early and coordinated consideration of embodied carbon in planning, design and procurement.[22]

The Built Environment Plan covers opportunities to reduce embodied emissions for buildings, as opposed to transport infrastructure.

Land transport infrastructure is a fundamental enabler of productive and connected communities, people, places and services, including facilitating freight movements around Australia and globally. The net zero transition will require the prioritisation of supporting infrastructure, including updates to ports and airports, building roads suitable for heavier electric vehicles, and enabling greater mode choice.

Extreme weather events will add additional strain and maintenance needs for transport infrastructure. Building resilience into the design, planning and maintenance of land transport infrastructure is an important consideration when understanding the long-term benefits these assets can provide. This includes using more long-lasting materials, not building in areas where climate impacts are likely to be severe, and ensuring redundancy in the road network to reduce single points of failure.

A net zero pathway for transport infrastructure

The Australian Government relies on state, territory and local government for the planning and delivery of most land transport infrastructure projects, and remains an informed and active co-investor on projects of national significance through the National Land Transport Act 2014, Infrastructure Policy Statement and the Federation Funding Agreement Schedule on Land Transport Infrastructure Projects (2024–2029) (FFAS). The FFAS is updated every five years to reflect changing priorities and concerns around transport infrastructure investments.[23] The FFAS will be reviewed approximately 12 months prior to its expiry to assess the degree to which its agreed objectives, outcomes and/or outputs have been achieved. These include the facilitation of efficient and effective delivery of land transport infrastructure projects, including reducing transport and infrastructure embodied emissions to support Australia's commitment to Net Zero by 2050.

Opportunities to reduce emissions from transport infrastructure need to be considered throughout the infrastructure lifecycle – the earlier the consideration in a project, the greater the influence on whole-of-lifecycle emissions. Under the FFAS, states and territories have committed to optimise their procurement practices to enable a reduction in embodied carbon in transport infrastructure in line with Australia's net zero commitments; and to increase recycled content in transport infrastructure to support Australia's transition to a circular economy. States will be required to report on progress against indicators on decarbonisation and the circular economy on an annual basis.

Achieving net zero will require establishing markets in low carbon and recycled materials, prioritising low or zero emissions procurement, and working to fill knowledge and skills gaps. The Safeguard Mechanism will help drive the transition to net zero for many relevant sectors, such as cement, iron and steel production.

In the short-term, national standards on data collection, measurement and reporting of embodied emissions will be required to enable accurate assessment and comparison between projects. Industry is also calling for increased investment in low and zero carbon materials production, particularly steel, cement, asphalt and aluminium, to increase their availability and accessibility on the market. Demand side drivers from areas such as transport infrastructure will support industrial decarbonisation efforts as well as future opportunities in green metals; this is further explored in the Industrial Sector Plan.

In the medium-term as industry capability grows, the Australian Government will continue to develop policy measures which incentivise significant reduction in embodied emissions, with a focus on achieving reductions across the entire sector, and embedding a strong industry preference for low and zero carbon concrete, steel and other building materials, including recycled materials. The Commonwealth's Environmentally Sustainable Procurement Policy is already reducing the environmental impact of Australian Government procurements.

In the long-term, the production of low and zero carbon concrete, steel and other materials, including recycled materials, should become price-competitive and the default choice for infrastructure projects, supported by actions to build the capacity of the sector. These measures will also support material manufacturers to innovate, increasing the competitiveness of Australian-made low carbon and recycled materials in a decarbonising global economy.

Figure 12: A net zero pathway for transport infrastructure

2025–2030

- National standards are developed for data collection, measurement and reporting of embodied emissions in order to enable consistent analysis and comparison between projects.
- Increased investment and industry trust in low and zero carbon materials (steel, cement, asphalt & aluminium), including recycled materials.

2030–2035

- Embodied emissions reduce across the whole life cycle of transport infrastructure projects.
- Low and zero carbon concrete, steel and other building materials, including recycled materials, are prioritised by industry, supported by government procurement policies and incentives.

2035–2050

- Low and zero carbon concrete, steel and other building materials, including recycled materials, become competitive and used by default.

End notes

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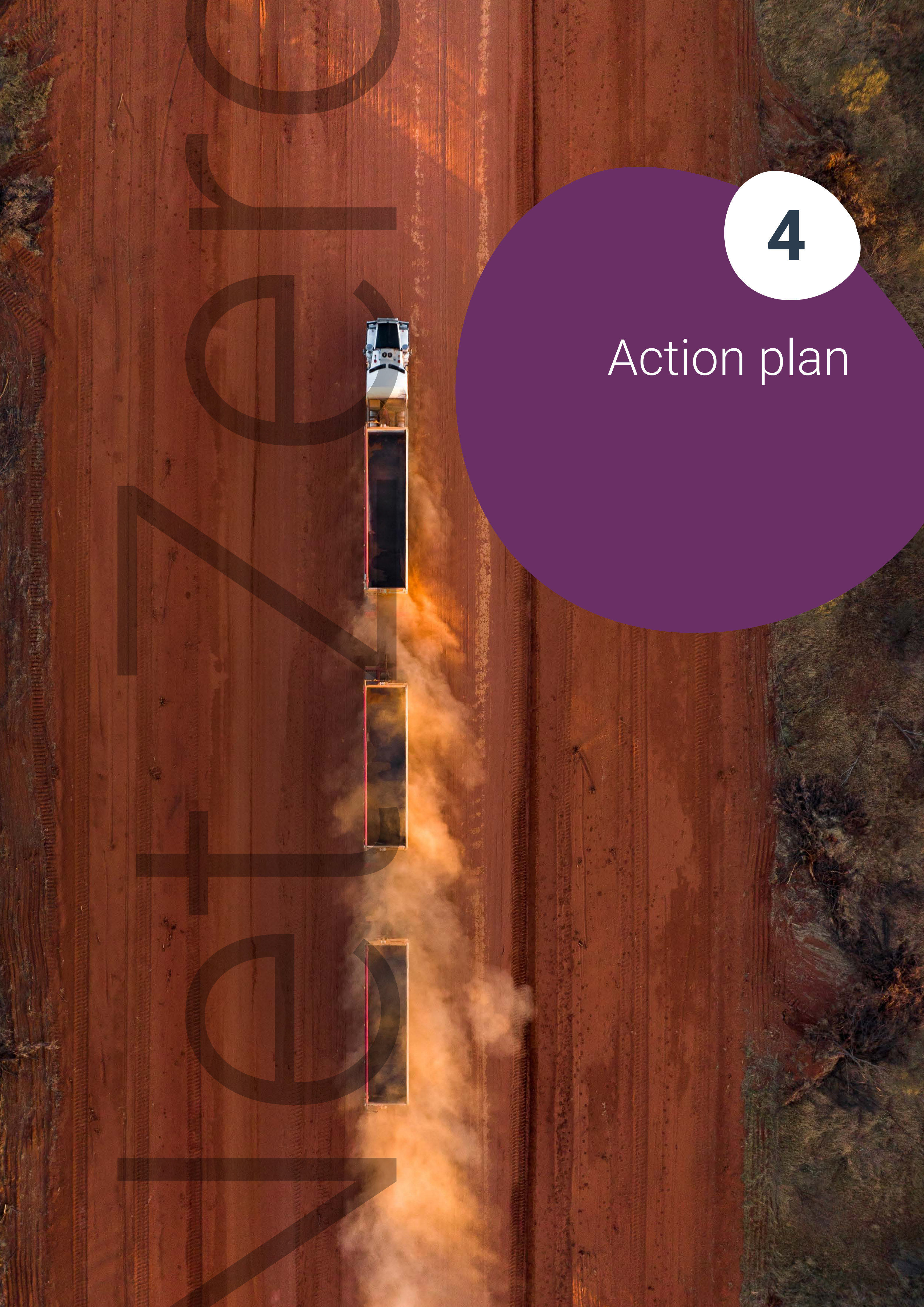
23 Australian Government, *'National Land Transport Act 2014'*, Commonwealth Consolidated Acts, AustLII, 2014, accessed 23 July 2025; Australian Government, *Infrastructure Policy Statement*, DITRDCSA, 2023; Australian Government, *Land Transport Infrastructure Projects (2024–2029)*, Federal Financial Relations, 2024.



4

Action plan

This plan provides a framework for transport and transport infrastructure to support economy-wide net zero. Extensive consultation highlighted five guiding principles and five priority action areas to guide effort and investment, underpinned by the avoid-shift-improve framework.

4. Action plan

Key points

- This Roadmap and Action Plan is guided by five guiding principles: maximise emissions reduction, provide value for money, maximise economic opportunity, be inclusive and equitable and be evidence-based.
- The Plan uses the avoid-shift-improve framework to identify all opportunities for abatement.
- There are five key priority actions across our transport systems, modes and enabling inputs in this Roadmap and Action Plan.
- Priority Action 1: Invest in enabling low and zero emissions transport infrastructure.
- Priority Action 2: Electrify and increase transport's energy performance.
- Priority Action 3: Switch to low carbon alternatives (LCLFs) to power transport where electrification is not feasible.
- Priority Action 4: Innovate to expand cost competitive transport technology options.
- Priority Action 5: Scale up efforts to reduce embodied emissions in transport infrastructure.

Guiding principles

Building on the Net Zero Plan's objectives, this Roadmap and Action Plan is guided by five guiding principles that underpinned the Consultation Roadmap:

- **Maximise emissions reduction:** Emissions reduction is at the centre of the Australian Government's Net Zero Plan. We will identify and implement effective policies at the earliest opportunity that will result in the largest reductions in emissions, consistent with achieving the Australian Government's targets.
- **Value for money:** We will promote cost-effective measures to achieve the maximum abatement potential. This includes encouraging the private sector to leverage their capital, innovation and effort to achieve net zero and working with states and territories.
- **Maximise economic opportunity:** The global transformation to a net zero economy is a source of economic opportunity for Australia, its regions, industries and workers. Australia's regions and communities can take advantage of the decarbonisation of the transport sector and create new job opportunities that workers in emissions-intensive industries can be supported to transition into.
- **Inclusive and equitable:** No-one should be left behind on the journey to net zero. Inclusivity and equity, including intergenerational equity, will underpin our policy mix. By addressing the needs of a diverse range of communities and demographic groups, all Australians can benefit from decarbonisation. In particular, government support, training and close collaboration with industry will be necessary to ensure Australia has an inclusive and diverse workforce ready for net zero. Actions to decarbonise can also support liveability, health and other outcomes.
- **Evidence-based:** We have drawn on expert analysis and experience to develop a Roadmap and Action Plan that acknowledges that no one pathway or technology will suit every transport mode. The outcome is a mix of technologies, policies and planning, based on evidence and market readiness.

Avoid-shift-improve

We use the avoid-shift-improve (ASI) framework to identify all opportunities for abatement.

- **Avoid** refers to removing travel which people would prefer not to undertake. By improving the efficiency of the transport system through integrated land-use planning, transport demand management and telecommuting, the need to travel and the length of some travel may be reduced or avoided.
- **Shift** refers to decarbonising travel by choosing to shift to more sustainable transport modes like active and public transport, or to low emission freight transport modes instead of fossil fuelled vehicles.
- **Improve** refers to improving the technology or efficiency of transport modes, such as through electrification.

Transport infrastructure is critical across all three domains. See also **Figure 3**.

Priority actions

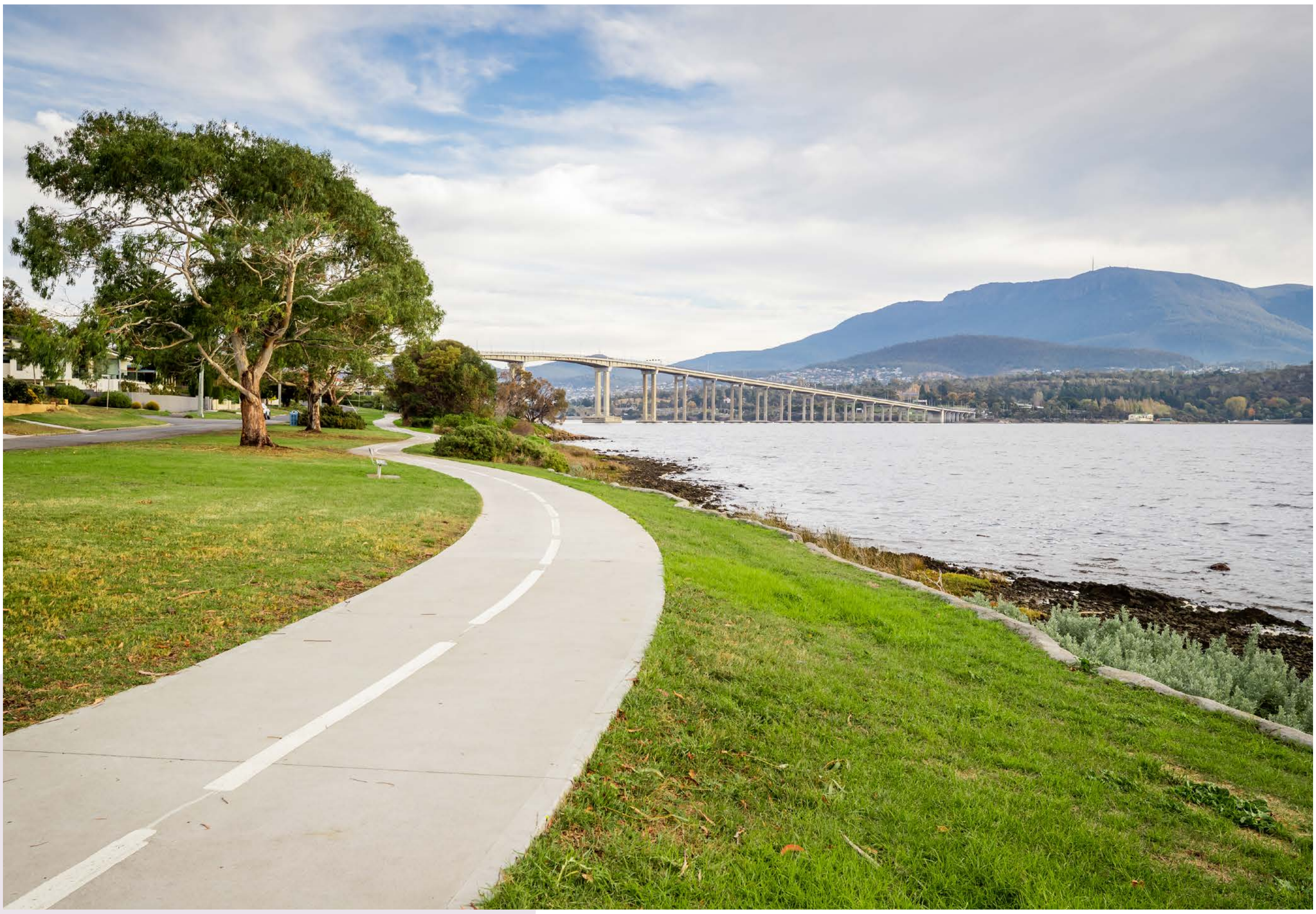
The Net Zero Plan sets out Australia's pathway to achieve our legislated target of net zero greenhouse gas emissions by 2050. The Net Zero Plan identifies 5 priority decarbonisation actions to reduce key emissions sources across the economy:

1. Decarbonise and expand the electricity network
2. Electrify and improve energy and materials performance
3. Switch to low-carbon fuels
4. Innovate to expand emissions reduction options
5. Scale up carbon removals to balance residual emissions.

This plan for transport and transport infrastructure has a particular focus on advancing priorities 2, 3 and 4, in alignment with the sector's decarbonisation pathways set out in chapters 2 and 3.

There are five priority actions that will ensure the transport sector makes its full contribution to Australia's medium and long-term emissions reductions goals. Achieving a net zero transport and transport infrastructure sector will require sustained effort and action from industry, all levels of government, the private sector and communities across these five actions:

1. Invest in enabling low and zero emissions transport infrastructure
2. Electrify and increase transport's energy performance
3. Switch to low carbon alternatives (LCLFs) to power transport where electrification is not feasible
4. Innovate to expand cost competitive technology options for transport and transport infrastructure
5. Scale up efforts to reduce embodied emissions in transport infrastructure.



Priority action 1: invest in enabling low and zero emissions transport infrastructure

Achieving a low and zero emissions transport system will require rethinking our transport networks to decarbonise how we move people and goods across our large and geographically diverse country. This links to the avoid and shift elements of the ASI framework as enabling low and zero emission transport infrastructure will improve the efficiency of our transport systems and encourage greater use of active and public transport and lower emission freight transport modes. There are five sub-actions that contribute to Priority Action 1.

1.1 Invest in transport infrastructure projects that support sustainable and decarbonised transport systems

While the design, construction and funding of transport infrastructure is a shared responsibility of Australian, state, territory and local governments, along with the private sector, the Australian Government is investing in infrastructure projects that support sustainable and decarbonised transport for both the movement of people and the movement of goods:

- The **Infrastructure Policy Statement** (IPS) guides the Australian Government's investment in land transport infrastructure to achieve economic, social, and environmental goals. Under its sustainability theme, the IPS raises the importance of decarbonising the design, construction and operation of transport infrastructure to achieve net zero by 2050; and affirms that the Australian Government will seek to invest in projects that promote integrated and more sustainable approaches to land use.
- Under the **Infrastructure Investment Program** (IIP), 38 active projects worth a total of $29.2 billion are dedicated to infrastructure that will support the decarbonisation of transport, such as infrastructure for active transport, public transport, or enabling freight to be moved by sea or rail rather than road.[24] A further 133 active projects have a component that supports decarbonisation, such as funding for a road upgrade that includes an adjacent active transport path.
- Under the **Federation Funding Agreement Schedule on Land Transport Infrastructure Projects** (FFAS), states and territories will aim to optimise their procurement practices to enable wider outcomes including a reduction in embodied carbon in transport infrastructure in line with Australia's Net Zero commitments; and optimising recycled content in transport infrastructure to support Australia's transition to a circular economy. States will report agreed indicators relating to decarbonisation and contribution to the circular economy on an annual basis.

The ***National Land Transport Act 2014*** (NLTA) provides the legislative framework that outlines the types of land transport infrastructure projects that are eligible for funding under the IIP. A future review of the NLTA provides an opportunity to consider how transport infrastructure investments can support decarbonisation, including in active and public transport.

Movement of people

A net zero transport pathway will require a substantial increase in the use of active and public transport, while providing access to transport options that are affordable and meet the needs of communities. The Australian Government is taking a range of actions to support the net zero pathway for the movement of people:

- The Australian Government's **Active Transport Fund** provides funding for bicycle and walking paths to promote active transport across Australia. The **National Health and Climate Strategy** aims to engage agencies at all government levels to promote active travel.
- Under the IIP, 26 active projects worth a total of $27.5 billion, are dedicated to infrastructure to support the use of public transport.[25]
- The Australian Government is planning for a future High Speed Rail network to connect communities across the east coast of Australia. **High Speed Rail** will better connect Australians and enable reduced car use.

Movement of goods

The Australian Government is also undertaking a range of actions to support the net zero pathway for the movement of goods:

- The **National Freight and Supply Chain Strategy** (NFSCS) recognises the role of supply chains in achieving net zero by 2050, highlighting decarbonisation as one of the four National Priority Action Areas.
- The Australian Government's investment in **Inland Rail** will enhance national freight and supply chain

capabilities by connecting existing routes through rail, roads, and ports and shifting more goods to rail, resulting in faster, more reliable freight; safer, less congested roads; and fewer emissions. Investments in **intermodal hubs** such as the Moorebank Intermodal Terminal Precinct will also support resilient and sustainable national supply chains.

- 10 active projects under the IIP worth a total of $2.1 billion are dedicated to infrastructure that enables more freight to be moved by rail.[26]
- The Australian Government's **Emerging Aviation Technology Partnership** (EATP) Program supports research into, and development of, low and zero emission propulsion systems with potential applications in conventional aviation, including freight. The EATP Program has enabled battery powered flight tests, and testing of hydrogen fuel cells that will enable hydrogen powered passenger transport flights with an estimated range of up to 3,000km in future. Under the Program, battery powered drones are also being used to deliver essential medical supplies to remote Aboriginal communities.

Using data to guide route planning and infrastructure investments will further enhance distribution strategy efficiency, thereby reducing unnecessary travel and, consequently, emissions. The *CSIRO's Transport Network Strategic Investment Tool (TraNSIT)*[27] can improve supply chain efficiency and help identify options for transport and logistics investment.

1.2 Support the path to net zero in the planning and development of urban areas

Considering the path to net zero in the planning and development of urban areas will be critical to supporting sustainable transport choices for the movement of people and movement of goods:

The **National Urban Policy** outlines a vision for the sustainable growth of our cities that are liveable and equitable, productive and innovative, and environmentally sustainable and resilient. Future planning for active and public transport infrastructure may be guided through the implementation of this policy, considering the distinct roles of each government level.

The NFSCS includes the **National Urban Freight Planning Principles**, which emphasise the connection between freight movement and land use planning, particularly the need to protect critical land and freight infrastructure in urban areas.

1.3 Develop place-based solutions to drive transport sustainability and decarbonisation at a local level

Place-based and local level programs are best placed to enable the identification of transport access and equity issues. Through the **Regional Investment Framework**, the Australian Government is investing in a range of programs to develop place-based solutions to drive transport sustainability and decarbonisation at a local level including:

- Growing Regions Program
- Thriving Suburbs Program
- Stronger Communities Programme
- Housing Support Program
- Safer Local Roads and Infrastructure Program
- Community Energy Upgrades Fund.

The Australian Government has also refocused programs to ensure that they support broader Australian Government priorities, including achieving net zero, through new application requirements.

1.4 Embed resilience to current and future climate change

Informed by the National Climate Risk Assessment and National Adaptation Plan, the Australian Government will seek to embed resilience to current and future climate change in our transport systems and infrastructure. For example, reflecting the importance of resilience to the future of efficient and productive freight operations, resilience has been added as a National Priority Action Area under the **National Freight and Supply Chain Strategy**.

Productivity and resilience are also strategic themes of the **IPS**. This involves investing in projects that enhance Australians' mobility in cities, towns, and regions, prioritising mass transit to develop more productive central business districts.

The Australian Government will look for opportunities to further embed resilience across transport and transport infrastructure. For example, innovative transport technologies will also play an increasingly important role in the management of extreme weather events. This will be particularly important for regional Australia, where areas with single or limited access routes can be cut off by extreme weather events. The **National Roadmap for Remotely Piloted Aircraft Systems in Bushfire Management** outlines a national pathway to implement emerging aviation technologies for bushfire management.

Priority action 2: electrify and increase transport's energy performance

Electrification and energy efficiency will be the primary decarbonisation pathway for much of the transport sector, especially light vehicles. As part of the avoid-shift-improve framework, where travel cannot be shifted away from vehicle use, decarbonising the transport sector will involve improving the fuel efficiency and carbon intensity of our vehicles and electricity.

There are five sub-actions that contribute to Priority Action 2.

2.1 Maintain, review and improve regulatory frameworks to reduce transport emissions

The Australian Government will use existing regulatory frameworks to reduce transport emissions:

- The Australian **New Vehicle Efficiency Standard** (NVES), which came into effect on 1 January 2025, encourages supply of more efficient light vehicles and will drive down emissions from new light vehicles. The Australian Government will commence a review on the operation of the NVES in 2026. The review process will offer the opportunity to assess policy effectiveness and refine the regulatory systems and mechanisms.
- The **Safeguard Mechanism** sets legislative limits on the greenhouse gas emissions of Australia's largest industrial facilities, including 11 transport facilities involving 1 in heavy vehicles, 6 in rail, 1 in maritime and 3 in aviation. As these limits decline over time, this will drive down emissions in the transport sector. In 2023–24, the Safeguard Mechanism covered 11% of transport emissions, including 82% of rail emissions and 71% of aviation emissions. The Australian Government will conduct a review of the Safeguard Mechanism policy settings in the financial year 2026–27 to ensure the scheme's design is appropriately calibrated and effectively delivering emissions reduction in line with Australia's targets.

2.2 Increase the supply of affordable and accessible EVs

The **National Electric Vehicle Strategy** establishes a consistent framework to boost EV adoption, reduce light vehicle emissions, and enhance Australians' wellbeing. Increasing the supply of affordable and accessible EVs is one of the Strategy's three key objectives, alongside encouraging increased EV demand and establishing the resources, systems and infrastructure to enable rapid EV uptake. As part of this, the NVES will also save Australians money on fuel and provide more car choices, as well as reducing greenhouse gases from cars and improving air quality.

The 2024–25 **Australian Design Rule (ADR) Harmonisation Review** is also assessing the current processes for harmonising ADRs with international vehicle standards, and seeking opportunities to improve these practices. The review is exploring how harmonisation practices influence timing and decisions about providing vehicles to the Australian market, including interactions with the NVES.

The Australian Government has also removed regulatory barriers where appropriate to accelerate the supply of heavy battery electric vehicles including:

- **Reforms to mass limits** by the National Heavy Vehicle Regulator, National Transport Commission, and states and territories ensure trucks with advanced safety and emissions features avoid productivity penalties. Steer axle mass limits have been increased from 6.5 tonnes to 7.0 tonnes for **Euro VI** and zero-emission trucks, allowing for larger battery electric models.
- The **Safer Freight Vehicles** package, to increase the overall width limit from 2.5 to 2.55 metres for new trucks that are fitted with a number of safety features and increasing the allowable space between front axles on trucks. This will increase the supply of zero-emission trucks available in Australia.

The Australian Government intends to also progress heavy vehicle reforms, including for heavy zero emissions vehicles (HZEVs), in partnership with the states and territories, and local governments. These reforms will be aimed at increasing transport productivity for all heavy vehicles and support the uptake of HZEVs.

2.3 Encourage increased uptake of more efficient vehicles, supported by energy performance improvements

To accelerate the decarbonisation of light vehicles, the Australian Government has introduced incentives and support to encourage the uptake of electric and efficient vehicles:

- Expanded the **Driving the Nation Program** (delivered through ARENA), and allocated $100 million to support heavy BEV technologies and charging and innovation in light vehicle charging, to accelerate the uptake of both light and heavy EVs.
- The **Electric Car Discount**, introduced in 2022, provides a Fringe Benefits Tax exemption for cars made available by employers for use by employees. The fringe benefits tax exemption is complemented by the removal of a 5% import tariff, making eligible electric vehicles more affordable and accessible to Australian families. The Government will complete a statutory review into the discount by mid-2027.
- The Clean Energy Finance Corporation (CEFC) is investing in **green car loans** to accelerate EV uptake, including partnerships with auto finance companies to get more EVs onto Australia's roads and for leasing and rideshare companies to boost their EV fleet. For example, up to $150 million has been made available to support workers earning less than $100,000 a year and eligible essential workers to purchase an EV.
- Funding the **Real World Testing of Vehicle Efficiency program** to test the fuel consumption and emissions of vehicles in real-world conditions so consumers have clear information on how much a particular vehicle will cost to run. The Real World Testing program has been expanded to test the efficiency of EVs in 2025.
- Reviewing the carbon dioxide testing framework for light vehicles and update the sticker that is required to be placed on new vehicles when they are sold. The Australian Government will put in place a conversion framework to allow vehicle suppliers to convert between different testing frameworks.
- The **Green Vehicle Guide** is a centralised website providing data and tools to help Australians quickly compare the fuel efficiency, running costs and environmental performance of new and used vehicles.
- EV.gov.au, **a centralised website for EV education and awareness** launched in July 2025. The website provides EV education and information in a 'one-stop-shop' with tailored resources for existing EV owners and those considering an EV in the future.
- The Australian Government, in consultation with states and territories, is undertaking a cost-benefit analysis (CBA) on whether there would be merit in increasing mass limits to facilitate the adoption of low and zero emission heavy vehicles. The results of the CBA will be published in 2025.

2.4 Support the efficient rollout of electric vehicle charging infrastructure

All levels of government, individuals and the private sector will have a role to play in shaping the national EV charging ecosystem. As uptake of EVs continues to grow, it will be important to have a policy environment that supports people to enjoy the benefits of charging their EV at home alongside efficient investment in and installation of appropriate public EV charging infrastructure in the places people most need to access it.

To support the transition, the Australian Government will continue to invest in EV charging infrastructure:

- The $475 million **Driving the Nation Fund** provides $39.3 million to the NRMA to deliver public fast charging stations across key highway routes as part of a National EV Charging Network and $60 million through the DRIVEN Program to support installation of EV charging infrastructure at car dealerships and repairers. Under the Fund, ARENA has also allocated $100 million to support heavy vehicle charging and light vehicle charging innovation.
- The Australian Government will provide $40 million to accelerate the rollout of EV kerbside and fast charging. The Government will leverage the complementary strengths of DNSPs and EV charge point operators to deliver up to 10,000 public chargers.
- Charging infrastructure will need continue to keep pace with the electrification of light road vehicles so that Australians can enjoy the benefits of charging their EV at home and access appropriate public EV charging infrastructure in the places where people need it most. Removing barriers to home charging for apartments could help reduce the reliance on public charging infrastructure. For example, governments at all levels could work together to establish a right to charge for apartments and households without off-street parking, such that owners' corporations cannot unreasonably restrict or prevent the installation of home charging.

- As part of the National Electric Vehicle Strategy, the Australian Government has developed **guides to help multi-residence (strata) buildings become 'EV ready'**. This guidance provides apartment buildings with a toolkit of resources, templates and checklists to support residents to transition to EVs when it suits them. The Strategy is also looking at how all levels of government can work together to provide a right to charge, such that bodies corporate cannot unreasonably restrict or prevent the installation of chargers in apartment buildings.
- The National **Consumer Energy Resources (CER)** Roadmap outlines the Government's vision and plan to scale CER across Australia.[28] It offers a national approach to reforms, to deliver the greatest benefits for Australian households, businesses and communities.
- ARENA commissioned the **National Roadmap for Bidirectional EV Charging** in partnership with the RACE for 2030 Cooperative Research Centre. The roadmap highlights the potential of bidirectional EV charging to reduce electricity costs and accelerate national emissions reduction. The V2G roadmap outlines possible pathways for commercial adoption of bidirectional charging in Australia and guides future investment.
- To ensure a consistent approach to EVs, the Australian Government, in collaboration with states and territories, has developed **minimum operating standards for EV charging infrastructure.** These standards guide the deployment of government-funded public EV charging by providing guidance on factors like uptime, accessibility, interoperability, and payment options.
- The Australian Government launched a **national mapping tool for EV charging infrastructure** in July 2025. This tool will aid in planning for infrastructure, energy, and telecommunications, provide certainty for EV drivers across borders, and guide future investments. The Australian Government is also working with states and territories to identify priority locations for regional charging infrastructure, ensuring optimal investment and certainty for all EV users in Australia.
- The Australian Government has also funded charging infrastructure for electric buses at depots in Western Australia and New South Wales. A future review of the *National Land Transport Act 2014* provides an opportunity to consider how transport infrastructure investments can further support decarbonisation, including through active and public transport.

2.5 Enhance the operations of ports, railways and airports to advance decarbonisation

Rail

The Australian Government is improving the productivity and resilience of the national rail network. This will contribute to lower emissions and increase the attractiveness of moving freight on rail. Rail freight is also captured by the Safeguard Mechanism. Actions to enhance the operations of railways that will support decarbonisation include:

- The second stage of the **National Rail Action Plan** aims to create an integrated, productive, and safe national rail network through interoperable technologies, a national approach to skills and training, and harmonised standards. The four-year program from 2024–25 to 2028–29 aims to streamline and reduce operational constraints, drive interoperability, harmonise standards and systems, and address rail's skills and labour shortages.
- The Australian Government is investing over $15 billion in major rail projects from 2023–24 to 2032–33, including **Inland Rail** and **High Speed Rail** planning, and strategies to support the rollingstock transition, such as the **National Rail Manufacturing Plan.**

Maritime

The **Maritime Emissions Reduction National Action Plan** (MERNAP) will set the strategic direction and set out actions to decarbonise our maritime transport. This includes:

- Supporting increased green energy exports
- Encouraging investment in research and development for maritime innovation
- Enhancing port infrastructure and operations to support maritime decarbonisation
- Continuing to engage with the International Maritime Organization and expanding green and digital corridor activities
- Supporting demand aggregation through collaboration among regional operators
- Supporting first movers by reducing regulatory barriers and mitigating costs
- Ensuring timely and effective upskilling of the maritime workforce.

Further information about the MERNAP is available online.[29]

Aviation

The Australian Government's **Aviation White Paper** sets out the vision for the aviation sector towards 2050. The Australian Government is encouraging the aviation industry to decarbonise by supporting the rollout of necessary enabling infrastructure, especially at airports:

- Amending the **Airports Regulations 2024** to require federally-leased airport master plans and major development plans to include information on how long-term planning will address decarbonisation. The new rules will allow the Minister for Infrastructure, Transport, Regional Development and Local Government to have regard to the suitability of the airport's sustainability and decarbonisation initiatives when making decisions about future master plans and major development plans.
- $40 million to expand the **Regional Airports Program** to improve safety and accessibility and support the transition to net zero at eligible regional airports.
- Releasing an **Advanced Air Mobility** (AAM) Strategy outlining the Australian Government's long-term AAM policy settings to provide certainty and encourage investment in this emerging sector.
- Developing **Advanced Air Mobility Infrastructure Planning Guidance** to ensure a nationally consistent approach to infrastructure planning to support the introduction of AAM.
- The **Uncrewed Traffic Management** (UTM) Action Plan will develop a safe and competitive market for drone traffic management in Australia and streamline approval processes for drone operations.
- Established the **Australian Jet Zero Council** to promote, mobilise and galvanise industry efforts on aviation and provide coordinated advice to the Australian Government.

Priority action 3: switch to low carbon alternatives (LCLFs) to power transport where electrification is not feasible

To support the transport sector's net zero pathways, low carbon alternatives such as low carbon liquid fuel (LCLF), including sustainable aviation fuel (SAF) and renewable diesel, and hydrogen, will be important to decarbonise hard-to-electrify transport modes, including heavy vehicles, rail, maritime and aviation. There are three sub-actions under Priority Action 3 that are aimed at improving the emissions intensity of hard-to-electrify transport modes.

3.1 Establish frameworks to verify and track the emissions intensity and production methods of LCLFs and hydrogen

The Australian Government is extending the **Guarantee of Origin (GO) scheme** to LCLFs and hydrogen to provide a robust, internationally aligned framework for tracking and verifying the emissions intensity and production methods of LCLFs and hydrogen.

The Australian Government has also developed the new ***Fuel Quality Standards (Paraffinic Diesel) Determination 2025*** so that diesel users can be confident that new types of diesel, e.g. renewable diesel, operate at the same standard as conventional diesel.

3.2 Fast track support for a domestic LCLF industry, with an initial focus on SAF and renewable diesel

The Future Made in Australia agenda will see the Australian Government fast-track support for a LCLF industry, including SAF and renewable diesel, to support Australia's transition to a net zero economy:

- The **GO Scheme** supports the Australian Government's Future Made in Australia agenda to attract investment in low carbon products and renewable electricity. The scheme will empower an Australian LCLF industry to make confident, objective and credible claims about the products they make. The scheme will also help Australian producers access emerging domestic and export low-emissions markets.
- The **Future Made in Australia Innovation Fund** supports projects to commercialise net zero innovations, with $250 million allocated to accelerate the pace of Australia's domestic LCLF industry.

ARENA's Sustainable Aviation Fuel Funding Initiative has also provided over $30 million in grants to support development of a SAF industry.

The **Australian Jet Zero Council** was established to lead on industry efforts to achieve net zero aviation in Australia, with an initial focus on SAF.

The Australian Government has also committed to developing a **bioenergy feedstock strategy**, to support a coordinated approach to developing a feedstock industry in a way that creates opportunities for agriculture and forestry producers but does not create concern around food security.

To build a supply chain for Australian low carbon liquid fuels, the Australian Government will invest $1.1 billion in a new **Cleaner Fuels Program**. This will help stimulate private investment in Australia's first onshore low carbon liquid fuel refineries, backing local innovators, making fuel supply more resilient and bridging the price gap for early adopters. The Government will engage with industry on how to make sure Australian liquid fuel users have a fair chance to capture the emissions reduction potential unlocked by low emission Australian fuels.

3.3 Support the development of renewable hydrogen

The **National Hydrogen Strategy** sets a growth trajectory through production and export targets with progress milestones. It identifies the most prospective hydrogen use cases that will be the focus for ongoing government economic incentives and policy support. The National Hydrogen Strategy includes a range of actions focused towards the transport sector.

The National Hydrogen Strategy builds on existing announcements like the expansion of the Hydrogen Headstart program, the Hydrogen Production Tax Incentive, funding for developing hydrogen hubs and the establishment of the Guarantee of Origin scheme to provide certification of hydrogen.

Priority action 4: innovate to expand cost competitive transport technology options

To support the transport sector's net zero pathways, developing strategic approaches through innovation, commercialisation, pilot and demonstration projects will expand cost competitive technology options and ensure Australia is an important part of the global net zero economy. The two sub-actions under Priority Action 4 will contribute to all aspects of the avoid-shift-improve framework.

4.1 Provide financial assistance and knowledge sharing to support improvements in the competitiveness and supply of renewable energy and the uptake of energy efficiency and electrification

The Australian Government is investing in financial assistance and knowledge sharing to increase energy efficient and decarbonised transport through:

- $250 million Low Carbon Liquid Fuel component of the $1.5 billion **Future Made in Australia Innovation Fund** to accelerate the pace of Australia's domestic LCLF industry.
- $475 million Driving the Nation Fund.
- $200 million CEFC **Clean Energy Innovation Fund**, the largest dedicated cleantech investor in Australia.
- **Cooperative Research Centres** (CRC) Grants Program which fosters partnerships translating research into practical applications, driving innovation, and enhancing the competitiveness of Australian industries.
- The **Australian Renewable Energy Agency** (ARENA) supports the global transition to net zero emissions by accelerating the pace of pre-commercial innovation. A key part of ARENA's work is to build knowledge that can be shared openly to help industry and governments better navigate the energy transition.
- $15 billion **National Reconstruction Fund** (NRF) to provide finance to support, diversify and transform Australia's industry across 7 priority areas of the economy, including transport and renewables and low emission technologies.
- The **National Battery Strategy** outlines actions for Australia to create a diverse and competitive Australian battery industry, including the $523.2 million Battery Breakthrough program. The Strategy highlights batteries for Australia's domestic equipment manufacturing (such as heavy vehicles) as a high value opportunity.
- The Australian Government has also worked with the CSIRO to highlight opportunities to build a domestic LCLF industry through the **Sustainable Aviation Fuel Roadmap** and **Opportunities and Priorities for a Low Carbon Liquid Fuel industry** research paper.

4.2 Develop nationally coordinated and consistent approaches to the rollout of new transport technologies

The Australian Government has a range of strategies to ensure the national rollout of new transport technologies is coordinated, consistent, and supports decarbonisation, including:

- National Electric Vehicle Strategy
- Heavy Vehicle National Law amendments
- Aviation White Paper
- National Rail Action Plan
- National Rail Manufacturing Plan
- Maritime Emissions Reduction National Action Plan (MERNAP)
- Advanced Air Mobility Strategy
- Advanced Air Mobility Infrastructure Planning Guidance
- UTM Action Plan
- Drone Rule Digitisation Project
- National Road Transport Technology Strategy
- 2024–27 National Connected and Automated Vehicle (CAV) Action Plan

Priority action 5: scale up efforts to reduce embodied emissions in transport infrastructure

Embodied emissions are expected to form a major and increasing proportion of infrastructure-related emissions as the electricity grid transitions to decarbonised sources and operational emissions decline. Reducing embodied emissions from transport infrastructure falls under the shift and improve sections of the ASI framework. There are four sub-actions that contribute to Priority Action 5.

5.1 Develop end-to-end carbon management policy and guidance, beginning with a nationally consistent approach to measuring embodied carbon in infrastructure projects

Through the Infrastructure and Transport Ministers' Meeting (ITMM), the Australian Government is collaborating with states and territories to deliver nationally applicable tools and guidance for the measurement, reporting and reduction of embodied carbon arising from transport infrastructure including roads, rail and bridges:

- Infrastructure Australia has developed **National Carbon Values** (NCVs) to ensure embodied emissions are considered in option selection and cost benefit analyses (CBAs) for transport infrastructure projects. All business cases submitted to Infrastructure Australia for evaluation must use the NCVs.
- Under the *Policy on the application of the National Carbon Values*, states, territories and the Commonwealth have also agreed in principle to apply the NCVs (or better) when assessing projects requesting over $100 million in government funding.[30]
- The **Embodied Carbon Measurement for Infrastructure: Technical Guidance** (National Measurement Guidance) promotes consistency across Australian jurisdictions by offering a common methodology, calculation assumptions, data usage approach, and reporting guidance for embodied carbon.
- The **National Sustainable Procurement in Infrastructure Guideline** offers best practice procurement and contracting approaches, including implementation options and supplier requirements to maximise emissions reductions throughout all project lifecycle stages.
- In May 2025, ITMM approved the development of a **National Embodied Carbon Databook** to provide industry and government with a reliable source of average emissions factors for materials used in transport infrastructure. The Databook will equip stakeholders to estimate embodied carbon for projects and identify opportunities to reduce emissions through material substitution or design changes.

5.2 Accelerate the commercialisation of low and zero emission construction materials

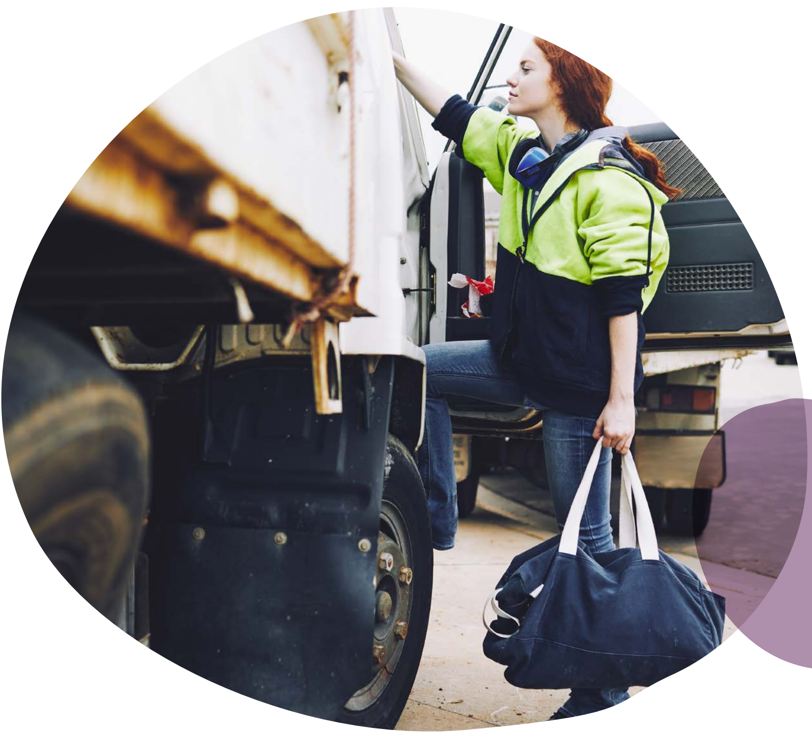
Improving access to low carbon construction materials is an important enabler for reducing embodied carbon in transport infrastructure projects. The Australian Government is funding a number of initiatives to support domestic manufacturers to accelerate production of lower carbon concrete and steel, which contribute the largest share of upfront embodied emissions in transport infrastructure projects, including:

- $21 million for the SmartCrete Cooperative Research Centre and La Trobe University to develop a **Low Carbon Concrete Centre**, accelerating the decarbonisation of concrete and improving confidence in low carbon concrete-based products.
- $59.1 million awarded via the Australian Renewable Energy Agency (ARENA) to support **low emissions steel, iron and renewable hydrogen research**, development and commercialisation projects.
- $750 million of the **Future Made in Australia Innovation Fund**, administered through ARENA, to support innovative green metal projects including iron, steel, alumina and aluminium.[31] The Australian Government is supporting the establishment of a green metals sector, including the $1bn Green Iron Investment Fund, $2bn Green Aluminium Production Credit, and the $10m Green Metals Innovation Network.
- Low or no cost loans from the Clean Energy Finance Corporation for **low carbon concrete initiatives** in housing and industrial developments; the technologies and methodologies of which will also be useful for the decarbonisation of transport infrastructure.

5.3 Mandatory requirements on companies for reporting, assessment and emissions reduction

Mandatory assessment and disclosure encourage businesses to implement measures that reduce embodied emissions from materials. The Australian Government has introduced initiatives requiring companies to consider emissions from direct operations and supply chains, including:

- Under the **Safeguard Mechanism**, facilities including steelworks, iron ore mines, cement suppliers, alumina refineries and aluminium smelters are required to reduce their net emissions in line with the declining baselines.
- **Mandatory climate-related financial disclosures** require large corporate entities to disclose information about climate-related risks including emissions arising from construction or maintenance of assets. This will enable shareholders, buyers and clients to better understand – and drive action to reduce – embodied emissions.



5.4 Support infrastructure decarbonisation capability in private and public sectors, including the development of resources, training and guidance

The Australian Government is working to deliver the tools and guidance required to accurately measure and reduce embodied carbon. Targeted training and capability uplift will assist stakeholders in industry and government to implement these resources and accelerate emissions reductions. It is also important to promote awareness of net zero career paths within the infrastructure sector and to work with the private sector to increase investment in workforce capability, particularly in net zero skills, and to help attract a larger, more diverse pipeline of workers to meet current and future industry demands.

The Australian Government engages with Austroads in development of resources and guidance to improve industry familiarity with and trust in low carbon and recycled materials. For example:

- The *Carbon reduction and the use of low carbon concrete* project seeks to facilitate a widespread use of concrete with lower cement content.[32]
- Circular economy guidelines provide users with information on how to improve the recycled content of roads using innovative materials.[33]

In collaboration with states and territories through ITMM, the Australian Government is developing options for an **infrastructure decarbonisation capability building program and central knowledge hub**. These options may include education and training programs which target carbon literacy, platforms showcasing emissions reductions achieved through innovative construction methods, and resources demonstrating learnings and specifications for low carbon solutions.

End notes

24 IIP project information is as at Pre-Election Fiscal Update 2025. It includes active major construction projects (planning projects not included) and Australian Government funding contribution only.

25 IIP project information is as at Pre-Election Fiscal Update 2025. It includes active major construction projects (planning projects not included) and Australian Government funding contribution only.

26 IIP project information is as at Pre-Election Fiscal Update 2025. It includes active major construction projects (planning projects not included) and Australian Government funding contribution only.

27 CSIRO, *Transport logistics-TraNSIT*, CSIRO, 2023.

28 Consumer energy resources (CER) include a diverse range of small to medium scale energy resources that are located behind the meter at residential, commercial and industrial premises and are owned or operated by the customer. These resources generate or store electricity and includes flexible loads that can alter demand in response to external signals. CER includes technologies such as rooftop solar small scale battery including community battery storage systems, inverters, bi-directional energy resources including electric vehicle supply equipment.

29 Australian Government, *Charting Australia's Maritime Emissions Reductions*, DITRDCA, 2024.

30 DITRDCSA, *Policy on the application of National Carbon Values*, infrastructure.gov.au, 2024.

31 Australian Renewable Energy Agency (ARENA), *Future Made in Australia Innovation Fund*, ARENA, 2024.

32 Austroads, *Carbon reduction and the use of low carbon concrete*, Austroads, 2024.

33 Austroads, *Guide to Pavement Technology Part 4E: Recycled Materials*, Austroads, 2022; Austroads, *National Specification for Crumb Rubber Binders in Asphalt and Seals*, 2021; Austroads, *Crushing, Processing and Cleaning of Recycled Crushed Glass for Transport Infrastructure*, Austroads, 2022.

5

Enabling the transition

Transport and transport infrastructure's contribution to economy wide net zero will be dependent on a number of enabling policies and resources, including access to sustainable finance and a qualified workforce. The Australian Government will continue to work collaboratively with all levels of government, the community, business and industry to deliver this Roadmap and Action Plan.

5. Enabling the transition

Key points

- The decarbonisation of Australia's transport system will require significant public and private sector investment in emerging low and zero emissions technology and enabling infrastructure.
- Major industry shifts are needed to prepare Australia's workforce for the meet the needs of the transition, including improving Vocational Educational Training, improving age and gender diversity of the workforce and addressing training opportunities and digital literacy, especially in rural and remote areas.
- Collective action is needed between all levels of government, business, industry and the community to reduce transport emissions.
- Australia will continue to be actively engaged in international fora to reduce emissions and look to establish international partnerships to advance low emission technologies.
- More resilient transport infrastructure will be required to support Australia's transition to a net zero economy and mitigate risks to remote communities, especially First Nations people.

5.1. Sustainable finance

The ability to access sustainable finance will be critical to the success of the net zero transition.

To facilitate greater private sector investment in the transition, the Australian Government has developed a Sustainable Finance Roadmap (SFR). The SFR aims to mobilise private capital at scale to support clean, resilient growth and support financial services to align with net zero targets. Key policies in the SFR include:

- climate related financial disclosures
- sustainable investment product labelling
- the Sustainable Finance Taxonomy
- climate-related transition planning guidance
- the Australian Government Green Bond Program.

More information on these policies and the Government's role in supporting private sector investment in innovation, infrastructure and equipment to deliver the transition is set out in Chapters 10 and 11 of the Net Zero Plan.

5.2. Workforce and skills

The Australian Government is committed to supporting Australia's workforce in the transition to net zero, in conjunction with businesses, unions, state and territory governments, and regional communities.

Skills in the transport and infrastructure sector relating to digital literacy, carbon literacy and environmental, social and governance compliance will need to be a focus of training programs and workforce investment. There is also a need to upskill the workforce to use, maintain, service and repair new transport technologies, such as electric vehicles; and to provide training for use of low carbon or recycled construction materials. Occupations with strong gender imbalances are more likely to experience shortages, and the rural and remote workforce may be impacted by a lack of quality training resources and connectivity challenges. Shortages already exist for crane, hoist and lift operators, and bus and truck drivers.[34] In developing this Roadmap and Action Plan, the Australian Government consulted with the union movement, including the Australian Council of Trade Unions, Australian Manufacturing Workers' Union, Electrical Trades Union of Australia, Transport Workers' Union of Australia, Maritime Union of Australia and the Australian Rail, Tram and Bus Industry Union.

To prepare the transport and infrastructure workforce for the net zero transition, the following will be required:

- additional quality and quantity of Vocational Educational Training (VET) to meet current and increasing workforce needs[35]
- responsive education and training offerings (higher education, VET, or industry continuing professional education) that allows workers to constantly upgrade their skills in line with rapidly changing industry needs and technological advancements
- a focus on improving age, gender and First Nations diversity in the workforce
- ensuring safe working environments with adequate facilities for all workers
- training that addresses emerging technologies including automation, artificial intelligence (AI), cyber security and zero-emission vehicles
- reconciling inconsistency between jurisdictions in regulations and funding opportunities.[36]

Industry Skills Australia, the Jobs and Skills Council for the transport sector, has released four **Workforce Plans** for the aviation industry, maritime industry, rail industry and transport and logistics industry. These Workforce Plans address the transport sector's complex workforce supply and skills required to enable decarbonisation.

Infrastructure Australia, in collaboration with Australian Sustainable Built Environment Council (ASBEC) and the Infrastructure Net Zero initiative, has also released the Delivering Net Zero Infrastructure: Workforce Report, which analyses the workforce and skills needed to achieve net zero in the infrastructure sector. The report focuses on the occupations and skills that contribute to net zero infrastructure, identifies major skills challenges and provides recommendations for accelerating capability uplift. These recommendations include the need for collaboration across government portfolios to prioritise skills development for the shared workforce delivering construction projects across the economy.

The transition for the transport and infrastructure workforce will also be supported by a range of government programs focused on the development of a net zero economy, discussed further in the Net Zero Plan.

First Nations people in the workforce

The net zero transition, if managed correctly, could also have benefits for the First Nations workforce. Currently, a significant number of First Nations Australians are employed as construction and mining labourers, machine and stationary plant operators, and automotive and engineering trades workers, particularly in regional areas. However, data shows that while First Nations people often take up apprenticeships in similar industries to non-Indigenous apprentices, they tend to do so at a lower skill level.[37] Initiatives that empower First Nations people to take on apprenticeships at the same level as non-Indigenous people, and place-based approaches that focus on regional workers in the net zero transition, will be critical to ensure First Nations workers are not left behind. These employment opportunities for First Nations people will contribute to the *National Agreement on Closing the Gap*, especially target 7 (youth employment) and target 8 (economic development).

In addition to training and transition plans outlined above, targeted initiatives to address skills challenges and barriers in the First Nations workforce include:

- The **Indigenous Skills and Employment Program** (ISEP) is a First Nations–specific employment and skills program which aims to connect First Nations people to jobs, career advancement opportunities, and to new training and job-ready activities.[38]
- The National Indigenous Australians Agency runs the Community Development Program, an employment and community development service operating in remote Australia. This is soon to be replaced by the **Remote Jobs and Economic Development program**, which will create 3000 new jobs over 3 years until 2027; and the **Remote Australia Employment Service**, which will support job seekers to build their skills and address barriers to employment.[39]

5.3. Enabling partnerships

Close collaboration with industry, communities and governments will support the transition.

The Australian Government will closely collaborate with industry, community and all levels of government to reach net zero by 2050. In order to do this, we will align our goals nationally and consistently with our international commitments. We will work together to help regions, workers and industry to transition.

Industry

Collaborating with industry is crucial to leverage the technological expertise and resources at the necessary scale to significantly reduce emissions. By fostering partnerships, we can enhance transport efficiency and address the complex challenges associated with achieving net zero emissions. Collaborative action can make the transition to net zero faster and at a lower cost. In order to maximise these benefits, collaboration needs to be inclusive and well-coordinated. The Clean Energy Finance Corporation (CEFC) and the Australian Renewable Energy Agency (ARENA) are two critical ways the Government will continue to work with industry.

Box 3: Australian Jet Zero Council

- The Australian Government established the Australian Jet Zero Council in June 2023 to promote, mobilise and galvanise industry efforts to decarbonise aviation, and provide coordinated advice to government. The Council is modelled on the successful UK version and has a broad membership of stakeholders from across the aviation sector and its supply chains as well as a number of relevant government agencies.
- The Council has delivered on its first forward workplan, which focused on barriers and opportunities to grow a Sustainable Aviation Fuel (SAF) industry in Australia, airport infrastructure decarbonisation and progressing non-SAF decarbonisation technologies. The Council is developing a second workplan to further progress industry efforts and champion least cost decarbonisation of Australian aviation. Policy settings are critical to attract vital industry investment and support the environmental, social and governance (ESG) outcomes of businesses.
- ARENA, one of the founding members of the Council, has provided over $30 million in grants to support development of a SAF industry through the Sustainable Aviation Fuel Funding Initiative.

States and territories

The Australian Government will continue to work with the states and territories to deliver infrastructure that shifts how people and goods move across Australia. Collaboratively we will deliver coordinated policies that reduce emissions through the Infrastructure and Transport Ministers' Meeting and collaboration on the National Electric Vehicle Strategy.

Local and regional organisations

Local and regional organisations have a key role to play in supporting the decarbonisation of transport and other economic sectors.

Local governments are responsible for the design, delivery and maintenance of local infrastructure, including roads and cycling and walking paths, and are crucial in promoting greater uptake of active and public transport options within their local community. The Australian Government supports local governments to deliver locally appropriate active transport solutions through the provision of funding for the construction of new, and the upgrade of existing, cycling and walking pathways through the **Active Transport Fund**. Local governments also have a key role to play in rolling out the charging infrastructure to support EV uptake.

Ensuring that the net zero transition addresses local concerns and that benefits are equally shared across local communities is also critical to the success of the transition and requires close collaboration with local and regional organisations. The Net Zero Plan sets out how the net zero transition is a shared responsibility and how governments will continue to work to together to realise positive national outcomes.

Working internationally

Australia will continue to be an active participant in international initiatives to reduce emissions.

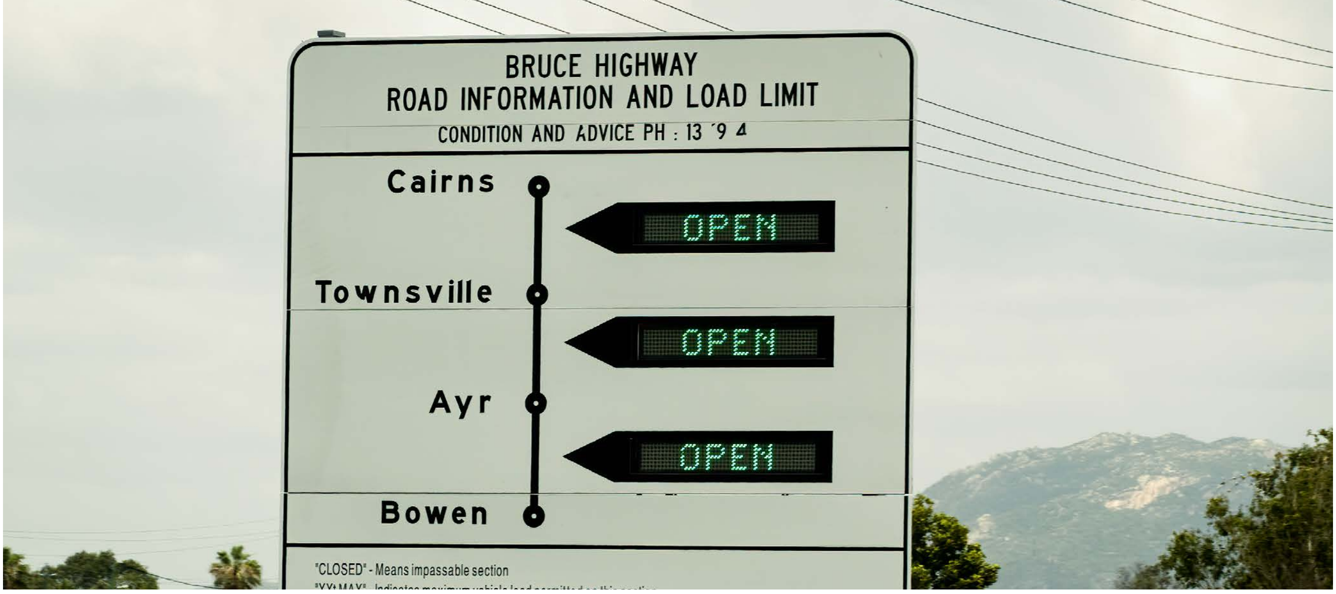
Australia supports **International Civil Aviation Organization** (ICAO) initiatives to reduce greenhouse gas emissions from international aviation while still facilitating growth in the industry, including ICAO's long term aspirational goal of net zero carbon emissions by 2050. In November 2023, ICAO and Member States agreed to a global framework to facilitate scaling up the development and deployment of sustainable aviation fuel (SAF), lower carbon aviation fuels (LCAF) and other cleaner energy sources, including a collective global aspirational vision to reduce CO_2 emissions in international aviation by 5% by 2030 through the use of SAF, LCAF and other cleaner energy sources.

A key global market-based measure that will help the sector reach this goal is ICAO's **Carbon Offsetting Reduction Scheme for International Aviation** (CORSIA), which aims to hold carbon emissions from international aviation at a global baseline. Australia's eligible international airlines have participated in CORSIA since 2019, and Australia continues to maintain and support the scheme through our work in ICAO.

Australia also supports a range of initiatives from the **International Maritime Organization** (IMO) to reduce emissions from international shipping. In 2023, member states of the IMO adopted the 2023 IMO Strategy on Reduction of Greenhouse Gas Emissions from Ships, with enhanced targets to tackle harmful emissions. The IMO Strategy includes an enhanced common ambition to reach net zero greenhouse gas (GHG) emissions from international shipping by or around, i.e. close to, 2050, with indicative checkpoints for 2030 and 2040, as well as a commitment to ensure a 5%, striving for 10%, uptake of alternative zero and near-zero emission fuels by 2030.

A key proposed global market-based measure that would help the sector reach this goal is the **IMO Net Zero Framework**, due for formal adoption in 2025. If adopted, the Framework would introduce new GHG reduction measures for international shipping, including annual fuel intensity targets, a GHG emissions pricing mechanism, and a reward system for sustainable fuel adoption. The proposed Framework sets CO_2 reduction targets through to 2035. Vessels will need to reduce emissions by 30–43% compared to 2008 levels to stay compliant.

The Australian Government is working closely with international partners to advance practical action on climate change and build new clean energy industries, particularly for hydrogen and its derivatives.



5.4. Building a resilient transport and infrastructure sector

The transition to net zero will require the prioritisation of new infrastructure and substantial capital investment.

Our roads will need to be prepared for the added mass of electric heavy vehicles, upgraded freight corridors will be required to deliver equipment, and new port facilities and other supporting infrastructure will be needed to support production and export low carbon liquid fuels (LCLFs) as well as hydrogen-derived fuels and hydrogen. Improving the resilience of new and existing infrastructure to a changing climate will be critical to safeguarding Australia's productivity and prosperity.

The Australian Government is working to quantify the cost of climate change on transport infrastructure and understand the opportunities arising from an increased focus on infrastructure resilience. Australia's National Climate Risk Assessment (NCRA) analyses the growing risks to transport infrastructure arising from increasingly severe natural disasters driven by a changing climate. The National Adaptation Plan (NAP) considers how these compounding risks can be managed to increase the resilience of critical freight routes and supply chains.

NCRA modelling finds that key risks to infrastructure and the built environment will increase from low-moderate (current risk rating) to high-very high by 2050 under likely global warming scenarios. Transport and supply chains will be particularly impacted by acute hazards such as flooding, bushfires and extreme winds causing widespread damage and disruptions. Supply and service chains in northern and central Australia, which is home to many remote First Nations Communities, are particularly at risk from a changing climate. Under a 3.0°C global warming scenario and in the absence of appropriate adaptation actions, increasingly severe flood events impacting Australia's East West freight corridors could result in average supply chain detours of 730 km by 2090, doubling freight costs. Health-related freight is projected to have the highest cost increase due to future climate change, further impacting First Nations people who already face greater challenges in reaching healthcare providers and receiving medicines.

Given these risks, governments' continued investments in supply and service chain resilience will have significant benefits for remote communities and First Nations people. Under the Infrastructure Investment Program, the government is investing in major infrastructure projects, such as the Bruce Highway Upgrade Program, which, by reducing the frequency and severity of road closures associated with extreme weather events experienced across Queensland, will improve supply chain resilience to support remote communities and First Nations people. The Australian Government is providing leadership to coordinate a nationally consistent approach to supply chain resilience through the National Freight and Supply Chain Strategy the supporting National Action Plan. The new National Action Plan will consider actions specifically in response to the findings of the Road and Rail Supply Chain Resilience Review and has resilience as one of four key priority areas.

Austroads, which is the association of the Australian and New Zealand transport agencies, is also scaling up its investment in research and guidance to improve climate resilience. This guidance will support transport agencies in developing adaptation plans, embedding consideration of climate resilience into asset management, and identifying and managing critical freight routes and networks[40]. Infrastructure Australia, which is the nation's independent infrastructure advisor, is also prioritising the resilience of critical infrastructure and communities in decision making and has developed *Resilience Principles* to guide its work.[41]

Critical infrastructure includes physical facilities, supply chains, information technologies and communication networks, which if disrupted could endanger Australia's national security. Under the NAP and the *2023 Critical Infrastructure Resilience Strategy and Plan*[42], the Australian Government is pursuing measures to increase the resilience of critical infrastructure to increasing climate extremes. Measures proposed in the NAP include a review of the *Security of Critical Infrastructure Act 2018* to consider the operation of risk management plans, and incorporate a systems perspective into government investments in infrastructure and built environment assets.

End notes

34 Infrastructure Australia, *Infrastructure Net Zero Workforce Report 2025*, Infrastructure Australia, 2025.

35 BuildSkills Australia, *Shaping the future of the built environment*, BuildSkills Australia, 2024.

36 Industry Skills Australia, Transport and Logistics Industry: 2025 Draft Workforce Plan, *Transport and Logistics Industry: 2025 Workforce Plan*, Jobs and Skills Councils, 2025.

37 Jobs and Skills Australia, *First Nations People Workforce AnalysisFirst Nations People Workforce Analysis*, Jobs and Skills Australia, 2023.

38 National Indigenous Australians Agency (NIAA), *'Indigenous Skills and Employment Program (ISEP)'*, NIAA, n.d.

39 NIAA, *'The Community Development Program (CDP)'*, NIAA, n.d.; NIAA, *'Remote Jobs'*, NIAA, n.d.

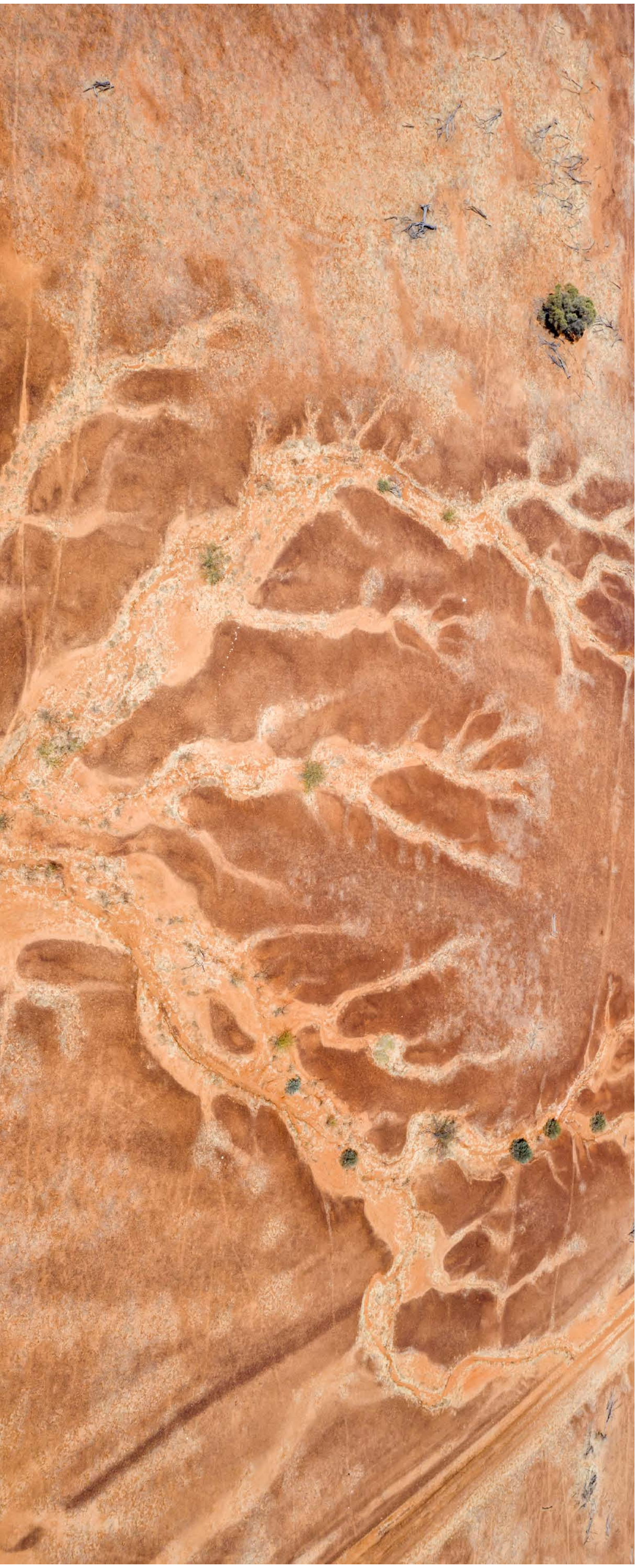
40 Austroads, *Climate Change and Natural Hazards Risk Assessment and Adaptation Planning Guidelines*, Austroads, 2024, accessed 8 July 2025; Austroads, *Incorporating Climate Change Resilience in Asset Management*, Austroads, 2024, accessed 8 July 2025; Austroads, *Opportunities to Increase Freight and Supply Chain Resilience*, Austroads, 2024.

41 Infrastructure Australia, *Resilience principles: Infrastructure Australia's approach to resilience*, Infrastructure Australia, 2022.

42 The Australian Government, *Critical Infrastructure Resilience Strategy*, Department of Home Affairs, 2023.

6

Moving forward



The *Climate Change Act 2022* (Cth) sets up a strong framework to ensure Australia remains on track to reach net zero emissions. It requires the Minister for Climate Change and Energy to report progress through an Annual Climate Change Statement to Parliament, including progress towards emissions targets, and whether current policies are effective.

This regular reporting ensures transparency and accountability. It also creates a clear cycle for reviewing and improving climate policies over time.

As detailed in section 5.3, the Australian Government will closely collaborate with industry, community and all levels of government to reach net zero by 2050. The Australian Government will also continue to work closely with international partners to advance action on climate change through the International Maritime Organization and International Civil Aviation Organization.

List of abbreviations

AAM	Advanced Air Mobility
ADR	Australian Design Rule
ASI	Avoid-shift-improve
ARENA	Australian Renewable Energy Agency
ASBEC	Australian Sustainable Built Environment Council
BEV	Battery electric vehicles
BITRE	Bureau of Infrastructure and Transport Research Economics
CAV	Connected and automated vehicle
CBA	Cost Benefit Analysis
CEFC	Clean Energy Finance Corporation
CER	Consumer energy resources
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide equivalent
CRC	Cooperative Research Centre
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
DCCEEW	Department of Climate Change, Energy, the Environment and Water
EATP	Emerging Aviation Technology Partnership Program
ESG	Environmental, social and governance
EVs	Electric vehicles
FBT	Fringe benefit tax
FCEVs	Hydrogen fuel cell electric vehicles
FFAS	Federation Funding Agreement Schedule on Land Transport Infrastructure Projects
GDP	Gross Domestic Product
GO Scheme	Guarantee of Origin Scheme
HVNL	Heavy Vehicle National Law
ICAO	International Civil Aviation Organization
ICE Vehicles	Internal Combustion Engine Vehicles
IIP	Infrastructure Investment Program
IMO	International Maritime Organization
IPS	Infrastructure Policy Statement
ISEP	Indigenous Skills and Employment Program
ITMM	Infrastructure and Transport Ministers' Meeting
LCLF	Low carbon liquid fuel
MERNAP	Maritime Emissions Reduction National Action Plan
Mt CO_2-e	Million tonnes of carbon dioxide equivalent
NAP	National Adaptation Plan
NCR	National Climate Risk Assessment
NCVs	National Carbon Values
NDC	Nationally Determined Contribution
NEVS	National Electric Vehicle Strategy
NVES	New Vehicle Efficiency Standard
NFSCS	National Freight and Supply Chain Strategy
NLTA	National Land Transport Act 2014
NRF	National Reconstruction Fund
SAF	Sustainable aviation fuel
SFR	Sustainable Finance Roadmap
UTM	Uncrewed Traffic Management
VET	Vocational Educational Training

Glossary

Abatement: A reduction in atmospheric greenhouse gases through emissions avoidance or removal and sequestration of carbon from the atmosphere.

Active transport: Ways of travelling including walking, cycling and other physically active modes of transport that can be undertaken alone or combined with public transport.

Adaptation: In human systems, the process of adjustment to actual or expected climate and its effects, to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.

Ammonia: Ammonia is a useful source of fertiliser, fuel and heat. Ammonia is traditionally produced by stripping hydrogen from natural gas using steam, which produces CO_2 as a by-product. Low-carbon ammonia can be produced using hydrogen from renewable energy.

Avoid-shift-improve hierarchy: The avoid-shift-improve hierarchy emphasises first avoiding unnecessary trips through telecommuting or better urban planning, then shifting to more sustainable transport modes like active and public transport, and finally improving the technology or efficiency of the transport mode, such as through electrification.

Battery electric vehicle (BEV): An electric vehicle that exclusively uses chemical energy stored in rechargeable battery packs to power at least one electric motor with no secondary source of propulsion.

Biodiesel: An older biofuel, typically made from vegetable oils, animal fats or recycled greases, which requires blending with conventional fuels for standard engines or engine modification to run. See also ***renewable diesel.***

Carbon dioxide equivalent (CO_2-e): A description of, for a given mixture and amount of greenhouse gases, the amount of CO_2 that would have the same global warming ability when measured over a specified time period.

Carbon dioxide (CO_2): Carbon dioxide is a colourless, non-flammable gas at room temperature and pressure. It is also a greenhouse gas which contributes to climate change. See also ***greenhouse gas.***

Carbon offset: A type of carbon credit that represents a reduction in emissions – whether prevented from entering the atmosphere or removed from the atmosphere – that is used to compensate for emissions that occur elsewhere.

Circular economy: An economic system focused on reducing waste, reusing resources and designing products for longer life, recyclability and minimal environmental impacts.

Climate change: Climate change refers to long-term shifts in temperatures and weather patterns. These shifts can be natural, but, since the 1800s, human activities have been the main driver of climate change, primary due to the burning of fossil fuels (coal, oil and gas).

Decarbonise: To stop or reduce carbon gases, especially carbon dioxide, being released into the atmosphere as the result of a process, like the burning of fossil fuels.

Direct emissions: See ***scope 1 emissions.***

Electric vehicles (EVs): Plug-in vehicles powered solely by electricity. Excludes hybrid vehicles, which are powered by electricity and fossil fuels.

Electrification: Switching from energy sources, such as liquid fuels or gas, to electricity.

Embodied emissions: Emissions generated during the production and transportation of goods, from the extraction of raw materials to the manufacturing process and final delivery to the consumer. For infrastructure, embodied emissions come from the emissions embodied in the input materials, as well as the emissions generated during the construction and installation processes.

E-methanol: Chemically identical to fossil fuel-based methanol, produced by combining green hydrogen and captured carbon dioxide.

Emissions intensity: A measure of the amount of emissions associated with a unit of output – for example, emissions per unit of GDP, electricity production, or kilometre travelled.

Emissions: A quantity of greenhouse gases released into the atmosphere.

Enabled emissions: Emissions resulting from the use of infrastructure, such as from the cars on the roads.

Euro VI standards: The Euro VI standards reduce the maximum permitted emissions of nitrogen oxides by up to 80% and the maximum permitted emissions of particulates by up to 66%.

Feedstock: Raw material that can be directly used as a fuel or converted to another form of fuel or energy product.

Fossil fuels: Fossil fuels include coal, petroleum, natural gas, oil shales, bitumens, tar sands, and heavy oils. All contain carbon and were formed as a result of geologic processes acting on the remains of organic matter produced by photosynthesis, a process that began in the Archean Eon (4.0 billion to 2.5 billion years ago).

Fringe benefit tax (FBT): A fringe benefit is a payment made to an employee which is not their salary or wages. These benefits are subject to a fringe benefits tax which is separate to income tax and calculated on the taxable value of the fringe benefit.

Global warming: The long-term heating of the earth's surface observed since the pre-industrial period due to human activities, primarily fossil fuel burning (coal, oil and gas), which increases heat-trapping greenhouse gas levels in earth's atmosphere.

Global warming potential: A measure of how much infrared thermal radiation a greenhouse gas added to the atmosphere would absorb over a given time frame, in essence, how strong of a greenhouse effect a greenhouse gas will have in the atmosphere.

Greenhouse effect: Some gases in the earth's atmosphere act like the glass in a greenhouse, trapping the sun's heat and stopping it from leaking back into space. The greenhouse effect is the cause of global warming.

Greenhouse gases: Any gas (natural or produced by human activities) that absorbs infrared radiation in the atmosphere, leading to warming effects. Greenhouse gases include carbon dioxide, methane and nitrous oxide.

Heavy vehicles (road): Vehicles that have a gross vehicle mass or aggregate trailer mass of more than 4.5 tonnes. The gross vehicle mass is the maximum it can weigh when fully loaded, as specified by the manufacturer. In this Roadmap, we consider heavy vehicles to be rigid trucks, articulated trucks and buses.

Hybrid vehicle: Hybrid vehicles use an electric motor powered by a battery as a primary or supplementary power to improve vehicle fuel efficiency, in addition to an internal combustion engine. The battery is either re-charged onboard by residual braking technology (conventional hybrid) or by an external EV charger (plug-in hybrid).

Hydrogen: A substance commonly used in industrial applications, such as the production of methanol and ammonia, and can also be used as a fuel. It is traditionally produced by stripping hydrogen from natural gas using steam, which produces carbon dioxide as a by-product. Low-carbon or renewable hydrogen can be produced from water using renewable energy.

Hydrogen-derived fuel: A fuel produced using hydrogen as an input, such as ammonia or methanol. Low and zero carbon hydrogen-derived fuels can be produced using low carbon inputs including renewable hydrogen, captured carbon dioxide, and renewable energy.

Hydrogen fuel cell electric vehicle (FCEV): An electric vehicle that uses electricity from a fuel cell powered by compressed hydrogen, rather than electricity from batteries.

Indirect (secondary) emissions: See ***scope 2 emissions***.

Intergenerational equity: The embodiment of care for future generations. It is the idea of fairness or justice between generations.

Intermodal terminal: Intermodal terminals play a significant role in the consolidation, storage and transfer of freight between rail and road at the beginning and end of each rail journey. Intermodal terminals provide connectivity to ports, regional networks and other capital cities and locations.

Internal combustion engine (ICE) vehicles: A conventional vehicle is a vehicle with only an internal combustion engine system – that is, a conventional vehicle powered by fossil fuel.

Lifecycle emissions: Emissions produced during a vehicle or product's production, operation and disposal.

Low carbon liquid fuels (LCLFs): Liquid fuels with lower lifecycle emissions than conventional fossil fuels. LCLFs can be sustainably produced from biomass, waste materials and/or renewable hydrogen.

Methanol: A substance used as a fuel, solvent, or as an input for other chemicals. Low carbon methanol can be produced using hydrogen, captured carbon dioxide, and renewable energy. See ***e-methanol.***

Mode shift: The shift from one mode of transport to another, for example from private vehicles to public and active transport, or from road freight to lower emissions modes such as rail.

National Greenhouse Gas Inventory: Australia's National Greenhouse Gas Accounts fulfils Australia's international treaty obligations by submitting National Inventory Reports to the UNFCCC.

Net zero: An overall balance between greenhouse gas emissions produced and greenhouse gas emissions taken out of the atmosphere.

Nitrous oxide: Nitrous oxide (N_2O) is an odourless, colourless, non-flammable gas. Nitrous oxide is a greenhouse gas, and its molecules stay in the atmosphere for an average of 121 years before being removed by a sink or through chemical reactions. The global warming potential of nitrous oxide is 265 times that of carbon dioxide. Globally, 40% of total nitrous oxide emissions come from human activities.

Offsets: See ***carbon offset.***

Operating emissions: Emissions from the energy use of an infrastructure asset during its use stage, for example from the energy used to operate a train station.

Paris Agreement: The Paris Agreement came into effect in 2016 and was a major step forward in international efforts to address climate change. It aims to strengthen the global response to the threat of climate change by holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit temperature increase to 1.5°C.

Particulate emissions: Emissions of particulate matter, which is a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, smoke or soot, are large or dark enough to be seen with the naked eye. Others are so small they can only be detected using a microscope. Particulate matter can be inhaled and can cause serious health problems.

Passenger kilometre: A passenger kilometre is the unit of measurement representing the transport of one passenger by a defined mode of transport over one kilometre.

Plug-in hybrid: A hybrid vehicle whose battery can be recharged by plugging it into an external source of electric power, as well as by its on-board internal combustion engine.

Pre-industrial: Pre-industrial, as defined in the Intergovernmental Panel on Climate Change, refers to the period 1850–1900.

Renewable diesel: An advanced biofuel made from a range of waste and biomass sources. Unlike first-generation biodiesel which requires blending with conventional fuels for standard engines or engine modification to run 100% biodiesel, renewable diesel can directly substitute conventional diesel and does not require blending.

Renewable energy: Energy from a source that is not depleted when used, such as wind or solar power.

Resilience: The capacity of people, communities and assets to cope with a hazardous event, trend or disturbance, responding to or reorganising in ways that maintain their essential function, identity and structure while also maintaining the capacity for adaptation, learning and transformation.

Rolling stock: Referring to railway vehicles, including both powered and unpowered vehicles – for example, locomotives, freight and passenger cars, and non-revenue cars.

Safeguard Mechanism: A legislated obligation on Australia's largest greenhouse gas emitters, or 'Safeguard facilities', to keep their net emissions below an emissions limit (a baseline).

Scope 1 emissions: The release of greenhouse gases into the atmosphere as a direct result of activities occurring within a responsible entity's control or geographic boundary.

Scope 2 emissions: The indirect release of greenhouse gases into the atmosphere from the consumption of purchased electricity, heating, cooling or steam that is generated outside of a responsible entity's control or geographic boundary.

Scope 3 emissions: All indirect emissions (not included in scope 2) that occur in the value chain of the reporting entity, including both upstream and downstream emissions.

Supply chain: The network of all the individuals, organisations, resources, activities, processes and technologies involved in the creation and sale of a product.

Sustainable aviation fuel (SAF): A liquid fuel which has the potential to reduce CO_2 emissions by up to 80% compared to traditional aviation fuel. SAF will be produced from biogenic feedstocks, such as oilseed and sugar, in the short to medium term as well as synthetic feedstocks such as hydrogen in the medium to longer term.

Tailpipe emissions: The product of fuel burning in an internal combustion engine, released through an engine exhaust. Tailpipe emissions include a number of pollutants such as carbon dioxide, carbon monoxide and nitrogen oxides.

Tonne kilometre: A unit of measurement of freight transport which represents the transport of one tonne of goods over the distance of one kilometre.

Transport infrastructure: The fixed installations, structures and networks that enable the movement of people and goods.

Whole-life emissions: See ***lifecycle emissions.***

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The Treasury

Australia's Net Zero Transformation:

Treasury Modelling and Analysis

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In the spirit of reconciliation, the Treasury acknowledges the Traditional Custodians of country throughout Australia and their connections to land, sea and community. We pay our respect to their Elders past and present and extend that respect to all Aboriginal and Torres Strait Islander peoples.

Foreword

The global transition to net zero is a golden economic opportunity for Australia.

The Albanese Labor Government has a clear and credible net zero plan to carefully manage and maximise the benefits of this economic transformation, helping Australia to attract investment, lift wages, grow living standards, and create jobs and spread economic opportunity around the country.

This *Modelling and Analysis Report* by the Treasury analyses three different net zero scenarios to provide insight into the scale and size of the economic opportunity under different pathways to net zero.

Treasury's modelling report makes five key conclusions:

1. Australia can be a primary beneficiary of the global net zero transformation if we continue to take decisive action on climate change
2. Cheaper, cleaner energy will strengthen Australia's international competitiveness
3. Clear and credible climate action will lead to more jobs, higher wages and better living standards for Australians
4. Our orderly net zero plan gives businesses the clarity and certainty they need to invest in Australia with confidence
5. A disorderly transition would mean fewer jobs, less business investment, lower wages, lower living standards and higher power prices in a smaller economy.

The world is changing, and the pace of change is accelerating as we move to a future powered by cheaper, cleaner energy.

We can make ourselves the primary beneficiaries of that change if we harness our unique combination of geological, meteorological, geographical and geopolitical comparative advantages.

Together we recognise our future economic growth prospects lie at the intersection of our industrial, resources, skills and energy bases and our attractiveness as an investment destination.

Our net zero plan and the release of this modelling will help give investors the certainty and clarity they need, and help Australia attract the private capital to finance this transformation.

We thank the Treasury team and officials from across the Government who put this modelling together, their colleagues across the government who contributed and the non-government stakeholders and experts for their perspectives and collaboration.

The Hon Jim Chalmers MP
Treasurer

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Executive summary

This report examines the impact of the net zero transformation on Australia and provides insights into the economic opportunities from different pathways. It uses scenario modelling to provide insights into how Australia can efficiently achieve emissions reductions over time, in the context of the global net zero transformation. The scenarios highlight the implications for the economy of different pathways and how to maximise opportunities.

The world is continuing to move towards net zero and countries are transforming their energy systems and economies. Australia's major trading partners, including China, Japan and the Republic of Korea, have committed to the Paris Agreement. The emissions gap between current global policies and the Paris goal has narrowed over time. Global energy intensity and carbon intensity have declined.

Technological change has reduced the cost of renewable energy and batteries, enabling a significant increase in renewable electricity generation. Over the past decade, around half of the increase in global electricity generation has been met by solar and wind. Structural shifts are expected to continue, with renewables dominating new electricity generation capacity in more economies and the continued advancement in electrification of transport and industry.

Australia is making substantial progress in reducing emissions. Over the past decade, annual emissions have fallen by almost 100 Mt CO_2-e and the share of renewable electricity generation has more than doubled. In 2020, just five years ago, it was estimated that Australia's emissions in 2030 would be 22 per cent below 2005 levels. The most recent estimates indicate that emissions will be around 43 per cent lower by 2030. Key policies to support the emissions reduction pathway are now in place, including the Safeguard Mechanism, the 82 per cent renewable electricity target underpinned by the Capacity Investment Scheme, and the New Vehicle Efficiency Standard. Significant additional action will be required for Australia to achieve net zero emissions by 2050.

This report models three scenarios to compare potential transition pathways to net zero for Australia. Two of the scenarios broadly reflect the Government's Net Zero Plan, which provides more investment certainty by establishing a 2035 target range and sector transition pathways. The Baseline Scenario presents an efficient pathway consistent with existing policies and the expected availability of abatement technologies. The Renewable Exports Upside Scenario additionally considers the upside if Australia realises its potential in emerging renewable energy export markets. By contrast, the Disorderly Transition Scenario assumes Australia does not set a credible 2035 emissions reduction target, but resumes a trajectory towards net zero in 2050 from 2040 onwards. A disorderly transition increases the cost of capital, reduces access to technology and limits businesses' ability to plan for future investment. Across all scenarios, global mitigation action is assumed to be sufficient to ensure global temperatures are kept well below 2°C by the end of this century.

Strong investment in renewable energy remains foundational to Australia's efficient transition, and emissions reduction will be required across all sectors. The modelling finds that expanding the supply of renewable energy continues to be the most cost-efficient abatement opportunity, reducing emissions in the electricity sector directly and enabling broad-based decarbonisation through electrification. Fuel switching and efficient use of energy will become increasingly important over time, enabled by improving abatement technologies, and scaling up carbon removals will be required to offset residual emissions later in the transition.

An orderly transition will place downward pressure on wholesale electricity prices, improving Australia's economic competitiveness. Firmed renewables will continue to be the cheapest form of new generation and put downward pressure on electricity prices. Greater reliance on ageing coal-fired power stations and more expensive gas-fired generation under a disorderly net zero transition would put upwards pressure on electricity prices. The Disorderly Transition Scenario is projected to increase wholesale electricity prices by 17 per cent on average during the 2030s and up to 54 per cent in the 2040s, relative to the Baseline Scenario. In contrast, investing in Australia's renewable exports potential could unlock broader competitiveness and help reduce cost-of-living pressures on households by reducing wholesale electricity prices by around 20 per cent by 2050, relative to the Baseline Scenario. In the long-term, wholesale electricity price levels under the orderly scenarios are projected to be around 10 per cent below the 10-year real historical average wholesale electricity price, consistent with the Australian Energy Market Commission's 10-year forecast.

Electrification is a key source of low-cost emissions reductions, particularly for transport, the built environment, and some industrial manufacturing processes. Where electrification is not a cost-effective or technically viable option, fuel switching and approaches that support take-up of abatement technologies are projected to support emissions reductions in the medium term. Low-carbon liquid fuels are expected to offer an increasingly cost-effective decarbonisation pathway over time. Australia's access to these technologies is expected to be more limited under a Disorderly Transition Scenario, increasing the cost of abatement to business at all stages of the net zero transition.

Australia's ambitious and achievable plan to reduce emissions will support continued economic growth, higher living standards and employment. Under the Baseline Scenario, the economy is projected to be 28 per cent larger by 2035 and 81 per cent larger by 2050, relative to current levels. In dollar terms, the economy is expected to be $2.2 trillion bigger by 2050, relative to current levels. Real GDP per capita is projected to be $12,000 higher in 2035 and $36,000 higher in 2050, compared to current levels. Employment is projected to increase by 5.1 million people by 2050. Australia's exports are projected to grow over time, with declining global demand for fossil fuels counterbalanced by the emergence of new renewable energy export markets. Manufacturing and construction activity are projected to grow as Australia replaces ageing energy infrastructure and realises new industrial opportunities.

Credible targets and policies are critical for investment certainty and growth. Australia's Net Zero Plan provides businesses with the certainty required to invest efficiently. Under the orderly transition scenarios – Baseline and Renewable Exports Upside – investment is projected to grow by 79-84 per cent between 2025 and 2050. With clear foresight around Australia's emission reduction pathways, businesses and households are able to replace existing capital, as it depreciates, with lower-emission upgrades in a way that positions Australia's economy to decarbonise efficiently and realise new industrial opportunities. A disorderly approach would ultimately lead to a more costly and less efficient transition.

Leveraging Australia's comparative advantages in renewable energy will deliver broad-based benefits to Australians and help grow our exports. The Renewable Exports Upside Scenario projects Australia's green exports could be $68 billion higher in 2050 than in the Baseline Scenario, including critical minerals, renewable hydrogen and green metals exports. Under this scenario, the economy is projected to be 84 per cent larger by 2050, relative to 2025. Similarly, real GDP per capita is projected to be $38,000 higher in 2050. Wholesale electricity prices are projected to be around 20 per cent lower in 2050 if Australia realises its renewable energy exports potential. Households that electrify their home and vehicles, and install solar and a battery, could reduce their energy costs by around 40 per cent to 2050. This scenario also sees Australia make a greater contribution to global abatement, with the global emissions displaced by Australian low-emission exports in 2050 projected to be greater than Australia's total net emissions in 2025.

A disorderly approach will cost investment, jobs and the economy. Under the Disorderly Transition Scenario, the economy is projected to be up to a cumulative $2 trillion smaller by 2050, compared to orderly scenarios. Real wages are projected to be up to 4.0 per cent lower in 2050 leading to lower participation and employment. Per capita GDP is projected to be $2,100 lower in 2050, compared to the Baseline Scenario, and $4,500 lower compared to the Renewable Exports Upside Scenario. Cumulative investment is expected to be half a trillion dollars lower than under the Baseline Scenario.

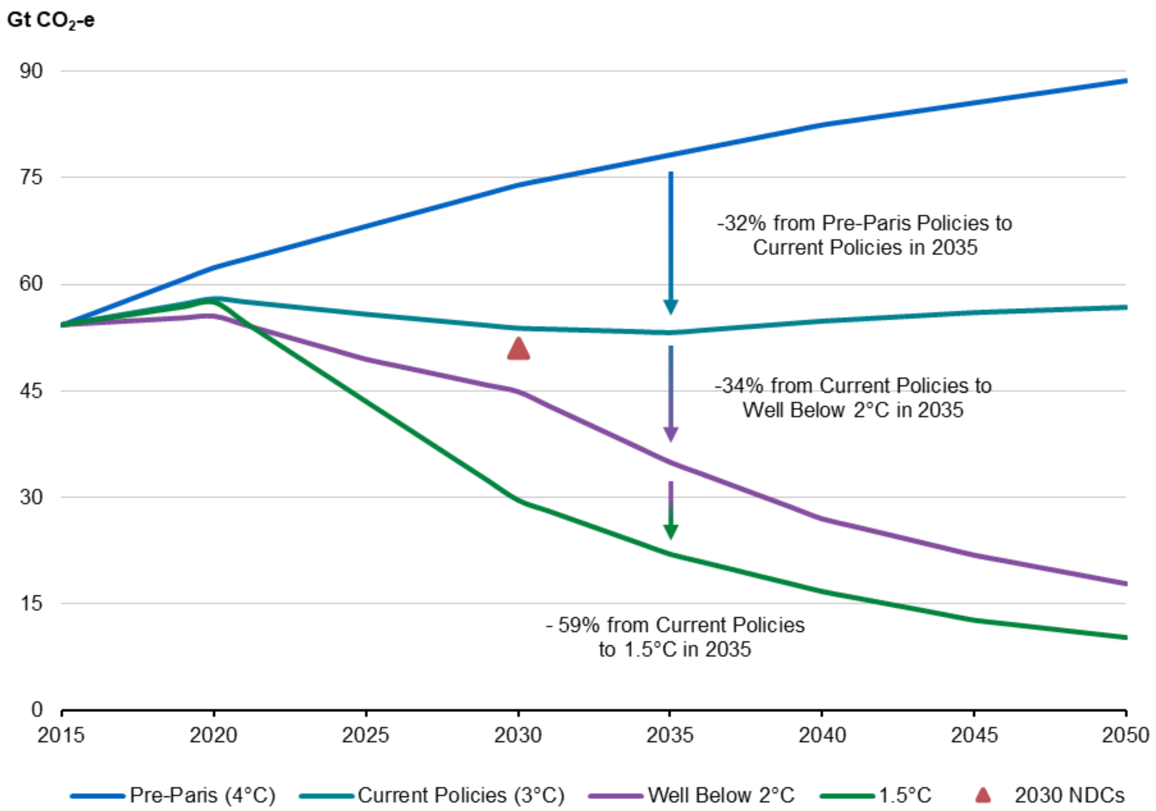
The economic costs to Australia of not pursuing net zero would be significant and consequential and exceed those modelled in the Disorderly Transition Scenario. A scenario where Australia does not pursue net zero has not been modelled in this report. However, this modelling finds that climate policy uncertainty reduces investment, increases energy costs for households and risks capital scrapping. Not pursuing net zero by 2050 risks lower economic growth, reduced investment, missed export and employment opportunities, and higher electricity prices. These outcomes would flow from several channels, including heightened policy uncertainty, increased borrowing costs on global markets and the loss of potential new export markets. The 2021 *Long-Term Emissions Reduction Plan* estimated that the economy-wide capital risk premium could increase by 100 basis points if Australia did not adopt a net zero target. It found that this could reduce investment by an average of 5.5 per cent from 2021 to 2050 and that gross national income could be $625 lower per person. Research by the Organisation for Economic Co-operation and Development (OECD) also concludes that climate policy uncertainty has a significant negative impact on business investment. By contrast, the Government's Net Zero Plan outlines an orderly pathway to net zero in 2050 which supports ongoing investment and economic growth.

1. Introduction

The global net zero transition represents one of the largest structural transformations since the Industrial Revolution. Widespread commitments to global decarbonisation have resulted in significant technological developments, policy innovation and green investment, reducing the projections of global emissions over time. A clear global commitment to net zero has unlocked increased investment in decarbonisation internationally. Clear and credible climate action will be required to attract investment to Australia and position Australians to benefit from the global net zero transformation.

Australia committed to achieving net zero emissions by 2050 in 2021, recognising the importance of action to prevent global warming and safeguard Australia's prosperity. While there remains an emissions gap between current global policies and the Paris goal, the gap has narrowed. Prior to the Paris Agreement, modelled scenarios suggested global temperature increases of approximately 4°C by 2100 (Chart 1.1). Under current policies this trajectory has fallen to around 3°C and with full implementation of nationally determined contributions (NDCs) submitted as of 2023, projected warming is estimated to be in the range of 2.1–2.8°C (UNFCCC 2023).

Chart 1.1: Global emissions trajectories



Note: 2030 NDCs represent the level of global emissions in 2030 if all unconditional and conditional NDCs are achieved. The Pre-Paris, Current Policies, Well Below 2°C and 1.5°C pathways use IPCC emissions scenarios to represent temperature outcomes.
Source: Treasury analysis of Byers et al. 2022; IPCC 2022; UNEP 2024; UNFCCC 2023

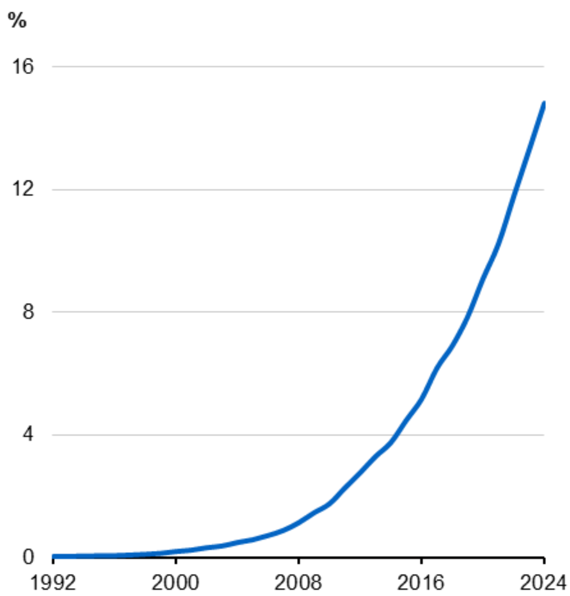
The world is continuing to move towards net zero and countries are transforming their energy systems and economies. Australia's major trading partners, including China, Japan and the Republic of Korea, have committed to the Paris Agreement. Today, 165 countries, accounting for around 80 per cent of global gross domestic product (GDP), are covered by national net zero commitments (DCCEEW 2025a). Globally, there is twice as much energy investment in clean energy as fossil fuels (Chart 1.3).

China, in particular, has rapidly accelerated investment in renewables to reduce its reliance on imported energy.

Global energy intensity (energy use per unit of GDP) declined by an average of 2 per cent per year between 2010 and 2019 and by 1.2 per cent per year from 2020 to 2023 (IEA 2025a). Similarly, carbon intensity (carbon dioxide emissions per unit of energy) fell on average by 0.3 per cent per year from 2010 to 2019 (IPCC 2023). This reflects structural changes in the global energy system, including a shift from coal to gas, improved energy efficiency and an increase in the use of renewable energy.

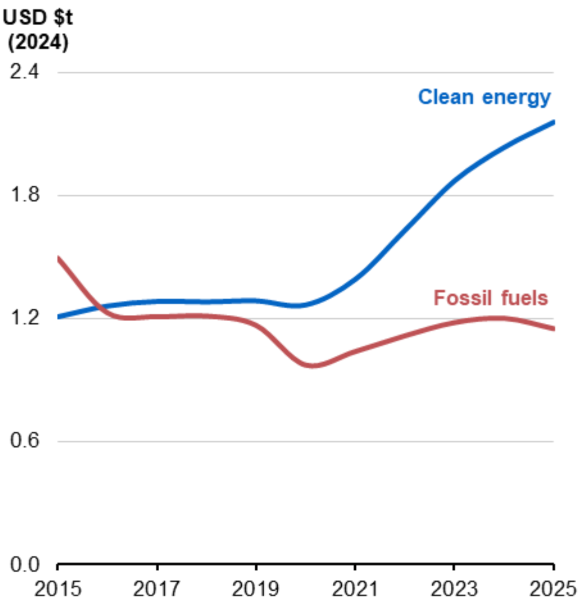
Over the past decade, global electricity generation has grown by an average of 2.6 per cent per year – around double the growth in the demand for energy – reflecting an increased reliance on electricity (Energy Institute 2025). Around half of this increase has been met by solar and wind, which accounted for almost 15 per cent of total generation in 2024, up from just under 4 per cent in 2014 (Chart 1.2).

Chart 1.2: Wind and solar generation as a share of total global electricity generation, 1992 to 2024



Source: Energy Institute 2025

Chart 1.3: Global energy investment, 2015 to 2025



Note: Clean energy includes: Clean Fuels, Direct Air Capture, Transitional fossil fuels, Nuclear, Renewable power, Battery storage, Electricity networks, Fossil fuels: with CCUS, Other clean power and End-use. Other end-use includes: Electrification, renewables for end-use, Hydrogen and industry CCUS. Bunker fuels are only accounted for at the World level. 2025 data is estimated.

Source: IEA 2025b

Technological change has contributed significantly to these developments. From 2010 to 2023, the cost of solar photovoltaic (PV) electricity decreased by 90 per cent, while the cost of wind electricity also declined (IRENA 2024). Battery storage costs also fell by around 90 per cent over this period, enabling increased adoption of electric vehicles and energy storage technologies (IRENA 2024). Investment in clean energy infrastructure, efficiency and electrification has increased since 2021 and is projected to reach USD2.2 trillion in 2025, around double that of investment in fossil fuel projects (Chart 1.3).

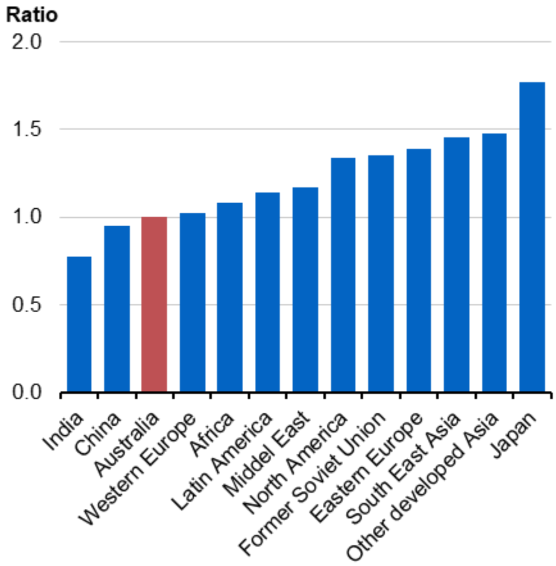
China is expected to continue to drive global energy transition investment, with Chinese investment outpacing the combined investment of the United States, European Union and United Kingdom in 2024 (BloombergNEF 2025a). Global momentum is also expected to continue at subnational levels (including in the United States) and within the private sector (E3G 2025; IEA 2025b). Structural shifts are expected to continue, with renewables dominating new generation capacity in more economies and the continued advancement of electrification of transport and industry (IEA 2024a; IEA 2024b).

As global climate action ramps up, patterns of global trade in energy and resources will change to meet shifting demand and align with emerging comparative advantages. Carbon-intensive production methods and carbon-intensive energy sources are expected to experience declining demand. At the same time, global demand for green commodities is projected to increase.

The global net zero transition could present a significant economic opportunity for Australia (Treasury 2024). Australia is a significant resources exporter – it is currently the world's largest exporter of iron ore and alumina. The success of the resources sector is underpinned by large reserves of mineral commodities, strong trade partnerships, fair and competitive markets, commitment to open trade and international investment, and proximity to key markets in Asia.

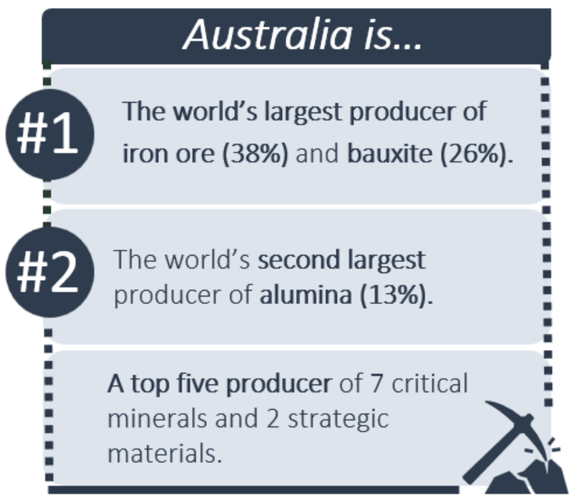
Australia could become an important producer and exporter of clean energy embedded products as the world decarbonises. Australia has a substantial endowment of low-cost renewable energy resources, a key input into the production of clean energy embedded products (Chart 1.4). It also has significant reserves and an existing footprint in the production of minerals that are likely to be in demand in a net zero world – including critical minerals like lithium, nickel and cobalt along with iron ore, bauxite and alumina (Chart 1.5). Critical minerals, which are essential for electric vehicles and grid-scale batteries, are projected to experience strong demand growth to support renewable technologies.

Chart 1.4: Estimated renewable electricity costs by country relative to Australia, 2050



Source: Graham and Havas 2023 (from Treasury 2024).

Chart 1.5: Australian production and reserves of key mineral commodities, 2023



Source: Geoscience Australia 2025

Treasury's climate modelling assesses the economic opportunities from the global net zero transformation for Australia and demonstrates the impact of different pathways to net zero on investment, economic growth, living standards, jobs and the structure of the economy. Other modelling exercises explore different questions. For example, the Climate Change Authority (CCA) has undertaken modelling, working with the Commonwealth Scientific and Industrial Research Organisation (CSIRO), to understand the potential impact of different 2035 targets.

This report is structured as follows. The opening section provides an overview of the modelling scenarios and framework, including the key dynamics of the global net zero transformation that underpin all three scenarios. The third section discusses the key drivers of modelled abatement for Australia. The fourth section presents economic projections for Australia across the three scenarios. The report concludes with technical appendices that describe the modelling approach and key assumptions in detail.

2. Modelling scenarios and framework

Scenario modelling has been undertaken to provide insights into how Australia can efficiently achieve emissions reductions over time. The scenarios highlight the implications for the economy of different pathways and how to maximise opportunities.

Modelling the domestic and global net zero transformation requires consideration of a wide range of factors, including the likely availability of abatement technologies, the interaction of abatement pathways across industries, and the expected behaviour of Australian households and businesses. Developing a whole-of-economy perspective on these factors requires combining a range of datasets and models, capturing the connections between the global and domestic economies, changes in Australia's industrial structure and industry-specific details.

Modelling long-term structural change also involves significant uncertainty. For this reason, a scenario-based approach is used to understand cost-effective emissions reduction sources for Australian industries and households, and their potential economic impacts.

This section provides a summary of the modelling scenarios and framework and discusses the uncertainty that exists in climate modelling through case studies on technology and land-based sequestration. More details on the modelling approach and key assumptions are in Appendices B-D.

2.1 Modelling scenarios

Three scenarios are modelled to compare different potential transition pathways for Australia. Two of the scenarios broadly reflect the Government's *Net Zero Plan* (DCCEEW 2025a):

- the Baseline Scenario illustrates an efficient domestic pathway consistent with existing policies and the expected availability of abatement technology, and a global economy that achieves emissions reductions consistent with keeping average temperature increases to less than 2°C.
- the Renewable Exports Upside Scenario presents the same domestic pathway and additionally considers the upside if Australia realises more potential in emerging clean energy export markets.

Both these scenarios achieve Australia's legislated commitments to reduce emissions by 43 per cent compared to 2005 levels by 2030 and net zero emissions by 2050. They also achieve emissions reductions in 2035 of 65 per cent compared to 2005 levels, which is consistent with the Government's 2035 target range.

These two scenarios are contrasted against a Disorderly Transition Scenario, where it is assumed that Australia does not set a 2035 emissions reduction target or does not set a credible 2035 target. Under this scenario, stalled climate policy action between 2030 and 2040 results in heightened policy uncertainty, which leads to less investment and a more costly abatement path to meet net zero in 2050.

A detailed description of the modelling scenarios is in Table 2.1.

Table 2.1: Summary of modelling scenarios

Scenario	Description
Baseline Scenario	**Australia builds on existing climate and energy policies, to achieve emissions reduction targets and net zero by 2050 via an orderly and efficient transition pathway.** Cornerstone policies such as the Safeguard Mechanism, 82 per cent on-grid renewable electricity target, Capacity Investment Scheme, Future Made in Australia agenda, and New Vehicle Efficiency Standard are in place and drive significant reductions in emissions. Beyond existing policies, the scenario identifies where cost-efficient emissions reduction opportunities – in the form of direct abatement or land-based sequestration – are likely to come from across the economy. Australia achieves 65 per cent emissions reductions by 2035. Exports of clean energy embedded products commence, but new, globally competitive export industries do not rapidly build to scale.
Renewable Exports Upside Scenario	**Australia follows the same domestic transition pathway as the Baseline Scenario but is additionally successful at leveraging its comparative advantages in renewable energy to capture a larger share of growing global demand for clean energy embedded products.** This scenario is consistent with the Baseline Scenario, including the achievement of 65 per cent emissions reductions by 2035. Additionally, Australia captures a significant share of global clean energy embedded product markets. This scenario assumes increased domestic hydrogen production in line with National Hydrogen Strategy targets, supporting production of clean energy embedded ammonia and green metals, which are primarily exported.
Disorderly Transition Scenario	**Australia delays further climate action, resulting in increased costs over time from a transition path that is more uncertain and disorderly.** Existing climate policies remain in place, but Australia does not set a 2035 emissions target or does not set a credible 2035 target, and does not undertake further climate policy action until the 2040s. Australia makes minimal progress on economy-wide emissions reduction throughout the 2030s, needing to accelerate emissions reductions from 2040 to achieve net zero by 2050. Prior to 2040, policy uncertainty is heightened, resulting in lower and misallocated investment.

The Baseline Scenario shows what the economy could look like under a net zero transition that is supported by a clear and credible net zero plan that enables cost-effective emissions reductions across sectors and over time. This environment allows households and businesses to plan ahead and make well-informed decisions. It is aligned with the Government's legislated 2030 target, 2035 target range and net zero in 2050, existing Government policies, and broadly reflects the Government's Net Zero Plan. It makes relatively conservative assumptions about Australia's contribution to new clean energy embedded export markets.

The Renewable Exports Upside Scenario assumes broadly the same domestic transition pathway as the Baseline Scenario but additionally assumes that Australia's relative cost advantages in producing renewable energy allow for increased production of clean energy embedded exports. Specifically, it is assumed that Australian exports of green iron and green ammonia reach about 120 million tonnes (Mt) and 35 Mt respectively in 2050, supported by renewable hydrogen production of 15 Mt. This is significantly higher than under the Baseline Scenario. It demonstrates the potential of Australia's Future Made in Australia agenda and provides insight into realising Australia's potential in clean energy embedded commodity production to build new sources of competitiveness.

The Disorderly Transition Scenario considers what could occur if there is heightened policy uncertainty due to the absence of long-term credible targets and policy settings. This scenario shows what the economy could look like under a net zero transition that is less certain and timely, where emissions reductions are not sequenced to allow the economy to transition along a pathway that minimises costs. This could result from not setting a 2035 target or not setting a credible 2035 target. The results show businesses are more reluctant to invest, delaying the achievement of the 43 per cent emissions reduction target, and insufficient early emissions reductions require rapid, and more costly, decarbonisation in the decade to 2050. Australia emits more cumulative emissions to 2050 than in both the Baseline Scenario and Renewable Exports Upside Scenario.

Appendix C contains further details on the key differences across the scenarios. A number of factors are held constant across the different scenarios to enable comparison of the implications of different potential pathways for Australia to achieve net zero.

Across all scenarios, global mitigation action is assumed to accelerate such that global temperatures are kept well below 2°C by the end of this century. The global scenario is aligned with the Intergovernmental Panel on Climate Change (IPCC) Illustrated Mitigation Pathway with over 67 per cent probability of limiting warming to below 2°C, and the International Energy Agency's (IEA) Announced Pledges Scenario.[1] These global pathways are closely aligned in their assumptions and outcomes, and provide a sense of how much additional action is required to reach global net zero targets. Small deviations in global mitigation action are unlikely to impact the overall trends identified.

The scenario modelling does not consider physical climate risks, geopolitical risks, alternative global pathways or other significant sources of uncertainty. Other modelling exercises, including analysis in the *2023 Intergenerational Report,* have shown significant economic costs are likely if Australia, and the world, fail to reduce emissions and limit future temperature increases (Australian Government 2023; NGFS 2024).

The modelling scenarios are projections rather than forecasts and are broadly consistent with the long-term modelling approach in the Intergenerational Reports. They do not represent a full update of Treasury's long-run economic projections. Each scenario makes a range of technical assumptions that do not reflect Government policy decisions, and these assumptions should not be interpreted as detailed prescriptions for specific policies to 2050. However, policy will need to evolve over time to support the significant additional action that will be required to put Australia on track for net zero emissions by 2050.

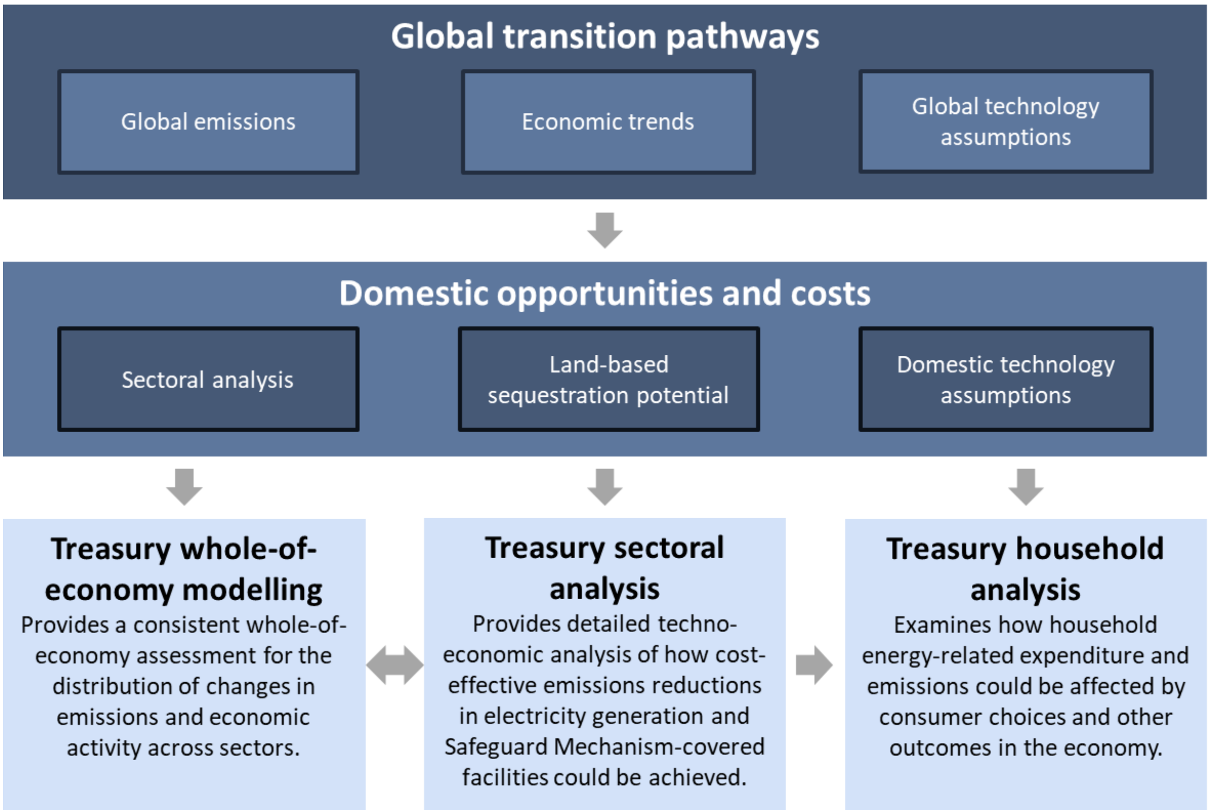
2.2 Modelling framework

Treasury's climate modelling framework is made up of a set of interconnected models that capture the dynamics of different parts of the economy (Chart 2.1). Global economic and technology assumptions, a domestic whole-of-economy model and detailed models for sectors critical to the transition are deployed in an integrated way to provide a coherent whole-of-economy perspective.

This approach is similar to the frameworks used in the CSIRO's *Pathways to Net Zero Emissions* (2023a), *ClimateWorks Centre Decarbonisation Scenarios 2023: Paris Agreement alignment for Australia* (2023a), and the *Long-Term Emissions Reduction Plan* (DISER 2021).

1 For this analysis, upper bound of 'well below 2°C' refers to IPCC scenarios where the median warming stabilises at around 1.6°C in 2100, with a likely chance (>67 per cent) of staying below the 2°C threshold. Similarly, the IEA's Announced Pledges scenario is consistent with limiting warming to 1.7°C. See Appendix C: Modelling scenarios for more detail on the global scenario.

Chart 2.1: Treasury's modelling framework



2.3 Treatment of uncertainty

The future of climate change and the net zero transformation is uncertain and will be affected by many interrelated and evolving factors. Changes in available technology, economic, and geopolitical conditions will affect the composition and timing of efficient abatement. For example, Russia's invasion of Ukraine increased global energy prices and accelerated investments in renewable energy and energy efficiency. Recent policies introduced by the United States Administration have also increased geopolitical and economic uncertainty, but long-term trends in adoption of lower-cost renewable energy technologies have continued (IEA 2025c).

Policy uncertainty, and its implications for economic outcomes, is a key issue for governments and for the investment decisions required to achieve the transition. The Disorderly Transition Scenario illustrates some of the costs of policy uncertainty.

The long-term costs and availability of decarbonisation technologies are critical assumptions for modelling of net zero transition pathways. The case study below considers this uncertainty in more detail and its potential implications for modelling outcomes.

Case study: Technology uncertainty

Examining past climate modelling exercises shows that specific technology costs are difficult to predict, but that innovation overall has delivered lower-cost abatement opportunities than anticipated. As a result, climate modelling has generally underestimated cost declines and subsequent take-up of new technologies.

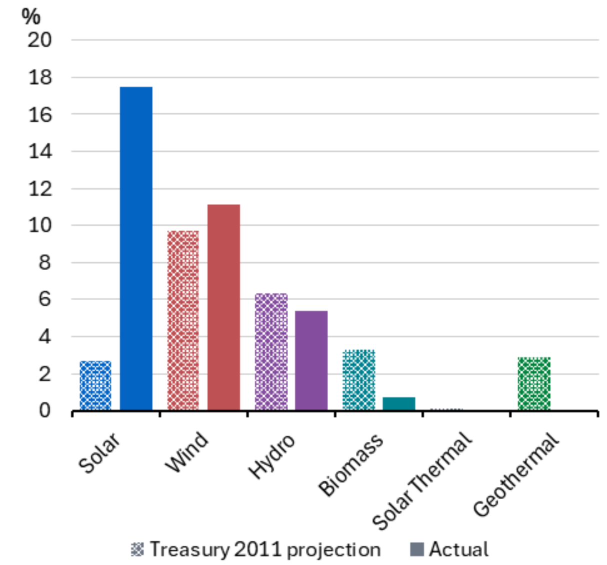
Declining costs of renewable energy

Treasury last undertook a large transition modelling exercise for the 2011 *Strong Growth Low Pollution* report (Treasury 2011). In that modelling, it was projected that solar photovoltaic (PV) would contribute 3 per cent of electricity generation by 2024. The actual figure was about 17 per cent (Chart 2.2). The underestimation was due to larger-than-predicted declines in solar PV costs, which fell by 75 per cent in the 5 years to 2014 (IRENA 2015), alongside generous feed-in tariff support and government subsidies.

In addition, previous Treasury modelling did not include either electric vehicles or batteries as feasible decarbonisation options. Electric vehicles accounted for 20 per cent of global vehicle sales in 2024, and applications for battery projects are higher than any other generation type on the National Electricity Market (NEM). On the other hand, the role of geothermal, solar thermal, and biomass generation was predicted to be higher than actual outcomes.

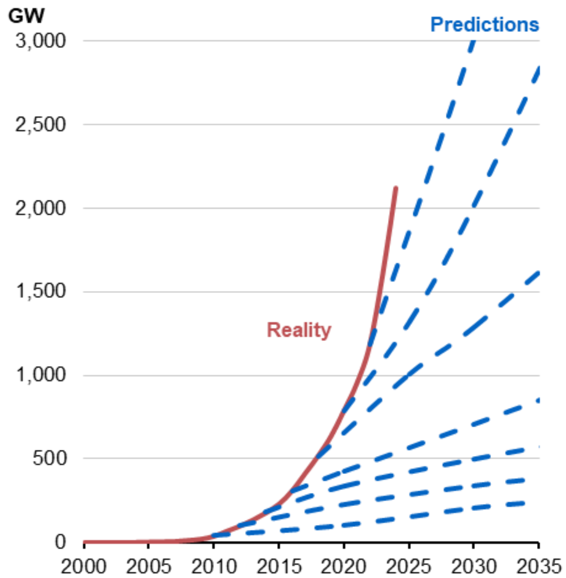
Modelling exercises by leading international agencies have faced similar challenges. The IEA, for example, has significantly underestimated investment in solar PV (Chart 2.3).

Chart 2.2: Australian generation share by renewable technology, 2024



Source: Treasury 2011 and DCCEEW 2024a

Chart 2.3: Global solar installed capacity, IEA



Note: IEA World Energy Outlook's Stated or Current Policies Scenarios taken biannually from 2010 to 2022.

Source: IEA 2024a

Improved understanding of the role of hydrogen

Hydrogen is another example of how information and assumptions have evolved since previous climate modelling exercises.

Australia's first *National Hydrogen Strategy* in 2019 set out a pathway to build an Australian industry, capitalising on global momentum (DCCEEW 2019). The Strategy noted the potential for broad use cases across industrial decarbonisation, electricity generation, heating homes and as a transport fuel. It also identified the potential for a large-scale Australian export sector.

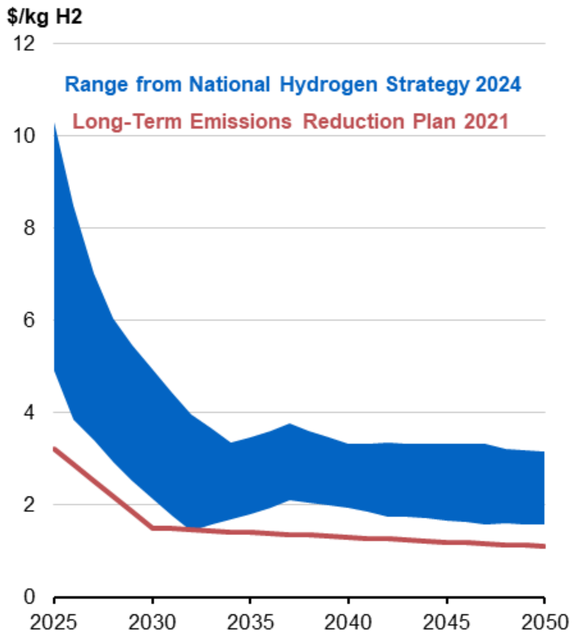
The work of the Strategy, and other sources, informed the outlook for hydrogen in the 2021 *Long-Term Emissions Reduction Plan* (DISER 2021). The Plan projected a decline in hydrogen production costs from around $4.60/kg in 2021 to $1.10/kg in 2050. Other leading organisations, including the International Renewable Energy Agency (IRENA) and the IEA, also forecast strong declines (IRENA 2021; IEA 2021).

Understanding of the economics of hydrogen production has evolved since this initial work, shaping understanding of what role hydrogen is likely to play in a net zero economy.

With forecast costs higher than anticipated in 2021 (Chart 2.4), hydrogen is now considered a viable option primarily where decarbonisation via electrification is not possible, such as for chemical feedstocks, hard-to-abate industrial processes, or certain long-haul transport applications. Where possible, electrification is more efficient as an energy carrier. For example, electric vehicles have half the efficiency losses of hydrogen cell vehicles (Chart 2.5), but electrification may not be well suited to all transport tasks.

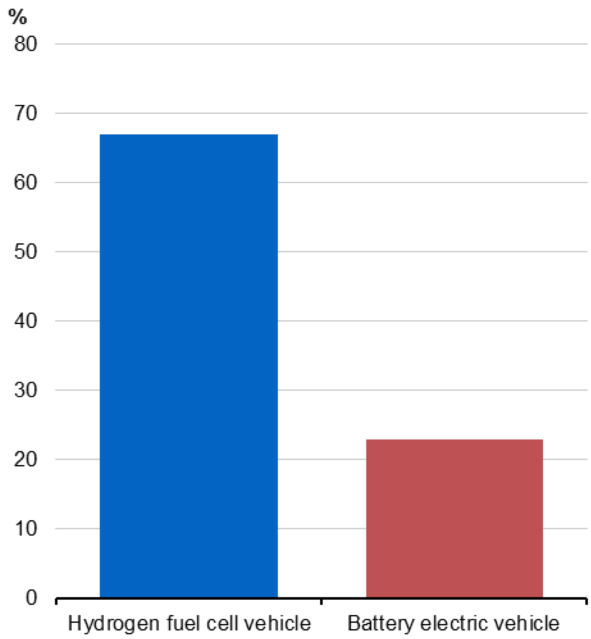
Views have also shifted around the likely future role of hydrogen in global export markets. Due to challenges in transporting hydrogen in its raw form, it is now expected that hydrogen is more likely embodied in other export products, such as green iron, steel and ammonia. Australia's hydrogen policy supports, such as Hydrogen Headstart and innovation support through the Australian Renewable Energy Agency, are designed for compatibility with any potential export vector that emerges.

Chart 2.4: Hydrogen cost projections



Source: DCCEEW 2024b & DISER 2021

Chart 2.5: Input energy lost, by vehicle type



Source: Transport and Environment 2024

Interactions with land-based sequestration

The use of land to support the net zero transition is another key uncertainty within modelling. This uncertainty stems from both the cost and availability of land-based abatement and the costs of other abatement technologies.

There is considerable uncertainty around the scale and composition of land-based sequestration required for Australia to achieve net zero. The sources of uncertainty include analytical and data constraints about the carbon sequestration potential of different land types, and uncertainty about the revenue landowners need to repurpose their land.

Credible estimates of the land-based sequestration that may be available for a given revenue vary widely, by a factor of more than 20. For example, for a revenue of $100/tonne of carbon dioxide (t CO_2), the Global Biosphere Management Model (GLOBIOM) estimates land-based carbon removals of 6.5 million tonnes of carbon dioxide (Mt CO_2) while Roxburgh et al. (2020) estimate carbon removals of 171 Mt CO_2 (IIASA 2024).[2] Another leading model, Land Use Trade-offs Model (LUTO), sits in the middle-to-upper end of this range at higher carbon prices (CSIRO 2023b).

Abatement technology development over the next 25 years will also influence the level of land-based sequestration. If abatement technologies develop faster than projected, for example, demand for land-based sequestration will be lower. As a stylised example, increasing the amount of abatement achievable through technology by 25 Mt CO_2-e in 2050 would reduce the need for additional land-based sequestration by around 20 per cent.

2 Provided by the Australian Bureau of Agricultural and Resource Economics and Science (ABARES). The curves for GLOBIOM, LUTO and Roxburgh et al. (2020) are based on mapping prices and quantities over time. These are not strictly supply curves.

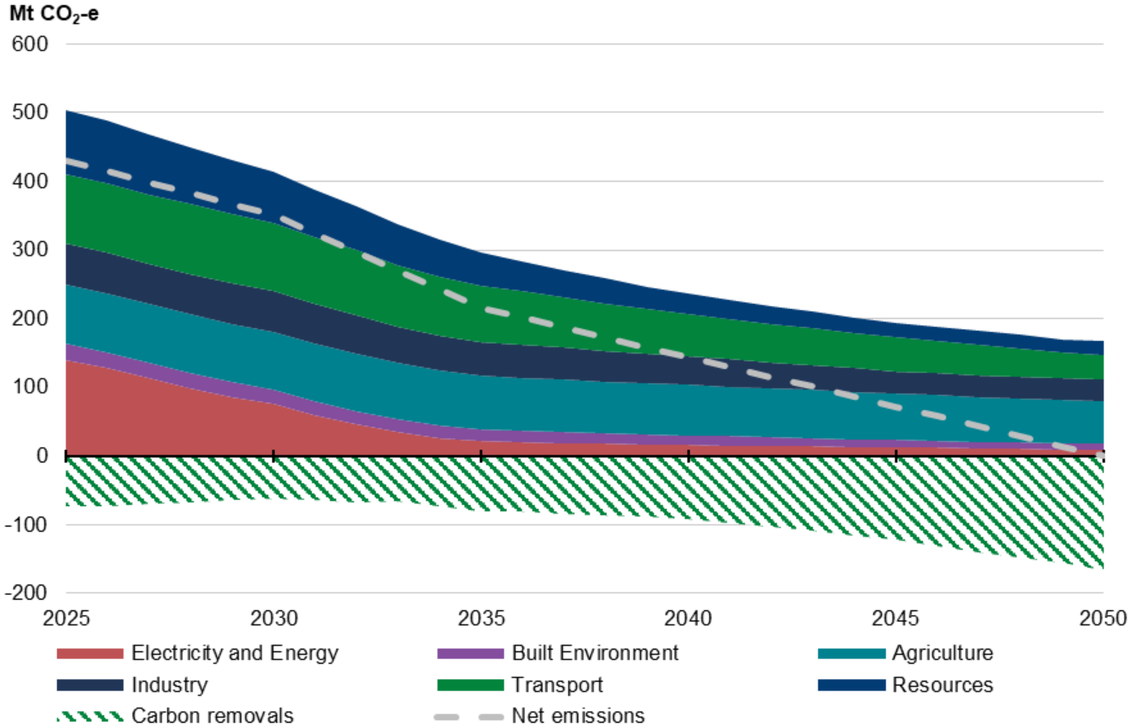
3. Emissions reduction pathways

Australia has made substantial progress in reducing emissions. Renewables now provide over 40 per cent of electricity in Australia's two major grids, up from just over 10 per cent a decade ago (Open Electricity n.d.), and are putting downward pressure on electricity prices.[3] The most recent estimates indicate that emissions will be around 43 per cent lower by 2030 and 51 per cent lower by 2035, based on current policies.

Key policies to reduce emissions are now in place, including the Safeguard Mechanism, 82 per cent renewable electricity target supported by the Capacity Investment Scheme, and the New Vehicle Efficiency Standard. Households are also taking opportunities to reduce emissions and lower energy costs. More than one in three homes now have rooftop solar, there has been a strong early response to the Cheaper Home Batteries Program, and electric vehicles reached 10 per cent of light vehicle sales in 2025, up from 0.8 per cent five years ago (Federal Chamber of Automotive Industries n.d.; Electric Vehicle Council n.d.).[4]

The scenario modelling shows that continued decarbonisation of Australia's electricity system and improvements in energy efficiency support emissions reductions in the near-term (Chart 3.1). Further out, fuel switching and the take-up of new abatement technologies across sectors, the efficient use of gas, and scaling up of carbon removals will also be key actions to support emissions reductions.

Chart 3.1: Projected emissions reductions, by Sector, Baseline Scenario



Note: For interpretability, agriculture and land have been split in the above figure. Emissions reductions from land-use change have been incorporated within carbon removals. Carbon removals refer to removing carbon dioxide from the atmosphere and storing it in land-based ecosystems, such as forests and soils.
Source: Treasury modelling.

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3 Simshauser and Gilmore (2025), Clean Energy Investor Group (2025), and the Clean Energy Council (2025) all find links between stronger renewable investment and better price outcomes for consumers.

4 Light vehicles include passenger vehicles and sports utility vehicles (SUVs).

Australia's strong renewable energy resources are foundational to driving an efficient transition. The scenario modelling shows that the most cost-efficient abatement opportunity at scale is to expand the supply of renewable energy. Renewables reduce emissions in the electricity sector directly and enable broad-based decarbonisation through electrification. Appropriately sequencing abatement to effectively manage critical dependencies – such as building out the renewable energy network to support electrification – can benefit cost efficient abatement opportunities for all sectors.

Over the medium-term, cost-efficient electrification, energy efficiency, fuel switching and other abatement technology opportunities in sectors like transport, industry and resources are expected to expand. Technology adoption is most cost-effective when it aligns with planned turnover or expansion of capital, highlighting the importance of credible long-term policy settings that allow businesses to time investment decisions effectively. Gas is projected to support the delivery of renewable energy and become more focused on higher-value and non-substitutable use cases over time.

Longer term, emerging technologies are anticipated to become available for hard-to-abate industrial processes and agriculture, as well as increased use of land-based carbon removals. Innovation and capacity building will be important in these areas to ensure Australia's competitiveness as the global economy transitions to net zero. As outlined in the Net Zero Plan, appropriate policy settings and support for research, development and adoption of technology are important to help broaden options for cost-effective abatement for sectors currently lacking suitable abatement options. This can help bring the availability of new technologies forward.

The sequencing of abatement is broadly consistent across the Baseline Scenario and Renewable Exports Upside Scenario. By contrast, delayed renewable energy rollout and technology availability under the Disorderly Transition Scenario constrains some sources of cost-efficient economy-wide abatement. This results in increased transition costs and economic disruption (see 4. Economic impacts).

3.1 Decarbonising Australia's electricity system

The modelling shows that decarbonising Australia's electricity system is already a cost-efficient way to achieve large-scale abatement. Ongoing investment in renewables ensures access to reliable and least-cost energy and enables subsequent least-cost abatement through electrification.

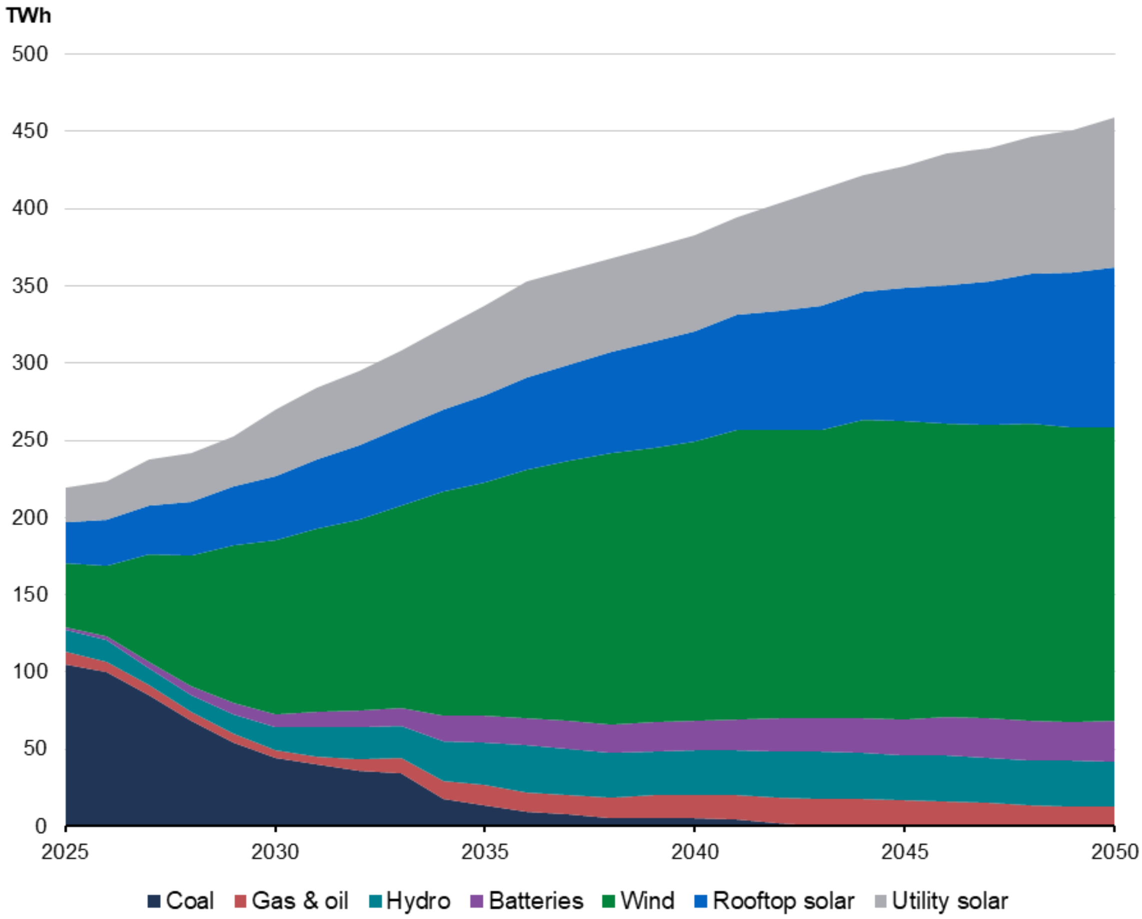
Australia's electricity system requires ongoing investment regardless of the net zero transition. Most of Australia's coal-fired power capacity is over 40 years old and is due to retire in the next decade. Several coal plants are already operating beyond their original lifespan. They are becoming increasingly unreliable as they age, with rising energy security and price risks. The CSIRO's analysis has identified firmed renewable generation as the lowest cost source of new generation (CSIRO 2025).

Disorderly coal plant closures have already had significant impacts on electricity supply and prices. For example, the unexpected retirement of the Hazelwood power station in March 2017 triggered a sharp and sustained rise in wholesale electricity prices. Hazelwood was over 50 years old with safety compliance issues and a prohibitive cost of repairs (AER 2018). More recently, an explosion at Callide C in Queensland in May 2021 caused around half a million customers to lose power (Pollard 2021) and left a unit out of service for 3 years (CS Energy n.d.). The wholesale electricity forward market reacted quickly to the Callide incident and the Q2-2021 quarter forward price jumped by more than $30/megawatt hour (MWh) to $95/MWh (Ros and Daley 2021).

Annual emissions in the electricity sector declined by 52 million tonnes of carbon dioxide (Mt CO_2-e) between 2010 and 2024. Under all modelling scenarios, decarbonisation of the grid is assumed to continue in the near-term, consistent with recent trends in the take-up of renewables and the Australian Energy Market Operator's (AEMO's) Integrated System Plan (ISP). The generation mix is assumed to reach 82 per cent on-grid renewable energy by 2030 across all scenarios, driven by state, territory and Australian government policies. Under the Disorderly Transition Scenario, the roll out of new renewable energy capacity is assumed to continue in the near-term, underpinned by existing policies, but slow beyond 2030.

The Baseline Scenario and Renewable Exports Upside Scenario demonstrate the value of decarbonising the electricity grid. Under both scenarios, renewable generation continues to expand beyond 2030 to support economy-wide electrification and decarbonisation (Chart 3.2). Australia's mix of electricity generation is expected to shift significantly to 2050, consistent with AEMO's Step Change scenario. Renewables are projected to ultimately reach 97–99 per cent of generation in the National Electricity Market (NEM) by 2050 (Chart 3.3). These higher renewable scenarios are associated with lower wholesale prices than the Disorderly Transition Scenario which has greater reliance on ageing coal-fired generators and more expensive gas-fired generation.

Chart 3.2: Generation by technology type in the NEM, Baseline Scenario



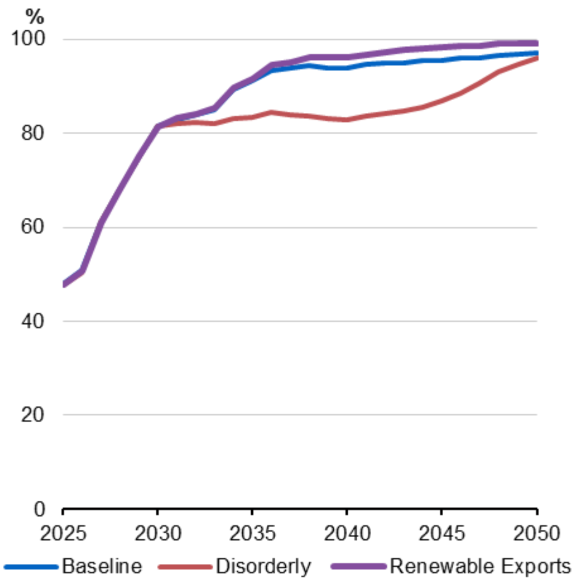
Note: Includes storage dispatch. Hydro includes conventional hydro generation and pumped hydro dispatch.

Source: Treasury EMM modelling.

Coal-fired generation is projected to mostly exit Australia's electricity system by 2035 consistent with the AEMO Step Change scenario (Chart 3.4). Replacing coal-fired electricity generation with firmed renewables is a cost-effective abatement opportunity. Consistent with AEMO's Step Change scenario, gas-fired generation (which uses natural gas as an input to produce electricity) plays an important role in firming renewable generation, particularly in winter, and as a critical backstop to ensure energy reliability, especially as coal exits the system.

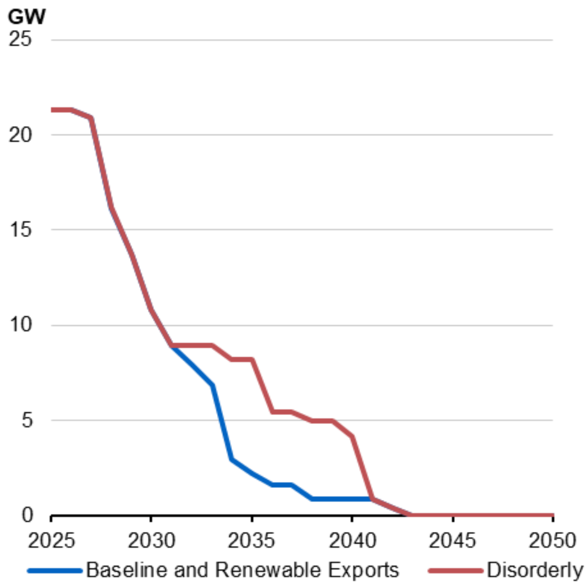
The Renewable Exports Upside Scenario also considers the implications of Australia achieving its renewable exports potential. It finds that higher and more flexible hydrogen production helps reduce the need for more expensive flexible sources of generation, including gas generators, and contributes to renewables reaching a projected 99 per cent of NEM generation by 2050.

Chart 3.3: Renewable electricity share, NEM



Source: Treasury EMM modelling.

Chart 3.4: Coal capacity, NEM



Source: Treasury EMM modelling.

In the Disorderly Transition Scenario, a lack of clear policy direction after 2030 slows the build-out of new renewable generation. Coal plants are required to operate for longer, increasing the risks of outages and failures, and gas generation is more heavily relied upon. Given that gas generation continues to have a higher cost than renewable generation, wholesale electricity prices are projected to be higher under the Disorderly Transition Scenario. The additional nearly 2,000 petajoules (PJ) of natural gas used in the NEM under the Disorderly Transition Scenario is projected to increase pressure on east coast gas demand and increase costs for industrial facilities, through higher gas and electricity prices.

3.2 Enabling electrification and energy efficiency

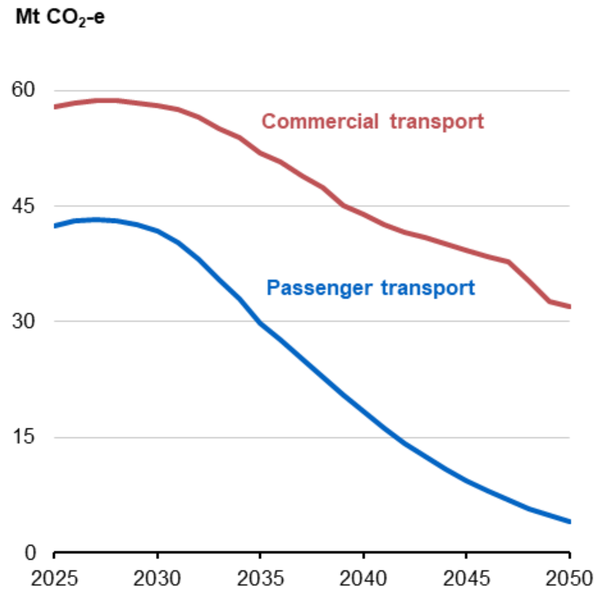
The modelling finds that electrification is a key source of low-cost emissions reductions, particularly for transport, the built environment, and some industrial manufacturing processes. Improvements in energy efficiency are also a significant contributor to reducing energy costs as electricity demand increases.

Electrification is projected to play a large role in decarbonising the transport sector across all scenarios. Take-up of passenger electric vehicles (EVs) is already cost effective in some use cases due to lower total ownership costs and assumed improvements to EV charging infrastructure.

Under the Baseline Scenario and Renewable Exports Upside Scenario, emissions from passenger transport are projected to decrease from 42 Mt CO_2-e to 4 Mt CO_2-e between 2025 and 2050 (Chart 3.5). Electrification of non-passenger vehicles (including heavy road, maritime, aviation, and rail) is projected to progress at a slower pace, supported by the switch to low-carbon liquid fuels.

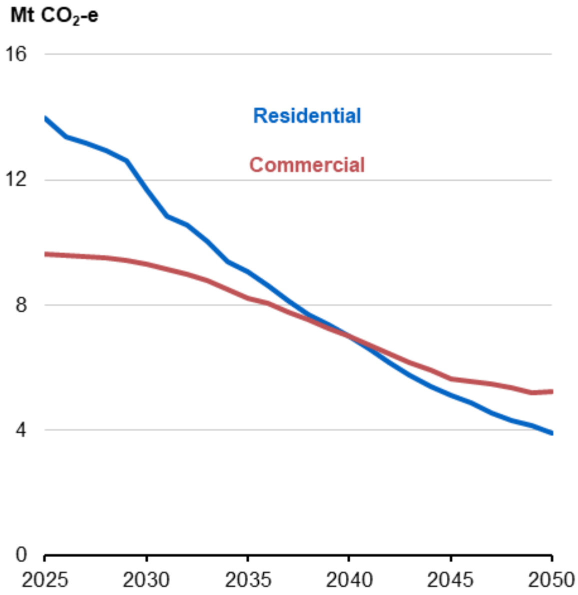
Across scenarios, emission reductions in the built environment occur gradually, as relative energy costs incentivise a switch from gas to electric appliances for residential and commercial buildings. Between 2025 and 2050, emissions from the residential sector are projected to decrease by 10 Mt CO_2-e, while emissions from the commercial sector decrease by 4 Mt CO_2-e (Chart 3.6). Translating this to a representative household level, Treasury's modelling finds that, under the Baseline Scenario, a fully electrified household with solar and a home battery, alongside EVs, reduces household total emissions by 130 t CO_2-e, compared to a non-fully electrified household from 2030 to 2050.

Chart 3.5: Commercial transport and passenger transport emissions, Baseline Scenario



Source: Treasury modelling.

Chart 3.6: Built Environment emissions, Baseline Scenario



Source: Treasury modelling.

Between 2025 and 2050, total energy use within residential buildings and the services sectors is projected to remain relatively flat, despite increased economic activity, due to improvements in energy efficiency (Chart 3.7). The shift towards electrification is projected to reduce emissions associated with gas use by 64 per cent in the built environment. Economy-wide, between 2025 and 2050, improvements in energy efficiency are assumed to reduce the energy required to produce a given amount of output by 45 per cent.[5]

The modelling also finds many production processes within the industry and resources sectors can be cost-effectively decarbonised through electrification, supported by improvements in energy efficiency. Early-use applications may include battery electric vehicles in mining and use of heat pumps in low temperature heat processes.

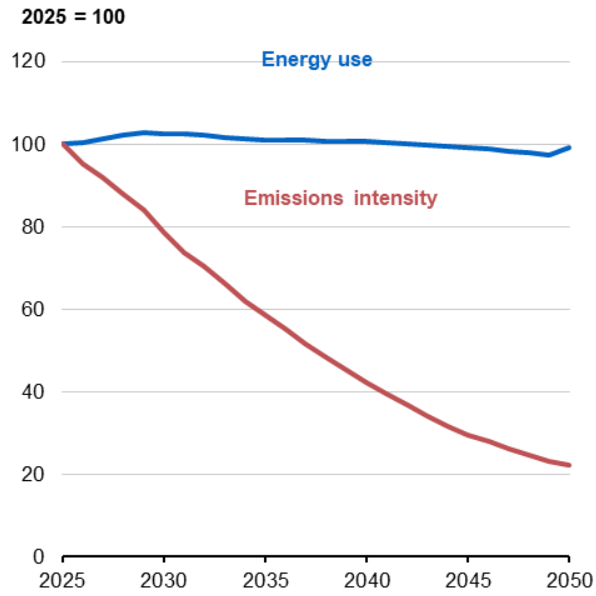
For example, under the Baseline Scenario, the iron and steel, and alumina and aluminium manufacturing sectors are projected to shift from relying on coal and gas as energy sources towards

5 Energy efficiency refers to process or technology improvements that allow for less energy to be used while producing the same amount of output. See Appendix D for more details on energy efficiency assumptions.

electricity and renewable hydrogen. These sectors reduce their emissions from around 20 Mt CO_2-e to around 2 Mt CO_2-e between 2025 and 2050 (Chart 3.8).

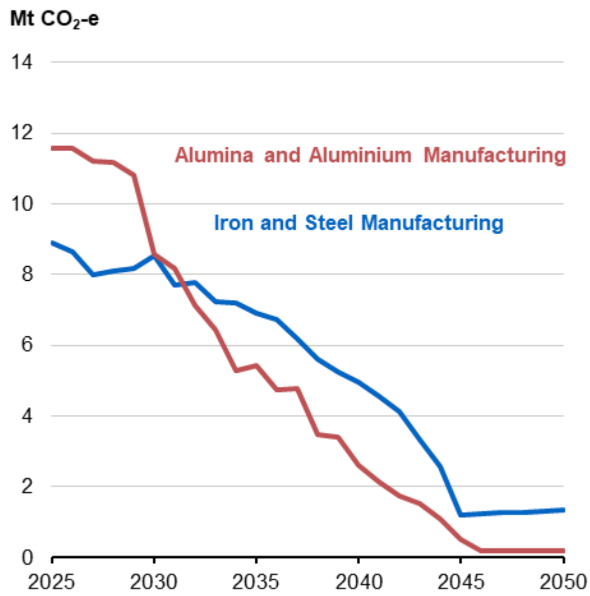
Under the Renewable Exports Upside Scenario, production of green iron is expected to be five times larger than the Baseline Scenario, underpinned by strong demand from trading partners.

Chart 3.7: Energy use and emissions intensity for residential buildings and the services sector, Baseline Scenario



Source: Treasury modelling.

Chart 3.8: Projected emissions for selected industrial sectors, Baseline Scenario



Source: Treasury modelling.

Economy-wide electrification is projected to result in substantial growth in electricity consumption across all three scenarios, consistent with the AEMO's ISP Step Change scenario. Under the Baseline Scenario, large grid[6] electricity consumption is projected to more than double from 2025 levels to 2050 (Chart 3.9). This growth is driven primarily by electrification, with some additional demand resulting from the establishment of new industries such as hydrogen and data centres.

Improvements in energy efficiency reduce the amount of new electricity generation needed to support continued growth in electricity demand, including demand from electrification. For example, under the Baseline Scenario, NEM demand would be over 20 per cent higher by 2050 without energy efficiency improvements. Reduced demand from energy efficiency helps relieve supply pressures to build renewables and firming capacity, and augment electricity networks.

Small and off-grid electricity consumption depends on the scale of new clean energy embedded export sectors. For example, small and off-grid electricity consumption for renewable hydrogen production is projected to increase from zero in 2025 to 130 terawatt hours (TWh) and 481 TWh in 2050 under the Baseline Scenario and Renewable Exports Upside Scenario, respectively.

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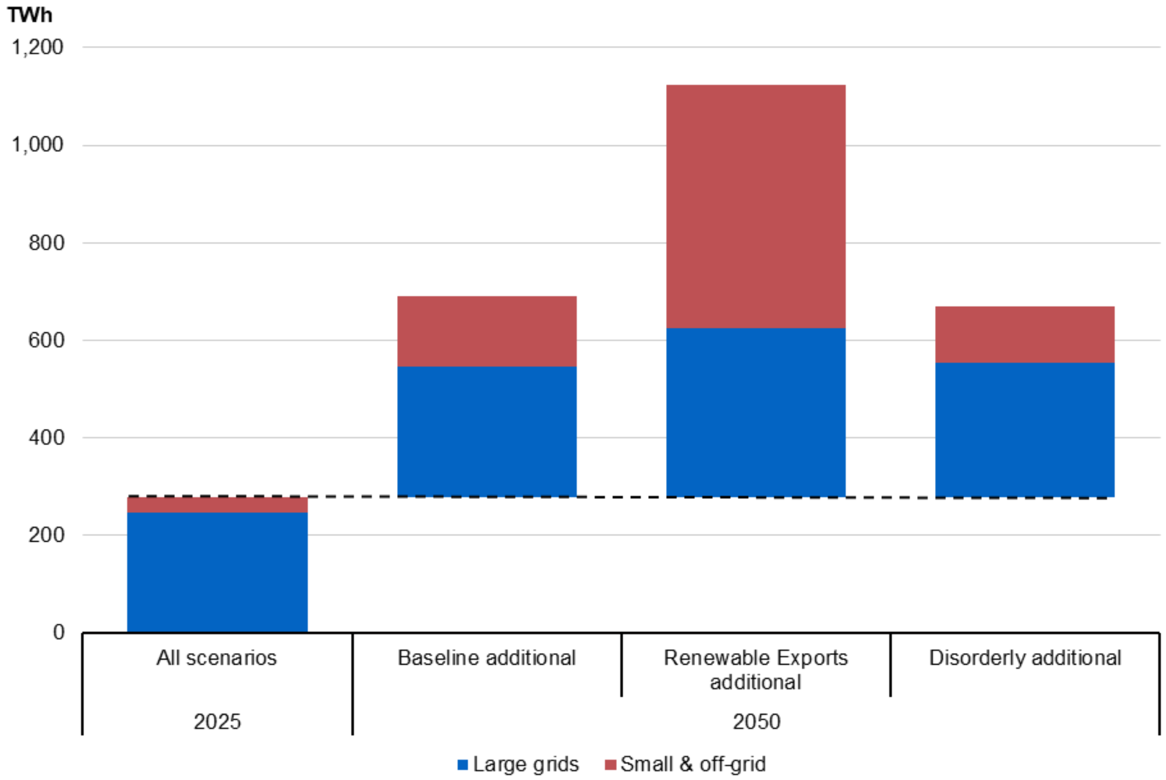
6 Refers to the National Electricity Market (NEM) covering the eastern states and South Australia, and the Wholesale Electricity Market (WEM) which covers the south-west area of Western Australia. The remaining electricity generation is included as a part of small and off-grid.

These demand increases are projected to more than offset declines in demand from other off-grid generation sources, such as gas extraction, liquid natural gas (LNG) and coal mining. Declines in emissions from these sources are driven by projected changes in global demand for fossil fuels and take-up of new technologies.

Chart 3.9: Projected electricity generation, 2025 and 2050



Note: Excludes storage dispatch such as batteries and pumped hydro.
Source: Treasury modelling.

3.3 Enabling fuel switching and take-up of abatement technology

Electrification may not be a cost-effective or technically viable option for some processes. In these cases, fuel switching or approaches that support take-up of abatement technology are projected to support emissions reductions in the medium-term.

Low-carbon liquid fuels are expected to offer an increasingly cost-effective decarbonisation pathway over time. Studies by CSIRO and others have found that while low-carbon liquid fuels are currently more expensive than their unabated fossil fuel counterparts, costs are expected to decrease over the medium-term as technology and scale improves.[7]

7 CSIRO's *Sustainable Aviation Fuel Roadmap* (2023c) and *Opportunities and Priorities for a Low Carbon Liquid Fuel Industry in Australia* (O'Sullivan 2025) report finds the levelised cost of production for a unit of fuel could decrease by between 10 per cent to 56 per cent (depending on the feedstock used) over the period to 2050.

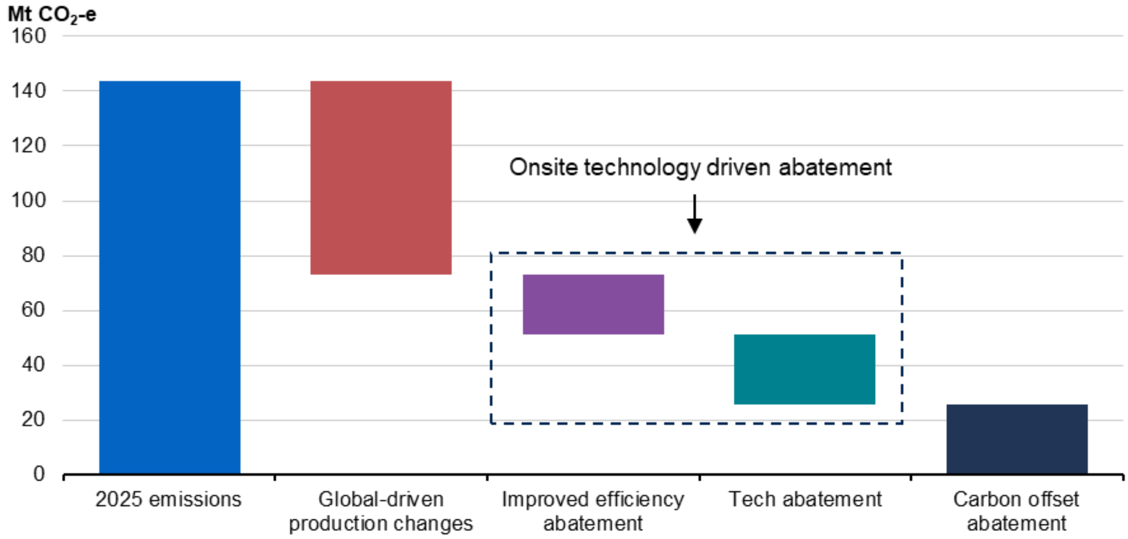
The modelling projects a steady increase in switching to low carbon liquid fuels across relevant sectors from the mid-2030s. Between 2035 and 2050, emissions associated with the use of diesel and aviation fuel, for example, are projected to decline by 32 Mt CO_2-e and 5 Mt CO_2-e, respectively.

Large emitting industrial facilities, which currently account for around 30 per cent of Australia's emissions, are another sector where electrification options are more limited.[8] These facilities face substantial trade-offs as they sequence abatement, meet policy obligations and manage the cost of reaching net zero. They also face varying abatement technology options, depending on their product and geographic location. The extent to which Australia will reduce the emissions-intensiveness of traditional products and adjust the mix of production is uncertain and depends on global factors, including changes in global fossil fuel demand.

The Safeguard Mechanism incentivises low-cost decarbonisation for covered industrial emitters.[9] The Safeguard Mechanism delivers abatement by incentivising investments in technology and carbon credit trading to efficiently sequence abatement between sectors and across time. Flexibility to use land-based abatement allows facilities to meet emissions reductions on a net basis.

Consistent with this, the modelling finds emissions reductions at large industrial facilities are driven by a combination of factors in the Baseline Scenario. They include global demand-driven declines in fossil fuel production (49 per cent), uptake of abatement technology (18 per cent), the purchase of Australian Carbon Credit Units (ACCUs) (18 per cent), and improved energy efficiency (15 per cent) (Chart 3.10).

Chart 3.10: Abatement from large emitters, Baseline Scenario



Source: Treasury MIRA modelling.

8 Figure 16 in *Australia's emission projections 2024* (DCCEEW 2024c): *Safeguard business-as-usual, gross emissions, on-site emissions reductions and net demand for units in the Baseline Scenario, 2025 to 2040, Mt CO_2-e*.

9 Large industrial emitters are those facilities with emissions over 100,000 t CO_2-e per year are typically subject to emissions reduction obligations in the Safeguard Mechanism.

Box 3.1: Estimating Australia's potential impact on global abatement

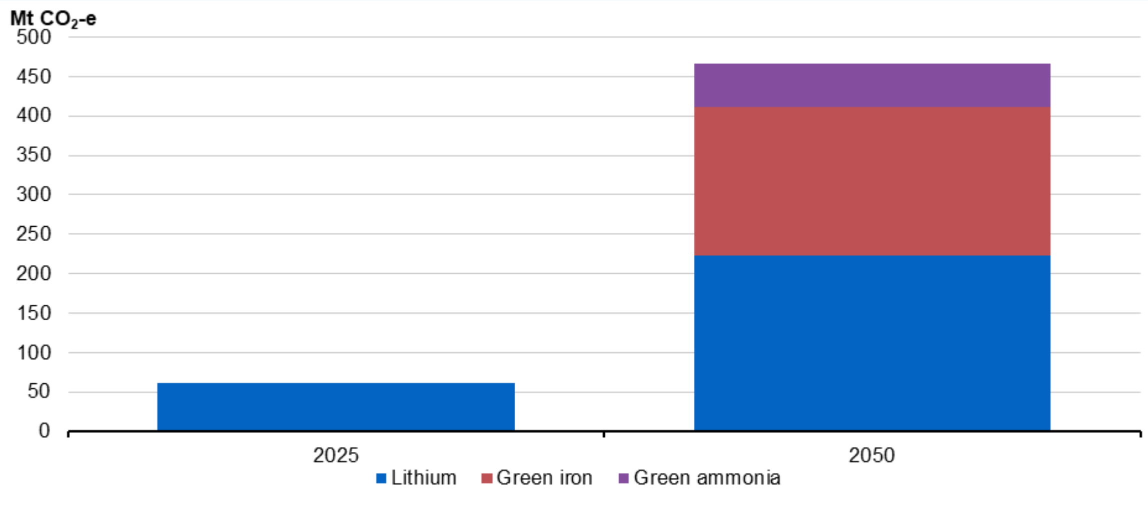
Treasury finds that Australian production of green commodities can support abatement in other jurisdictions. International abatement would be additional to Australia's domestic targets and contributes to global emissions reductions.

Estimating the potential impact of Australian green products on global abatement requires making assumptions about what would otherwise happen in the global economy. For this analysis, low-carbon Australian production is assumed to displace carbon-intensive production or use overseas on a one-for-one basis. The impact of green iron, green ammonia and lithium is considered due to clearer links between Australian production and global abatement.

Under the Renewable Exports Upside Scenario, Australia's production and exports of green iron, green ammonia and lithium could contribute 466 Mt CO_2-e to global emissions reduction in 2050. This level is equivalent to 1.2 per cent of global emissions and more than Australia's net emissions in 2024.

Decarbonisation could come from green iron exports displacing 188 Mt CO_2-e of emissions from coal-based steel production, green ammonia exports displacing 55 Mt CO_2-e of emissions from energy, fuel and conventional ammonia and lithium could help to displace 222 Mt CO_2-e of emissions from carbon-intensive transport and electricity generation.

Chart 3.11: Australia's impact on global abatement, selected products, Renewable Exports Upside Scenario



Note: Green iron is assumed to displace traditional steelmaking. Green ammonia is assumed to have mixed use across fertiliser production, 'co-firing' at coal-fired power, and as an alternative to oil-derived fuels. Lithium is assumed to help replace internal combustion vehicles and gas peaking generation, with its share of that abatement based on the embedded value of lithium in those products. See Appendix D for further information.
Source: Treasury modelling.

3.4 Deploying gas efficiently

The modelling projects that emissions from gas use decline by 70 per cent to 2050 under the Baseline Scenario (Chart 3.12). Natural gas use is projected to shift towards higher-value and non-substitutable use cases.

Australia currently accounts for a fifth of global LNG trade and will remain a reliable trading partner as the world transitions to net zero and emissions associated with Australian gas production are abated or offset by 2050. Global demand for LNG is forecast to decline, consistent with global action to limit warming to 2°C.

Domestic use of gas also declines in the Baseline Scenario. Efficient use of gas in the electricity sector can support emissions reductions and gas is expected to continue to play a role in electricity generation to 2050. Some gas generation is modelled to be a cost-effective critical backstop to ensure reliable electricity supply under emissions reduction targets. This role includes risk management of low frequency but high impact events on the grid when other options have been exhausted, such as in extended periods of low renewables output and high demand during winter.

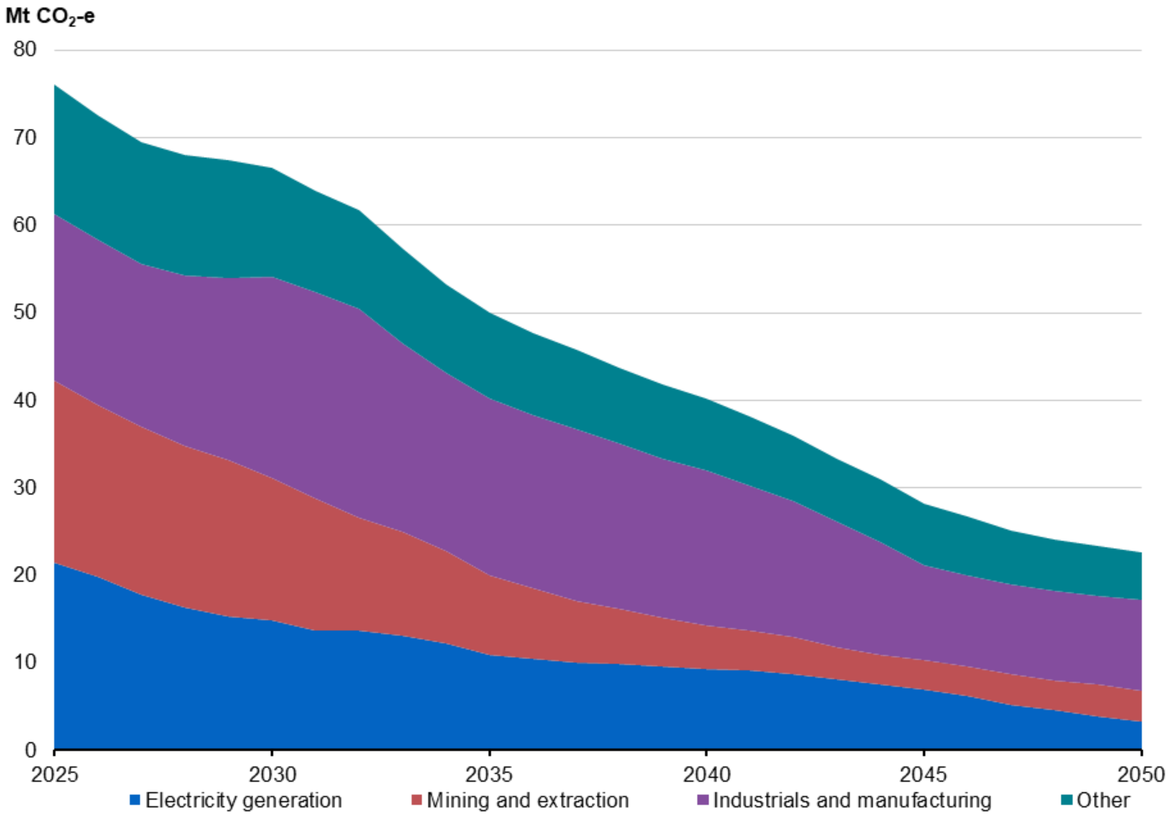
Energy efficiency, electrification and fuel switching technologies are expected to reduce gas demand by industrial users and households over time, as capital stock turns over and electric appliances become more cost efficient. Off-grid electricity generation, particularly in the mining sector, is also projected to shift from gas to renewables.

In some hard-to-abate use cases, such as where gas is used for high temperature heat or chemical processes, the extent of residual gas use in 2050 will depend on technological progress. Use of abatement technologies such as carbon capture and storage are expected to contribute to reductions in the emissions-intensity of gas production and use over time. Access to new abatement technologies is delayed under the Disorderly Transition Scenario, reflecting reduced engagement in the net zero transition and reduced incentivisation during the 2030s.

There are other industries – such as steel and alumina – where gas is expected to be used as a less emissions-intensive alternative to coal during the 2030s, before making the transition to renewable electricity and hydrogen by 2050. Technology take-up often depends on when existing assets reach end of life. For these industries, credible long-term policy settings and clear forward guidance is highly valuable, as it allows firms to make well-informed investment decisions and avoid capital scrapping.

Outcomes of the Gas Market Review, currently underway, are not accounted for in this modelling. The Review is intended to ensure that domestic industrial gas users have access to sufficient affordable gas.

Chart 3.12: Projected emissions from domestic gas use by industry grouping, Baseline Scenario



Note: 'Other' includes agriculture, built environment, and transport industries. Some emissions reduction from the use of gas is achieved via carbon capture and storage technologies.

Source: Treasury modelling.

3.5 Scaling up carbon removals

Cost-efficient abatement solutions are not expected to be available to all activities, so carbon removals will be required to abate residual emissions.[10] The Intergovernmental Panel on Climate Change (IPCC) has identified carbon removals as essential if the world is to meet net zero.[11]

The modelling projects that carbon removals become increasingly important closer to 2050, once cost-efficient abatement opportunities have been widely adopted. Carbon removals refer to processes for removing carbon dioxide from the atmosphere, for example by storing it in land-based ecosystems, such as forests and soils. This can be achieved through a variety of methods including reforestation, afforestation (planting trees on land previously not forested), improving soil health and engineered removals.

Residual emissions are projected to be most significant in the agriculture sector, where abatement technology options are most nascent. Under both the Baseline Scenario and Renewable Exports

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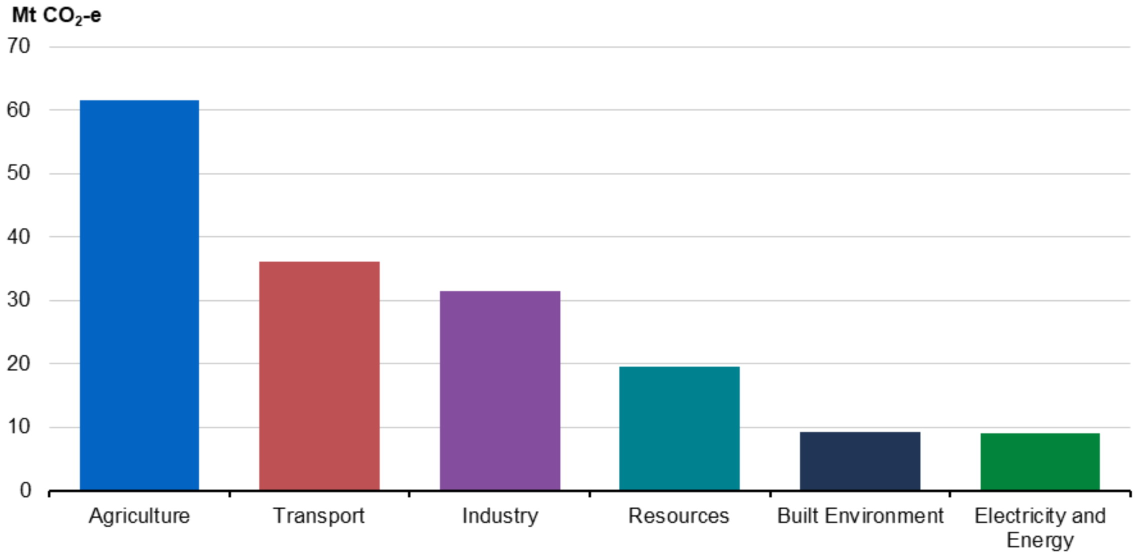
10 Residual emissions are those greenhouse gas emissions that remain after all economical or technically feasible abatement options have been exhausted (IPCC 2022).

11 *"The deployment of carbon dioxide removal (CDR) to counterbalance hard-to-abate residual emissions is unavoidable if net zero CO_2 or GHG emissions are to be achieved."* (IPCC 2022).

Upside Scenario, 167–168 Mt CO_2-e of residual emissions are projected to remain in the economy in 2050 (Chart 3.13). Agriculture is projected to contribute the largest proportion of this at 62 Mt CO_2-e, reflecting lower projected availability of cost-effective abatement technologies. Land-based carbon removals are projected to become a significant revenue opportunity for landholders.

Chart 3.13: Projected residual emissions in 2050, by sector, Baseline Scenario

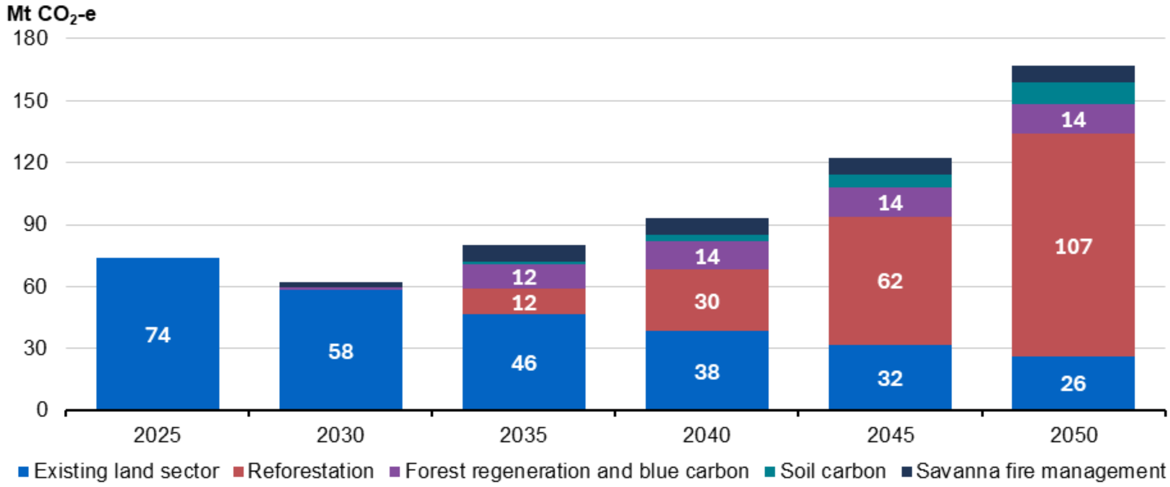


Source: Treasury modelling.

For Australia, the most prospective carbon removal option is currently land-based sequestration (Chart 3.14). This modelling projects that land-based abatement could increase modestly by 9 per cent to 2035, and that reforestation is currently expected to be the most scalable source of land-based abatement in 2050. However, estimates of the cost-efficiency of different approaches vary significantly. Other opportunities, like engineered direct-air-capture, may become more cost-effective over time, but this is uncertain given limited projects currently operating at scale.[12]

12 Current estimates by CSIRO place the cost of direct-air capture technology, for example, at around \$500-1,000 t/CO_2-e abated, falling to around \$400 t/CO_2-e in 2050 (CSIRO unpublished).

Chart 3.14: Projected sources of land-based sequestration, 2025 to 2050, Baseline Scenario



Note: The 'Existing land sector' category refers to the existing net sink, including emissions reductions and sequestration being generated from existing ACCU projects. The decline in this category reflects the ageing of existing vegetation and the related decline in the ability to sequester carbon. The category does not include the sequestration from *new* sequestration projects incentivised through the Safeguard Mechanism. The sequestration volumes for reforestation, forest regeneration and blue carbon, soil carbon, and savanna fire management represent *new* sequestration projects in the Baseline Scenario.

Source: Treasury modelling.

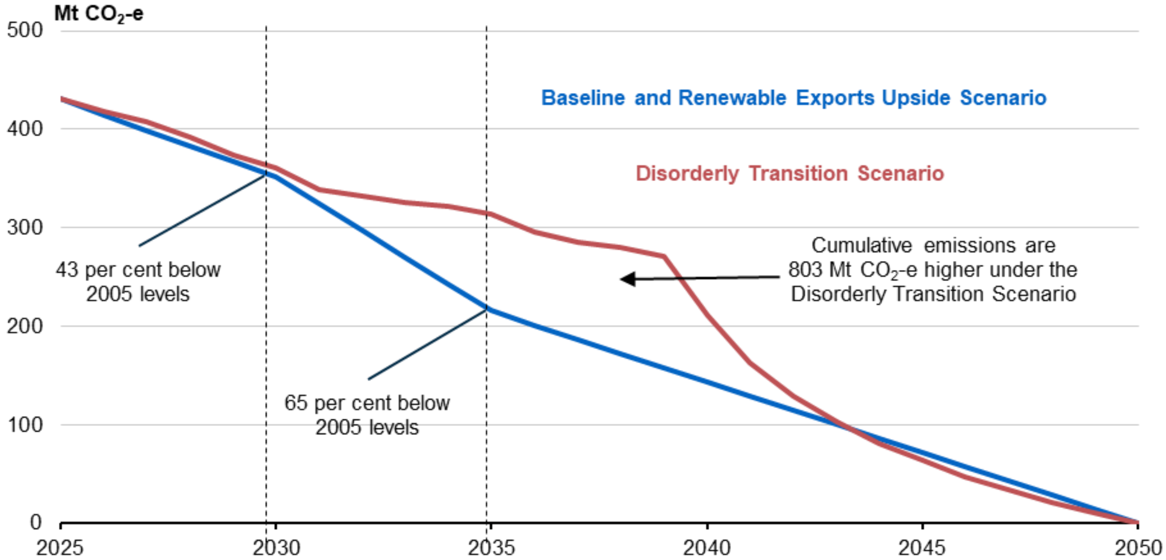
3.6 Abatement outcomes under a disorderly transition

The Climate Change Authority assessed in December 2024 that current policies put Australia within reach of its 2030 target of 43 per cent emissions reduction on 2005 levels. However, significant further action is required to reduce emissions to net zero by 2050.

If maintained, current policies are expected to reduce emissions by nine percentage points more by 2035, reducing emissions to 51 per cent. The Baseline Scenario and Renewable Exports Upside Scenarios present pathways where further steady policy action reduces emissions to 65 per cent by 2035. In contrast, the Disorderly Transition Scenario demonstrates that if existing policies remain in place, but further steady action is not taken during the 2030s, emissions reduction would need to occur at a much faster pace during the 2040s.

The total difference in emissions between scenarios peaks in 2039 with emissions 112 Mt CO_2-e higher under the Disorderly Transition Scenario, before action resumes in 2040 (Chart 3.15). Cumulative emissions are 803 Mt higher to 2050 under the Disorderly Transition Scenario, compared to the Baseline Scenario and Renewable Exports Upside Scenario.

Chart 3.15: Net emissions, 2025 to 2050



Source: Treasury modelling.

Under this scenario, investment uncertainty slows the rollout of renewables through the 2030s, increasing the reliance on natural gas and coal. Emissions in the electricity sector are projected to be 37 Mt CO_2-e higher than in the Baseline Scenario in 2039. Gas use in the NEM is projected to be nearly 2,000 PJ higher in the Disorderly Transition Scenario, which has implications for the supply for industrial users and export partners, and for gas prices.

Electrification across the economy also slows in the Disorderly Transition Scenario, leading to higher emissions for the built environment (2 Mt CO_2-e) and transport (17 Mt CO_2-e) sectors in 2039, compared to the Baseline Scenario.

Under the Disorderly Transition Scenario, large emitters are assumed to have delayed availability of low-cost decarbonisation technology due to businesses being reluctant to invest and a lack of policy action. This delay contributes to emissions being 34 Mt CO_2-e higher in 2039 for the industry and resources sectors than the Baseline Scenario.

Credible and ambitious targets and policies are critical to an efficient net zero transition, as they enable businesses and investors to have confidence in Government policies and anticipate how the economy will transform to achieve net zero emissions by 2050. A lack of policy signalling restricts the availability of cost-effective abatement, such as land-based sequestration, which requires time for the physical growth of biomass.

4. Economic impacts

Australia's natural resource endowments, renewable energy potential, skilled labour force and reputation as a trusted and reliable trading partner, position the economy well. Continuing to take credible policy action will enable Australia to harness the opportunities of the net zero transformation and other structural shifts in the economy.

Australia has already made significant progress on reducing emissions over the past three years as a result of policy action, including renewables delivering over 40 per cent of electricity in Australia's two major grids. At the same time, inflation has returned to the Reserve Bank of Australia's target, unemployment has remained low and positive economic growth has been achieved. However, there are headwinds, including global economic volatility, and there is further work to do to manage the long-run challenges of making the economy more resilient and productive.

The modelling in this report shows how Australia's economy can continue to respond to the global net zero transformation. An orderly, well-signalled transition to net zero can support economic growth, investment, jobs and living standards through a period of significant structural change.

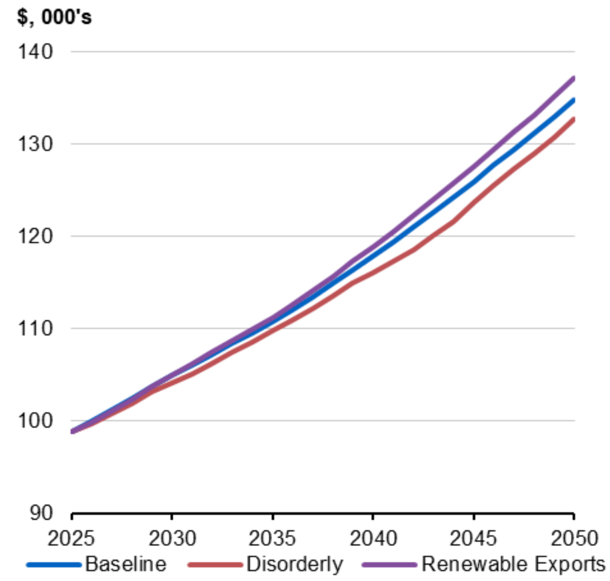
4.1 Maintaining economic growth

The strong fundamentals of the Australian economy have underpinned its adaptability and resilience to shocks over recent decades, including the Global Financial Crisis and the COVID-19 pandemic. Australia has also historically been able to capitalise on the opportunities presented by changes in the global economy, such as the mining commodities boom during the 2000s, and improvements in technology to boost living standards and economic growth.

Setting credible, long-term targets to reduce emissions and transition to net zero is critical for growth and economic prosperity. Treasury's modelling illustrates that an orderly transition to net zero will support investment in energy and new industries and enable new export opportunities to be realised. This will support growth and job creation.

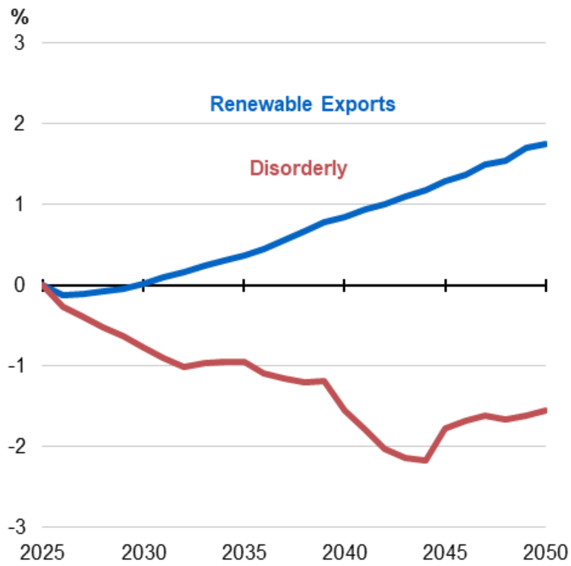
Under the Baseline Scenario, the Australian economy is projected to be 28 per cent larger by 2035, relative to current levels, the equivalent of $12,000 per capita (Chart 4.1). Annual GDP growth is projected to average 2.5 per cent over 2025–35, and 2.4 per cent over 2035–50, broadly consistent with the *2023 Intergenerational Report*. This translates to the Australian economy being 81 per cent or $2.2 trillion bigger by 2050, compared to 2025 – the equivalent of $36,000 per capita.

Chart 4.1: Real GDP per capita



Source: Treasury modelling.

Chart 4.2: Real GDP, per cent deviation from Baseline Scenario



Source: Treasury modelling.

The global net zero transformation presents an export economic opportunity for Australia. Economic growth is projected to be higher from 2030 onwards, relative to the Baseline Scenario, if Australia is successful at realising its clean energy exports potential (Chart 4.2). The Renewable Exports Upside Scenario results in the economy being an additional $85 billion bigger by 2050, compared to the Baseline Scenario, and real GDP per capita increases by $38,000 over the 25 years to 2050.

By contrast, a disorderly approach to the net zero transformation will have significant adverse economic consequences. Under the Disorderly Transition Scenario, heightened policy uncertainty is projected to reduce investment. It also results in capital misallocation as businesses invest without clear direction and are forced to adjust their investment plans – and rapidly abate – in the 2040s, leading to capital shallowing. Additionally, lower investment in renewable energy constrains activity in new clean energy embedded export industries. For these reasons, a disorderly transition is projected to result in average annual GDP growth being 0.1 percentage points lower between 2025 and 2050. This results in cumulative real GDP being $1.2 trillion lower than the Baseline Scenario and $2 trillion lower than the Renewable Exports Upside Scenario over the 25 years to 2050.

4.2 Adjusting to structural change

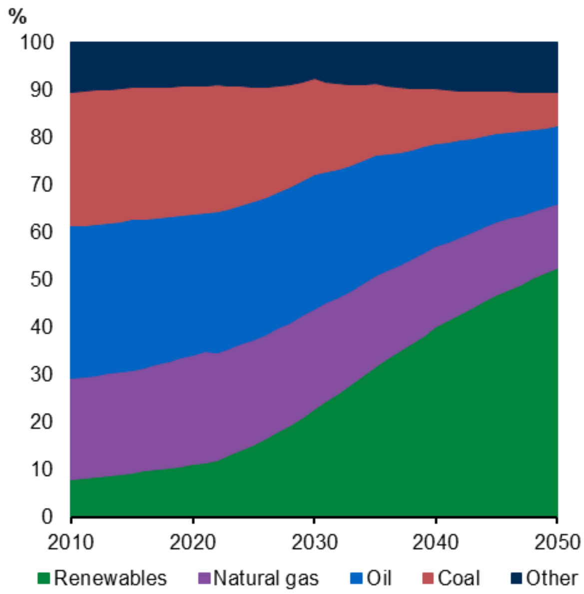
The structure of the Australian economy is constantly evolving. As highlighted in the *2023 Intergenerational Report*, the Australian economy is expected to undergo further structural change, due to the adoption and diffusion of new technologies such as artificial intelligence, the net zero transformation, ageing of the population, geopolitical tensions and growing demand for care economy services (Australian Government 2023).

Over the past half-century, Australia's economy has shifted increasingly towards services. The contribution of services to overall economic output has risen almost five-fold in the past 40 years, rising from around 70 per cent of GDP in 1982 to around 80 per cent today

(Australian Government 2023).[13] The corollary of this is that the share of the goods sector has declined over this period, barring a short-term pause through the COVID-19 pandemic. These high-level trends are projected to continue in the scenarios modelled in this report. The services sector is projected to reach 86 per cent of Australia's GDP in 2050 across all scenarios. Underlying these high-level trends are substantial changes to the industrial mix as the economy adjusts to the net zero transformation. The transition to net zero emissions by 2050 will change the demand for products, and how different goods and services are produced, sold and consumed.

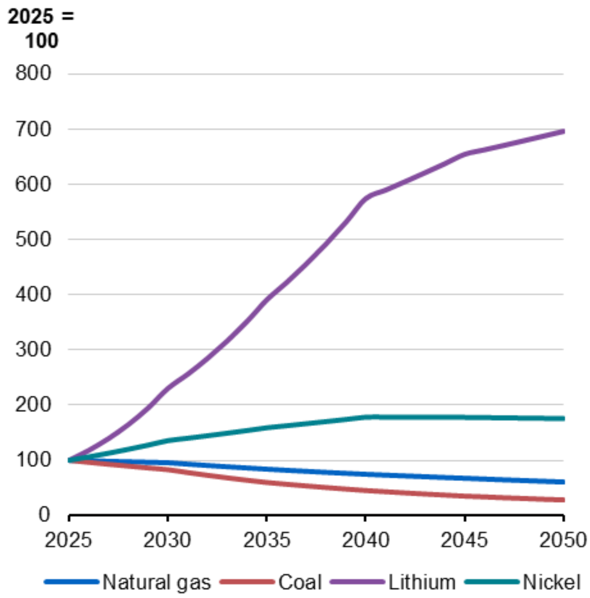
As the global energy transformation accelerates to meet Paris Agreement goals, the patterns of global energy and resource trade will change, which will in turn affect the structure of the Australian economy. Use of coal is projected to decline from 24 per cent of the global energy mix in 2025 to around 7 per cent in 2050 (Chart 4.3). Under a well below 2°C-aligned global scenario, renewables are expected to provide the majority of global energy by 2050, driven mainly by solar, wind, and modern bioenergy.

Chart 4.3: Global energy mix, under a well below 2°C scenario, 2010 to 2050



Source: IEA 2023

Chart 4.4: Global demand for commodities, under a well below 2°C scenario, 2025 to 2050



Source: IEA 2023; IEA 2024c

Australia's high degree of global trade integration is a source of prosperity and resilience. For example, in the 2000s, increases in international demand for commodities generated strong growth in mining investment, which is estimated to have increased real per capita household disposable income by 13 per cent (Tulip 2014). Between 2010 and 2022, investment of over $398 billion in the oil and gas sectors supported the development of an LNG export industry, demonstrating Australia's ability to adapt to new opportunities (DISR 2024). Additional sources of growth – particularly in emerging clean energy embedded industries – are projected to emerge as the domestic and global economies evolve.

Around one-third of Australia's goods exports in 2024 were fossil fuels and these exports are projected to decline as trading partners implement their net zero commitments (DFAT 2025a). This

13 See also Appendix A: Additional outputs.

has implications for Australia's terms of trade because declining demand pushes down prices of fossil fuel commodities.

On the basis of IEA forecasts, Australia's coal production is projected to decrease by at least 42 per cent to 2035 and 71 per cent to 2050 across all scenarios (Table 4.1). While global demand for LNG is forecast to decline more slowly than coal, Australian gas and LNG production is projected to decline by 66 to 68 per cent by 2050, alongside changes in global demand. Australian iron ore production is projected to decline by 17 to 18 per cent to 2050, reflecting the assumed redirection of some output to the domestic iron and steel manufacturing sector to support clean energy embedded iron production, as well as some declines in global demand. Actual outcomes will depend on the emissions reduction pathways adopted by Australia's trading partners, and the success of Australian industries at reducing emissions intensity and improving competitiveness in this environment.

Table 4.1: Change in output for selected sectors, across scenarios, from 2025

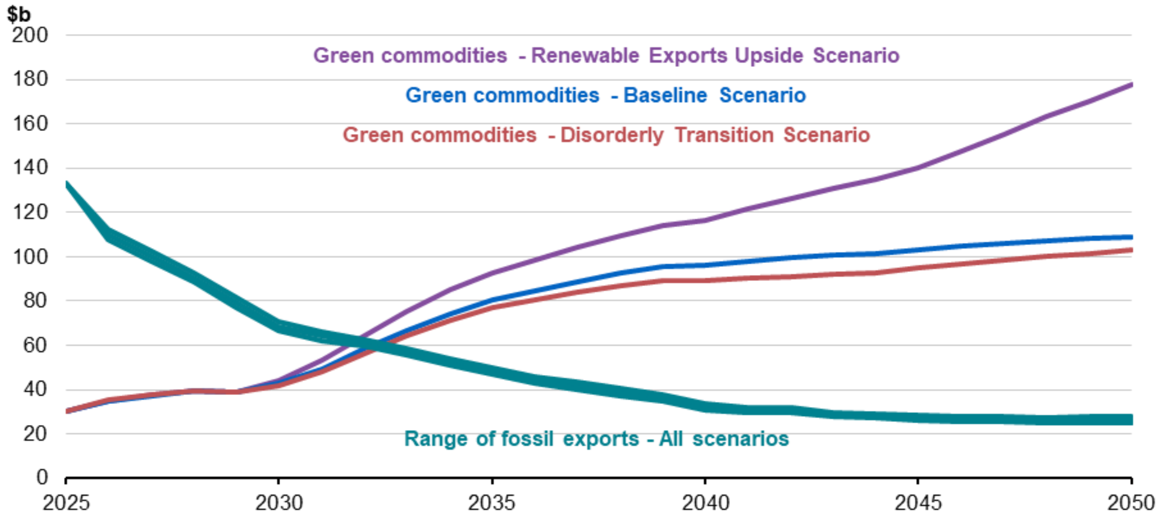
	Baseline Scenario		Renewable Exports Upside Scenario		Disorderly Transition Scenario	
Sector	To 2035	To 2050	To 2035	To 2050	To 2035	To 2050
Agriculture	14%	32%	13%	31%	16%	33%
Coal	-47%	-72%	-51%	-74%	-42%	-71%
Gas and LNG	-27%	-67%	-29%	-68%	-24%	-66%
Iron Ore Mining	-11%	-18%	-13%	-17%	-12%	-18%
Construction	21%	71%	22%	74%	20%	70%
Services[14]	34%	94%	34%	95%	33%	92%
Hydrogen and Ammonia	520%	993%	736%	3,648%	278%	754%
Renewable hydrogen	2 Mt	4 Mt	3 Mt	15 Mt	1 Mt	3 Mt
Green ammonia	6 Mt	8 Mt	8 Mt	35 Mt	2 Mt	5 Mt
Iron and Steel Manufacturing	40%	119%	107%	419%	27%	98%
Green iron	7 Mt	23 Mt	27 Mt	120 Mt	2 Mt	15 Mt

Australia is well placed to respond to rising global demand for the commodities needed to support the net zero transition, given its abundant natural and renewable energy resources. Demand for critical minerals such as lithium and nickel, essential for electric vehicles and energy storage technologies, is expected to experience strong growth by 2050 under a well below 2°C-aligned global scenario (Chart 4.4). This provides an opportunity for Australia to expand its critical mineral exports. Australia's critical minerals processing output is projected to increase by more than 170 per cent to 2050 across all scenarios, making Australia a key part of global clean energy supply chains.

Additional opportunities are presented by other new-growth sectors critical to the net zero transition. The total value of Australia's green exports – which includes green ammonia, green iron, alumina, aluminium and critical minerals – is projected to reach $80–93 billion in 2035 and $109–178 billion in 2050 under the Baseline and Renewable Exports Upside scenarios, supporting an increase in total exports (Chart 4.5). These trends reflect assumptions about the output of the hydrogen and ammonia sectors that are projected to increase by over 250 per cent to 2035 across all scenarios, with Australia producing 15 Mt of hydrogen in 2050 under the Renewable Exports Upside Scenario (in line with the National Hydrogen Strategy's base production target).

14 This 'Services' sector in this table refers to the industry in the Treasury Industry Model (TIM), rather than the ABS definition which also includes industries such as construction and transport. Construction is captured as its own separate industry within TIM.

Chart 4.5: Projected value of Australian exports, 2025 to 2050



Note: Fossil fuels include coal and LNG. Green commodities are those which are broadly covered by the Future Made in Australia agenda. These include green ammonia, green iron, alumina and aluminium, and raw and refined critical minerals. These projections reflect an assessment of Australia's export potential based on a range of sources.
Source: Treasury analysis.

In response to the projected increase in global demand for green exports, manufacturing's share of production is projected to grow from 5.8 per cent today to 6.2 per cent in 2050 in the Renewable Exports Upside Scenario.[15] This growth is supported by the establishment of new clean energy embedded industries. Some of this increase also reflects the projected redirection of mined critical minerals and iron ore to support domestic manufacturing, away from export.

Total export growth across the scenarios is also supported by increased production in other export-facing sectors like agriculture. Agriculture output is projected to increase by at least 13 per cent to 2035 and by 31 per cent to 2050 across all scenarios, supported by growth in crops and horticulture in particular.

4.3 Attracting and deploying investment

Investment in clean energy infrastructure, efficiency and electrification globally is already approaching USD2.2 trillion each year, which is almost double the combined investment in new oil, gas and coal supply (IEA 2025b). In Australia, investment in utility-scale renewable energy construction exceeded $8 billion in 2023–24, with an additional $13 billion investment in other electricity-related assets, including transmission and infrastructure (ABS 2024).

Under an orderly transition to net zero where the direction of policy is clear, businesses will find it easier to plan the investments they need to modernise processes and reduce their carbon emissions as part of their regular capital replacement program.[16] This is particularly relevant in sectors of the

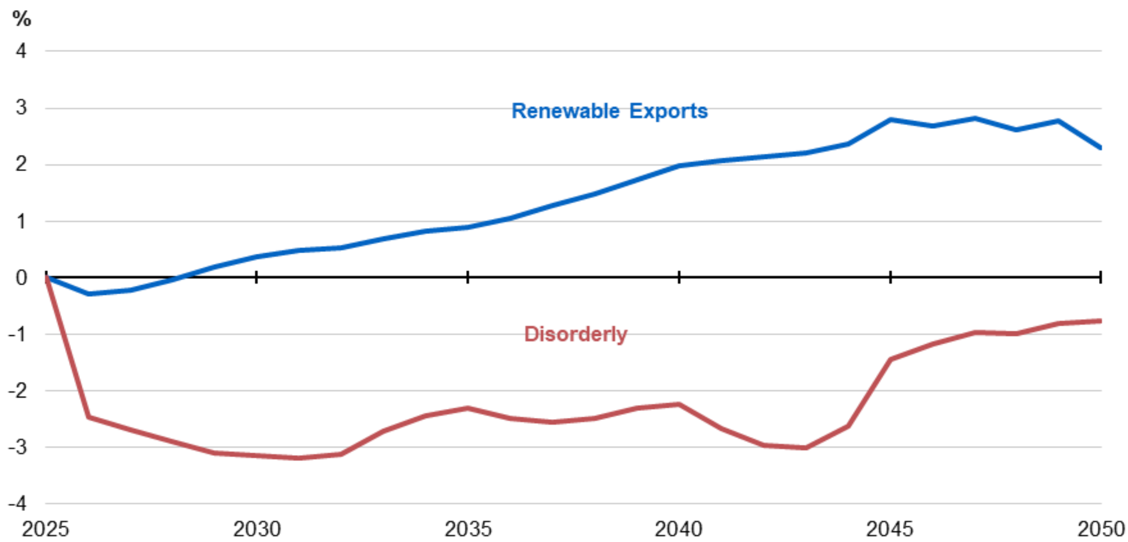
15 See Appendix A: Additional outputs.
16 Recognising that investment in lower-emissions buildings, plant, equipment and technologies will occur as part of regular investment cycles, investment in emissions reduction technologies cannot be readily distinguished from broader investment in the economy across the scenarios.

economy where productive assets are long-lived.[17] Under the Baseline Scenario and Renewable Exports Upside Scenario, investment is projected to grow by 79–84 per cent between 2025 and 2050. The projected increase under the Renewable Exports Upside Scenario is similar to growth in investment during the mining boom of the early 2000s.[18]

Clear and credible emissions reduction targets and policies are critical for increasing investor certainty, and for unlocking more investment across the economy. The economic cost of uncertainty is considered in the Disorderly Transition Scenario through an increase in the cost of capital through higher risk premia. As a result, investment is persistently lower in this scenario than in the Baseline Scenario (Chart 4.6), and cumulative investment is projected to be half a trillion dollars lower over the 25 years to 2050.

In the 2030s, investment in emerging clean energy sectors is projected to be lower in the Disorderly Transition Scenario, compared to the Baseline Scenario. Without clear signals to drive investment in clean energy, there will be an over-investment in fossil fuel sectors in the 2030s, compared to the Baseline Scenario. This leads to fossil fuel firms 'scrapping' up to 8 per cent of their capital stock over the 2040s, as they are forced to transition to net zero in just one decade, well before the optimal replacement date for their long-lived assets. This equates to a cumulative $41 billion of capital scrapped over the decade to 2050. Further, under the Disorderly Transition Scenario, there is projected to be 20 per cent less cumulative investment in hydrogen, ammonia, iron and steel over the 25 years to 2050, relative to the Baseline Scenario. As a result, output and exports in these sectors do not reach the same scale as the Baseline Scenario, even in 2050.

Chart 4.6: Investment, per cent deviation from the Baseline Scenario



Source: Treasury modelling.

17 Depreciation data from the ABS suggest that the time required to turn over the capital stock is around 15 years for the mining sector, 10 years for the agriculture and manufacturing sectors, and 20 years for the transport, postal, and warehousing sector.

18 The comparison is based on analysis of Australia's gross fixed capital formation, which increased by 87 per cent between 1999–2000 and 2014–15 (ABS 2025).

Electricity investment

Greater policy certainty is particularly important for electricity sector investment, because long-term investment in new renewable generation and storage underpins a cost-efficient net zero pathway for the whole economy. Investment in new generation capacity is required over coming decades in all scenarios as most of Australia's coal-fired power capacity is over 40 years old and is due to close in the next decade.[19]

Scenario analysis shows that increased investment in renewable energy under the Baseline Scenario is projected to lower energy costs for domestic industries and consumers compared to the Disorderly Transition Scenario.[20]

Under the Disorderly Transition Scenario, investment in renewable energy generation in the 2030s is projected to be around 45 per cent lower than the Baseline Scenario. Under this scenario, greater reliance on gas-fired generation is projected to require nearly 2,000 PJ more gas to 2050, which is similar to the total volume of natural gas used by Australia's manufacturing sector over the past five years (Chart 4.7).[21] Higher reliance on gas and ageing coal plants results in higher wholesale electricity prices, which are projected to be 17 per cent higher on average during the 2030s and up to 54 per cent higher in the 2040s, than under the Baseline Scenario (Chart 4.8). These impacts could be compounded by failing to realise benefits from a more flexible grid, with prices projected to be up to 70 per cent higher in the Disorderly Transition Scenario than the Renewable Exports Upside Scenario.

Greater reliance on ageing coal plants under the Disorderly Transition Scenario also increases the risk of plant failures, posing a significant upside risk to wholesale prices. For example, the failure of two of the oldest coal-fired generation units in 2032 would be expected to increase the wholesale electricity price by a further 13 percentage points on average in the early 2030s, resulting in wholesale electricity prices that are up to 30 per cent higher than projected to be under the Baseline Scenario.

Realising Australia's renewable export potential is projected to improve Australia's broader competitiveness by putting significant downward pressure on wholesale electricity prices. Under the Renewable Exports Upside Scenario, greater flexibility from industrial capacity is projected to reduce wholesale electricity prices by around 20 per cent by 2050, relative to the Baseline Scenario. This reflects the broader economic benefits of energy-intensive industries such as green metals, through additional flexibility in the electricity grid.

In the long-term, wholesale electricity price levels under the orderly scenarios are projected to be around 10 per cent below the 10-year real historical average wholesale electricity price, consistent with the Australian Energy Market Commission's (AEMC's) 10-year forecast. The decline in wholesale electricity prices is driven by greater use of firmed renewable electricity and reduced reliance on ageing coal-fired generation. Long-term price levels are consistent with the costs of firmed renewables in 2050 reported by CSIRO's *GenCost 2024–25 Report* (CSIRO 2025).

Projections of relative wholesale electricity prices across the three scenarios modelled have been compared to existing wholesale electricity price projections by independent bodies, including the AEMC and Endgame Analytics. These exercises show similar wholesale price trajectories for equivalent scenarios and consistent drivers of changes. The projection of lower wholesale electricity prices is attributed to the rapid renewable buildout to achieve the 82 per cent renewable electricity target, as

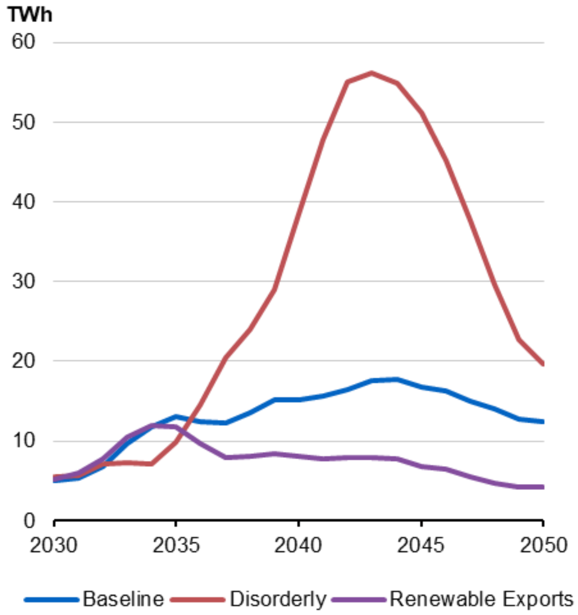
19 Strong renewable investment is consistent with AEMO's Integrated System Plan Step Change scenario, which identifies the net present value of new electricity infrastructure as $122 billion to 2050.

20 All results in this section are for the NEM unless noted otherwise.

21 Australia Energy Statistics, Table F (DCCEEW 2025b).

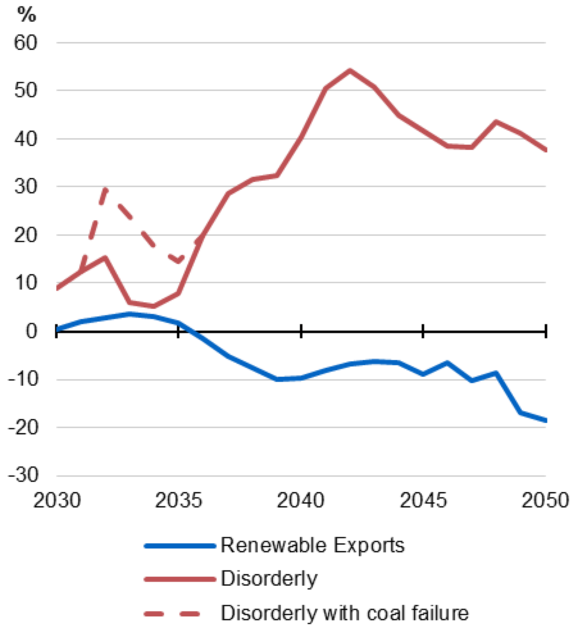
outlined in AEMO's Integrated System Plan. The AEMC anticipates lower wholesale electricity prices will flow through to lower retail prices over time.

Chart 4.7: Gas powered generation in the NEM



Source: Treasury EMM modelling.

Chart 4.8: Wholesale price relative to the Baseline Scenario, NEM



Source: Treasury EMM modelling.

4.4 Broader benefits of the net zero transformation

An efficient and well-signalled transition to net zero is projected to provide broad benefits to Australians, both directly through downward pressure on energy costs and indirectly through higher incomes over time. By contrast, a disorderly transition is projected to create additional costs for many households. The exact experience of the net zero transformation will vary across households and communities.

Living standards and wages

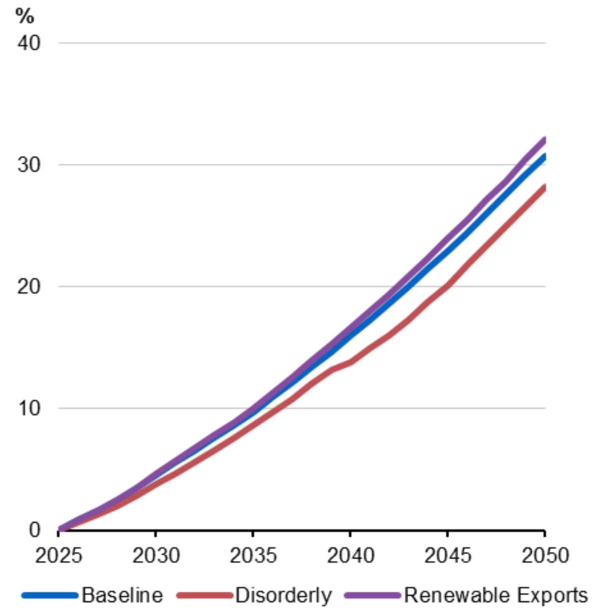
An orderly transition to net zero can support sustained increases in living standards. Real wages are projected to increase by 10 per cent over the 10 years to 2035, and 31 per cent over the 25 years to 2050, under the Baseline Scenario (Chart 4.9). Under the same scenario, real GDP per capita is projected to increase by 12 per cent to 2035 and by 36 per cent to 2050. The additional economic activity generated through the increased production of clean energy embedded products under the Renewable Exports Upside Scenario provides an added boost, with real wages projected to be around 1.6 per cent higher in 2050, compared to the Baseline Scenario (Table 4.2). Similarly, real GDP per capita is projected to be 1.7 per cent higher in 2050, compared to the Baseline Scenario.

Table 4.2: Per cent difference in real wages and GDP per capita, relative to Baseline Scenario

	Renewable Exports Upside Scenario		Disorderly Transition Scenario	
	2035	2050	2035	2050
Real wages	0.8%	1.6%	-1.6%	-2.5%
Real GDP per capita	0.4%	1.7%	-0.9%	-1.6%

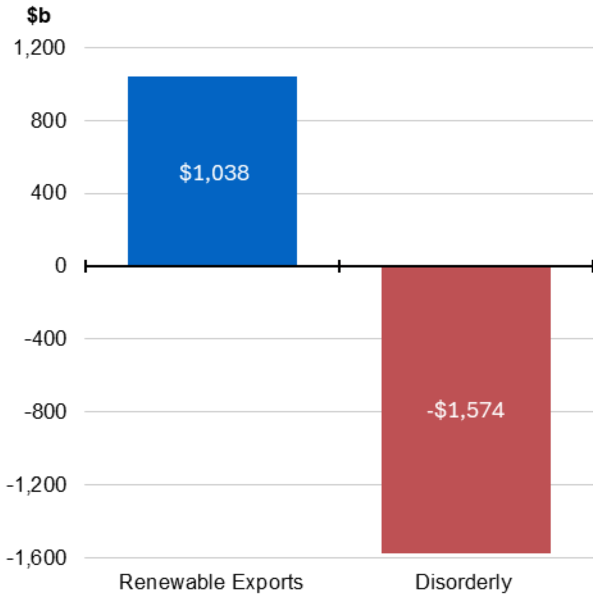
By contrast, increased uncertainty and lower economic growth dampens real wage growth under the Disorderly Transition Scenario throughout the period to 2050. Real wages are projected to be 2.5 per cent lower in 2050, compared to the Baseline Scenario, and 4.0 per cent lower relative to the Renewable Exports Upside Scenario. This results in significantly lower consumption, with cumulative real household consumption projected to be $1.6 trillion lower to 2050, compared to the Baseline Scenario (Chart 4.10). Real GDP per capita in 2050 is projected to be 1.6 per cent lower under the Disorderly Transition, compared to the Baseline Scenario, which equates to $2,100 less per person in 2050. Compared to the Renewable Exports Upside Scenario, real GDP per capita is projected to be $4,500 lower in 2050 under the Disorderly Transition Scenario.

Chart 4.9: Growth in real wage, 2025-2050



Source: Treasury modelling.

Chart 4.10: Cumulative consumption difference from Baseline Scenario, 2025-2050



Source: Treasury modelling.

Employment outcomes

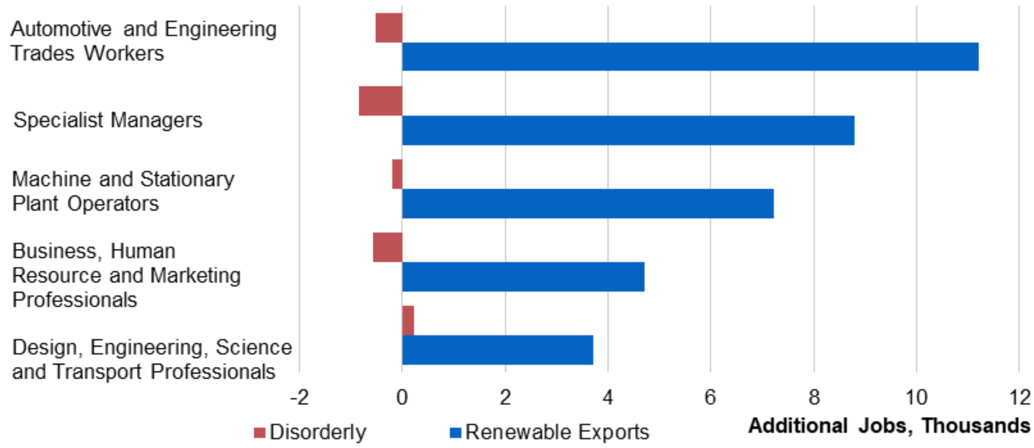
Under the Baseline Scenario, 2.3 million more people are projected to be employed in 2035, and 5.1 million more in 2050, compared to 2025. This increase in employment is larger under the Renewable Exports Upside Scenario, with 5.3 million more people employed in 2050, compared to 2025.[22]

The distribution of employment across sectors largely follows the economy's broader structural shifts through the net zero transformation. As new clean energy embedded product sectors are established, for example, they increase their demand for labour. Hours worked in the hydrogen and ammonia sector and iron and steel manufacturing sectors under the Baseline Scenario increase by more than 300 per cent and by 79 per cent respectively from 2025 to 2050.

The services sector is projected to continue to employ the largest proportion of the workforce to 2050, across all scenarios. The construction sector is also projected to experience solid growth in hours worked across all scenarios, partly because it employs labour to support the build and operation of new clean energy related projects.

Mapping high-level sectors to their occupations provides additional detail on potential shifts in the composition of the Australian workforce through the net zero transformation. The analysis presented in Chart 4.11 disaggregates occupations projected to be increasingly in demand as new clean energy embedded industries are established and expand – particularly under the Renewable Exports Upside Scenario. This includes automotive and engineering trades workers, and machinery and stationary plant operators who are required to support the increased manufacture of hydrogen, ammonia, green iron and alumina and aluminium.

Chart 4.11: Occupation growth relative to the Baseline Scenario in 2050, Clean energy embedded industries only



Source: Treasury modelling.

22 Under all scenarios, employment increases, reflecting underlying population growth. Total hours worked in the Baseline Scenario are aligned with the *2023 Intergenerational Report*. Total hours worked can deviate from this in other scenarios as labour force participation responds to deviations in the real wage between scenarios. In the Treasury Industry Model, the substitution effect can dominate the income and wealth effects at different points in time. As a result, labour force participation is higher in the Renewable Export Upside Scenario than the Baseline Scenario.

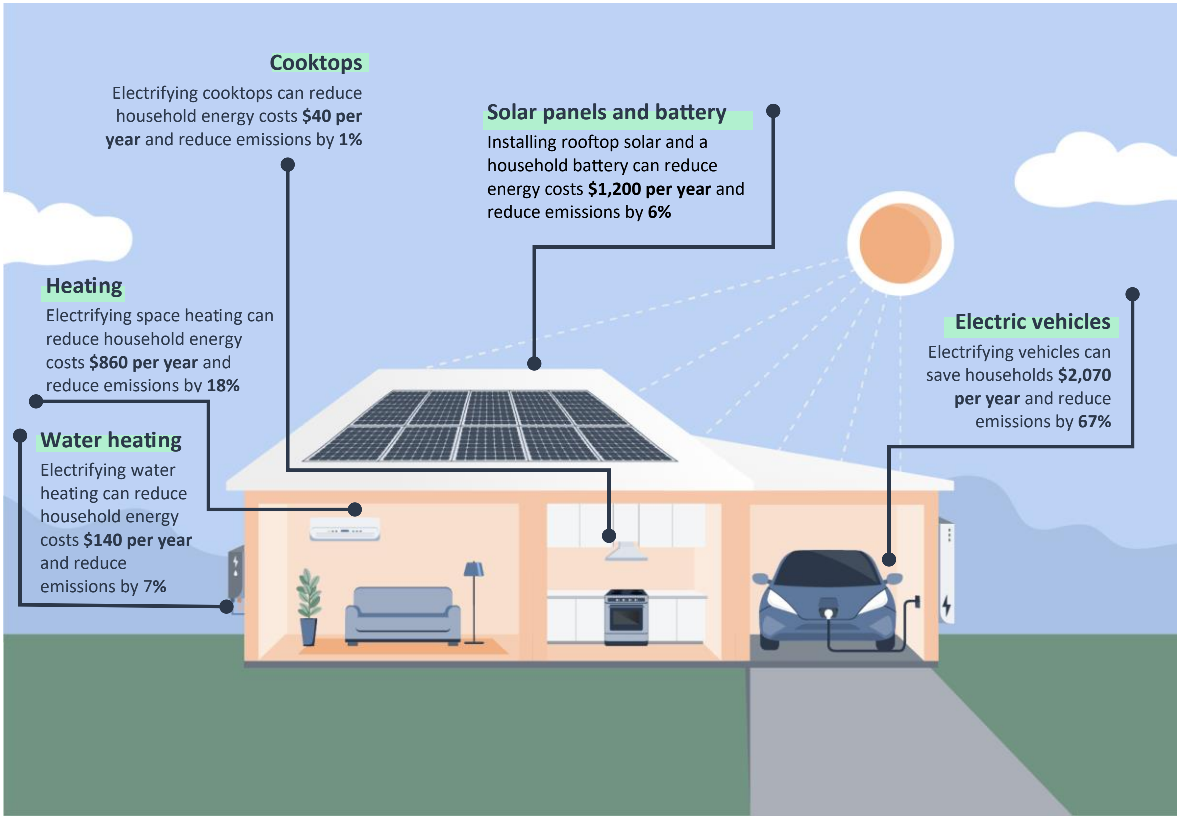
Household energy costs

Household benefits come through the long-run savings that can be made by electrifying homes and vehicles and installing solar panels and home batteries. Energy costs are a significant proportion of household spending, at around 5 per cent of disposable income. This proportion more than doubles to 11 per cent for households in the bottom 20 per cent of incomes.[23]

Electrification technologies can reduce household running costs. For example, a typical household could reduce their energy costs by around $1,000 per year by electrifying their household appliances, hot water systems and space heating, even accounting for up-front costs (Chart 4.12).

Households who also purchase a solar panel, home battery and electric vehicles could reduce their energy costs by around 40 per cent or $4,300 per year, after accounting for upfront and financing costs. The upfront costs and projected saving in energy costs will depend on individual households.

Chart 4.12: Modelled benefits of electrification, Baseline Scenario



Note: Annualised real costs from 2030 to 2050, including upfront, financing and ongoing costs. Assumes a typical two-to-three-person household with two vehicles, average consumption for home heating, cooking and hot water, and purchases a 10.6kW solar system and 10.0kWh battery. For more detail, see Appendix D: Key assumptions.

23 Analysis of the ABS's 2015-16 Household Expenditure Survey (ABS 2017).

Households that are not fully electrified are still projected to benefit under both the Baseline Scenario and Renewable Exports Upside Scenario compared to the Disorderly Transition Scenario. Higher wholesale energy prices from lower renewables investment and greater reliance on ageing coal and gas generators under the Disorderly Transition Scenario increase energy costs for all households. Electrified households with solar and battery are less impacted by changes in energy prices as they rely less on the grid.

Regional outcomes

While the modelling cannot be disaggregated by region, it is important to acknowledge that the net zero transformation will have distinct regional impacts (DCCEEW 2025a; Australian Government 2023).

Around 1.1 per cent of the Australian workforce is employed in sectors directly exposed to the net zero transition (coal mining, coal-fired power, oil and gas, and downstream fossil-fuel activities), and most of these people work in regional areas (JSA 2023). In addition, around 4 per cent of the workforce is employed in emissions-intensive sectors, with around one-quarter of these people working in emissions-intensive manufacturing (metals, chemical manufacturing, and cement) (JSA 2023). Many regional areas, especially those economically reliant on fossil fuel industries, face significant structural change as emissions-intensive activities like coal mining and coal-fired power generation decline (Edwards et al. 2022)

An orderly and well-signalled net zero transition provides the best chance for regional Australia to harness the opportunities of emerging clean energy embedded industries. The abundant renewables resources in regional areas mean they are well-positioned to benefit from large-scale renewable energy and transmission projects in green hydrogen, critical minerals and green metals (CCA 2024). The Net Zero Economy Agency was established to support regions, communities and workers significantly affected by the net zero transition so that they can share in the benefits of a net zero economy.

4.5 The costs of not pursuing net zero

The economic costs to Australia of not pursuing net zero are expected to be significant and consequential, and exceed those modelled in the Disorderly Transition Scenario. Not pursuing net zero by 2050 risks lower economic growth, reduced investment, missed export and employment opportunities, and higher energy prices. These costs would flow from several channels, including heightened policy uncertainty, increased borrowing costs on global markets and the loss of potential new export markets. Additionally, inaction domestically and globally will exacerbate physical climate risks, resulting in higher costs from adapting to and managing these.

While this modelling focuses on pathways to net zero and does not specifically model a scenario where there is no further policy action, other exercises illustrate the potential costs of policy inaction. For example, the latest scenario modelling by the Network for Greening the Financial System (NGFS) that assumes no further policy action globally and global temperatures reach 3°C by 2100, projects Australia's GDP could be 14 per cent lower by 2050. This translates to an estimated $6.8 trillion reduction in GDP over the next 25 years (IGCC 2024).

Avoiding the many costs of not pursuing net zero by 2050 through an orderly, well-signalled transition will result in better economic outcomes for Australia. Australia committed to net zero by 2050 in October 2021, having previously joined 194 other parties in signing the Paris Agreement, and has enshrined this commitment in legislation. It has also legislated an emissions reduction target of 43 per cent compared to 2005 levels by 2030. These emissions targets, underpinned by policy settings, have provided more policy certainty and supported investment by households and businesses in activities consistent with an orderly transition. The 2035 emissions reduction target range adds further certainty to the direction of climate policy in Australia.

Heightened uncertainty constrains investment

History shows that heightened uncertainty leads to less investment. The Productivity Commission has estimated that businesses managed heightened uncertainty following the Global Financial Crisis by increasing the risk premium they use to assess new projects by 2.3 percentage points on average (Fontenay et al. 2024). A recent OECD study provides evidence that climate policy uncertainty has an immediate and material impact on business investment decisions, and more capital-intensive and pollution-intensive firms are disproportionately affected (Berestycki et al. 2022). The study finds that a 37 per cent increase in uncertainty about climate policy, equivalent to one standard deviation in their Climate Policy Uncertainty Index, reduces investment by around 4 per cent for the average business.

Under the Disorderly Transition Scenario, it is assessed that a lack of medium-term policy certainty would suppress and delay investment, increase the likelihood of capital scrapping and delay the net zero transition. In this scenario, this has been modelled as a risk premium of up to 75 basis points for the 2030s, which results in cumulative investment being half a trillion dollars lower in 2050 compared to the scenarios that assume an orderly and well-signalled transition.[24] Abandoning net zero would create significantly greater uncertainty, which implies higher costs associated with investment uncertainty, than captured in the Disorderly Transition Scenario.

Uncertainty around climate policy is particularly problematic and consequential for energy investment. Not pursuing net zero by 2050 would be expected to reduce energy investment by reducing near-term demand for low-emissions energy, lowering confidence in the future competitiveness of energy-intensive industries and creating significant regulatory policy uncertainty.

24 Estimated based on Berestycki et al. (2022).

Australia's coal plants are ageing and need to be replaced regardless of net zero goals. Not replacing coal in an orderly manner increases the risk of outages and extended periods of higher prices.

Under the Disorderly Transition Scenario, delayed investment in electricity generation is projected to have a pronounced impact on wholesale electricity prices. A scenario of more significant energy policy uncertainty would be expected to have wholesale electricity price increases that exceed the 54 per cent increase in the Disorderly Transition Scenario, relative to the Baseline Scenario.

Increased cost of capital in global financial markets

Australia is likely to face a higher cost of capital in international financial markets if it does not pursue net zero. Australia is deeply integrated with international financial markets and will need to access international capital to support ongoing investment. At the same time, global investors have continued to increase the capital they are allocating towards net zero-aligned investments (AIGCC 2025). The IEA notes that capital is flowing more readily into jurisdictions with clear transition plans and stable consistent policy that supports long-term decision making (IEA 2025b).

Together, this indicates that any increase in uncertainty about climate policy in Australia, including commitments to the net zero target, is likely to be detrimental when other countries are taking action. China, for example, continues to invest heavily in clean energy[25] and set records for its levels of renewable energy capacity installed (Energy Watch 2025). This has led to China surpassing its 2030 renewable energy targets in mid-2024 (IEA 2025b). Similarly, the United States has more than tripled its renewable energy capacity over the past decade (Bird et al. 2025). A record $386 billion was invested globally for new renewable energy development in the first half of 2025 (BloombergNEF 2025b).

The 2021 *Long-Term Emissions Reduction Plan* assessed that the economy-wide capital risk premium could increase by 100 basis points if Australia did not adopt a net zero target in the context of a global economy that was acting to transition to net zero (DISER 2021). The modelling found that this increase in the risk premium could reduce investment in Australia by an average of 5.5 per cent from 2021 to 2050. GDP was estimated to be 0.9 per cent lower, declining to 0.5 per cent in 2050. GDP per capita was similarly estimated to be $650 lower, and gross national income (GNI) per capita $625 lower, in 2050. The 2021 modelling additionally found that the impact of adopting and deploying advanced technologies and increased hydrogen production, along with the avoided capital risk premium, translated to an increase in GNI per person of $2,000 in 2050.

The Reserve Bank of Australia has emphasised that failing to pursue net zero in a credible and orderly way risks limiting Australia's access to sustainable capital markets and increasing financial costs for businesses (Debelle 2021). This would reduce the capacity for the economy to invest in renewable energy projects and increases the risks of divestment. This, in turn, risks Australia's energy security and competitiveness in global markets.

Loss of potential clean export markets

Australia is deeply integrated into global supply chains and risks having less access to emerging trade opportunities if it does not effectively leverage its comparative advantages in clean energy production. New green supply chains will develop as countries with commitments to net zero implement policies to achieve their climate targets. This includes over 90 per cent of Australia's export partners

25 More than 70 per cent of China's energy investment from 2023–2025 went to clean energy sources (IEA 2025b).

(DFAT 2025b). As noted in the Net Zero Plan, the development of policies such as the European Union's Carbon Border Adjustment Mechanism will be particularly favourable for low-emissions imports. In this global context, Australia's potential as an exporter of clean energy products would be placed at risk if there was no further action on climate change.

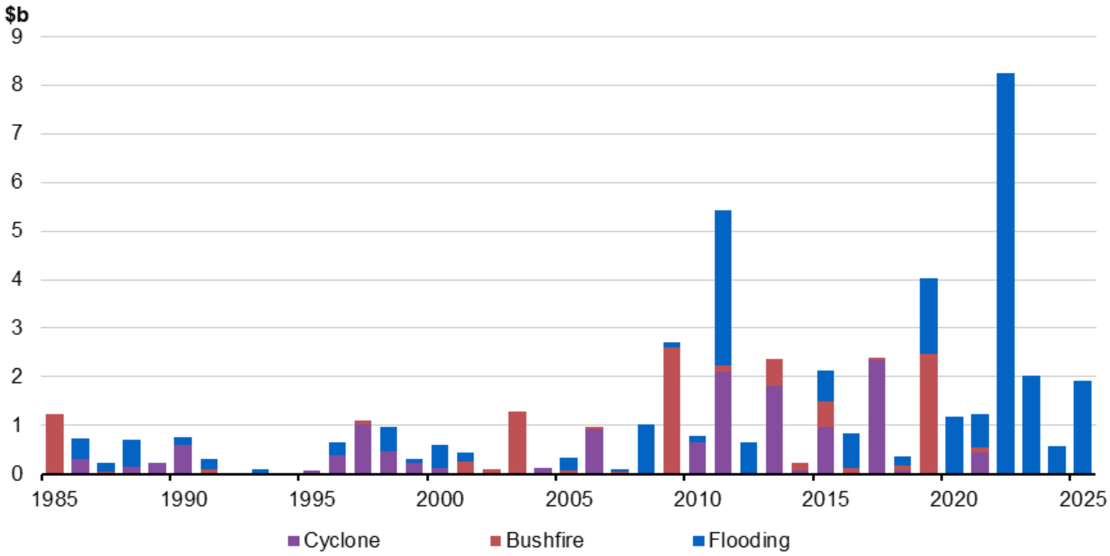
Less global climate ambition increases the cost of physical risks

The costs of physical climate risks from unabated carbon emissions are already apparent (Australian Government 2023; ACS 2025). Global policy inaction on reducing emissions will significantly increase the costs of adapting and responding to the consequences of physical climate risks.

Physical climate impacts affect economic activity through damage to physical capital, lower productivity, and disruption to supply chains. As the impacts of climate change are global, the Australian economy will also experience indirect economic effects of physical risks resulting from temperature increases across the globe. This will affect the trade of goods and services, the flow of capital and public and private investment, and the redistribution of economic opportunities and populations.

Physical climate risks present a headwind to productivity growth by reducing capital stock, decreasing the return on these investments and diverting capital and labour from other investments. Data on insured losses over the past 40 years illustrates the extent of this headwind, showing a steady increase in natural disaster related payouts, particularly since the turn of the century (Chart 4.13).

Chart 4.13: Normalised value of insured losses caused by selected natural disasters, 1985 to 2025



Source: Insurance Council of Australia 2025

The implications of physical climate risk for productivity in sectors highly exposed to the effects of climate change were explored in the *2023 Intergenerational Report* (Australian Government 2023). In this Report, the direct impacts of higher temperatures on labour productivity were estimated to reduce Australia's economic output by between \$135 billion and \$423 billion to 2063. In the absence of adaptation measures, Australian crop yields were also estimated to be up to 4 per cent lower by 2063 in a scenario where global mitigation does not keep temperature increases below 3°C this century.

There is a wide range of additional channels through which physical climate risks will affect the value of capital and productivity in the Australian economy over the next 40 years and beyond, including biodiversity loss, storm surge, sea level rise and health impacts. These will present significant costs, beyond those discussed above, for people, communities, businesses and the broader economy.

The *National Climate Risk Assessment* finds that increasing levels of global warming pose significant risks to Australia (ACS 2025). Time spent in drought across most of the country will increase, bushfire risk will increase in forested areas, and sea level rise will increasingly threaten Australia's coastlines. As these physical risks to Australia increase, so too will the number of compounding, cascading and concurrent hazards.

Estimates of the costs of physical climate risk have typically increased over time, as new data and methodologies have been developed. The NGFS projects global GDP could be between 7–15 per cent lower by 2050 under a future in which global temperatures remain on track to increase by 3°C by 2100, which is consistent with no further policy action (NGFS 2024). Australia was found to be at the higher end of these estimates. Recent extensions on the NGFS analysis, which incorporate the impacts of global weather changes as well as local weather changes, see larger impacts. These extensions estimate that global GDP could be 40 per cent lower in 2100 under a high-emissions scenario compared to a low-emissions scenario (Neal et al. 2024). Potential impacts on Australia were again found to be at the upper end of global outcomes.

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