

VICTORIA'S 2035 CLIMATE ACTION TARGET: DRIVING GROWTH AND PROSPERITY



**INDEPENDENT EXPERT PANEL
FOR THE VICTORIAN 2035
EMISSIONS REDUCTION TARGET**

Final Report March 2023

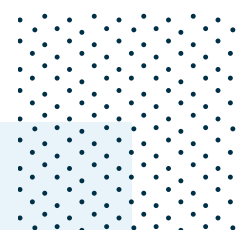
**We acknowledge and respect
Victorian Traditional Owners as
the original custodians of Victoria's
land and waters. We honour their
Elders past and present.**

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EXECUTIVE SUMMARY

VICTORIA AND THE WORLD ARE ACTING ON CLIMATE CHANGE

Climate change is a fundamental threat facing humanity.¹ The latest climate science from the Intergovernmental Panel on Climate Change is clear: climate change is widespread, rapid and intensifying.² Victoria is feeling the effects of climate change — the ravaging bushfires in 2019 to 2020 and the devastating floods in 2022 impacted communities across the state. To limit global warming to 1.5°C and avoid the worst impacts of climate change, immediate and large-scale reductions in greenhouse gas emissions are needed, and global emissions must reach net zero in the middle of this century.³ Delaying action or moving slowly in the near term would require more disruptive and costly changes to global emissions to remain consistent with 1.5°C.

Victoria's *Climate Change Act 2017* (the Act) sets out the framework for the state's response to climate change. At its heart is a legislated goal to reach net zero emissions by 2050 — which the Government has committed to bring forward to 2045 — and a requirement to set five-yearly interim targets to map Victoria's pathway to get there. Victoria has already set the first two of these targets: 28 to 33 per cent reductions in 2025 and 45 to 50 per cent in 2030, compared to 2005 levels. We, the independent expert panel — Martijn Wilder AM (Chair), Emma Herd and Tennant Reed — were appointed under the Act to provide advice on a target for 2035, Victoria's trajectory to net zero emissions, and opportunities across the economy to achieve these targets.

The context in which we provide this advice is dramatically different to when the Act was passed five years ago. There has been a major shift across the global economy towards rapid decarbonisation,

as both the impacts of climate change and the economic growth opportunities from climate action have become more tangible and immediate.

More recently, Russia's invasion of Ukraine has profoundly disrupted global energy markets and looks likely to accelerate the global transition away from fossil fuels in the medium term. This is occurring as concerns for energy affordability, energy security and a safe climate are converging. As a result, we are seeing the large-scale transformation of energy sources flowing through to entire economies.

International resolve to limit warming to 1.5°C has strengthened with the Glasgow Pact. A step-up in global commitments — including from China, India and the United States (US) — means that for the first time, limiting warming to below 2°C is a real prospect if commitments are implemented on time and in full.⁴

Governments are acting swiftly and strongly on these commitments, implementing holistic policy, legal and investment frameworks to decarbonise their economies. This includes the US Inflation Reduction Act of 2022, the European Union's (EU) REPower EU plan, and the United Kingdom's (UK) 'Net Zero Strategy: Build Back Greener'. These are accompanied by billions of dollars of investment in areas including offshore wind, energy efficiency, clean hydrogen, battery storage and zero emissions vehicles.

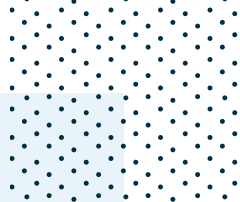
Governments recognise the significant gains to be made from strong action. These include new local industries and jobs in the goods and services needed for a zero emissions economy — from renewable energy to zero emissions vehicles to low-methane cattle. Investing in these areas can help drive robust, sustainable economic growth, combat debt, and make the economy more resilient to future shocks, especially in the energy sector. Failing to

1 Intergovernmental Panel on Climate Change (2022) *Climate Change 2022: Impacts, Adaptation and Vulnerability. Working Group II contribution to the Sixth Assessment Report*. Accessed: www.ipcc.ch/report/ar6/wg2/ Accessed: <https://www.ipcc.ch/report/ar6/wg2/>.

2 Intergovernmental Panel on Climate Change (2021) *Climate Change 2021: The Physical Science Basis. Working Group I contribution to the Sixth Assessment Report*. Accessed: www.ipcc.ch/report/ar6/wg1/.

3 Ibid.

4 Meinshausen, M et al (2021) *Realization of Paris Agreement pledges may limit warming just below 2°C*. Accessed: <https://doi.org/10.1038/s41586-022-04553-z>; Birol, F (2021) *COP26 climate pledges could help limit global warming to 1.8°C, but implementing them will be the key* International Energy Agency. Accessed: www.iea.org/commentaries/cop26-climate-pledges-could-help-limit-global-warming-to-1-8-c-but-implementing-them-will-be-the-key.



act at the necessary pace and scale — in addition to exacerbating the climate crisis — will see slower economic growth, assets stranded, and increase the risk of being penalised by trade partners and citizens alike.

Significant momentum is also building in Australia and Victoria. The Victorian Government has committed to a 2035 target of 75 to 80 per cent below 2005 levels in 2035, and net zero by 2045 — both among the most ambitious targets in the world. The New South Wales (NSW) Government has committed to a 2035 target of 70 per cent below 2005 levels. The Australian Government has almost doubled its 2030 target to 43 per cent below 2005 levels, and has committed to net zero emissions by 2050. Work is underway to strengthen key national-level emissions reduction policies such as the Safeguard Mechanism and vehicle fuel efficiency standards, and the 2022 Federal Budget dedicates funding to multiple climate action measures, from low-emissions manufacturing to decarbonising transport. Australian states have brought forward the exit of electricity generation from coal, with Western Australia announcing it will shut down its state-owned coal-fired generators by 2030, Queensland announcing it will have no regular reliance on coal-fired generation by 2035, and the Victorian Government announcing a renewable energy target of 95 per cent in 2035.

Importantly, investors and businesses have recognised climate change as a systemic risk, and are taking this into account in their strategies and investment decision-making frameworks. Companies representing 70 per cent of the ASX200's collective market capitalisation have committed to net zero emissions by 2050. Financiers are increasingly redirecting capital away from emissions-intensive assets, making it increasingly difficult to finance new emissions-intensive projects; for example, over 140 globally significant banks, insurers, asset managers and asset owners have announced their divestment from thermal

coal — including Australian operators ANZ, NAB, CommBank, Westpac, QBE, Suncorp, IMF Investors, HESTA, IAG and Macquarie Group — and 75 have announced financing restrictions for oil and gas.⁵

The approach of the finance sector to climate risk and opportunity is also becoming increasingly sophisticated and systemic. In 2017, the global Network of Central Banks and Supervisors for Greening the Financial System was established to enhance the role of the financial system to manage risks and mobilise capital for the transition to net zero emissions.⁶ In November 2022, the Australian Prudential Regulation Authority published its first Climate Vulnerability Assessment of Australia's five largest banks, looking at how climate change may test the resilience of the banking system in coming years and how banks might react to and manage these impacts.⁷

This seismic shift in global sentiment means governments and corporates are in a race to exit old assets and business models, decarbonise established models, and move towards new sources of economic value. The speed and scale of this shift is creating a challenge where demand for low-emissions materials, products and skills is outstripping supply. Leading players who move early are more likely to secure the supply chains necessary for their transformation. While this requires more effort up front, followers run the risk of being forced to play catch up without access to the supply chains and skilled workers they will inevitably need.

5 Institute for Energy Economics and Financial Analysis (IEEFA) (2022) *100 and Counting*. Accessed: <https://ieefa.org/100-and-counting>. IEEFA defines globally significant financial institutions as banks and insurers / reinsurers with AUM>US\$10billion. IEEFA defines globally significant asset managers /owners as having assets under management (AuM) greater than US\$50 billion.

6 *The Network of Central Banks and Supervisors for Greening the Financial System*. Accessed: www.ngfs.net/en.

7 Australian Prudential Regulation Authority (2022) *APRA releases results of inaugural Climate Vulnerability Assessment*. Accessed: www.apra.gov.au/news-and-publications/apra-releases-results-of-inaugural-climate-vulnerability-assessment.

THE PANEL'S RECOMMENDED 2035 TARGET: 80%

The Panel has considered a broad range of evidence, including: Victoria's share of global emissions to keep warming to 1.5°C; current trends in Victoria's emissions including commitments around Latrobe Valley coal plant shutdowns and various interconnectors; ways to reduce emissions across the economy; benefits and costs of measures to cut emissions; action in Victoria, such as the commitment to 95 per cent renewable energy electricity by 2035; and action by others. We have also consulted widely with stakeholders, the public, and Victorian Government departments.

In light of this information, **the Panel recommends a 2035 emissions reduction target of 80 per cent below 2005 levels (Figure 1)**. This target continues Victoria's pathway to net zero emissions by 2045 in a way that is consistent with Victoria playing its part in limiting the global temperature rise to 1.5°C.

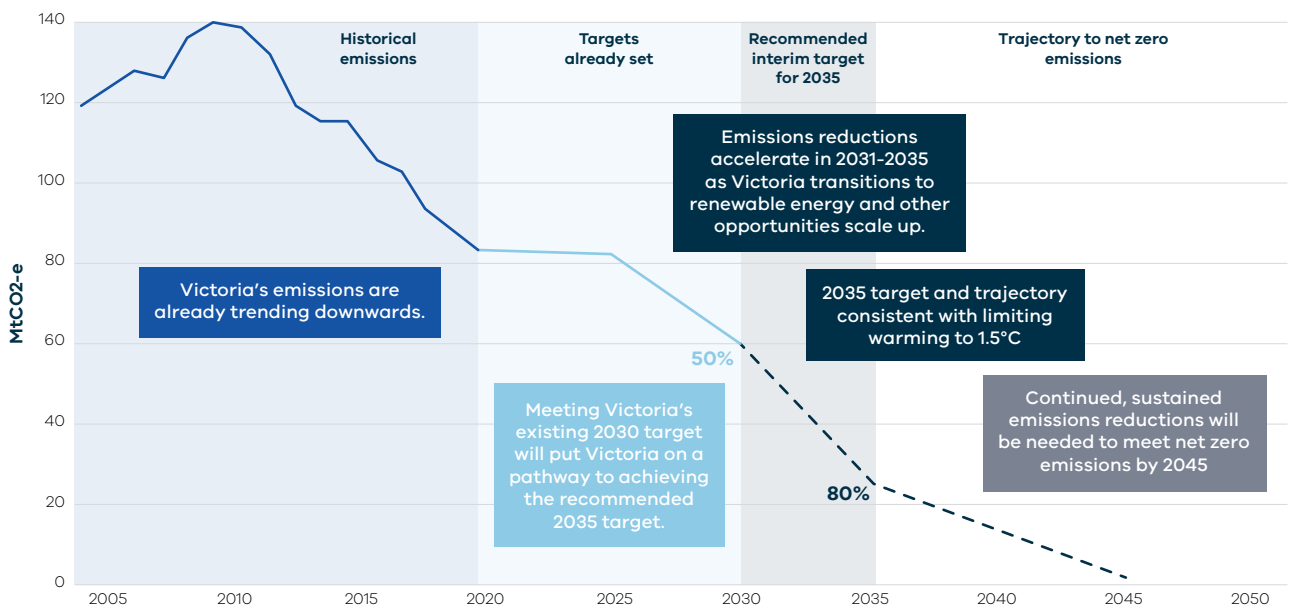
The Panel is confident the recommended target is achievable with the accelerated deployment of known solutions. Meeting Victoria's 2030 target will put the state on a pathway to meet an ambitious 2035 target, since the transition of the economy will be in motion (Figure 1). Implementing the pledged transition to 95 per cent renewable electricity by 2035 also plays a strong role. Complementing this commitment with action in other sectors as recommended in this report will place the 80 per cent target in reach.

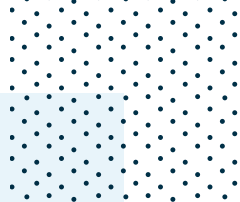
Global momentum on climate action has been enabled and accelerated by a suite of new technologies, and the costs of many of these will continue to fall as they are rapidly deployed. The likelihood of falling costs creates an additional incentive for Victoria to be ambitious.

PANEL RECOMMENDATION I

Set a target of 80% emissions reductions below 2005 levels in 2035

Figure 1. The Panel's recommended target for 2035 and indicative trajectory to net zero emissions





This recommended target and indicative trajectory to net zero reflect the profile of Victoria's emissions reduction opportunities:

- The steep emissions reduction pathway between 2030 and 2035 capitalises on mature, cost-effective solutions in electricity generation — Victoria's current largest source of emissions — being deployed in this period and reflects the Government's commitment to 95 per cent renewable electricity by 2035.
- Decarbonisation is likely to be more gradual after 2035, as remaining opportunities are either more incremental — such as continuing to replace cars and building appliances with cleaner alternatives and to apply methane-inhibiting technologies to grazing animals — or more difficult and expensive to address, such as natural gas use in some parts of industry.

An 80 per cent target for 2035 is among the most ambitious in the world and puts Victoria ahead in the global race to net zero emissions. It sends a strong signal to investors that Victoria is serious about decarbonisation, which may help attract a portion of the estimated \$US130 trillion of global private capital required for the transition to net zero.⁸ Setting a strong target backed by credible policies may also improve Victoria's standing in the global competition for skills and resources needed to decarbonise economies, and help avert supply chain pressures by signaling to manufacturers and the resources sector that Victoria will be a reliable market for low-emissions products and materials.

Most importantly, however, the policies and measures Victoria puts in place to achieve the recommended target can help drive sustained economic growth and revitalisation through new industries, innovation and efficiency. Victoria's communities and ecosystems will also flourish, experiencing benefits such as cleaner air, more comfortable homes and increased biodiversity. Acting as early as possible

to achieve an ambitious 2035 target allows more of these benefits to be enjoyed sooner.

ACHIEVING THE 80% TARGET: RECOMMENDATIONS

To achieve a target of 80 per cent, no sector can avoid or delay action. While the transition of Victoria's electricity sector to renewables will be central to meeting the target, it alone will not be enough. Every sector must make a step change away from business-as-usual, and the work to do this must accelerate now.

Immediate action is needed not only because the scale of the task is significant, but also because there is a lag between implementing measures and cutting emissions. The turnover of long-lived, high-emitting assets such as cars and hot water systems can take many years. For example, analysis by the Grattan Institute shows that even if no new petrol or diesel cars were sold from 2035, emissions from the overall light vehicle fleet would not reach zero until 2050.⁹ There is also a lag in sequestering emissions in the landscape — for example, it will often take many years after planting for a tree to reach its full carbon-absorbing potential.¹⁰

The Panel recommends that the Victorian Government focus on taking actions in all its large emitting sectors. These actions should be coordinated with the Australian Government, other governments, communities, workforce and the private sector. The sooner these actions are implemented, the more achievable Victoria's 2030 and 2035 targets will be. Delay would mean less policy flexibility for the Government, and may also force difficult options such as negative emissions technologies to be explored.

8 The Glasgow Financial Alliance for Net Zero (2022) *Amount of finance committed to achieving 1.5°C now at scale needed to deliver the transition*. Accessed: www.gfanzero.com/press/amount-of-finance-committed-to-achieving-1-5c-now-at-scale-needed-to-deliver-the-transition/.

9 The International Council on Clean Transportation (2022) *Fuel efficiency standards to decarbonise Australia's light-duty vehicles*. Accessed: <https://theicct.org/publication/pv-australia-co2-standards-dec22/>.

10 Carbon storage rates for trees vary greatly according to species and conditions. For most species, growth rates increase continuously with tree size, so old trees capture and store more carbon than young trees. Stephenson NL et al (2014) *Rate of tree carbon accumulation increases continuously with tree size*, *Nature*. Accessed: www.nature.com/articles/nature12914.

PANEL RECOMMENDATION 2

Create a whole-of-economy climate action delivery plan

Victoria's transition to a low emissions economy involves all parts of the economy and will deliver maximum benefits if well coordinated, targeting clear and deliverable outcomes. The Victorian Government is due to deliver an update to its Climate Strategy by October 2025. However, earlier, additional guidance in the near term will help to clarify the scope and staging of implementation and investment requirements for decarbonisation.

The Victorian Government should:

- Develop a world-leading climate action delivery plan by June 2024 to guide the state's transition to a net zero economy by 2045. This plan must be a comprehensive implementation plan to transform Victoria's economy in line with the recommendations below to deliver all necessary measures to achieve the 80 per cent target.
- Demonstrate how the Government intends to unlock investment in the transition for all major sectors, including creating investable policy frameworks that require the reduction of emissions and adoption of new technologies; underwriting investment; or investing directly (as planned in the revived State Electricity Commission (SEC)).
- Map out, through this plan, an approach to secure access to key supply chains and the skilled workforce needed for the transition.
- Involve, collaborate and coordinate with all levels of government, Traditional Owners, experts, community groups, industry, unions, the research community and the investment community in the development and execution of the plan.

PANEL RECOMMENDATION 3

Rapidly manage transition of Victoria's electricity system

Victoria's transition to a zero-emissions electricity sector is well underway, with commitments to coal retirement now largely in place. Deep decarbonisation of Victoria's electricity generation is core to the transition to a net zero emissions economy by 2045. Decarbonising the sector will both directly address Victoria's largest source of emissions, and will enable emissions reductions in other sectors such as in transport, industry, buildings and agriculture through electrification.

The Victorian Government should:

- Plan for and facilitate the full exit of coal power in Victoria by or before 2035.
- Accelerate well-planned and sequenced construction of renewable generation, transmission, and storage, enough to replace retiring capacity and prepare for forecast needs. Investment may also be needed into measures such as demand management, demand response and distributed energy resources. This will capture the full benefits including investment attractiveness, energy security, affordability and reliability.
- Ensure secure long-term funding and governance arrangements to coordinate and lead the broader transition to a net zero emissions economy for the whole state. This will enable a just transition for affected communities, and will help build and maintain social license.

PANEL RECOMMENDATION 4

Accelerate phase out of natural gas use with an immediate focus on Victoria's built environment

Over two million Victorians use natural gas in their homes and businesses, and natural gas is also widely used across Victorian industry. The Victorian gas sector contributes around 17 per cent of the state's net emissions. The built environment sector is also a priority for action, given it is a significant emissions source, solutions are readily available, and these have the potential to create a wealth of co-benefits for Victorians.

Building on the Gas Substitution Roadmap, the Victorian Government should:

- Significantly step up the ambition, urgency and scope of actions to electrify homes and buildings and to electrify or deploy alternatives in other sectors to enable natural gas use across Victoria to be largely phased out by 2035.
- Accelerate the transition through Victorian reforms including planning policies and through national changes, such as step changes to the National Construction Code.
- Substantially upgrade the energy efficiency of Victoria's built environment to deliver multiple benefits for energy affordability, emissions, energy system management, human health and comfort and public finances.

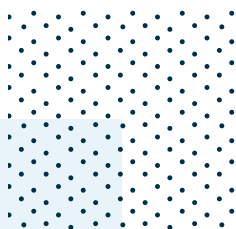
PANEL RECOMMENDATION 5

Accelerate uptake of zero emissions vehicles (ZEVs)

Transport is Victoria's second largest — and fastest growing — source of emissions. Reducing emissions from the transport sector will be critical. Coordination with the Australian Government is vital, since issues such as vehicle emissions standards fall within federal jurisdiction, and Victoria should be an advocate and champion for zero emissions vehicles at a national level as part of its actions in the transport sector.

The Victorian Government should:

- Phase out new sales of emitting road vehicles in Victoria by 2035. This should be facilitated by taking measures to urgently increase supply of ZEVs in Victoria such as increasing ZEVs in the government fleet and measures to accelerate fleet turnover. Victoria should also advocate for and facilitate a national ZEV approach.
- Noting the approach in other jurisdictions such as California, invest in development of every part of the enabling ecosystem to support large-scale deployment of ZEVs in Victoria including insurance, skills to maintain and repair electric vehicles, and charging infrastructure.



PANEL RECOMMENDATION 6

Prioritise and invest in carbon-rich and biodiverse landscapes

Victoria's land sector has been a net carbon sink since 2013, absorbing around 25 per cent of Victoria's emissions in 2020. Increasing this natural carbon storage while at the same time increasing biodiversity must be a key part of achieving Victoria's emissions reduction targets. Green infrastructure also provides resilience benefits to the impacts of climate change. The government should develop rigorous policy frameworks and innovative financial instruments that drive investment.

The Victorian Government should:

- Increase land covered by trees and native vegetation in Victoria by at least 400,000 hectares by 2035, a step change which is approximately double the existing commitments in Victoria's Biodiversity Strategy 2037. This must consider biodiversity at every stage, and could include both new plantings and protection of existing native vegetation.
- Take steps towards mandating Taskforce on Nature-related Financial Disclosures-style reporting by government and the development of natural capital accounts for Victoria as soon as possible, building on its existing Taskforce on Climate-related Financial Disclosures-style reporting.
- In delivering its existing policy commitment to phase out commercial native timber harvesting in state forests by 2030, accelerate measures to cease native logging and build a leading sustainable plantation forestry industry while protecting Victoria's natural carbon stores, biodiversity, and the tourism potential of native forests.
- Work in partnership with Traditional Owners around management of Victoria's landscapes.

PANEL RECOMMENDATION 7

Begin a step change in emissions from livestock

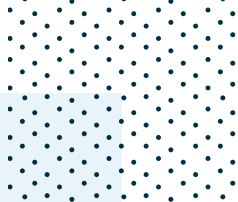
Agriculture accounts for 19 per cent of Victoria's total emissions, with beef and dairy cattle making up almost half of this. Addressing emissions from these animals is the most immediate large opportunity in this sector to reduce emissions. Action for dairy and feedlot cattle can be complemented where possible with other actions, including for example on-farm energy efficiency or transition from diesel to electric technologies.

The Victorian Government should:

- Prepare Victoria's beef and dairy sectors for immediate large-scale deployment of methane reduction technologies — more than 80 per cent of feedlot beef and dairy cattle, and around a third of pasture-fed beef, will need to be treated with these technologies by 2035.
- Help the agricultural sector rapidly adopt technology to reduce livestock emissions by introducing policies that consider every part of the value chain, including incentives for farmers and buyers of goods and services.
- Accelerate deployment of methane-inhibiting technology for livestock through supporting commercialisation of promising options to enable demonstration under Victorian farming conditions, and rapid deployment across the sector.

OPPORTUNITIES FROM RAPID TRANSITION

The structural economic transformation implied by the move to net zero will require a mobilisation and reorientation of Victoria's finances, resources and labour force. While this may slightly moderate economic growth in the short term, this up-front investment will set Victoria up for sustained economic success: Deloitte Access Economics estimates that achieving a target of around 80 per



cent in 2035 and net zero emissions by mid century would see the Victorian economy at least \$63 billion larger (net present value 2022-2070) than if no further action is taken.¹¹

Strong climate action provides opportunities to revive manufacturing in Victoria by building industries and supply chains to support the transition, such as zero emissions vehicles, renewable energy components and batteries. It will also stimulate job creation both in and beyond manufacturing, from renewable energy installation to energy efficiency retrofits to advanced recycling. A study by Net Zero Australia estimates that by 2060, Victoria's renewable energy industry alone could employ more than 50,000 people.¹²

Many actions to reduce emissions and rapidly transitioning our energy system will also save households and businesses money. A study published in September 2022 provides empirically grounded evidence that a rapid clean energy transition will most likely provide significant global cost savings relative to scenarios where transition is slow or where there is no transition.¹³ A pathway where government is committed to a rapid clean energy transition will see households and businesses be the beneficiaries of lower-cost energy generation.

Strong climate action will also increase Victoria's economic resilience. Victoria will be positioned well as global demand for low-emissions products from trade partners and consumers rises. Failure to act now will leave Victoria disadvantaged in global markets and at the back of the queue in supply chains for low-emissions products such as electric vehicles. A planned and orderly transition to a net zero emissions energy system will also increase Victoria's resilience to future energy market shocks, such as those currently being experienced in gas markets due to conflict in Ukraine.

Strong climate action brings community and environmental benefits. The transition to renewable electricity and zero emissions vehicles will improve local air quality with tangible health benefits, particularly in the Latrobe Valley and Greater Melbourne. Improving the energy performance of the built environment will lower energy bills and make homes more resilient to extreme temperatures, with particular benefits for low-income households. Increasing vegetation can bring a range of environmental benefits including better biodiversity, water quality and reducing soil erosion.

Achieving this target and reaching net zero emissions will involve changes for people's everyday lives. It will change the cars people drive, how people heat their homes and cook their food, and the jobs that are available. It will transform Victoria's land and seascapes, as trees are planted and renewable energy generation and transmission infrastructure is built. The Panel notes that while there is strong support from the Victorian community for bold action on climate change, Victorians will still need to be consulted early and deeply on emissions reduction measures as they are developed and implemented, and have any concerns meaningfully addressed.

CONCLUSION

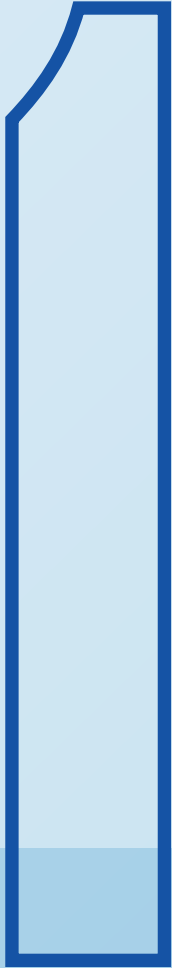
To capture the benefits of a transition to net zero in Victoria, the work must accelerate and scale-up immediately. While this will involve significant planning, large-scale investment and rapid implementation, the benefits are too big to ignore, and the risks of slow action are too great. It is also a necessary stepping stone in an orderly transition to remain competitive in a net zero global economy. The Panel is confident that our recommended 2035 target and actions will ensure the Victorian economy and community are positioned for long term prosperity, equity and success.

11 Deloitte Access Economics (2022) *Economic and social impacts and benefits of Victoria's 2035 emissions reduction interim target*, prepared for the Victorian Government Department of Environment, Land, Water and Planning. This scenario assumes a target of 78 per cent in 2035, and that the world also keeps warming to below 2°C.

12 Net Zero Australia (2022) *Employment Impacts – Modelling Methodology and Preliminary Results*. Accessed: www.netzeroaustralia.net.au/wp-content/uploads/2022/08/NZAu-Employment-Impacts-Modelling-Methodology-Preliminary-Results.pdf.

13 Way, R. et al. (2022), *Empirically grounded technology forecasts and the energy transition*, Joule 6, 2057-2082, accessed: [www.cell.com/joule/pdf/S2542-4351\(22\)00410-X.pdf](http://www.cell.com/joule/pdf/S2542-4351(22)00410-X.pdf).

INTRODUCTION



THE PANEL AND ITS TASK

Victoria's Climate Change Act 2017 (the Act) establishes a legislative framework for the state's transition to net zero greenhouse gas emissions; currently this is prescribed to be achieved by 2050, and the Government has expressed its intention to legislate to bring this forward to 2045. The Act includes a process to set five-yearly emissions reduction targets (interim targets) — on which independent expert advice must be sought.

In January 2022, the Minister for Energy, Environment and Climate Change appointed Martijn Wilder AM, Emma Herd and Tennant Reed as the Independent Expert Panel (the Panel) to provide advice under Victoria's Climate Change Act on:

- an emissions reduction target or targets for the period 2031–2035
- indicative trajectories to net zero emissions by 2050,¹ and
- opportunities to reduce emissions across the Victorian economy in the period 2031–2035.

This advice represents the next step in Victoria's journey to net zero emissions under the Climate Change Act. It builds on the advice of the Independent Expert Panel appointed in 2017, led by the Hon Greg Combet AM, which recommended targets of 32–39 per cent in 2025 and 45–60 per cent in 2030 below 2005 levels. In 2021, the Victorian Government released its first Climate Change Strategy, which included interim targets of 28–33 per cent in 2025 and 45–50 per cent in 2030 below 2005 levels and pledges to reduce emissions across the Victorian economy.

The Panel members' biographies are at [Appendix 1](#), and their Terms of Reference at [Appendix 2](#).

The Panel has met 20 times and considered a broad range of evidence to inform this report, including:

- the latest climate science, including the Sixth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC)
- climate action being taken by other jurisdictions, the international community and the private sector
- projections of Victoria's business-as-usual emissions to understand the magnitude of

additional emissions reductions required to meet any given 2035 target option

- emissions reduction scenario analysis to understand what different pathways to net zero emissions by 2050 imply for a 2035 target, and the technology options available to achieve a range of 2035 targets
- economic impact analysis to understand the potential benefits and costs of different 2035 targets for Victoria's economy.

The Panel has engaged extensively with a wide range of stakeholders and with Departments across the Victorian Government in developing its advice. The Panel has held bilateral meetings, roundtables — including one specifically designed for youth, and one in the Latrobe Valley — and a public consultation process with submissions and surveys. All submissions, and a summary of submissions and survey responses, are published at <https://engage.vic.gov.au/climate-action-target-2035>. Stakeholders consulted are listed in [Appendix 3](#).²

THE ROLE OF TARGETS IN VICTORIA'S TRANSFORMATION TO NET ZERO

Emissions reduction targets provide a clear signal to businesses, investors, households and governments on the ambition and trajectory to transform the Victorian economy to reach net zero emissions.

Regular targets, set years in advance, help provide clarity and certainty around the state's direction of travel, which in turn helps guide the preparation for and implementation of Victoria's economic transition, by influencing investment decisions, business strategies, and policy development. They also enable a review of the approach being taken in the context of a rapidly evolving global economy and the latest climate science.

Stakeholders have asked for this certainty for years. For example, the finance sector has called for emissions reduction targets to help guide investment. The longer-term clarity provided by interim targets allows both the public and private sectors to proactively plan for and implement long term structural changes to business and industry, beyond responding to short-term events. This investment certainty is particularly important

now that dramatically strengthened policies and investments in the US and other major economies (see the following section) have intensified the global race to attract investment in energy transition.

A 2035 target allows a shift in focus from short- to medium-term planning, meaning a change in the types of investment decisions and the policy horizon being considered. Just as decisions made in the next few years about long-lasting assets and infrastructure — such as transport and energy infrastructure, vehicles, buildings and industrial assets — will affect our emissions in 2035, decisions in 2030 to 2035 will significantly impact Victoria's ability to meet its net zero emissions goal.

'Emissions reduction targets are an important guide to the direction in which the government and the community more broadly think the economy should be heading. As such, they help to ensure that scarce public and private resources are not wasted on projects that have limited or no future in a carbon-constrained world, thus mitigating the risk of stranded assets and wasted investment'

Victorian Trades Hall Council

'Victoria has an opportunity to show national leadership and inspire other jurisdictions to support science-based targets needed to match the scale of the problem'

Friends of the Earth

'These targets provide certainty for business and industry operating in Victoria which is crucial to allow for appropriate planning and coordination of activities and processes'

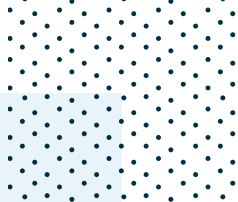
Victorian Chamber of Commerce and Industry

'Interim emissions reduction targets to set guideposts for the transition to a net zero economy are an important component of realising this objective [net zero by 2050]. In addition to an overall emissions budget and a legislated long-term emissions reduction trajectory, interim targets assist to provide clarity on the future operating environment and allow all stakeholders and communities to plan for the future'

AGL

Setting a 2035 target now can help deter investment in high-emissions assets that lock in emissions over a long period of time. These assets can either make it harder for Victoria to achieve net zero or become 'stranded' if they lose value or become liabilities before the expected end of their economic life. Conversely, early investment in assets that help reduce emissions — such as renewable energy generation, battery storage, highly energy-efficient equipment and buildings, and electric vehicle charging infrastructure — facilitates the acceleration of the transition to net zero emissions and achievement of ambitious interim targets.

By 2035 Victoria's transition will need to be well underway if it is to achieve net zero by 2045. This means that the 2031 to 2035 period will need to be one of significant implementation of emissions reduction and sequestration measures, and achievement of emissions reduction or sequestration outcomes. The 2035 target should reflect these needs and drive the required action.



Finally, a target for 2035 is largely uncharted territory. Many jurisdictions including most Australian states and territories have set 2030 targets. However, the only major jurisdiction to have set a 2035 target so far is the UK (78 per cent below 1990 levels).³ NSW announced a 2035 target of 70 per cent below 2005 levels in December 2022. This means there are few benchmarks against which to consider a 2035 target. As such, Victoria has an opportunity to show leadership, set an example for other jurisdictions to follow, and illuminate many of the same issues others will grapple with.

While targets play a key role in signaling the transformation of the Victorian economy, a target cannot be reached without the policies and measures put in place to achieve it. This point has been repeatedly underlined by stakeholders throughout the Panel's consultation process. The value of a target lies not in being easily met, but in stretching Victoria to accomplish more than it could have otherwise.

THE CONTEXT FOR TARGET-SETTING HAS EVOLVED

The context for target-setting has evolved significantly since Victoria was considering targets for 2025 and 2030. Momentum towards net zero emissions has accelerated substantially, both in Australia and globally. Victoria itself in 2022 brought forward its intended date of achieving net zero emissions from 2050 to 2045. Technology costs have continued to fall, in some cases rapidly. The Australian and global energy sectors — a primary source of emissions — are in a period of profound disruption and transition. The impacts of climate change are being felt more acutely — such as the bushfires affecting Australia's east coast in 2019–2020 followed by severe flooding in 2021–2022. And the Intergovernmental Panel on Climate Change has issued its strongest call to action yet, with its Sixth Assessment Report unequivocally stating that immediate, significant emissions reductions are needed to secure a liveable future.

'There have been a number of contextual developments since the last interim target was set in 2021. Rapid advancements have been made in the technological and financial feasibility of emissions reduction solutions... The most recent climate science has highlighted the necessity of keeping global temperature rise to 1.5 degrees, and there is increased global resolve to achieve this goal.'

ClimateWorks Centre

The 2022 Australian federal election result significantly changes the national context in which Victoria operates. The national 2030 emissions reduction target has been almost doubled from 26–28 per cent below 2005 levels to 43 per cent below 2005 levels⁴ and work is underway to strengthen key national-level emissions reduction policies including the Safeguard Mechanism, which covers large industrial, resources and transport facilities with direct emissions above 100,000 tonnes CO₂-e per annum. The proposed changes would steadily reduce these facilities' entitled emissions intensity, and cut total covered emissions by about 30 per cent by 2030 and to net zero by 2050, with further interim targets to be considered. In January 2023, the Chubb review affirmed the essential soundness of Australia's carbon crediting regime, but recommended a range of refinements to institutions, processes and methodologies. The Australian Government has accepted these in principle and its proposed Safeguard redesign will allow access to Australian Carbon Credit Units as a key source of flexibility, likely driving significant additional demand for abatement from creditable activities. This is being complemented by action to strengthen climate reporting for corporations.

The Australian Government has stated it will use the 43 per cent target as a minimum that it is aiming to beat. Australia's emissions projections 2022 report shows action committed to by the Australian Government is already on track to deliver a 40 per cent reduction by 2030 and that further emissions reductions are expected as more policies are included in future projections.⁵

Australia has also signed the Global Methane Pledge, which commits signatories to contribute to reducing global methane emissions by 30 per cent below 2020 levels by 2030. The 2022-23 Federal Budget dedicates funding to multiple climate action measures, such as low-emissions manufacturing, transitioning to renewable energy and decarbonising transport. Stronger action at the federal level can catalyse further emissions reductions in Victoria, bringing even more ambitious emissions reduction targets within reach. The Australian Government will develop a new national plan for achieving net zero emissions by 2050, including its own 2035 target, by the end of 2025.

'...The federal context has changed and now is our best opportunity in a decade to commit to real action.'

Australian Services Union

Other Australian states are also stepping up their climate action and accelerating the transition to renewable energy. For example, Tasmania has legislated a net zero target by 2030, Western Australia has announced it will shut down its state-owned coal-fired generators by 2030 and Queensland has announced it will have no regular reliance on coal by 2035.

Climate action in Victoria has gained significant maturity and momentum since the last independent expert panel provided advice on Victoria's 2025 and 2030 interim targets. The Victorian Government released its Climate Change Strategy in May 2021, which outlined Victoria's first two interim targets for 2025 and 2030 and emissions reduction pledges — policies and measures — to reduce emissions by sector and from government operations for the period 2021–2025. Victoria has met and exceeded both its emissions reduction target and its renewable energy target for 2020,⁶ and is on track to achieve the 2025 targets set in both areas.

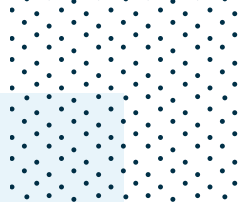
'Victoria's performance demonstrates that with strong policies and public investment, the state can exceed its own targets even under a federal government that stalls action. The Victorian Government has the momentum to aim well above 'business as usual' and align Victoria's 2035 target with climate science'

Friends of the Earth

Action by the international community has also strengthened — in November 2021, it strengthened its resolve through the Glasgow Pact to focus on limiting warming to 1.5°C above pre-industrial levels. The COP27 climate summit in Egypt in 2022 reaffirmed this resolve, in the light of the global energy crisis triggered by Russia's invasion of Ukraine and took decisions that should help finance flow to accelerate developing nations' mitigation, adaptation and management of climate-related loss and damage.⁷

In recent years, the step-up in emissions reduction commitments by individual jurisdictions⁸ has meant that for the first time, the collective ambition that governments have put on the table could be enough to hold global warming to below 2°C.⁹ Although collective national commitments still fall short of a 1.5°C pathway, the global commitments process has been designed to ratchet up over time towards this goal.

These commitments are beginning to be backed by strategies and actions that recognise that tackling climate change and planning for economic prosperity go hand in hand. The UK has released its 'Net Zero Strategy: Build Back Greener', outlining actions to reduce emissions across the economy and backed by £26 billion of government investment, which is expected to leverage £90 billion of private investment by 2030. The European Commission launched REPowerEU in May 2022, which aims to accelerate the EU's transition to renewable energy and improved energy efficiency to both reduce emissions and end dependence on gas from Russia. The plan is estimated to involve €210 billion of investment to 2027. The US landmark



Inflation Reduction Act, passed in August 2022, includes \$US369 billion in funding, finance and tax credits for emissions reduction measures that will support a still larger volume of private finance, including investment in solar energy, offshore wind, clean hydrogen, battery storage, electric vehicles, carbon capture use and storage, advanced nuclear, electrification and energy efficiency. The law will play a critical role in the US achieving its emissions reduction targets, and it seeks to enhance America's global economic competitiveness, innovation, and industrial productivity.

The global and local energy crises associated with the war in Ukraine and their impacts on the case for energy transition are discussed further in **Box 3** below.

Investors and businesses have also recognised climate change as a financial risk and are setting emissions reduction targets and incorporating climate change risk into their strategies and investment decision-making. There has also been an acceleration in the establishment of platforms and partnerships for collaborative climate change action (**Box 1**). As of 2021, financial institutions holding 40 per cent of global financial assets — around \$US130 trillion — were committed to net zero, up from around \$US5 trillion in 2019.¹⁰ As for businesses, more than one third of the world's largest publicly traded companies (Forbes 2000) have set net zero targets, up from one fifth in December 2020.¹¹

There has been a step change in sophistication of the finance sector in thinking through decarbonisation pathways and understanding risks and opportunities of these pathways. Central bankers are now increasingly setting economy-wide climate transition scenarios, and requiring stress testing against them. A global network of central bankers is working together to enhance the role of the financial system to manage risks and mobilise capital for the transition to net zero emissions.¹²

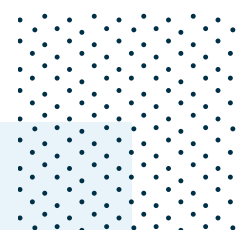
This trend is reflected in the Australian and Victorian contexts. In November 2022, the Australian Prudential Regulation Authority published its first Climate Vulnerability Assessment of Australia's five largest banks, looking at how climate change may test the resilience of the banking system in coming years and how banks might react to and manage these impacts.¹³

As of March 2022, 95 ASX200 companies had committed to net zero emissions by 2050 or earlier, a significant jump from the 49 companies that had done so at the same time last year. Together these companies represent \$1.59 trillion, or 70 per cent, of the ASX200's collective market capitalisation.¹⁴ Companies are now turning their attention to increased climate reporting obligations and ensuring that their targets are backed by a credible strategy. This will ensure they avoid the regulators' enhanced efforts to crack down on 'greenwashing': The Australian Securities and Investment Commission (ASIC) issued its first significant greenwashing fine for making factually incorrect statements about environmental credentials in October 2022.

Increasingly climate change is not just part of aspirational company targets, but has a measurable effect on financial practices across the whole of companies. For example, Cbus super fund now has sophisticated scenario development and modelling supporting their commitment to reduce portfolio emissions by 45 per cent by 2030 and net zero by 2050, and all major Australian banks have now set climate investment or lending targets. This is related to a broader movement by investors to redirect capital away from emissions-intensive assets. Over 140 globally significant banks, insurers, asset managers and asset owners have announced their divestment from thermal coal — including Australian operators ANZ, NAB, Commonwealth Bank of Australia, Westpac, QBE, Suncorp, IMF Investors, HESTA, IAG and Macquarie Group — and 75 have announced financing restrictions for oil and gas.¹⁵ Many carbon-intensive companies have reported experiencing a higher cost of capital or access to capital implications in accessing debt and equity unless they can demonstrate clear transition and decarbonisation strategies.

BOX I. COLLABORATIVE ACTION ON CLIMATE CHANGE

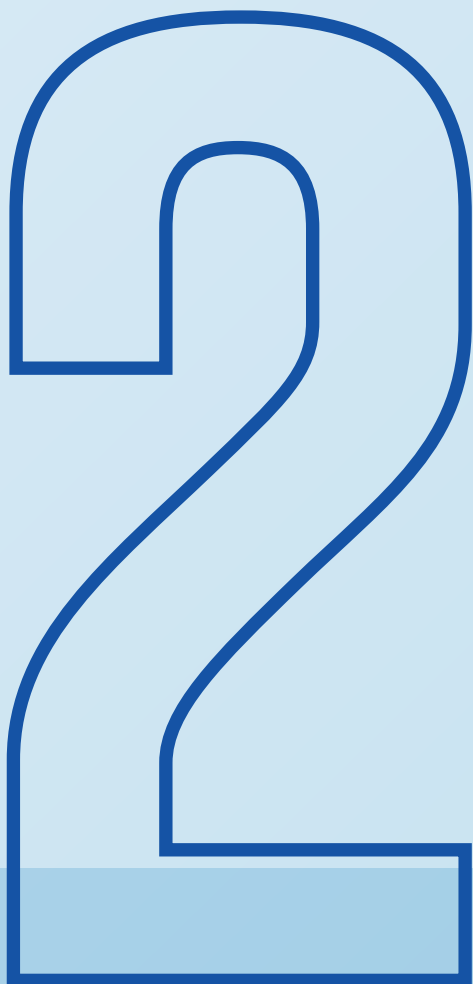
- Climate Action 100+ — launched in 2017, this is an investor-led initiative through which 700 investors — with over \$US68 trillion in assets under management — are engaging with the world's largest corporate greenhouse gas emitters to cut emissions, improve climate change governance and strengthen climate-related financial disclosures. Climate Action 100+ engagement focuses on 166 companies that together make up nearly 80 per cent of corporate industrial emissions. Fifteen of these companies are in Australia, including AGL Energy, Bluescope Steel, Incitec Pivot, Qantas and Woolworths. Forty-seven Australia-based investors are part of the network, including HESTA, IFM Investors and Cbus. Investors are responsible for driving engagement and developing and implementing company specific engagement strategies. They are supported in the process by five investor networks who co-founded the initiative, as well as other technical experts.
- Race to Zero** — launched in 2020, this is a global coalition of cities, regions, businesses, investors and higher education institutions all committed to achieving net zero by 2050. Between November 2020 and November 2021, the number of private sector members increased five-fold to over 5,200. Collectively, members cover nearly 25 per cent of global CO₂ emissions and over 50 per cent of global gross domestic product (GDP). Various Victorian organisations have committed to the initiative, including Deakin University, Transurban and City of Glen Eira.
- First Movers Coalition — launched in 2021, this is a private sector platform harnessing the buying power of 50+ companies to scale up and improve the cost-competitiveness of zero-emissions technologies in hard-to-abate sectors by increasing demand for aluminium, aviation, chemicals, concrete, shipping, steel, and trucking, as well as carbon removal technologies. Key members of the First Movers Coalition include Fortescue Metals Group, BHP, Deloitte and PwC.
- Breakthrough Agenda — launched in 2021, this is an international clean technology plan that steps out what milestones need to have been reached in each sector, by when, to keep 1.5°C of warming within reach. It is driven by a coalition of countries, including Australia, who together represent 70 per cent of global GDP, and provides a framework for private sector and sub-jurisdictional involvement as well. The first five sectors of focus, called the 'Glasgow Breakthroughs', are power, road transport, steel, hydrogen and agriculture.
- Climate Leaders Coalition — CLC is a group of cross-sectoral Australian corporate CEOs supporting the Paris Agreement commitments and setting public decarbonisation targets. The 2022 Scope 3 Roadmap provides practical advice on steps for CEOs to address scope 3 emissions through adaptation of business modes, different commercial arrangements and new risks being profiled and mitigated.



The business case for climate measures is only continuing to strengthen as technology costs fall. Renewable energy is the cheapest source of new power, and these costs are continuing to plummet. Between 2010 and 2021, the weighted average levelised cost of energy (LCOE) declined by 88 per cent for newly commissioned utility-scale solar photovoltaic (PV) projects, 68 per cent for onshore wind and concentrated solar power, and 60 per cent for offshore wind.¹⁶ One study estimates that by 2030, 70 per cent to 80 per cent of investments in decarbonisation technologies could be better value for money than conventional, emissions-intensive alternatives.¹⁷

Finally, the scientific imperative for immediate, ambitious action is only becoming more urgent. Victoria has been experiencing first-hand natural disasters exacerbated by climate change, such as the widespread bushfires in the summer of 2019 to 2020 and the significant flooding affecting the state in October to November 2022. The Intergovernmental Panel on Climate Change's Sixth Assessment Report — which brings together the latest research from leading scientists around the world — states that “the scientific evidence is unequivocal: climate change is a threat to human well-being and the health of the planet. Any further delay in concerted global action will miss the brief, rapidly closing window to secure a liveable future”.





**WHAT:
THE PANEL'S
RECOMMENDED
TARGET**

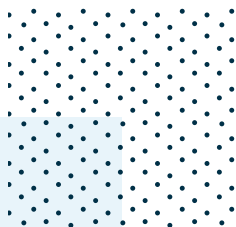
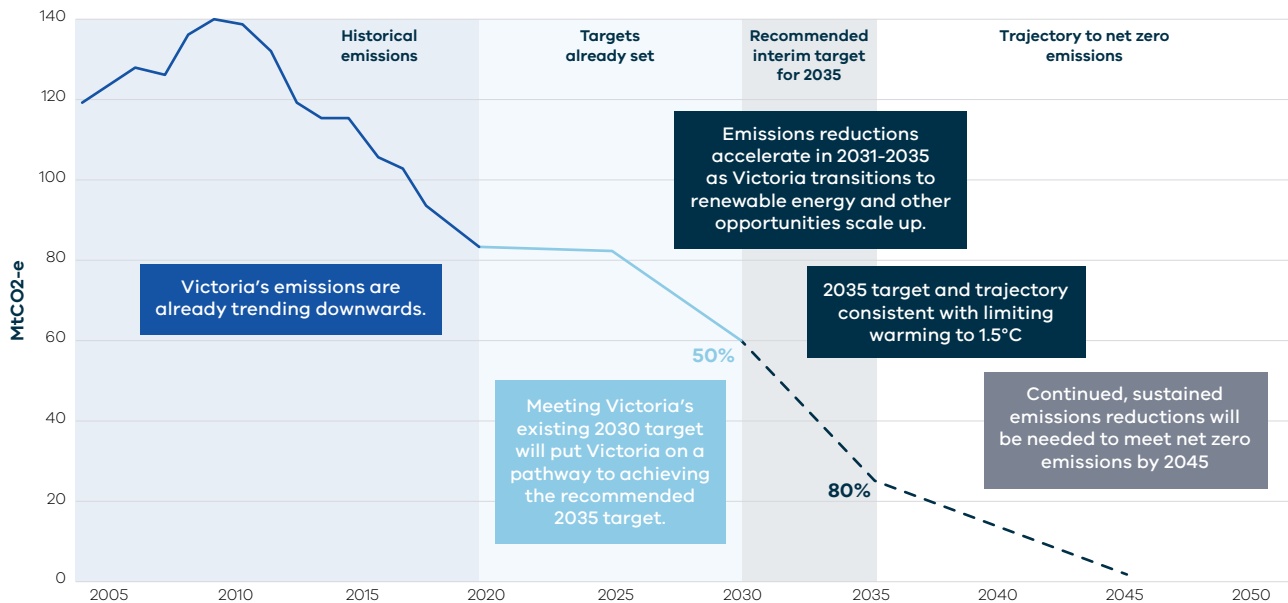


THE PANEL RECOMMENDS A 2035 TARGET OF 80% ON A TRAJECTORY TO NET ZERO

In light of the evidence it has reviewed and the stakeholders it has consulted, **the Panel recommends a 2035 emissions reduction target of 80 per cent below 2005 levels (Figure 2)**. This target continues Victoria's pathway to net zero emissions by 2045 in a way that is consistent with Victoria playing its part in keeping global temperature rise to 1.5°C and positions Victoria to reap the benefits of, and maintain competitiveness in, the global transition to net zero emissions.

The Panel is confident that the recommended target is achievable with the accelerated deployment of known solutions. This implementation will need to happen in the 2020s to also meet Victoria's 2030 target (Figure 2), and the transformation that this will set in motion — plus the transition to 95 per cent per cent renewable electricity by 2035 as pledged by the Victorian Government — puts an 80 per cent target within reach. This is confirmed by the Panel's consideration of Victorian modelling, see Box 2.

Figure 2. The Panel's recommended target for 2035 and indicative trajectory to net zero emissions



BOX 2. INSIGHTS FROM MODELLING EXERCISES MAPPING VICTORIA'S PATH TO NET ZERO

Modelling was undertaken for the Panel by Jacobs to help understand a range of possible future emissions trajectories and emissions reductions options for Victoria. **Appendix 5** has more detail on this modelling.

The Panel has also had the benefit of consulting with other organisations that are modelling Victoria's future emissions pathways, in particular Net Zero Australia and ClimateWorks Centre, both of which are undertaking modelling efforts that are intended to be released in 2023.

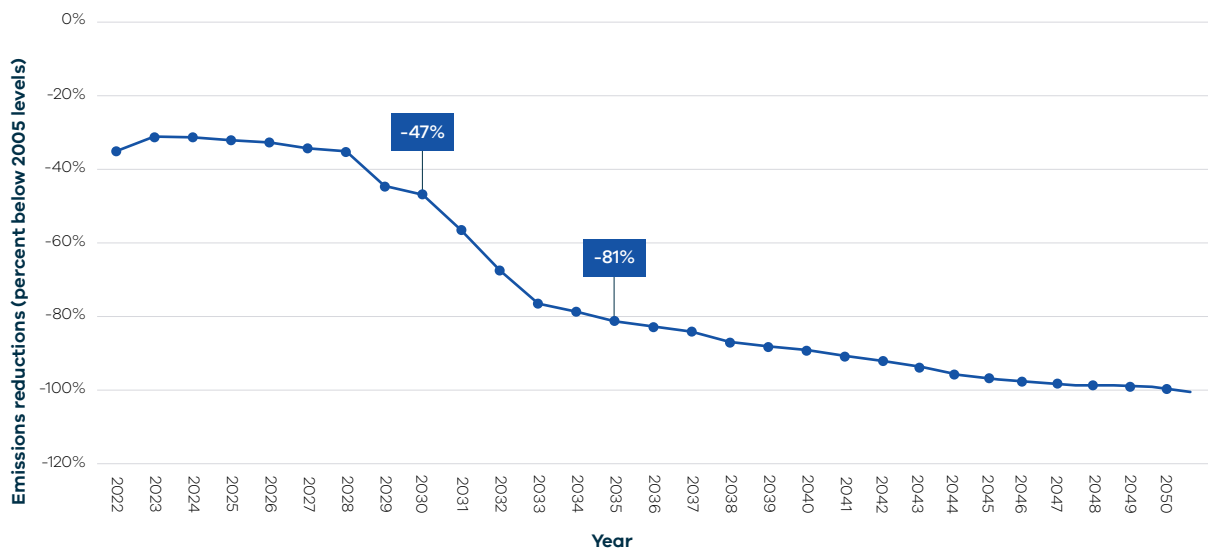
All these modelling efforts, while helpful in describing possible futures with analytic rigour and systemic thinking, are subject to similar limitations. In particular, as described in **Box 4**, they take conservative approaches to technology learning rates and so have tended to underestimate the scale and overestimate the cost of achievable emissions reductions. They are also forced to make assumptions for one state (Victoria) that are dependent to some extent on action elsewhere. Faster action to decarbonise

the National Electricity Market (NEM) or faster Australian Government action on climate change can greatly change the ability of Victoria to unlock its emissions reduction potential. And these actions are evolving rapidly. The amount of change in Australia's electricity sector and national climate policy in 2022 can mean that any modelling exercise soon falls behind reality.

That said, the Panel notes that the overall findings from modelling of Victoria are clear and consistent:

- With well-planned policy action, Victoria will be able to achieve ambitious targets, including the Panel's recommended 80 per cent target, in 2035.
- This will require action in all major emitting sectors, as recommended in this report.
- The overall trajectory is initially dominated by the closure of coal fired power stations, but more ambitious action must accelerate immediately in other sectors, to drive the sustained reductions needed beyond 2030.

Figure 3. Jacobs Panel modelling scenario (See Appendix 5)



The recommended target and indicative trajectory reflect the profile of Victoria's emissions reduction opportunities. The steep emissions reduction pathway to 2035 capitalises on mature, cost-effective solutions in electricity generation — Victoria's largest source of emissions — being deployed in this period.

After 2035, reducing Victoria's remaining emissions is either more incremental — such as continuing to replace cars and building appliances with cleaner alternatives and to apply methane-inhibiting measures to livestock — or potentially more difficult and expensive, such as clean alternatives for natural gas use in some parts of industry.

An 80 per cent target for 2035 is among the most ambitious in the world and puts Victoria ahead in the global race to net zero emissions. It sends a strong signal to investors that Victoria is serious about decarbonisation, which may help attract a portion of the estimated \$US130 trillion of global private capital available for the transition to net zero.¹⁸ Clearly-telegraphed ambition may improve Victoria's standing in the global competition for skills and resources needed to decarbonise. It could also help address supply chain pressures by sending a stable medium-term signal to manufacturers and the resources sector to invest to increase production of products and materials necessary to enable decarbonisation.

Most importantly, however, the policies and measures Victoria puts in place to achieve this target can help drive sustained economic growth and revitalisation through new industries, innovation and efficiency. This economic growth will, in the medium-term, act to reduce state debt levels, and policies can also be designed to have prominent roles for private investment and deliver some of the gains from action to the state. Victoria will also be ready to seize the opportunity created by rising demand for low-emissions products by trade partners and consumers. A planned and orderly transition to a net zero emissions energy system will increase Victoria's resilience to future energy market shocks, such as what is currently being experienced in gas markets as a result of conflict in Ukraine. Finally, Victoria's communities and ecosystems will also flourish,

experiencing benefits such as cleaner air, more comfortable homes and increased biodiversity. By pulling forward and scaling up emissions reduction measures, an ambitious 2035 target allows more of these benefits to be enjoyed sooner.

The Panel considered recommending a five per cent target range, consistent with the form of Victoria's 2020, 2025 and 2030 interim targets. However, it did not wish to limit the ambition of the Victorian Government by including targets less than 80 per cent, particularly given the scientific imperative and strong economic arguments for an ambitious target that harnesses global momentum towards net zero. The Panel also felt that the evidence around the achievability of an 85 per cent target or higher is not yet firm enough, and therefore ruled out an 80 to 85 per cent range. In the Panel's view, 80 per cent strikes the best balance between ambition and achievability. The Panel was also attracted to a point target instead of a range for the clarity of signal that it sends, and notes that this is a common form of target used by other jurisdictions. Examples include Australia's 2030 target (43 per cent below 2005 levels), NSW's 2035 target (70 per cent below 2005 levels) and the UK's 2035 target (78 per cent below 1990 levels).

To put Victoria on a pathway to achieving the 80 per cent target in 2035, the Panel recommends that Victoria should develop a whole-of-economy climate action delivery plan to capture the benefits of a rapid transition. The Victorian Government should also focus on priority actions in the major emitting areas of the economy, described later in this report:

- Electricity generation
- Natural gas use and the built environment
- Transport
- Land and Forestry
- Agriculture

EARLY CONSIDERATION OF EMISSIONS AFTER NET ZERO

After 2045, Victoria's emissions will be net zero. There are several plausible reasons the Victorian Government may wish to pursue further emissions reductions after this point, driving Victoria into net negative emissions for a sustained period.¹⁹ These reasons could include:

- Slow progress in executing global climate targets such that the global carbon budget for 1.5°C is exceeded.
- Global consensus that global climate targets are inadequate or carry consequences that in 2045 have become unacceptable, leading to a further ratcheting of collective global ambition to lower temperatures over the long term.
- Negotiated positions on global equity, for instance where richer jurisdictions such as Australia (and its states, including Victoria) agree to drive their net emissions below zero to allow some poorer countries to continue to emit a limited amount of greenhouse gases that would help their development.
- Market reasons, such as where Victoria is able to sell credits from net-negative emissions projects internationally (in this scenario, globally-agreed rules could provide a framework for how these emissions should be credited in Victoria's inventory).

In addition to these longer-term reasons, every decision that Victoria makes about choice of interim targets and effort to achieve targets between now and 2045 will include options that may lead to greater eventual reliance on net negative emissions, even if this is unconsidered or unarticulated. Weaker targets or slower progress in achieving them entail either accepting the serious consequences of higher levels of climate change, relying on other jurisdictions to take up the slack, or undertaking more net negative emissions.

The global scale of net negative emissions involved in most 1.5°C scenarios assessed by the IPCC is already large, and in some scenarios challenges economic or even physical plausibility. The world is contemplating a new set of industries comparable in size and resource requirements to the world

aluminium or steel industries, but with no output except emissions reduction. Some degree of global reliance on net negative emissions is extremely likely, but at some point, reliance would exceed what can or will be done.

Given the immediate and long-term decisions involved in net negative emissions, the Victorian Government could productively begin to consider its potential stance and options on negative emissions investments.

FACTORS TO CONSIDER FOR NET NEGATIVE EMISSIONS

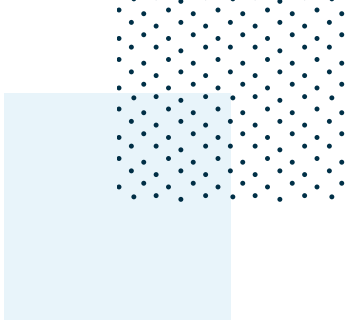
Considerations that should inform any analysis of net negative emissions include:

Prices for negative emissions technologies are likely to be high in 2045

The cheapest current form of technology that draws down emissions is planting vegetation.²⁰ Achieving interim targets and net zero in 2045 will already require a substantial revegetation effort across Victoria, where the Government will already have to manage competing land use priorities carefully. Most suitable land for carbon plantings is likely to be already used for this purpose by the time net negative emissions would need to be delivered.

Victoria could be already pursuing some negative emissions projects to offset its residual emissions from some sectors. Carbon capture and storage (CCS) is one likely example, and some stakeholders have expressed views to the panel that CCS is necessary for Victoria to achieve net zero. Any negative emissions projects required for a net negative trajectory would be additional to these efforts, and potentially even more costly.

Two of the leading technologies for achieving net negative emissions, Bioenergy Carbon Capture and Storage; and Direct Air Carbon Capture and Storage (BECCS and DACCS) have cost estimates averaging \$US200 per tonne in 2050.²¹ The variability of these estimates is also very wide, reflecting uncertainty about their development and effectiveness at scale (\$US60–\$US1000 per tonne).²²



Negative emissions technologies may have few co-benefits, and require specific resources to deploy

Unlike most efforts to reduce emissions, not all technologies to create negative emissions have cobenefits. For instance, CCS adds to the cost and reduces the efficiency of the underlying process to which it is attached. While Carbon Capture and Use (CCU) can contribute to useful, albeit likely expensive, products such as synthetic fuels, CCS appears to rely solely on the value of emissions removals. This is likely to make it harder to incentivise private investments towards these technologies without robust and sustained public policies.

Many technologies also require a precise configuration of resource availability. For example, DACCS is extremely energy intensive, and some forms of it are also very water intensive, requiring the creation of solvents to draw carbon from the air. DACCS and BECCS require specific geological formations where the captured gases can be securely stored for the extremely long term. These requirements would need to be factored into planning.

Many negative emissions technologies are unproven at scale

As well as being unproven, the degree of certainty about their effectiveness at the scales required is also not firm. In addition, many of these technologies also carry with them a long-term liability regarding the permanent storage of the carbon they capture.

The relationship between carbon budgets and net negative emissions is extremely complex

It is not possible to make 1:1 tradeoffs between emissions reductions now and emissions reductions later, because emissions contribute to cumulative warming while they are resident in the atmosphere and this is not fully reversed when they are removed. So Victoria could not, for instance, fairly slow down its emissions reduction efforts before 2045 and expect to compensate later by negative emissions equal to the emissions 'lost' by not making stronger pre-2045 reductions.

'Any form of Carbon Capture and Storage or Direct Air Capture should adhere to strict environmental and social safeguards and monitoring to minimise negative consequences and must be applied as a means of minimising atmospheric carbon as opposed to prolonging reliance on fossil fuels.'

WWF Australia

In light of the above, Victoria should develop tools for analysis and decision-making that make the costs, resource requirements and uncertainties of net negative emissions more explicit and able to be reflected within processes for emissions targets, emissions policies and planning.

Responsible fiscal budgeting involves the acquisition of long-dated public obligations such as bonds whose costs, benefits and servicing requirements are fully articulated and carefully weighed. Responsible emissions budgeting requires an equally measured and transparent approach to net negative emissions.

PANEL RECOMMENDATION: SET A TARGET OF 80% EMISSIONS REDUCTIONS BELOW 2005 LEVELS IN 2035

This target continues Victoria's pathway to net zero emissions by 2045 in a way that is consistent with Victoria playing its part in keeping global temperature rise to 1.5°C and positions Victoria to reap the benefits of, and maintain competitiveness in, the global transition to net zero emissions.



WHY THE TARGET AND MEASURES ARE NECESSARY



There are multiple imperatives for setting and achieving an ambitious 2035 target for Victoria. Doing so will harness and create economic opportunities while also making the economy more resilient to future shocks. Many Victorians are demanding strong targets backed by strong measures, as the Panel heard through its consultation process. Finally, an ambitious target is important for Victoria to play its part in global efforts to avoid the worst impacts of climate change by working towards limiting global temperature rise to 1.5°C above pre-industrial levels.

THE SCIENTIFIC IMPERATIVE TO AVOID THE WORST IMPACTS OF CLIMATE CHANGE

Since the 2030 target decision was made, the IPCC released its Sixth Assessment Report (AR6) — the latest authoritative global reference point on how the climate is changing, the state of play in adaptation and mitigation efforts, and possible future impacts and measures to reduce emissions, compiled by leading climate scientists from around the world using the whole body of global published research.

The IPCC AR6 sends the strongest message yet about the breadth and scale of the negative impacts that climate change is having around the world, and the imperative for strong, rapid action. Evidence gathered by the IPCC shows that ‘human-induced climate change is already affecting many weather and climate extremes in every region across the globe.’²³ These negative climate change impacts are being felt in Victoria. Overall, the state is becoming hotter and drier²⁴ with dire consequences.

The IPCC notes with high confidence that extreme weather — like the weather leading to Victoria’s devastating bushfires in 2012–13 and 2019–20 — is projected to increase due to climate change.²⁵ Most recently, Victoria has been experiencing severe flooding. Impacts are also being felt in other Australian states and territories, including heavier rainfall, increased flooding events, and more frequent drought episodes. These have caused significant damage to regional economies and communities and are now occurring on a more regular basis. For example:

- The Black Saturday bushfires in Victoria (2009) cost an estimated \$7 billion. This covers direct tangible costs (such as damage to private properties and infrastructure), indirect tangible costs (flow-on effects such as business and

network disruptions), and intangible costs (such as death and injury, impacts on health and wellbeing, and community connectedness).²⁶

- The Queensland floods (2010–11) cost an estimated \$14.1 billion, in both tangible and intangible costs.²⁷
- The Victorian floods (2010–2011) are estimated to have cost the Victorian economy \$1.3 billion.²⁸
- Australia’s 2019–20 bushfires are estimated to have cost about \$100 billion in tangible costs, and around \$230 billion if intangible costs are also included.²⁹ Smoke-related health costs from these fires are estimated to have cost \$486 million for Victoria alone.³⁰
- The estimated insured losses from the 2022 floods across Queensland and NSW totalled \$4.3 billion as of 1 June 2022, according to the Insurance Council of Australia.³¹

‘As the last three years have shown across Australia and Victoria, including the devastating floods in northern New South Wales and south-east Queensland in February and March of this year, the impacts of climate change are already more severe than anticipated.’

Environment Victoria

Past emissions have already locked in further changes to the climate system. This includes more extreme weather events,³² further warming of the oceans, rises in the global mean sea level, and melting of mountain and polar glaciers.³³ This is because once emitted, greenhouse gases remain in the atmosphere for tens to hundreds of years. This further strengthens the imperative to minimise future emissions. If global emissions continue to accumulate at recent rates, climate change is likely to create significantly more risk and damage, for the world and for Victoria. The IPCC AR6 emphasises that climate change impacts will be significantly greater, and effective adaptation significantly compromised, at higher levels of warming. It also reiterates the message first communicated in the IPCC's Special Report on 1.5°C (2018) — that the impact of 2°C of warming is significantly greater than the impact of 1.5°C of warming. For example, coral reefs are projected to decline by a further 70–90 per cent at 1.5°C of warming but that loss grows to more than 99 per cent with 2°C of warming.³⁴

'The exhaustive, science-based modelling in the IPCC AR6 Report emphasises the recent and harrowing experiences of our own Victorian communities, who even in the last two years have endured fatal wildfires (2020), flash floods (2021), intense wind and storm events (2021), and severe drought (2019–2021). If these experiences are to be amplified three-fold in less than 80 years, local governments, communities and the biodiverse environments that support them, will be facing a world that is dangerously unliveable.'

Victorian Greenhouse Alliances

'Healthcare worker workload will increase and become more difficult in times of climate crisis, the Covid-19 pandemic has shown. To avoid the worst impacts of climate change which will wreak havoc on workers and their communities, emissions cuts must be made well before 2050. The Victorian government should increase its climate policy ambition and set a 2035 Emissions Reduction Target which is based on the latest climate science and recommendations.'

Health and Community Services Union

Keeping the temperature rise to as low as possible is essential to significantly reduce the risks and impacts of climate change.³⁵ Victoria must play its part in global action. The Panel's recommended 2035 target and trajectory to net zero emissions represent Victoria playing its part in keeping global temperature rise to 1.5°C above pre-industrial levels. This is supported by emissions budget analysis, as presented in [Appendix 4](#).

THE ECONOMIC IMPERATIVE FOR AMBITIOUS ACTION

The global transition to net zero emissions is inevitable and well underway. Victoria has a choice in how it positions itself. The state has led with both its Climate Change Act and its 2030 target. Accelerating Victoria's action is a major opportunity for economic growth, allowing the state to harness the significant private investment available for the transition, develop new industries and jobs, and increase Victoria's resilience to future economic shocks. If Victoria does not take strong action, not only will it miss out on these benefits — it also risks losing competitiveness, access to skills and global supply chains, and being subjected to potential trade penalties. If Victoria does not at least keep abreast of global momentum — and evolve its industries and know-how accordingly — it risks not being able to catch up later.

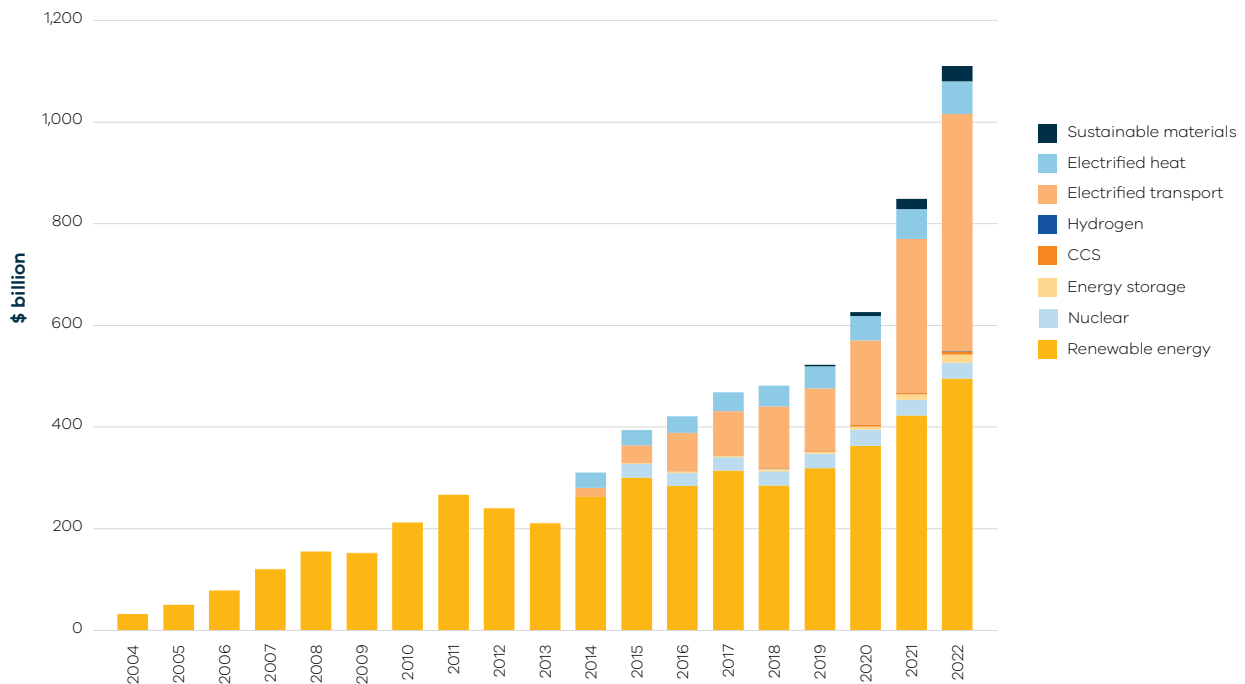


The structural economic transformation implied by the move to net zero will require a mobilisation and reorientation of Victoria’s finances, resources and labour force. While this may delay ongoing economic growth in the short term, this up-front investment will set Victoria up for sustained economic success: one study estimates that achieving a target of around 80 per cent in 2035 and net zero emissions by 2050 stands to make the Victorian economy at least \$63 billion larger (net present value 2022–2070) than if no further action is taken. This is likely to underestimate the full benefit to the Victorian economy because it is likely to overstate technology costs (Box 4) and does not include many difficult-to-quantify benefits to ecosystems and communities, such as health benefits from more active transport options, or biodiversity from more vegetation plantings.³⁶

While this transformation will require significant investment, not all of this needs to come from governments: one study estimates that the private sector could deliver 70 per cent of total investments needed to meet net zero goals, and that there is currently \$US130 trillion of global private capital available for the transition.³⁷

We are already seeing an acceleration in investment in clean technologies: for example, between 2021 and 2022, global investment increased by 30 per cent to reach \$US 1.1 trillion (Figure 4). As climate change considerations become embedded in the targets and decision making frameworks of investors, this trend is set to continue.

Figure 4. Global investment in the energy transition by sector, 2004–2021



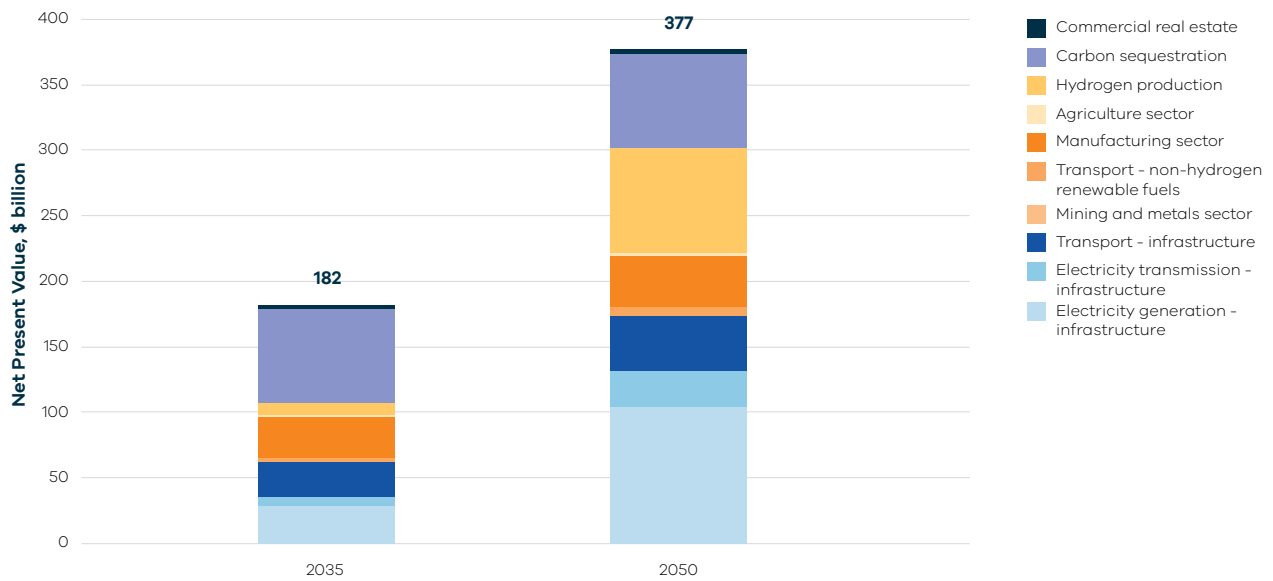
Source: Bloomberg New Energy Finance (2022) *Energy Transition Investment Trends 2023*. Accessed: <https://about.bnef.com/energy-transition-investment/>.

In Australia, it is estimated that an orderly transition to net zero emissions could unlock around \$182 billion in total investment to 2035 and \$377 billion to 2050³⁸ (Figure 5).

Victoria is competing on the national and global stage for these investment dollars. High ambitions backed by large and durable policies in the US, Europe and elsewhere have raised the stakes in that competition. Signaling with its 2035 emissions reduction target that it is committed to the transition to net zero emissions, coupled with ensuring it maintains a stable policy environment conducive to private investment, can help Victoria to harness a share of the significant private capital available for the transition. It may also help to attract skilled international labour to help work in the future low emissions industries that will be needed.

During the Panel's tenure, many significant developments have occurred across Australia's energy sector that indicate strong, swift change is underway that will accelerate the transition away from fossil fuels (Box 3). The Panel's view is that a strong 2035 emissions reduction target can help signal to both policymakers and the private sector the need to plan for rapid change, making this inevitable transition more orderly.

Figure 5. Potential investment in Australia by sector under an orderly transition to net zero emissions



Note: This scenario assumes clear, long-term policies and market signals to promote a timely and orderly investment pathway to net zero emissions. It assumes that Australia updates its 2030 target to 45 per cent below 2005 levels – which is close to what the Australian Government has since done – and sets a target of net zero emissions by 2050, which was implemented by the Australian Government in 2021.

Source: Investor Group on Climate Change (2020) *Mapping Australia's net zero investment potential*. Accessed: https://igcc.org.au/wp-content/uploads/2020/10/121020_IGCC-Report_Net-Zero-Investment-Opportunity.pdf.

BOX 3. CHALLENGES AND CHANGE FOR AUSTRALIA'S ENERGY MARKETS

Russia's invasion of Ukraine in 2022 has disrupted international energy markets and sent world prices for coal, gas and oil soaring. While the situation continues to evolve, it is plausible that international price pressures on traditional energy sources will be strong for years. Russian gas exports to Europe are down by around 85 per cent; Europe is replacing Russian gas with energy conservation and Liquefied Natural Gas (LNG) in the short term, and through faster transition to renewables, energy efficiency, biogas and hydrogen in the medium term. Beyond Europe, this conflict and accompanying global energy crisis are likely to further accelerate the global transition away from fossil fuels in the medium term, although there is intensified competition for natural gas and reliance on coal in the short term.

Eastern Australia is heavily exposed to these global pressures through large exports of black coal and LNG. For Victoria's power markets in 2022 this situation was compounded by unusually cold early winter conditions driving up demand for gas, and both planned and unplanned outages at a quarter of the ageing coal-fired generation capacity across the NEM. Outages will recur, both as the power stations get older, and with increased impacts from climate-related events such as flooding, bushfires and intense heatwaves affecting the operation of the stations.

These international and operational pressures have significantly and rapidly raised electricity and gas prices across Eastern Australia, including in Victoria. The operation of Eastern Australia's gas and electricity markets has been under pressure, with the zone facing unprecedented gas shortages and price caps, while the NEM spot market was temporarily suspended by the Australian Electricity Market Operator (AEMO) in June 2022 as it could no longer ensure the secure and reliable supply of electricity to consumers. In December 2022, the Australian Government intervened to cap coal and gas prices for twelve months.

These price and operational pressures mean that there is a greater urgency to transition away from fossil fuels, and that the expected returns of this transition are higher. As stated in AEMO's 2022 Integrated System Plan³⁹.

A clear message from our stakeholders and recent market events is that our energy system transformation is accelerating and irreversible. Recent international events and Australian market events have further strengthened the case for the shift to renewables...Investment in low-cost renewable energy, firming resources and essential transmission remains the best strategy to deliver affordable and reliable energy, protected against international market shocks.⁴⁰

Many energy industry stakeholders view AEMO's 2022 Integrated System Plan 'Step Change' as the scenario most likely to eventuate, based on the Australian Government's net zero policy commitments, corporate commitments, rapid technology advances, consumer preferences, and the age of incumbent generators. This is further supported by the accelerated steps other states are now taking around the shutdown of coal-fired electricity generators, and the actions of the owners of such assets such as AGL to bring such shutdowns forward. The Victorian Government's 2022 commitment to 95 per cent renewable electricity by 2035 also signals a rapid and significant shift away from coal.

Reaching net zero by 2050 Australia-wide means a major transformation of the NEM including (under the 'Step Change' scenario):

- a near doubling of electricity consumed from the grid to 330 terawatt hours (TWh) as transport, heating, cooking and industrial processes are electrified
- construction of nine times the NEM's current utility-scale wind and solar generation capacity (from 15 gigawatts (GW) to 140GW)

- installation of four times the current distributed PV capacity (from 15GW to 70GW), with most coupled with an energy storage system, and
- triple the firming capacity that can respond to a dispatch signal (including 30GW at utility scale.)

Scenarios where Australian clean energy also contributes to decarbonising the world economy through exports of energy and energy intensive products would see an even larger expansion in our electricity systems.

The Panel acknowledges that the Victorian Government is planning for and supporting a significant increase in renewables in the system, through the Victorian Renewable Energy Target, renewable energy storage targets and investment in battery initiatives, Victoria's Offshore Wind Strategy, the development of Renewable Energy Zones, and investment in interconnectors. The Panel strongly supports this planning and urges the Victorian Government to make the state ready for all coal-fired generation to exit Victoria's energy system by 2035. The Panel also acknowledges the Victorian Government's 2022 Gas Substitution Roadmap which signals the progressive phase-out of natural gas for most gas users in Victoria.

Greenhouse gas emissions and climate ambition are also becoming an increasingly important trade consideration. Australia's top 10 trading partners, including the US, the UK, Japan and South Korea, have committed to achieving net zero emissions.⁴¹ Seventeen of Victoria's top 20 export markets also have net zero pledges.⁴² These commitments signal stable future demand for low-emissions goods and services, which could provide an opportunity for new Victorian industries to develop to meet this demand. The Victorian industry can reach low, zero or negative emissions faster than international competitors, this could increase the competitiveness and profitability of Victorian exports. By contrast, if Victorian industry lacks a basis to keep up with the pace of global decarbonisation, this will reduce the competitiveness of Victorian exports over time. Both the opportunity and the risk will increase as 'Carbon Border Adjustment Mechanisms' (CBAMs) take shape in Europe and elsewhere.

Momentum is building to tax the carbon content of imports through CBAMs. The EU became the first jurisdiction to approve a CBAM in December 2022. This requires importers of key products including aluminium, cement, electricity, fertilisers, hydrogen, iron and steel to report their production emissions from 2023–24 and pay the equivalent of the EU's domestic carbon price for them from 2026–27. Although none of these items is yet in Victoria's

top ten exports to Europe, which are dominated by agricultural products, the mechanism is expected to expand to further products over time. This approach is also being explored by Canada, the US and the UK. Meanwhile the EU and the US have begun work on a trade agreement to encourage production of green metals and discourage trade in high-emissions metals. Australian research suggests that relatively low-emissions suppliers to markets with a CBAM will become more profitable, while higher-emissions suppliers lose ground over time. The Australian Government will undertake a review of policy options to further address carbon leakage in relation to the reformed Safeguard Mechanism, including options for an Australian CBAM.

Multiple stakeholders raised these issues in their submissions to the Panel's public consultation process.

'If no action is taken it will leave Australian business exposed and will lead to harmful impacts on all Australians'

Victorian Chamber of Commerce and Industry

'Victoria is a trading state, with substantial exports of agricultural and manufactured goods as well as specialist services. These revenues will be at risk if European and US decarbonisation expectations are not met. Our export industries certainly don't need the risk of climate-related import tariffs.'

Centre for Climate Safety

'Delays in reducing emissions will increase the practical and economic costs of avoiding dangerous climate change and place a greater burden on future generations to adapt to higher levels of warming.'

Melbourne Climate Futures

'The economic risks of climate inaction are increasing including higher cost of capital and poorer credit ratings, as well as trade implications for governments and businesses delaying climate action.'

ClimateWorks Centre

FALLING TECHNOLOGY COSTS WILL HELP A RAPID TRANSITION

The global momentum towards climate action has been enabled and accelerated by a suite of new technologies, from now-familiar solar panels to still-unfamiliar precision fermentation technology that can create edible proteins. Regular innovations can create potentially transformative improvements. For instance, in March 2022 a team of University of New South Wales researchers announced they had demonstrated solar panels that can generate some energy at night, from capturing energy absorbed by the earth during the daytime as it is released back into the atmosphere after sundown.

Transformative impacts are not just about novel 'breakthroughs'. Steady improvements in cost and capability, driven by increased deployment of technology as suppliers scale up and learn by doing, have overturned past expectations for the scope and cost of abatement possible through renewable energy and electric vehicles.

Technological change and innovation have been grappled with poorly by many policy-makers and modellers, who often find it easier to estimate that change happens in a linear manner or is subject to tight limits on potential improvement. **Box 4** explains why this approach is unfounded for key emissions reduction technologies.

Finally, a wide body of domestic and international economic research supports the finding that it is cheaper to act on climate change than not to act.⁴³ All drivers continue to point in this direction, as the costs of emissions reduction technologies keep falling⁴⁴ and the observed and projected impacts of climate change become more severe.⁴⁵ If global emissions continue to accumulate at recent rates, climate change is likely to create significantly more risk and damage for Victoria's communities and economy. A study by the University of Melbourne conservatively estimated that Victoria would incur damage costs of about \$150 billion by 2050 and \$1 trillion by 2100 if emissions continue to grow at the rate seen in recent decades.⁴⁶ This is likely to understate the true costs as it does not include most of the costs of floods, bushfires, pollution and biodiversity loss — which, as outlined above, can be significant. Another study at the global level found that the physical impacts of unmitigated climate change could be up to 20 per cent of global GDP by 2100.⁴⁷

BOX 4. TECHNOLOGY COSTS FALL FASTER THAN MOST PREDICTIONS

Many approaches to estimating costs for key technologies to reduce emissions underestimate how quickly and steeply costs of many new technologies will fall. In 2010, for instance, solar photovoltaics was seen as a niche and expensive technology. Since then, solar costs have fallen by more than 89 per cent. The costs of wind energy and batteries, including electric vehicle batteries, have also fallen by far more than most predicted. This can lead to large overestimates of the cost of future actions, and deter ambition to set stronger climate targets.

In modelling, including in the modelling prepared for this Panel's work, artificial constraints are often placed upon the growth of renewable technologies, to attempt to enforce assumptions that seem realistic at the time of modelling.

A new proposed approach to predicting future technology costs has been proposed by researchers at Oxford University. This approach has a much stronger predictive ability than other approaches, as tested against historical data. It uses the well-evidenced concept that each technology has a 'learning rate', distinctive to that technology, which can be observed after a few years of data, and stays constant for up to several decades. The learning rate represents the many minor or major improvements, from technological breakthroughs to factory-floor tweaks, that happen as things get made and make it easier and cheaper to make and deploy more of those things. Many technologies, such as coal and gas extraction, have low learning rates and broadly steady costs over the long term. Others, including solar, wind, battery and electrolysis technologies, have much higher learning rates.

For technologies with fast learning rates, the more we deploy, the more costs fall. The Oxford team's forecasting approach lets well-evidenced learning rates play out in line with assumed rates of technology deployment, rather than imposing artificial and poorly evidenced limits on how far innovation can go. Applying this approach to

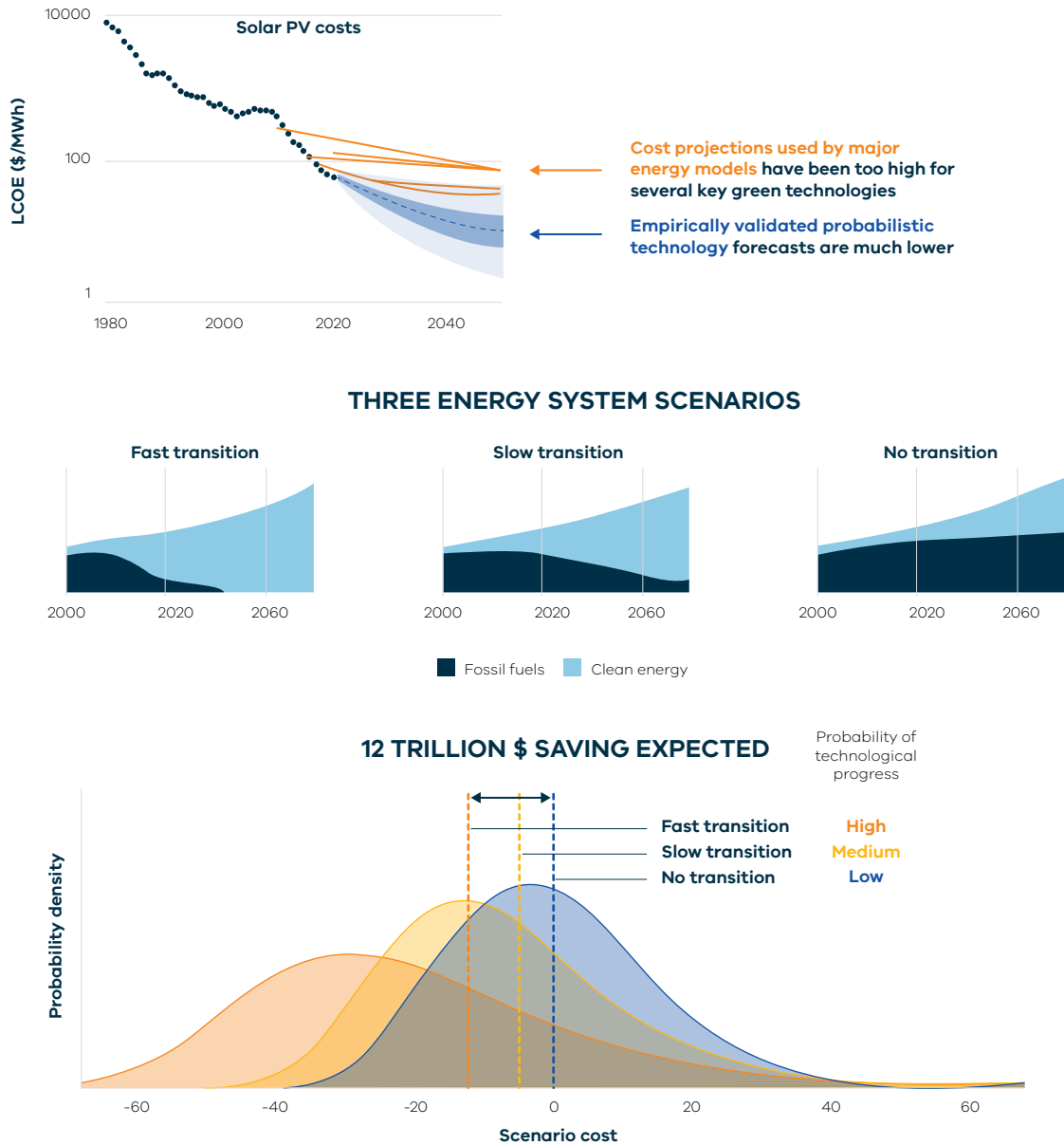
several scenarios for global climate transition, the Oxford team conclude:

- Faster deployment of technologies with high learning rates produces faster cost declines.
- For these technologies, there is no green premium from faster action. There is a green prize. Exponential deployment and exponential cost reduction reinforce each other.
- A fast global transition to net zero emissions, focusing as far as practical on deployment of technologies with high learning rates especially solar, wind, batteries and electrolysis, is not low-cost but negative-cost, producing net savings through 2070 of \$US5 trillion – \$US15 trillion compared to no transition — and without accounting for avoided climate damages at all.
- Existing economic modelling approaches need to be balanced, and assumptions underpinning climate policy need to be updated, by more realistic treatment of the expected costs of technologies with high learning rates. Doing so "could fundamentally change the debate about climate policy and dramatically accelerate progress to decarbonise energy systems around the world."

Figure 6 depicts three data sets for solar PV costs: historical costs, the high-cost estimates in widely used Integrated Assessment Models, and the lower probabilistic forecasts from the Oxford paper; along with the modelled costs of scenarios for faster and slower global transition.

For Victoria, this research is a reminder that energy transition has already been much faster and cheaper than expected; that forecasts about future costs of action should be based on a careful consideration that includes rates of learning about that technology, not just on its current availability or costs; and that backing successful technologies with sustained rapid deployment is the key to reducing costs both for those technologies and our transition as a whole.

Figure 6. Graphical abstract of the Oxford learning rates research, examining the global transition



Source: Way, R. et al. (2022), Empirically grounded technology forecasts and the energy transition, *Joule* 6, 2057-2082, accessed: [www.cell.com/joule/pdf/S2542-4351\(22\)00410-X.pdf](http://www.cell.com/joule/pdf/S2542-4351(22)00410-X.pdf).

The reality of non-linear technology change reinforces the imperative for strong action in Victoria. The Government can take account of the cost reductions driven by global deployment, make calculated decisions about where to invest directly in new technologies that have strong potential, and secure its own further cost reductions through learning from Victorian action. As well as the immediate benefits, obtaining an early-mover advantage in a technology that then takes off around the world creates a whole potential market for skills, advice and expertise on the future of that technology as its learning curve progresses. The Government's decision to invest directly in renewable energy through a revived State Electricity Commission (SEC) can be viewed through this lens, as can policies to attract private investment such as the Offshore Wind Target.

Technology change may be fast but change in social readiness to adopt new technologies takes time and planning. Capitalising on opportunities from new technologies will require investment in skills, training and corporate and regulatory structures that can respond to upcoming changes. Building a degree of resilience to technological change into all its climate change planning will help the Victorian Government maximise opportunities from the transition.

'Transitioning to zero emissions presents enormous opportunities to develop the clean energy industry, generate jobs, boost economic productivity, and position Victoria as a leader in renewable technologies.'

City of Melbourne

THE COMMUNITY EXPECTS AMBITIOUS ACTION IN LINE WITH CLIMATE SCIENCE

The Panel heard from a wide range of stakeholders through their consultation process and found strong community and business support for ambitious emissions reduction targets and increased government climate action. While most organisations did not put forward an emissions reduction target, about one third of submissions and half of survey respondents recommended an emissions reduction target of net zero by 2035.⁴⁸

The most consistent message from stakeholders was the call for a science-based emissions reduction target for 2035, that is aligned with limiting peak warming to 1.5°C. The findings of the Panel's consultation are consistent with studies into Australian attitudes to climate change and expectations of government, with a clear majority of people wanting to see urgent climate action.⁴⁹

'Setting a science-based 2035 climate target will decrease the long-term risk of climate disasters, which will (and should not) fall on the shoulders of younger generations to deal with.'

Youth survey respondent

'The BSL recommends that Victoria adopt a 2035 emissions target consistent with our Paris Agreement commitments, and make a fair contribution to global efforts to limit global warming to 1.5°C if at all possible. Warming above 1.5°C will lead to very large additional harm [...] People facing disadvantage are likely to be affected disproportionately badly.'

Brotherhood of St Laurence

'The science has proven that limiting global warming to 1.5°C is the best result for Victorians' health and wellbeing, which should be the basis of the state's 2035 emissions reduction target.'

Victorian Council for Social Services

Many stakeholders the Panel heard from also highlighted the need for careful planning for the state's transition to net zero emissions. These stakeholders wanted to see a transition that seizes the economic opportunities and shares the benefits fairly. Respondents to the Panel's survey identified economic benefits as the biggest opportunity in Victoria's transition to a low emission economy, with a focus on the potential economic opportunities from the growing renewable energy industry. Many stakeholders also highlighted the need for strong planning and investment to reduce risks and to support an orderly shift to renewables, including the continued supply of affordable, reliable, and safe energy for Victoria's homes and businesses.

'We know the transition is coming. It is foreseeable. It should, therefore, be manageable. How we act today to prioritise a just and orderly transition will determine whether Australia fulfils its potential to emerge a winner in the global race to net zero'

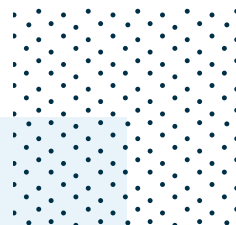
Investor Group on Climate Change⁵⁰

'Not only is cutting emissions imperative for the safety of our state and its people, serious reductions are vital to provide investment signals, stimulate innovation, create new jobs, improve health and drive economic efficiency. In other words, action on climate change is not just a challenge; it is also a major opportunity'

Victorian Trades Hall Council

As with the impacts of climate change, the costs and benefits of economic transition to net zero will be unevenly distributed. Many stakeholders the Panel consulted with wanted to see a fair transition, which includes support for communities shifting away from high emissions industries, while also sharing the benefits of new industries and jobs that can come from a well-managed economic transition to net zero in Victoria.

Action to reduce localised negative socio-economic impacts from the shift to net zero emissions is embedded in the Paris Agreement,⁵¹ and is a guiding principle of Victoria's Climate Change Act. Careful planning and early consultation will be needed to ensure a fair and equitable transition for communities dependent on carbon intensive industries such as the Latrobe Valley community where Victoria's coal powered stations are located (see **Box 5**), Portland which is home to an aluminium smelter, and Gippsland which is where Victoria's native timber harvesting is concentrated.



BOX 5. TRANSITION IN THE LATROBE VALLEY

Victoria's largest current source of emissions is electricity generation from coal-fired generators. A central component of the Victorian economy's transition to net zero emissions will therefore be an energy transition which, as noted in **Box 3**, is well underway and accelerating. Victoria's major coal-fired generators are all located in the Latrobe Valley, meaning that the impacts of this transition will be concentrated in this community.

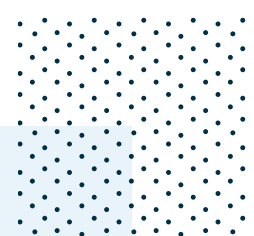
The Panel met with a broad range of industry and community stakeholders from the Latrobe Valley region as part of their consultation process. It was clear that the region's experience of the 1990s electricity sector reforms was painful and the impacts continue to be felt. Many stakeholders emphasised the importance of deep, early and meaningful consultation with affected communities to co-develop and implement a proactive plan for the community's future. Others emphasised the need for a clear timeline for the transition, well in advance, to give the community time to evolve and adapt. Attracting and building new industries in affected regions, creating new jobs, reskilling workers, and ensuring broader community benefits have been underlined as key. Participants were clear that electricity system transition plans like AEMO's Integrated System Plan are not a substitute for planning the transition of regions, communities and workers.

Government work is underway in the space. The Victorian Government has committed to establishing an office in Morwell for the revived

State Electricity Commission. The Victorian Government's Latrobe Valley Authority (LVA) — established in response to the sudden closure of the Hazelwood Power station in 2017 — has sought to bring together workers, companies, unions, and governments to change and diversify the regional economy and address entrenched disadvantage over the coming decades. Stakeholders expressed support for the work of the LVA⁵² and for their current work on a Transition Plan.⁵³ The Victorian Parliamentary Inquiry into the closure of Hazelwood and Yallourn Power Stations, found:

The Latrobe Valley Authority's approach to regional transition is aligned with Victorian Government objectives to facilitate transition and development. As the first consolidated model of program and economic support for large-scale economic transition in Australia, it aligns with international place-based approaches to equivalent challenges. It is tailored, proactive and well-integrated across the Latrobe Valley's communities, and has a significant role in the implementation of broader Victorian Government policies and programs.⁵⁴

The Panel's recommendations for whole of government planning in this report envisage a strong and continuing role for bodies including the LVA to play vital coordination roles in their areas, and potentially to increase their scope and activities to help communities engage in the low emissions transition.



FIRST PEOPLES

During the Panel's consultation, there was broad stakeholder support for the Victorian Government to improve collaboration with Victoria's Traditional Owners and Aboriginal Victorians on climate action. The Panel's statutory deadlines to finish this report permitted only limited engagement with Traditional Owners and Aboriginal Victorians, rather than a more thorough two-way dialogue that could consider the specific needs and aspirations of different Traditional Owner groups within Victoria.

'The changes that we are seeing in the climate are placing pressure on already fragile ecosystems, and we expect this impact to continue'

Dhelkunya Dja, Dja Dja Wurrung Country Plan 2014-2034⁵⁵

'With climate change, harsher weather patterns and longer fire seasons prevail... More frequent and severe droughts due to climate change will result in less water in waterways and wetlands and therefore less water for plants and animals...Our warr or sea country is heating up with climate change.'

Paleert Tjaara Dja, Let's make Country good together 2020 – 2030, Wadawurrung Country Plan⁵⁶

'Yorta Yorta have known for generations that the land, water and air of our Country is damaged...The science is overwhelming that climate change has arrived, and that the problem is the level of carbon emissions and other greenhouse gases that are in the atmosphere. That comes from a deeper sickness in the land and water, and our way of life...It distresses and shames us that our Country is under this threat'

We call for urgent local, national and international action to fix the causes of global climate change...We demand action to heal the land and water of our Country and the lands and waterways around us, to restore their natural capacities to store carbon, and to increase the resilience of Country to deal with the impacts of a hotter, drier climate and more extreme weather...We commit to sharing our knowledge and leading the healing of our Country through our work on land and water in partnership with governments, conservation groups and land holders, and through our activism and our influence.'

Yorta Yorta Whole-of-Country Plan 2021-2030⁵⁷

'Caring for Country...requires the skills to manage introduced plants and species, climate change and land management practices that are damaging our Country...We are determined to take an active role in healing Country for future generations. We will work with others to heal Country, above and below the surface, so that it is healthy for all.'

Taungurung Buk Dadgabi, Taungurung Country Plan⁵⁸

On the advice of Victorian Traditional Owners, the Panel has reviewed Traditional Owner Country Plans and considered priorities for Country as articulated in these plans. The plans state that Country is sick, with many referencing the specific impacts of climate change. The plans are centred on healing, protecting and managing Country in harmony with the natural and cultural traditions and values of Traditional Owners. Many include references to building climate resilience and reducing the impacts of climate change as part of this healing, or describe actions that would likely reduce emissions even though the main intent of the action is other benefits. Many also talk about aspirations for developing employment and economic opportunities On-Country. The plans can be used by the Victorian Government as a starting point for working with Traditional Owners to find points of intersection between actions to reduce emissions and their aspirations for their lands and peoples.

The Panel acknowledges the Victorian Government commitment to Aboriginal self-determination and supports the development of Treaty as the embodiment of self-determination in Victoria, recognising that Aboriginal Victorians hold the knowledge and expertise about what is best for themselves, their families and their communities. The Panel also notes the wealth of knowledge Aboriginal Victorians have in holistic management of country, including leading cultural burns and cultural land conservation.

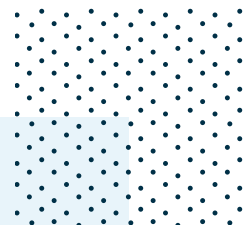
The Panel considers that the Victorian Government should work closely with Traditional Owners and Aboriginal Victorians in planning Victoria's transition to net zero emissions, guided by the principles of self-determination. This includes working with Traditional Owners as resource holders and decision makers for Country, providing adequate resourcing for Traditional Owner engagement and adhering to timeframes that respect the community protocols Traditional Owners operate within. The Panel also suggests that the Victorian Government work with Traditional Owners and Aboriginal Victorians on climate actions that support the advancement of Treaty and aspirations in Traditional Owner Country Plans and in the Victorian Traditional owner Cultural Landscapes Strategy, including climate action that helps to heal country and to transfer power and resources.

'[Youth roundtable] members expressed feeling frustrated and stressed at the lack of action being taken by those with power to make tangible change.'

Youth roundtable report

'Climate change is already having a huge impact on my health as a disabled person... Every year it gets worse, and I am already being forced to consider moving to survive the impacts of climate change.'

Youth roundtable participant



'Meet more with young people and groups who have been advocating for climate justice for years and get their insight (School Strike 4 Climate, SEED mob, AYCC).'

Youth roundtable participant

'Aboriginal and Torres Strait Islander people need to be actively engaged in decision making at the government level, and appropriate structures should be in place to ensure they have safe, accessible and meaningful participation in decision making, such as involving them in genuine co-design practices'

Youth roundtable recommendation⁵⁹

YOUNG VICTORIANS

Young people in Victoria were among those with passionate views about climate action. The Panel ran a youth survey to get a broad understanding of youth views, and a youth roundtable to understand young people's views of climate issues in more depth. Young Victorians expressed deep anxieties about their future and serious concerns about the climate impacts they were already facing. They wanted to see broad social and economic system change that shifts the balance of responsibility to reduce emissions from individuals to businesses and government. Young people were also eager to co-design climate policy and particular emphasis was placed on Aboriginal and Torres Strait Islander justice, sovereignty and equity in developing climate action.

Other priority climate actions for Victoria's young people were banning new coal and gas projects, the protection of forests and ecosystems, increased urban green space, improved public transport, regenerative and local agriculture, energy efficiency support for renters and those living in apartments, climate education, and protecting those most vulnerable from the impacts of climate change.

The Panel encourages the Victorian Government to work closely with young Victorians on planning and policy for the state's zero emissions future, using tailored consultation approaches to engage and involve them. Beyond engagement, it is critical that the ambition and credibility of Victoria's climate targets provides a strong basis for young Victorians' confidence in their future.

CLIMATE ACTION BRINGS COMMUNITY AND ENVIRONMENTAL BENEFITS

Climate action can also bring other wide-ranging and valuable co-benefits including improvements for health, environment, and social equity.

REDUCING THE HEALTH AND WELLBEING IMPACTS OF CLIMATE CHANGE

The World Health Organisation has called climate change the greatest health challenge of the 21st century.⁶⁰ Reducing the impacts of climate change such as extreme heat, bushfires, drought and floods, has direct benefits for the health and wellbeing of Victorians. The impacts include heat stress, respiratory issues, exacerbation of cardiovascular disease, injury and death. Climate change also has serious and wide-reaching impacts on mental health and wellbeing,⁶¹ with youth being particularly affected.⁶² Some Victorians have been found to be more vulnerable to all impacts of climate change including children, people over 65, people experiencing financial hardship or homelessness, and people with a disability or chronic health conditions.⁶³

HEALTH IMPROVEMENTS FROM REDUCED EMISSIONS

The combustion of fossil fuels in electricity generation and transport, and in gas appliances in homes and businesses, not only creates greenhouse gas emissions, it also creates local air pollutants such as nitrous oxides (N₂O), sulphur dioxide (SO₂), carbon monoxide (CO) and fine particulate matter (PM₁₀, PM_{2.5}). These can have serious health impacts such as increasing the risk of cardiovascular and respiratory illnesses.⁶⁴ Young children are at particular risk of impacts from the use of gas appliances in the home, such as increased asthma, reduced lung function and slower brain and behavior development.⁶⁵ One study estimates that the measures to meet a 2035 emissions reduction target of around 80 per cent could create human health benefits for Victoria of 5.7 billion (net present value 2022 to 2070), relative to the state taking no further action beyond 2030.⁶⁶ This only considers benefits from reduced outdoor air pollution, and is therefore likely to be an underestimate as it does not include other difficult-to-quantify health benefits such as effects on mental health that were raised by many young people in Victoria.⁶⁷

Electrification and improving the energy efficiency of homes can have both health and financial benefits for Victorians. Homes that are too cold in winter contribute to six per cent of deaths in Australia, double the rate of Sweden.⁶⁸ Australian homes also use significantly more energy than those designed to higher standards overseas.⁶⁹ While the quality of electrification and system integration will shape overall savings, one source estimates that improved energy efficiency and electrification of an average Australian household could create \$5,433 of financial savings per year by 2030, while also improving thermal comfort.⁷⁰

'Ensuring cities have plenty of green spaces is key to the liveability of cities and improving people's impacts on climate change'

Youth roundtable participant

'The design of urban spaces is crucial in lowering [climate and air] pollution. While the adoption of electric vehicles may help reduce the use of more polluting petrol and diesel vehicles, it is better to avoid the use of vehicles entirely.'

Australian Parents for Climate Action

'Better health is exciting (reduced pollution, less heatwaves), the climate crisis is a health crisis, so better health and wellbeing is exciting.'

Youth roundtable participant

'[I'm excited] at the possibility of breathing fresher air and seeing the stars at night.'

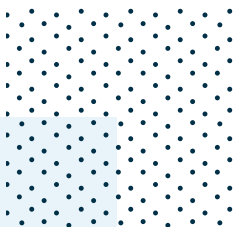
Youth roundtable participant

IMPROVING ENVIRONMENT AND BIODIVERSITY

Reducing emissions through preserving and increasing vegetation across the state has economic benefits but can also have further critical co-benefits for biodiversity and the environmental systems that support Victorians. Emissions can be reduced through improved forest management, revegetation of public and private land, and working with landholders to increase vegetation. The actions can have flow-on effects such as increasing resilience to climate-related extreme events, improving air quality, habitat preservation and creation, supporting biodiversity, and addressing wider land and water management challenges.

EMISSIONS REDUCTION BENEFITS FOR COMMUNITIES

Increasing plantings in urban areas was raised as an opportunity by many stakeholders and was a key topic at the Panel's youth roundtable. Youth advised the Panel that 'ensuring cities have plenty of green spaces is key to the liveability of cities and improving people's impacts of climate change'⁷¹ Urban areas with more tree cover can reduce the impacts of extreme heat, improve air quality and support healthy and connected communities, by providing spaces for social interaction and exercise. Other stakeholders cited urban planning as providing many opportunities, not only for climate but also for health and community-building. Active transport such as cycling and walking, is a demonstrated example of a policy with multiple overlapping benefits.





HOW TO ACHIEVE THE TARGET AND SUPPORTING ACTIONS



INTRODUCTION

A 2035 target of 80 per cent below 2005 levels, and net zero emissions by 2045, can be achieved with known technologies and actions while the economy continues to grow, and communities thrive. This requires early, deliberate, holistic and transformational policy and investment. This part of the report identifies priority areas of action for the Victorian Government.

EMISSIONS REDUCTION ACTION NEEDS TO BE ACCELERATED ACROSS THE WHOLE VICTORIAN ECONOMY

A step change is required across all sectors of Victoria's economy, and this needs to accelerate now. While the speed and ultimate extent of decarbonisation by 2035 will vary by sector, depending on abatement costs and available technologies, no sector will be able to avoid transformative change. This is in line with the IPCC's latest advice that global emissions pathways to limit warming to 1.5°C imply an immediate strengthening of policies and rapid reductions in emissions.⁷²

Victoria's projected emissions indicate the state is on track to achieve its 2025 interim target, based on current and committed government policies and projected market conditions. Significant additional action is required to meet both the Victorian Government's existing target to halve emissions by 2030, and to reduce emissions by 80 per cent below 2005 levels by 2035 (**Box 6**).

BOX 6. ACHIEVING AN 80% 2035 TARGET REQUIRES GOVERNMENT ACTION TO DELIVER A STEP CHANGE FROM BUSINESS-AS-USUAL

The Panel looked at emissions projections to inform its advice to Government. These projections reflect Victorian and Commonwealth policy settings as of July 2022, with the exception of the electricity sector, which incorporates the Panel's expectation that all of Victoria's remaining coal-fired power stations will be closed by 2035, in line with AEMO's 'Step Change' scenario.

Without further action, emissions are projected to decline to 38 per cent below 2005 levels in 2030, due to a flattening in transport emissions and continued decline in emissions from electricity generation — leaving a 7 to 12 percentage point gap to meet the Victorian Government's target of 45–50 per cent reductions by 2030. This means that action must accelerate this decade to meet the Government's

2030 target as well as enabling Victoria to achieve strong targets for 2035 and beyond.

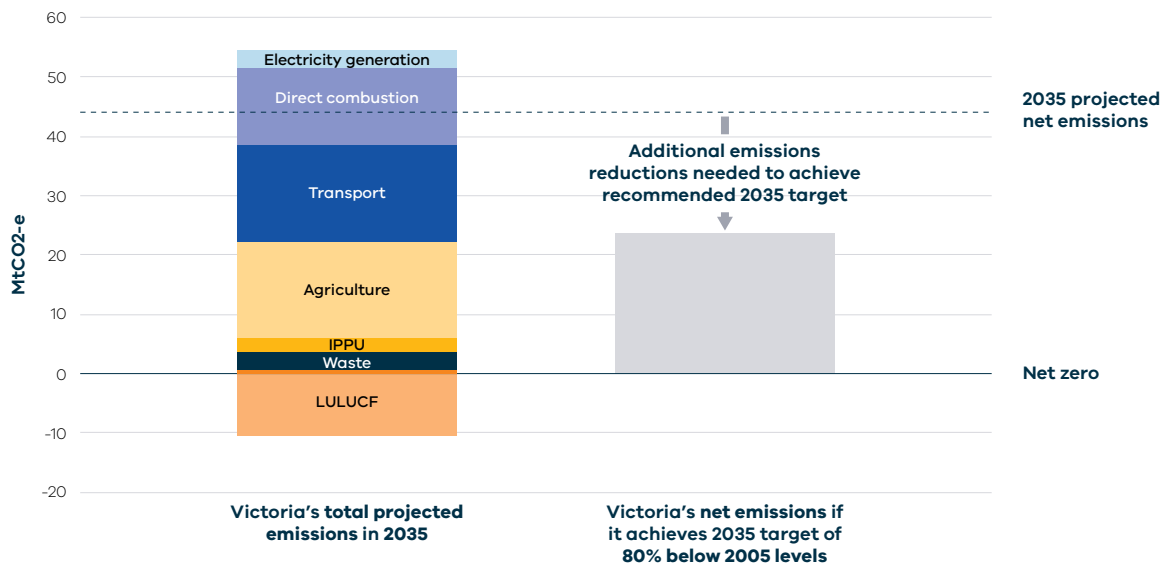
Emissions are then projected to decline further to reach 63 per cent below 2005 levels in 2035. This is primarily due to the significant decarbonisation of electricity generation by 2035. Transport emissions are also projected to fall between 2030 and 2035 as zero emissions vehicles become mainstream, with a small contribution from a continued switch to use of low emissions refrigerant gases. Emissions in other sectors are projected to remain relatively flat.

Emissions would need to decline by a further 17 percentage points, or nearly double the projected business-as-usual rate, to meet the recommended 2035 target of 80 per cent below 2005 levels.

Thus, while significant, the rapid decarbonisation of Victoria's electricity generation sector between 2030 and 2035 alone will not be sufficient to meet the Panel's recommended 2035 target (Figure 7). New, ambitious action must be taken in all other

sectors as well. Priority actions in Victoria's major emitting sectors, and cross-cutting considerations, are set out later in this section.

Figure 7. Substantial additional cuts to emissions across the economy will be needed to achieve a 2035 target



Notes:

- These projections show what Victoria's emissions are expected to be with no new policies beyond the Victorian and Commonwealth emissions reduction policies as of July 2022, with the exception of the electricity sector which reflects the Panel's expectation that Victoria's remaining coal-fired power generators will be closed by 2035. The projections also incorporate projected market conditions out to 2050.
- Direct combustion emissions are primarily from gas use in industry, commercial buildings and homes.
- LULUCF is an abbreviation of Land Use, Land Use Change and Forestry.
- IPPU is an abbreviation of Industrial Processes and Product Use
- The non-labelled sector is fugitives (dark orange).
- Net emissions are the sum of emissions from all sectors minus net absorption by the LULUCF sector.



ACHIEVING ADDITIONAL REDUCTIONS BY 2035 REQUIRES POLICIES TO BE PLANNED AND IMPLEMENTED NOW

Planning and implementing good policy takes time, and there can be a lag between policy implementation and realisation of actual emissions reductions. For example, it can take between five and ten years for new tree plantings to deliver a small carbon benefit and decades for the full potential rates of sequestration to be realised.⁷³

Households, businesses and governments also need time to adjust their behaviour and investments to reduce emissions in a cost-effective way. This is particularly the case for policies relating to long-lived assets such as power stations, vehicles, buildings and industrial equipment. For example:

- Substantial lead times are required to plan, permit and build new electricity generation projects, as well as the infrastructure, manufacturing facilities and resources projects needed to supply and support them — particularly when changing from predominately fossil fuel generation to a system mainly using renewables.
- The average age of a light passenger vehicle on Victoria's roads is 10.3 years, and the average lifespan of a domestic gas hot water system is similar. Given the turnover rate of these assets, new purchases of these assets is likely to lock in emissions for at least a decade and policy intervention is required as soon as possible.
- Almost every capital investment decision made by the industrial sector from today will impact emissions for decades.⁷⁴
- Buildings last multiple decades. Over half the buildings standing in 2050 will be built from now,⁷⁵ meaning policies to reduce the emissions of new builds today will help meet the 2035 target and net zero emissions by 2045.

Putting emissions reduction policies in place now will give households, businesses and governments the confidence to invest in low-emissions technology and innovation — setting them up to reduce their emissions to 2035 and beyond.

Early signals, planning and policy implementation are also necessary to secure supply of low-emissions products. Victoria is dependent on global supply chains for many products and components needed to support a low-emissions transition — such as zero emissions vehicles — and is competing with other jurisdictions to secure currently-limited supply of these. If manufacturers and the resources sector are going to increase production of low-emissions products and the materials that go into them, they need to have confidence that the demand will be there for these products both now and in the future. Sending a clear signal with a strong 2035 target and a clear policy pathway to achieve this target, and diversifying supply chains, can help ensure that Victoria has access to the products it needs to decarbonise.

The gap between Victoria's projected business-as-usual emissions and the Panel's recommended 2035 target, coupled with the lag times and supply chain challenges outlined above, mean that policy action needs to accelerate now. Several stakeholders stressed this point in their submissions to the Panel's public consultation process.

'To support Victoria to decarbonise, the Victorian Government will need to prepare and establish stable policy settings to transform the energy, waste, resources, transport and building sectors for the future. Considering the time it takes to plan, design, finance and build new infrastructure, Australia's market and regulatory structures will also need to adapt to cope with the global shifts underway and accelerating growth in low emissions technologies, storage and generation.'

Victorian Chamber of Commerce and Industry

'The significant lead time for the development and production of vehicles must be considered in setting future regulation'

Federal Chamber of Automotive Industries

'We encourage the Panel to think in terms of appliance and vehicle lifetime emissions and to prioritise incentives and measures that ready our state for full decarbonisation. Personal cars and home appliances for hot water, space heating, cooking and pool heating are major investments that tend to be operational for well over a decade. Replacements are purchased only very infrequently.'

EnergyAustralia

INTRODUCING THE PANEL'S RECOMMENDATIONS

Climate action planning

Victoria's transition to a low emissions economy will deliver maximum benefits if well coordinated. The scale of action needed in Victoria touches on all parts of the economy, and therefore needs to be planned centrally, early and with clear deliverable outcomes. This planning will need to coordinate and sequence climate action between sectors, attract and leverage private sector finance, and secure the supply chains and skilled workforce needed for the transition.

Priority areas for action

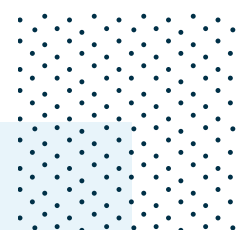
The Panel advises that strong and urgent policy action needs to be taken by the Victorian Government in all of the following five areas to support the scale of change required by 2035.

- Rapidly manage the transition of Victoria's electricity system.
- Accelerate phase-out of natural gas use with an immediate focus on Victoria's built environment.
- Accelerate uptake of zero emissions vehicles (ZEVs).
- Prioritise and invest in carbon-rich and biodiverse landscapes.
- Begin a step change in reducing emissions from livestock.

These correspond to the largest sources of emissions in the Victorian economy, and are supported by multiple analyses mapping potential Victorian pathways to net zero emissions.

Cross sector enablers

Delivering action in the priority areas will also require enabling policies that support change across the whole economy including the investment, workforce skills and supply chains needed for the new economy. Details on these cross-sector enablers are at the end of this section.



WHOLE OF ECONOMY CLIMATE ACTION DELIVERY PLAN

Achieving the recommended target for 2035, and net zero emissions by 2045, will require a complete transformation of Victoria's entire economy. This cannot be achieved with a siloed or piecemeal approach. A holistic, centrally-led plan is needed to manage a transition of this speed and scale, which not only encompasses all sectors of the economy, but also maps out a whole-of-government approach to the critical enablers necessary to implement the transition: finance, supply chains and skills. A single, central plan can also ensure that cross-sectoral linkages are considered in a holistic way, and can take an overarching approach to considering how Victoria can leverage the state's key competitive advantages and points of difference in a global economy transition to net zero emissions. Other jurisdictions have demonstrated what a whole-of-economy climate action delivery plan can look like, as illustrated in the Case study below.

CASE STUDY: HOLISTIC PLANNING IN ACTION

Many of the jurisdictions leading ambitious climate and emissions reductions action have developed economy-wide plans. These plans provide the overarching strategy required to best support rapid emissions reductions while seizing the potential opportunities and minimising transition risks.

California

In November 2022, California released its Scoping Plan for Achieving Carbon Neutrality (Scoping Plan). This provides a roadmap for the state to achieve net-zero emissions by 2045 or earlier, and is based on principles including the pursuit of private and public partnerships and innovation. Through the Scoping Plan, the Californian Government is setting clear, sustained market and policy signals to support scalable emissions reduction innovations for commercialisation and deployment.

California's holistic approach includes policies and programs targeting both supply and demand to build new markets.

- Supply-focused policies include supporting businesses to demonstrate and refine technologies which can progress to the establishment critical supply chains, including technology developers, manufacturers, processors and assemblers across low-emissions industries.
- On the demand side, policies and programs provide outreach, education, and incentives to motivate everyone from consumers to utility planners to adopt new, climate smart technologies.⁷⁶

The UK

In 2021, the UK released its 'Net Zero Strategy: Build Back Greener' (Net Zero Strategy). Like California, the Net Zero Strategy sets out how the UK intends to decarbonise, including planned transitions for fossil fuels, internal combustion vehicles and residential gas boilers. The Net Zero Strategy also outlines the steps required to seize green economic opportunities and leverage further private investment towards decarbonisation.

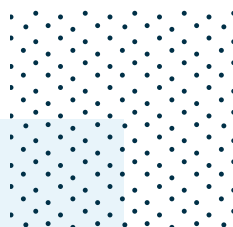
Strategic use of public funds, establishing stable and long-term policy frameworks, and providing market signaling are central goals to best leverage private investment into the technologies and infrastructure that will be needed to deliver net zero. Complemented by other spending initiatives and regulations, the policies and programs included in the UK's strategy are expected to support 440,000 jobs and leverage up to £90 billion of private investment by 2030.⁷⁷

The EU

The EU's Green Deal is a holistic and multi-faceted approach to deliver transformational economy-wide change.⁷⁸ It will support the EU to achieve its 2030 emissions reduction target of 55 per cent and its net zero by 2050 target.

To be backed by an estimated €500 billion in investments⁷⁹ — and including other enabling factors such as tax reforms — the overarching EU Green Deal will guide the delivery of a comprehensive suite of policy reforms, including:

- Creating a more sustainable transport sector including a target of 55 per cent emissions reductions from cars by 2030.
- Catalysing a green industry transition through renovating 35 million buildings and creating 160,000 additional green jobs by 2035. This aims to create markets for clean technologies and products across entire value chains.
- Generating cleaner electricity by legally-binding targets of 40 per cent for renewable energy and 36 to 39 per cent for energy efficiency by 2030.
- Renovating the built environment, including requiring EU Member States to renovate at least 3 per cent of the total floor area of all public buildings annually.
- Restoring and protecting carbon and biodiversity in Europe's lands and forests with the aims of increasing carbon sequestration from current levels of negative 268 Mt to negative 310 Mt.



The process to develop such a plan is as important as the plan itself. Achieving the transition to a net zero emissions economy will need the full cooperation and coordination of all players, at all levels of government as well as the private sector and the Victorian community. Developing this plan through a process of deep and broad consultation would help ensure there is a shared understanding of the collective effort required to reach net zero emissions by 2045, and that the plan leverages the knowledge and strengths of all players.

For maximum impact, state-level climate planning should be integrated with the plans of others. In Western Australia, each council is required to produce a strategic plan in consultation with its community, reviewed every 5 years, and integrated with other council processes to ensure integration of workforce and budget planning to strategic community-informed goals.⁸⁰ Plan Melbourne is a similar initiative in Victoria, that already includes clear sustainability goals out to 2050, backed by an implementation plan.⁸¹ The Victorian Government's

climate action delivery plan should inform these place-based planning efforts, and be informed by them in its development.

The plan will also need to be able to facilitate the fast tracking of development where required, while still involving the community at every stage. The Victorian Government has already begun this balancing function for renewable energy developments. For instance, in March 2020 the Victorian Government passed amendments to the *National Electricity (Victoria) Act 2005* to allow it to depart from the national electricity rules where needed to expedite necessary network investments. And the Victorian Renewable Energy Roadmap Transition Economic Modelling Tool has a user-friendly site that can show overlays of planning data required to help inform both communities and potential investors, including for instance a map of truck routes around the state that are large enough to carry large equipment.⁸² Such integrated thinking could helpfully be extended to all other sectors in the transition to net zero in Victoria.

PANEL RECOMMENDATION: CREATE A WHOLE-OF-ECONOMY CLIMATE ACTION DELIVERY PLAN

Victoria's transition to a low emissions economy involves all parts of the economy and will deliver maximum benefits if well coordinated, targeting clear and deliverable outcomes. The Victorian Government is due to deliver an update to its Climate Strategy by October 2025. However, earlier, additional guidance in the near term will help to clarify the scope and staging of implementation and investment requirements for decarbonisation.

The Victorian Government should:

- Develop a world-leading climate action delivery plan by June 2024 to guide the state's transition to a net zero economy by 2045. This plan must be a comprehensive implementation plan to transform Victoria's economy in line with the recommendations below to deliver all necessary measures to achieve the 80 per cent target.
- Demonstrate how the Government intends to unlock investment in the transition for all major sectors, including creating investable policy frameworks that require the reduction of emissions and adoption of new technologies; underwriting investment; or investing directly (as planned in the revived State Electricity Commission).
- Map out, through this plan, an approach to secure access to key supply chains and the skilled workforce needed for the transition.
- Involve, collaborate and coordinate with all levels of government, Traditional Owners, experts, community groups, industry, unions, the research community and the investment community in the development and execution of the plan.



ELECTRICITY GENERATION

THE CASE FOR ACTION: ELECTRICITY GENERATION

Deep decarbonisation of Victoria's electricity generation will be central to meeting the 2035 target, and is core to the transition to a net zero emissions economy by 2050. Decarbonising the sector will both directly address Victoria's largest source of emissions, and is a critical enabler for emissions reductions in other sectors through electrification, such as in transport, industry, buildings and agriculture.⁸³ Renewable energy and phasing out fossil fuels were the top opportunities to cut Victoria's emissions identified by participants in the Panel's consultation process.

In the Panel's view, all signals point to the closure of all of Victoria's coal-fired power stations by 2035. EnergyAustralia has announced the closure of Yallourn Power Station in 2028, AGL has announced the closure of Loy Yang A power station in 2035, and AEMO's Integrated Systems Plan 'Step Change' — viewed by energy sector stakeholders as the most likely scenario to eventuate — has all of Victoria's coal-fired power stations exiting the system by 2032.⁸⁴ The Victorian Government's commitment to 95 per cent renewable electricity by 2035 commits to a rapid electricity sector transition. Confidence in and growing anticipation of a deep and rapid decarbonisation of the electricity sector is strengthened by the clear, affordable technological solutions that are available now.⁸⁵

Replacing the two thirds of Victoria's electricity generation capacity currently provided by coal — and adding more capacity, to meet increased demand driven by electrification of other sectors — by 2035 is a significant task. By way of illustration, under the AEMO's 'Step Change' scenario the

capacity of the National Electricity Market will need to almost double from today's levels by 2035, and more than treble today's levels by 2050, with the majority of this coming from wind, utility-scale solar and distributed solar photovoltaic panels.⁸⁶ Transforming the electricity system at this speed and scale will require significant planning, coordination and investment.

'The sooner that Victoria capitalises on and maximises the 'easier' wins — such as renewable energy, the early retirement of Australia's coal-fired generation fleet by 2035 and accelerating the introduction of electric vehicles — the more scope this gives Victoria to tackle more challenging sectors and questions.'

Melbourne Climate Futures

VICTORIA'S CURRENT ACTIONS: ELECTRICITY GENERATION

Victoria's electricity sector emissions are already down by over a third compared to 2005 levels, and the Victorian Government has a range of policies in place to further decarbonise the electricity sector. These include:

- A commitment to 95 per cent renewable energy in 2035.
- The legislated Victorian Renewable Energy Targets (VRET) of 40 per cent renewable electricity and 2025 and 50 per cent by 2030 — which the Victorian Government has committed to increase to 65 per cent. These targets help create the policy certainty needed for investment to build new large-scale energy

generation projects. They are underpinned by the VRET reverse auction mechanism which attracts and leverages private investment to build the projects needed to meet the targets.

- The Offshore Wind Policy and accompanying offshore wind generation targets of 2 gigawatts (GW) by 2032, 4 GW by 2035 and 9 GW by 2040. These targets will help Victoria harness and capitalise on this high-potential renewable energy source, as is also being done in other jurisdictions such as the US.
- Renewable Energy Zones, which target areas in Victoria with the highest renewable energy potential and develop renewable energy generation, transmission and battery storage in a coordinated way.
- Renewable energy storage targets of 2.6 GW of capacity by 2030 and 6.3 GW by 2035. Already, projects such as the 'Big Battery' near Geelong and the Neighbourhood Battery Initiative are contributing to these targets.

The Victorian Government has also committed to reinstating the State Electricity Commission (SEC) as an active energy market participant to build new renewable energy projects. As part of this commitment, the SEC is expected to receive an initial investment of \$1 billion towards delivering 4.5 GW of power — the equivalent replacement capacity of Loy Yang A — through a range of renewable energy projects. An additional \$20 million has been committed to prepare the SEC for its new role in Victoria's energy market, which includes establishing an SEC office in the Latrobe Valley town of Morwell.

The Victorian Government is not doing this alone. The Australian Government has committed substantial funding to support projects crucial to the transformation of Victoria's electricity generation system, including:

- \$1.5 billion of concessional financing from the Australian Government's Rewiring the Nation (RTN) initiative will be made available for Renewable Energy Zone projects in Victoria, including offshore wind projects.
- A commitment to coordinate Victorian and Commonwealth regulatory processes to support the rapid development of the Victorian offshore wind industry.

- RTN will provide a concessional loan of \$750 million for VNI West ('Keranglink') to ensure it is completed by 2028. This project will strengthen the interconnector between Victoria and NSW.
- Victoria will contribute equally with the Tasmanian and Commonwealth Governments to a total 20 per cent of project equity to deliver Marinus Link, a cable between Tasmania and Victoria.

Victoria may also benefit from other national renewable energy initiatives including the remainder of the \$20 billion RTN initiative; elements of the \$15 billion National Reconstruction Fund; the \$1.9 billion Powering the Regions fund, designed to encourage communities and industries to switch to cleaner energy; and the Australian Government's funding for community batteries and solar panels in apartments and for low-income households.

UNLOCKING OPPORTUNITIES: ELECTRICITY GENERATION

Building and financing the transition of the grid

The Panel acknowledges that the Victorian Government already has multiple, significant policies in the electricity sector. However, building the generation, storage and transmission infrastructure at the necessary speed and scale will require coordinated planning, proactive measures to address skills shortage and supply chain challenges, and an unprecedented level of investment. A range of intersecting areas must be considered, including:

- Further development of utility-scale, geographically diversified renewable electricity generation including onshore wind, offshore wind and solar.
- Building on the government's commitments, developing large volumes and capacities of energy storage such as batteries and pumped hydro.
- Urgent progress on transmission lines to connect new resources and share energy and capacity across regions.
- Strong growth and smart integration of distributed energy resources such as rooftop solar, home batteries, zero emissions vehicles and electrified appliances.
- A renewed focus on energy efficiency and demand management opportunities.

- Keeping the peaking and backup capacity currently provided by gas-fired generation, and the transition of its fuels to low- or zero-emissions sources.

While other new innovative technologies are likely to become available over time, meeting ambitious targets in 2035 does not need them, and Victoria should not wait to act. Existing renewable and network-enhancing technologies not only have the potential to rapidly decarbonise Victoria's electricity network while ensuring it remains reliable, affordable and secure, they can create new jobs and industries, attract private investment and promote economic growth.

Finally, private sector investment can and must be leveraged to finance the transition of the electricity generation sector. The Panel acknowledges that this is already being done successfully through the VRET reverse auction scheme. Consideration could be given to using this type of mechanism to also develop Victoria's offshore wind industry, as is being done in California, New York and New Jersey. The proposed Capacity Investment Scheme agreed to in principle by Victoria and the other NEM jurisdictions may be an important vehicle to derisk investment in firm renewables.

Energy efficiency

In parallel with decarbonising Victoria's electricity network, improving the way households, businesses, and industry manage their energy use will play a critical role. Improving energy efficiency was identified by stakeholders as a low-cost, high-benefit measure that will provide essential support for Victoria's transition to a high-renewables, highly-electrified economy.

Reducing energy use and better managing it can help to reduce the investment required in new infrastructure to support a decarbonised grid, lowers the energy bills of households and businesses, and increases human comfort, health and safety during extreme temperatures. Energy efficiency measures also create jobs — in 2020, the International Energy Agency identified energy management as the most jobs-intensive part of the energy sector.⁸⁷

'To ensure that supply is sufficient for demand as we decarbonise our grid, we will need to invest in generation, storage and networks. However, we should reduce this infrastructure spend to the minimum necessary in order to minimise energy bills. Adjusting our energy use patterns will be critical to minimising infrastructure needs.'

Energy Efficiency Council

Social license

Transforming Victoria's electricity sector will require significant changes in land and sea use. The Victorian Government will need careful infrastructure planning and consultation to secure buy-in or social license from local communities. Planning will need to consider potential landowner and community benefits from construction projects and changing landscapes. The Victorian Government will also need to work closely with Traditional Owners to understand local heritage and cultural values, as well as community aspirations, and integrate this into planning, including of transmission lines. Infrastructure development plans should enhance environmental outcomes, where possible, and minimise negative impacts to biodiversity and ecosystem function, to holistically anticipate and address environmental concerns.

Ensuring that Victorian households and businesses have continued access to affordable and reliable energy will also be critical to securing social license for the shift to renewable energy. These concerns were raised by many stakeholders in the Panel's consultation. The Victorian Government can address these risks through strong planning and investment, and by addressing potential labour and supply chain issues outlined in the section on cross-cutting enablers below.



The Panel notes that while energy developments must be handled sensitively, Victoria's energy status quo is high-emissions, growing less reliable as it ages, and becoming more expensive due to movements in international markets for fossil fuels. The whole Victorian community has a strong interest in a swift and successful transition.

Some specific economic sectors and regions will inevitably experience some forms of transition disruption as Victoria progresses towards its 2035 emissions reduction target and to net zero. The role of government authorities or bodies such as the Latrobe Valley Authority (LVA) will be essential to support these vulnerable and potentially disadvantaged communities.

The LVA, established in response to the closure of the Hazelwood Power Station, has supported impacted businesses, workers and their families. Working in collaboration with the community, the LVA has helped deliver on a suite of major and community infrastructure, events and programs — providing a local economic stimulus and boost to liveability that benefits the community and attracts visitors to the region.⁸⁸ As Victoria's transition accelerates, the Panel notes the increasingly important coordination role such government authorities will need to play to ensure all Victorian regions, communities and economies have access to the opportunities a low emissions economy can offer. The Victorian Government should ensure that they have the long-term support and stability they need to play an effective coordination role for the benefit of communities undergoing transition. It may also be appropriate for these bodies to connect to transitioning regions and authorities in other states and territories, and link up with any efforts of the Australian Government in this space.

'The VFF supports local content policies aimed at supporting local industry in the construction of renewable energy developments. Such policies must be targeted towards supporting economic development and job creation within the region where renewable energy developments are taking place, not just at a national or state level.'

Victorian Farmers Federation

POTENTIAL BENEFITS: ELECTRICITY GENERATION

Utility-scale, diversified renewable energy generation, transmission and storage needs to be built at an unprecedented pace and scale. This presents significant new economic and employment opportunities for Victoria. For example:

- The Victorian Government estimates that achieving 50 per cent renewable electricity by 2030 will create an estimated 24,400 jobs,⁸⁹ and the Government is now aiming for 95 per cent renewable energy by 2035, which would increase this number further.
- One study estimates that Victoria's renewable energy industry could employ more than 50,000 people in the state by 2060.⁹⁰
- MarinusLink and the KerangLink interconnector projects alone are expected to generate \$3.3 billion in net market benefits and investment.⁹¹

There is also a potential emerging opportunity for Victoria to leverage the state's manufacturing history and advanced manufacturing capabilities to develop new industries for renewable energy infrastructure components. An example of this is the Vestas Renewable Energy Hub assembling wind turbines at the former Ford Motor factory in Geelong.⁹² Another is the announcement in November 2022 of Recharge Industries intending to build a one of the world's largest lithium-ion battery cell production facilities at Avalon. The 'gigafactory' is estimated to add \$14.9 billion to the region's economy over 20 years, and to create up to 2,000 jobs at the facility.⁹³

Measures such as these that build local manufacturing capability of low-emissions products keep the economic benefits of the net zero transition here in Victoria. These new industries create jobs and drive economic growth, particularly in regional Victoria. The Panel acknowledges that zero and low-emissions technologies are a focus of both the Victorian Government's manufacturing statement,⁹⁴ and that mechanisms such as the Low Carbon Manufacturing Grant Program have been established to support this.⁹⁵

Victoria could also consider co-locating renewable energy zones with manufacturing activities more broadly, so that the state's renewable energy transition can be leveraged to accelerate the decarbonisation of Victoria's manufacturing sector. Some examples of this being done successfully are in the Case study below.

CASE STUDY: MANUFACTURING/RENEWABLE ENERGY CO-LOCATION

Renewable Energy Precincts propose co-locating or clustering regional manufacturing industries and operations to leverage renewable energy zones or other sources of local renewable energy sources. By doing so, clustered manufacturing precincts can operate entirely on renewable energy, significantly reducing the total operational emissions of what is often high energy intensive industries and economic sectors.

Economic analysis undertaken on two potential Renewable Energy Precincts, in Geraldton Queensland and Hunter Valley in NSW, found that the successful implementation of these projects could transform these economies and their manufacturing bases. This analysis found that by 2032 these precincts have the potential to create tens of thousands of high-quality jobs within the communities and more widely across the state and attract billions in new capital investment to these communities.⁹⁶

There are many similar regional communities in Victoria, with long histories as regional manufacturing and industrial leaders. Geelong, Portland and the Latrobe Valley all have the economic blueprints and skilled workforce capability to establish Renewable Energy Precincts.

While creating new economic opportunities within these communities, Renewable Energy Precincts are based on leveraging and harnessing the existing strengths and resources of their location. Importantly, this can greatly minimise the disruption of Victoria's manufacturing and industry sector as the state transitions to net zero emissions. By powering existing industries with clean energy, Renewable Energy Precincts can provide continuity and protection to well-established and traditional economies and help retain the existing jobs and skilled workforces these communities value.

Economic opportunities extend beyond manufacturing. A whole ecosystem of support services is needed to service and maintain this renewable energy infrastructure, and to then decommission it and recycle the materials at the end of the infrastructure's economic life. This will create further skilled jobs in the Victorian economy.

Burning coal for electricity generation produces air pollutants such as sulfur dioxide (SO₂), oxides of nitrogen (NO_x) and fine particulate matter (PM₁₀, PM_{2.5}). These are harmful to human health; exposure to these pollutants has been shown to provoke and exacerbate respiratory and cardiovascular conditions. The closure of Victoria's remaining coal-fired power stations will improve the air quality in the Latrobe Valley where these stations are located, benefitting the health of the local community.

PANEL RECOMMENDATION: RAPIDLY MANAGE TRANSITION OF VICTORIA'S ELECTRICITY SYSTEM

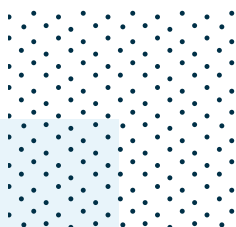
Victoria's transition to a zero-emissions electricity sector is well underway, with commitments to coal retirement now largely in place. Deep decarbonisation of Victoria's electricity generation is core to the transition to a net zero emissions economy by 2045. Decarbonising the sector will both directly address Victoria's largest source of emissions, and will enable emissions reductions in other sectors such as in transport, industry, buildings and agriculture through electrification.

The Victorian Government should:

- Plan for and facilitate the full exit of coal power in Victoria by or before 2035.
- Accelerate well-planned and sequenced construction of renewable generation,

transmission, and storage, sufficient to replace retiring capacity and prepare for forecast needs. Investment may also be needed into measures such as demand management, demand response and distributed energy resources. This will capture the full benefits including investment attractiveness, energy security, affordability and reliability.

- Ensure secure long-term funding and governance arrangements to coordinate and lead the broader transition to a net zero emissions economy for the whole state. This will enable a just transition for affected communities, and will help build and maintain social license.





TRANSITION FROM GAS AND BUILT ENVIRONMENT

THE CASE FOR ACTION: TRANSITION FROM GAS AND BUILT ENVIRONMENT

Gas

Over two million Victorians use natural gas in their homes and businesses, more than any other Australian state or territory. Gas is also widely used across Victorian industry. The Victorian gas sector contributes around a fifth of the state's net emissions.⁹⁷ Victoria will need to rapidly phase down the use of natural gas to meet the 2035 target and ultimately phase out the use of natural gas to achieve net zero by 2045.

Built environment and energy efficiency

The construction and use of buildings contribute to almost a quarter of Australia's emissions.⁹⁸ Victoria has both the highest emissions intensity of electricity generation, and the highest gas use, of any state or territory. Stakeholders in the Panel's public consultation process consistently identified the built environment as a priority for action, given it is a significant emissions source, solutions are readily available, and these have the potential to create a wealth of co-benefits for Victorians.

VICTORIA'S CURRENT ACTIONS: TRANSITION FROM GAS AND BUILT ENVIRONMENT

The Victorian Government has developed a holistic plan to transition away from gas – the Gas Substitution Roadmap, released in 2022.⁹⁹ This covers a range of measures to improve energy efficiency, electrify buildings, and explore the development and uptake of hydrogen and biogas, and was informed by comprehensive advice from Infrastructure

Victoria on how to transition to a net zero emissions gas sector.¹⁰⁰ The Panel notes the Victorian Government's commitment to release an updated Gas Substitution Roadmap in 2023.

The Panel acknowledges the work the Victorian Government is doing to capture the potential future benefits of a renewable hydrogen industry, through industry development planning, grant programs and collaboration projects with businesses, universities, and communities. The Victorian Government has also foreshadowed consideration in 2023 of a potential tradable certificate scheme to encourage renewable gas production or consumption. The Australian Government is also making strong investments into new uses of renewable hydrogen and developing an Australian renewable hydrogen industry.

Work is also underway to reduce emissions from the construction and operation of the state's built environment. The Victorian Energy Upgrades Program has been supporting households and businesses to install energy-efficient products since 2009, and is set to expand to support the replacement of gas appliances with electric alternatives.¹⁰¹ Meanwhile, the Solar Homes program supports households and businesses to install solar photovoltaic panels, solar hot water or heat pump systems, and solar batteries.¹⁰² The Victorian Government was a champion for the adoption of the new seven-star Nationwide House Energy Rating Scheme (NaHERS) standard for homes in the 2022 update to the National Construction Code (NCC). The Government is also improving the state's planning systems to better address climate change in the built environment, informed in part by the work of many Victorian councils.

UNLOCKING OPPORTUNITIES: TRANSITION FROM GAS AND BUILT ENVIRONMENT

Electrification

There are many readily available, cost-effective and low emissions alternatives for gas use for houses and businesses. A key opportunity is to shift Victorian homes and businesses from gas to energy efficient electric appliances. This includes appliances for heating, cooling, refrigeration, hot water, lighting and cooking. There are also parts of industry in which electrification is an immediate, viable option — such as the food and beverage industry. The industry accounts for over a quarter of gas used by manufacturing in Victoria and the majority of this is used for thermal energy that can be delivered by commercially available electric technology.¹⁰³

Switching to electric appliances now will reduce emissions because the generation mix that supplies additional demand produces less emissions than the gas use it displaces. As Victoria's grid switches to 95 per cent renewable energy by 2035, incremental emissions from electricity are reduced to almost zero.¹⁰⁴

'Victoria's current reliance on natural gas is likely to have detrimental economy-wide impacts in the event of persistent high gas prices or gas supply shortfalls... It is therefore sensible for Victoria to consider the economic benefits of transitioning away from gas in a sustainable fashion.'

AGL

'...the use of gas in homes is contributing significantly to climate change (as well as poor indoor air quality and childhood asthma), and broadening and promotion of schemes to replace outdated gas heating, stoves and hot water with efficient electric (heat pump/induction) alternatives is required.'

'New houses should not be allowed to install outdated gas infrastructure that will lock them into expensive dirty fuels of the past for decades to come.'

Dr Annabelle Warren

'...renewable gas and innovative applications of existing gas fuels - including combining them with renewables and fuel cells - will be pivotal to maintaining consumer choice for Victorians'

Gas Energy Australia

Multiple measures are required to accelerate electrification. Infrastructure Victoria considered many of these in their report to the Victorian Government on the gas transition, though their proposed timelines would need to accelerate to contribute to the Panel's recommended 2035 emissions reduction target of 80 per cent.¹⁰⁵

One crucial area is planning and building regulations, such as decisions on whether and when to ban new gas connections and how fast to improve the energy efficiency of new builds. This will involve close collaboration at the national level on improvements to the NCC, as well as close collaboration with local governments on changes to Victoria's planning framework. Financial support may also help overcome the upfront cost of purchasing electric appliances that are often more expensive than their gas counterparts.

Electrification of homes and businesses will also require shifts in skills, supply chains and culture. More tradespeople will need familiarisation and upskilling with electrified appliances. Appliance and equipment suppliers will need a clear basis to plan and evolve their offerings. Development of adequate and diverse equipment supply, including the ongoing role of Australian manufacturing, will be important, especially given the current global rush for heat pumps. Many Victorians still believe gas is a cheaper source of energy services than electricity, as this used to be the case. Some gas applications, particularly cooktops, are strongly valued by some businesses and households, including among culturally and linguistically diverse communities. Many people are unfamiliar with the effectiveness of induction cooktops, heat pumps or reverse cycle air conditioners, and how these can help save money over time. Further measures to increase familiarity, demonstrate real-world performance and increase accessibility should be considered.

Careful management of energy system implications will also be required to ensure Victoria's electricity system is prepared to supply the additional energy required and to moderate and manage peak demand. There is a large difference between the costs and resource requirements of high-quality electrification, with efficient electrified appliances operating in close coordination with the wider energy system, and low quality ad hoc electrification with inefficient and poorly coordinated appliances. Investment in Victoria's electricity and gas networks is subject to regular economic regulation processes and these will need to take account of the state's emissions targets and strategy as soon as possible to ensure necessary investments are made in good time while unnecessary investments are avoided.

Gas alternatives

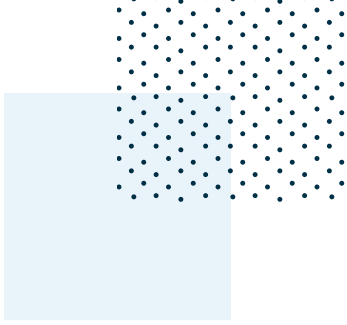
Electrification is not the only option to transition current natural gas users to a net zero emissions economy. Biogas and hydrogen can be low- or near-zero-emissions alternatives, depending on how cleanly they are produced and the leakiness of transmission and distribution systems.¹⁰⁶ Given the diversity of current gas use contexts across different sectors, processes and regions, the most appropriate alternatives are likely to vary too.

The Panel supports a zero natural gas use plan for homes. However, some gas users, particularly in industry, are unable to electrify in the near-term, whether because of long-lived capital assets that require gas or a poor fit between operational needs and current electric alternatives. These users may still have near-term opportunities to use gas more efficiently, and over the medium to longer term will have greater opportunity either to electrify or, where this is not possible, to use alternative gases including hydrogen and biogas, as appropriate to their needs and context. The most challenging uses to substitute will be for:

- Chemical feedstock, which requires molecules not just energy. Biogas and biomass, green hydrogen and captured carbon, and advanced chemical recycling of existing fossil-derived plastics may all be relevant solutions.
- Backup electricity generation during high-impact low-probability events, where a stock of chemical fuel such as hydrogen, ammonia or biodiesel for a rarely used peaking generator may be a much cheaper solution than a similarly underutilised battery or pumped hydro facility.

Systemic implications are as important as individual user contexts in considering all alternatives to fossil gas:

- As discussed above, electrification requires reinforcement of electricity distribution networks, moderated by the quality of electrification.
- Biogas production requires adequate supplies of affordable feedstock, such as agricultural wastes, located close enough to use or processing capacity to be economic. To play a role in a net zero emissions economy, biogas applications will need to compete with many other potential uses for Australia's substantial but limited potential to sustainably produce and harvest biomass. These may include sustainable aviation fuels, bioplastics, and biomass energy with carbon capture and storage (BECCS).
- Hydrogen requires substantial electricity generation to produce (exacerbated where the final use of the hydrogen is relatively inefficient, such as in combustion for heat), the upgrade or replacement of transmission (and older distribution) infrastructure, and replacement of a range of different appliances.



- Existing gas distribution networks are potentially vulnerable to a negative feedback loop. Diminished network use and disconnections (whether due to the high price of export-market-exposed gas or to potential policy support for efficiency and electrification) may lead to fixed network costs being recovered from remaining users through higher connection charges. This may encourage further demand reduction and disconnection. It will be important to maintain systemic supply security, reliability and quality as gas use declines. There are a range of options to manage and allocate financial impacts as the user base and asset value decline, including accelerated depreciation, targeted compensation of asset users or asset owners, or asset write downs. These will need careful consideration, noting that gas distributors are already developing regulatory proposals including both accelerated depreciation and hydrogen readiness investments.

Noting the likelihood of at least some gas alternatives being required by industry (in contrast to households) in a net zero emissions economy, the Panel supports continued work on these alternatives — such as through the Victorian Government’s renewable hydrogen program — for essential industrial uses. The national Safeguard Mechanism and associated federal funds may be significant drivers and enablers of industrial gas transition, but most Victorian industrial gas users will be below the current thresholds for inclusion in the Safeguard. Policy should avoid both duplication and gaps in support.

‘The development of a hydrogen industry in Victoria represents a cost-effective mechanism that can help Victoria achieve its net zero ambitions. Growing evidence shows that hydrogen is a cost-effective way to achieve zero emissions in replacing existing uses of natural gas as well as diesel. This is particularly important for the hard-to-abate sectors for which electrification is not an option.’

Australian Gas Infrastructure Group

‘Investing in hydrogen carries very large opportunity costs given that energy efficiency and electrification offer cheaper pathways to comfortable homes.’

Dr Jim Crosthwaite

As noted, there was some limited advocacy among gas industry stakeholders for the potential role of hydrogen in residential energy networks, involving preparatory steps in the 2020s followed by a larger push in the 2030s. Most global evidence suggests that the residential role of hydrogen in cost-effective pathways to net zero emissions will be small or nil.¹⁰⁷ However, if residential hydrogen use is to contribute to the achievement of the Panel’s recommended emissions target, advocates would urgently need to revise their proposals to deliver significant transition this decade and a complete switch by the mid-to-late 2030s.

Built environment

‘The built environment offers some of the fastest, easiest, most cost-effective opportunities to decarbonise our economy, meaning it can form a significant part of Victoria’s 2035 target, and pathway to net zero emissions.’

Green Building Council of Australia

While work is underway to reduce emissions from Victoria’s built environment, the scale of emissions involved, and the long-lived nature of built assets, requires immediate and stronger action. The average lifespan of a building is about 50 years,¹⁰⁸ with buildings constructed today likely to be in operation until at least the 2070s.

Key opportunities for action include the deployment of on-site renewable energy, energy efficiency, electrification, phase out of gas appliances and all-electric new builds — all of which have been discussed above. These measures are consistent

with what is set out in the Green Building Council of Australia's Climate Positive Roadmap. Electrification, energy efficiency and renewable energy may be considered together as a suite of options to reduce emissions from, and increase the resilience of, Victoria's built environment.

The Victorian Government has an opportunity to continue to play a key leadership role in NCC updates, including the 2025 updates for commercial building energy efficiency and in ongoing updating cycles for all building types. The Australian Sustainable Built Environment Council identified the NCC as the most powerful lever to encourage change for all new buildings.

At the state level the Victorian Government needs to further improve planning systems to reflect the required step change in emissions reductions. The Panel heard from Victorian councils about their leadership in this space, with 24 councils proposing planning scheme amendments to encourage net zero emissions and many councils providing environmental upgrade finance for residential and commercial buildings. Councils highlighted the need for more state level support to achieve their climate ambitions for Victoria's built environment, with some suggesting legislative changes to the planning system and state government underwriting of council finance mechanisms to allow their expansion.

Emissions embodied in the materials, equipment and construction of buildings are an emerging focus in the property sector. Embodied emissions can be reduced by using less materials; reusing, repairing and recycling existing materials and equipment; using alternative low-emissions materials, like low emissions steel and concrete or cross-laminated timber; and through low-emissions construction process. This is aligned with Victorian Government policy on shifting to a more circular economy, outlined in the Recycling Victoria policy.¹⁰⁹ While the associated emissions embodied in materials and equipment often do not fall within Victorian boundaries for carbon accounting purposes, demand for low-emissions alternatives will be important to underpin investment in clean supply. Through the Victorian Government's large building and infrastructure investment projects, there is an opportunity to support industry to invest in low emissions building product supply chains and construction processes, through strengthened

procurement standards and processes. More detail on opportunities to reduce emissions through government procurement is included in the 'Cross-section enablers' section of the report below.

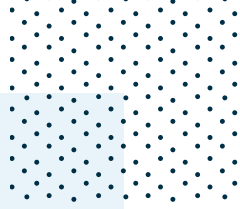
The Victorian Government may also consider supporting the growth of innovative finance mechanisms to encourage electrification and energy efficiency in Victoria's built environment, such as environmental upgrade agreements or concessional loans like Bank Australia's Clean Energy Home Loan.¹¹⁰

POTENTIAL BENEFITS: TRANSITION FROM GAS AND BUILT ENVIRONMENT

The transition from gas and improving the energy performance of Victoria's built environment hold many potential benefits beyond reducing the state's emissions. These include new jobs and industries, lower energy bills, and improved health outcomes.

There is significant potential for new jobs and industries arising from the electrification and energy efficiency measures needed to transition away from natural gas and improve Victoria's built environment. For example, analysis by the Centre for Policy Development found that public investment of \$400 million to improve the energy efficiency of 60,000 Western Melbourne homes could create 3,100 direct jobs and support \$500 million of further private co-investment. It could also lead to savings of \$70 million per year on home energy bills and reduce the state's emissions by 205,000 tonnes of CO₂e per year.¹¹¹ The Victorian Government estimates that its current Gas Substitution Roadmap will create 2,200 jobs, so enhanced measures would add to this baseline.¹¹²

For many Victorians, shifting to energy efficient electrical appliances will provide significant savings. Residential and commercial gas bills have increased in Victoria over the previous few years, in part due to international prices rises, that are expected to continue. Modelling has found that a household living in an existing, typical detached house that moves from gas to electric appliances for heating, hot water and cooking could reduce its average annual energy bill by around \$1,020 per year.¹¹³ At the national level, one study estimates that aggressive residential electrification could produce cumulative savings of over \$300 billion nationwide by 2035 with an initial investment of about \$12 billion.¹¹⁴



However, the final extent of savings from electrification will also be shaped by the extent of transition investment required in reinforcing electricity distribution networks and the management of declining utilisation of gas distribution networks. During the Panel's consultation, many stakeholders expressed support for full electrification including AGL, Climateworks Centre, the Australian Energy Council and the Green Building Council. Some gas industry stakeholders raised cost and reliability concerns with electrification, notably the Australian Gas Infrastructure Group and Gas Energy Australia, and prefer biogas and hydrogen as transition pathways for phasing out gas use.

Lifting the energy performance of Victoria's residential sector is likely to improve health and resilience outcomes for households. Energy-efficient buildings are more resilient to temperature extremes which can have significant health benefits for their occupants, particularly if they do not have the means for adequate heating or cooling. The

Victorian Healthy Homes Program funded modest efficiency improvements in the homes of 1,000 low-income elderly households and closely monitored outcomes; the financial value of resulting health system savings was ten times greater than that of the energy savings.¹¹⁵

Electrification of the residential sector is also likely to bring significant health benefits. Burning gas in homes for cooking, heating and hot water creates indoor air pollutants which can exacerbate the risk of illnesses such as childhood asthma.¹¹⁶ One study estimates that Australia-wide, transitioning away from home gas appliances would avoid \$2.6 billion in healthcare costs associated with pollution-related respiratory illnesses in 2035.¹¹⁷

Finally, improving energy efficiency in Victoria can also reduce demand on the electricity grid. If energy efficiency for new and existing buildings is taken up on a large scale, this reduced demand could have a significant impact on lowering system distribution costs.¹¹⁸

PANEL RECOMMENDATION: ACCELERATE PHASE OUT OF NATURAL GAS USE WITH AN IMMEDIATE FOCUS ON VICTORIA'S BUILT ENVIRONMENT

Over two million Victorians use natural gas in their homes and businesses, and natural gas is also widely used across Victorian industry. The Victorian gas sector contributes around 17 per cent of the state's net emissions. The built environment sector is also a priority for action, given it is a significant emissions source, solutions are readily available, and have the potential to create numerous co-benefits for Victorians.

Building on the Gas Substitution Roadmap, the Victorian Government should:

- Significantly step up the ambition, urgency and scope of actions to electrify homes and buildings and to electrify or deploy alternatives in other sectors to enable natural gas use across Victoria to be largely phased out by 2035.
- Accelerate the transition in the built environment through Victorian reforms including planning policies and through national changes, such as step changes to the National Construction Code.
- Substantially upgrade the energy efficiency of Victoria's built environment to deliver multiple benefits for energy affordability, emissions, energy system management, human health and comfort and public finances.



TRANSPORT

THE CASE FOR ACTION: TRANSPORT

Transport is Victoria's second largest source of emissions, making up about a quarter of Victoria's total emissions in 2020. It is also the sector in which emissions are rising the fastest. Although current market trends and policies are expected to result in transport emissions beginning to fall in the 2030s, accelerating these efforts will be critical to achieving an ambitious 2035 emissions reduction target.

While reducing emissions from all forms of transport will be required, cars are a major source of transport emissions and need to be a focus for Victorian Government action. They account for almost half of Victoria's transport emissions, and 12 per cent of Victoria's total emissions.¹¹⁹

'By adopting strong policies to substantially increase sales of electric cars, trucks and buses, reducing transport emissions could play an important role in achieving Victoria's stronger emissions reduction target.'

Climate Council

'International markets that have adopted targets have achieved significantly greater penetration of these technologies and are already achieving positive results in terms of CO₂ transport emissions reduction.'

Federal Chamber of Automotive Industries

Governments around the world, such as the UK and California, are urgently acting to reduce this specific source of emissions. This includes regulatory and legislative frameworks to provide clear direction to the sector and investors on the need to transition vehicle production to zero emissions vehicles (ZEVs).

VICTORIA'S CURRENT ACTIONS: TRANSPORT

In Victoria, the Transport Sector Emissions Reduction Pledge set the state a target for 50 per cent of new light vehicle sales to be ZEVs by 2030.¹²⁰ The release of the pledge was supported by a \$100 million investment package. This investment package will deliver a range of policies and programs designed to support the uptake of ZEVs in Victoria while progressing emissions reductions actions in other areas of Victoria's transport sector, including:

- \$20 million for a Zero Emissions Bus Trial to support the transition to 100 per cent zero emissions bus purchases from 2025.
- A \$46 million ZEV subsidy program, the first of its type in Australia, providing grants to individuals and businesses wanting to buy ZEVs, targeted at the supply of low to medium-priced vehicles.

- \$5 million commercial sector ZEV Innovation Fund to encourage the uptake of ZEV light commercial vehicles in the commercial passenger vehicle, logistics, construction and service-sector industries.
- \$19 million to establish a ZEV fast-charging network on major highways, at key tourist and community destinations and at high use locations.
- 400 electric vehicles will be added to the Victorian Government fleet over the next two years.¹²¹

Victoria's ZEV sales target was built on at the COP26 in Glasgow in 2021, where Victoria joined the Accelerating to Zero (A2Z) Coalition. A2Z pledges to work towards all sales of new cars and vans being zero emission globally by 2040, and in leading markets by 2035.¹²²

The Panel notes the early actions now being taken in the heavy duty and freight sector. The \$20 million joint grant initiative between the Victorian and NSWs Governments Hume Hydrogen Highway supports the design and delivery of the Australia's first renewable hydrogen refuelling network. The network will connect freight services between Melbourne and Sydney — Australia's busiest freight corridor — and demonstrates the role collaborative interjurisdictional partnerships can play in reducing more challenging and harder-to-abate emissions sources.

UNLOCKING OPPORTUNITIES: TRANSPORT

While Victoria's commitments and policies establish strong foundations and helpful long-term market signals for emissions reductions in the transport sector, the Panel notes that a significant acceleration in immediate and meaningful action is still required. Currently, ZEVs only make up around 3.4 per cent of new light vehicle sales in Victoria.¹²³

The Panel recommends a target to phase out new sales of greenhouse gas emitting road vehicles in Victoria by 2035, and strong supportive actions that consider every part of the enabling ecosystem. This includes legislative and regulatory changes, charging infrastructure, repair and maintenance provisions, insurance and financing.¹²⁴

The Australian Government holds many of the key legislative and policy levers for transport, including vehicle emissions standards, importing of road vehicles and tax incentives. While the Australian Government is making progress, the Panel recommends the Victorian Government will need to advocate and champion for further action on zero emissions vehicles at a national level to achieve the step change in emissions required for the state from the transport sector.

The Panel also recommends that the Victorian Government use its purchasing power to urgently increase the supply of ZEVs in Victoria by significantly increasing ZEVs in the government fleet above the exiting target of 400 vehicles by 2023. Acknowledging current global supply chain challenges, the right policies can help send a signal to suppliers that there will be a rapidly developing and reliable long-term market for ZEVs in Victoria. Increasing ZEVs in the government fleet can have the dual benefits of establishing a strong ZEV market in the state while also providing for a robust second-hand ZEV market from accelerated fleet turn over.

ZEVs are a relatively new market in Australia and have underdeveloped supply chains for parts for repairs and a lack of workforce capability for maintenance and repair. This increases the costs of maintenance and repairs, as well as the costs of ZEV insurance premiums as a result. Well-designed skills and training programs are needed develop the maintenance and repair ecosystem needed for the successful transition to ZEVs in Victoria. Such programs could expand on opportunities already being piloted in Victoria. Accredited training programs have begun providing transport technicians and bus mechanics the opportunity to enhance and expand their skillsets and prepare them for the transport sector jobs of the future.¹²⁵

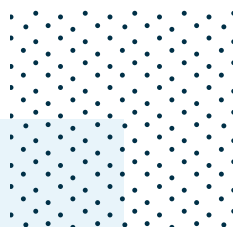
The Victorian Government could also consider tailored initiatives, such as advice and support incentives to increase sales of ZEVs and ensure they are affordable for all Victorians. This could build on the package of programs in the Transport Sector Emissions Reduction Pledge and include advice and support for ZEV insurance requirements and for low-income households.

As the proportion of ZEVs in Victoria's total vehicle fleet increases, investments and planning in ZEV infrastructure to support this growth must be well managed:

- Planning will be needed for the density and distribution of fast charging sites and the strategic planning of this network. The Victorian Government can ensure that local charging infrastructure is in place to accommodate these vehicles. Co-operation with other Australian governments can deliver changes such as an updated NCC that covers charging infrastructure. Already, Australian states and territories are making significant commitments to develop robust and expansive fast-charging networks and infrastructure. NSW has announced a plan to ensure fast charging is available every 100km along regional routes, every 5km in residential areas with limited off-street parking, and every 5km along major commuter corridors in Sydney.¹²⁶
- Providing and optimally managing slow charging is required to meet driver needs while supporting a stabler and more affordable electricity system. This may include encouragement for installation of slow chargers at workplaces and other locations where vehicles are parked during the day; support for uptake of time-of-use network tariffs and market reforms to reward efficient use of distributed energy resources; and further strengthening building codes to provide for the growth of charging needs.

- The Victorian Government can also work with the Australian Government to quickly deliver strong fuel efficiency standards, which will increase the supply of electric, hybrid and other fuel-efficient vehicles.¹²⁷ Globally, over 80 per cent of vehicles sold are covered by some form of fuel efficiency standard. In the absence of fuel efficiency standards, Australia and Victoria are very likely to remain markets for more emissions intensive and less efficient vehicles.¹²⁸

The Victorian Government can look to other jurisdictions, such as California, for examples of comprehensive policy packages to accelerate ZEV uptake (Case study).



CASE STUDY: PASSENGER AND LIGHT VEHICLES IN CALIFORNIA

The California Air Resources Board's *Advanced Clean Cars II* regulations have established a year-by-year roadmap for the state to achieve 100 per cent zero ZEVs for new light vehicle sales by 2035.

Rapidly accelerating the number of ZEVs on California's roads and highways will deliver substantial emissions reductions and play a crucial role in meeting the state's whole-of-economy emissions reduction targets. Achieving the 2035 sales target will also greatly reduce air pollution.

The regulation's design requires passenger and light vehicle manufacturers to deliver an increasing number of ZEVs each year beginning in model year 2026. Sales of new ZEVs will start with 35 per cent that year, build to 68 per cent in 2030, and reach 100 per cent in 2035. These rules provide a clear pathway and the market certainty required for rapid transition.

To complement *Advanced Clean Cars II*, the Californian Government has announced programs to increase access to ZEVs for all Californians. These include:

- Ensuring that the transition to ZEVs is affordable to low-income households and meets the needs of communities and small business through targeted incentive programs

- Rapid development of a robust network of ZEV refueling infrastructure
- Incentives for heavy-duty ZEV deployment in areas with the highest concentrations of air contaminating emissions
- Promoting private investment for the transition to ZEVs through measures to give regulatory certainty, such as infrastructure credits and fuel standards.¹²⁹

This ecosystem approach, where there is a target and clear complementary measures, is what the Panel is recommending for Victoria in transport. The early success of clear regulations is evidenced by the ZEV annual car sales already being achieved in California and the adoption of similar regulations by other US states.¹³⁰ This demonstrates the potential for industries, consumers and markets to positively respond and embrace emissions reductions interventions, when clear and holistic planning and well-defined long-term regulatory pathways are established and effectively implemented.

POTENTIAL BENEFITS: TRANSPORT

There are likely to be significant benefits from the shift to a zero-emissions transport sector, but investment and jobs will greatly depend on where vehicles are manufactured. The Victorian Government could potentially improve investment and jobs prospects by supporting local manufacturing following detailed feasibility analysis.

Component manufacturing, assembly and conversion industries for different classes of ZEV could be established across the state. Already, Nissan Casting in Dandenong manufactures components for global distribution to ZEV markets.¹³¹ While assembly of light internal combustion engine vehicles exited Australia last decade, assembly of heavier and specialty vehicles continues and should be able to transition to ZEVs. Light vehicle assembly is a challenging business, but new combinations of high automation and strong vertical integration have made ZEV manufacturing viable in other economies with high labour costs and could be viable in Australia.

Opportunities for local battery production, assembly, repair and recycling using Australian lithium and other transition minerals can create further economic opportunities while also supporting the delivery of Victoria’s goals to create a circular and more sustainable economy. Beyond automotive uses, end-of-life hybrid and electric vehicle batteries can be refurbished for re-use in static storage.

Decreasing the number of internal combustion engine vehicles on Victorian roads will also have important co-benefits to human health. Not only do these vehicles produce direct emissions, their tailpipes emit a range of other pollutants. Transitioning to ZEVs has the potential to reduce the incidence of respiratory disease and improve urban amenity due to less air and noise pollution. Victorian towns and cities can complement the transition to ZEVs through the encouragement of and investment in active transport as an alternative mode of transportation. Greater adoption of active transport, especially through short-journey walking and cycling, results in positive health impacts, substantial savings in healthcare costs, and can lead to emissions reductions.¹³²

PANEL RECOMMENDATION: ACCELERATE UPTAKE OF ZERO EMISSIONS VEHICLES (ZEVs)

Transport is Victoria’s second largest — and fastest growing — source of emissions. Reducing emissions from the transport sector will be critical. Coordination with the Australian Government is vital, since issues such as vehicle emissions standards fall within federal jurisdiction, and Victoria should be an advocate and champion for zero emissions vehicles at a national level as part of its actions in the transport sector.

The Victorian Government should:

- Phase out new sales of emitting road vehicles in Victoria by 2035. This should be facilitated by taking measures to urgently

increase supply of ZEVs in Victoria including increasing ZEVs in the government fleet and measures to accelerate fleet turnover. Victoria should also advocate for and facilitate a national ZEV approach.

- Noting the approach in other jurisdictions such as California, invest in development of every part of the enabling ecosystem to support large-scale deployment of ZEVs in Victoria including finance and insurance, skills to maintain and repair electric vehicles, and charging infrastructure.



LAND AND FORESTRY

THE CASE FOR ACTION: LAND AND FORESTRY

Victoria's land use, land use change and forestry (LULUCF) sector has been a net sink since 2013, absorbing around 25 per cent of Victoria's emissions in 2020. Growing this natural carbon storage will be a key part of achieving Victoria's emissions reduction targets. This will involve improved forest management, revegetation of public and private land, and working with landholders to increase on-farm forestry, shelterbelts and environmental plantings.

Importantly, emissions reduction in the LULUCF sector can also deliver valuable co-benefits such as economic opportunities for land managers including Traditional Owners, increasing resilience to climate-related extreme events, improving air and water quality, and addressing wider land and water management challenges.

VICTORIA'S CURRENT ACTIONS: LAND AND FORESTRY

The Victorian Government major policies in the land and forestry sector are:

- A commitment to phase out native timber harvesting by 2030.
- 'Protecting Victoria's Environment: Biodiversity 2037', a policy framework which includes a target for 200,000 hectares of revegetation in priority areas for connectivity between habitats.

- BushBank. This \$77 million program aims to restore natural environments across Victoria on both public and private land through planning millions of native plants and trees. This includes \$14.5 million available over ten years to provide opportunities for Traditional Owners to lead and participate in habitat restoration and carbon markets. BushBank is contributing to meeting the 'Biodiversity 2037' revegetation target.
- The Victorian Carbon Farming Program, which commits \$15.3 million to support farmers to plant agroforestry and shelterbelt trees.

These policies are estimated to reduce emissions in Victoria by 1.4 Mt CO₂ by 2030.¹³³

UNLOCKING OPPORTUNITIES: LAND

Protecting and increasing vegetation

Modelling shows a further step change will be required to meet a strong 2035 emissions reduction target. An 80 per cent target would require revegetation of at least 400,000 hectares by 2035, an area comparable to the size of greater Melbourne (Figure 8), at least double the already ambitious 200,000 hectare target in Biodiversity 2037. This figure is for cumulative planting from now until 2035. The speed and scale of planting requires immediate action by the Victorian Government, given the years it can take for newly planted saplings to start to remove significant quantities of carbon from the atmosphere.

Figure 8. Approximate scale of revegetated land area required

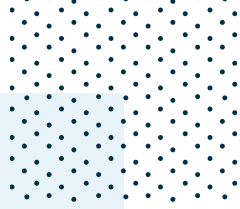


Protecting and enhancing existing native vegetation across the state is also important, given the role it already plays in being a net sink for Victoria's emissions, as well as a range of other human and environmental benefits discussed at the end of this section. Mature trees capture more carbon than young trees and leaving forests intact has large carbon benefits¹³⁴, with Victoria's Central Highlands forests among the most carbon dense in the world.¹³⁵ A 2022 report found that ending native forest logging now could prevent up to 14 Mt CO₂ emissions by 2030.¹³⁶ Victoria's Parliamentary Budget Office has calculated an immediate end to native forest logging could save Victoria \$191 million over the period to

2030.¹³⁷ Ending native timber harvesting before 2030 was raised by a range of stakeholders during the Panel's consultation and was particularly important to youth, as identified in youth survey responses and recommended by the youth roundtable. This is in a context of increasing demand for wood and a growing timber export opportunity for Victoria.¹³⁸

'End native logging and preserve forests.'

Youth roundtable recommendation



The Panel's conversations with stakeholders also highlighted potential sequestration limitations that need to be considered in government planning, including the risks of carbon releases due to increasingly common bushfires, droughts and heatwaves. How vegetation offsets from plantings are used across the state needs careful consideration and does not negate the need for immediate and strong emissions reduction action in all sectors of the Victorian economy.

Land management has traditionally been thought of as either an individual rights-holders' issue, or a challenge for public investment. There are, however, potentially many scalable opportunities for private sector investment in the land sector. Examples include sustainability linked loans,¹³⁹

where organisations and lenders agree to tie funding incentives (including potentially negotiated discounts on interest rates) to the measurable meeting of climate or environmental goals.

This is enabled and facilitated by better natural capital accounting, where an accurate and comprehensive assessment of the environment is undertaken, so it can act as an accountable and transparent yardstick for changes to that environment over time. The Victorian Government could look to establish and facilitate private investment in land restoration and management as part of the step change needed to achieve ambitious 2035 targets. Queensland offers an example of this (see Case study below).

CASE STUDY: INNOVATIVE FINANCE MECHANISMS TO INCREASE PLANTINGS - QUEENSLAND'S LAND RESTORATION FUND

The \$500m Land Restoration Fund (LRF) is Queensland Government's primary financial mechanism to support research, innovation, and the expansion of carbon farming projects and participation across the state.

As a carbon market mechanism, the LRF demonstrates innovation in its approach to rescope the value and pricing for co-benefits carbon farming projects create — beyond emissions reductions. The LRF is designed to expand the Queensland carbon market by valuing and rewarding carbon farming projects on the environmental, economic, cultural and social co-benefits they generate.¹⁴⁰

By incentivising and rewarding projects on the co-benefits derived from carbon farming, the LRF can create a comparative advantage for the Queensland carbon market and attract greater participation. This innovative approach

has the potential to establish a robust carbon market, decreasing the state's total emissions while improving the health of waterways and aquacultures, restoring and increasing habitat for threatened species and native animals, and strengthening the resilience of natural landscapes.

By expanding the pricing and value scope of the co-benefits generated under the LRF, this mechanism has the capacity to expand market access and participation by rewarding innovation, scientific and technological solutions to climate change.¹⁴¹

This creates a market that can attract a range of private and public investors seeking to have their investments deliver not only emissions reductions and offsets but also on measured environmental, social or cultural outcomes.¹⁴²

Working with Traditional Owners

The Panel's consultation also identified a strong community expectation that the Victorian Government will work closely with Traditional Owners on actions to meet the 2035 targets. Acknowledging the BushBank program, the Panel encourages the Victorian Government to collaborate with Traditional Owners to explore further economic

opportunities in land restoration and carbon markets, consistent with the Victorian Government's commitment to Aboriginal self-determination and in line with Traditional Owner priorities. The partnership between the University of Melbourne and the Gunaikurnai Land and Waters Aboriginal Corporation provides an example of this (see Case study below).

CASE STUDY: TRADITIONAL OWNERS CARING FOR COUNTRY AND CARBON FARMING

Gunaikurnai are the Traditional Owners of the lands and waters of Eastern Victoria. Gunaikurnai country covers an area spanning approximately 1.33 million hectares.¹⁴³

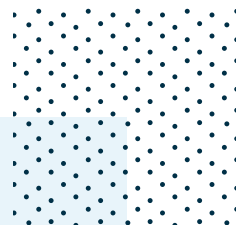
The University of Melbourne's School of Ecosystem and Forest Sciences and Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) have been exploring forest and land management projects, including carbon projects for Gunaikurnai country. The practices and projects identified have the potential to improve and protect biodiversity, natural habitats and waterways, while also providing economic opportunity and potential income streams through carbon farming projects and creating access to potential carbon markets.

These practices include:

- Revegetation carbon farming which focuses on managing land to expand and increase carbon in vegetation.
- Seed production, collection and supply — a major component in maintaining consistent and ongoing natural regeneration and environmental plantings.

- Cultural burning, which can restore Traditional Lore and culture to the landscape and mitigate wildfire risk, enhance biodiversity, stimulate native seed production and increase resilience to intense wildfires.
- Active forest management, including prescribed fire, cultural burns and silvicultural practices to increase forest health, recovery and resilience.
- The potential for biomass based industries to use organic materials (for instance, from clearing invasive species) as feedstock for new industries.
- Blue carbon, which focuses on increasing the carbon storage capacity of coastal ecosystems, and can support Gunaikurnai aspirations for managing coastal lands and water.¹⁴⁴

Some of these types of projects can be put forward for Australian Carbon Credit Units under the Australian Government's Emissions Reduction Fund and associated carbon markets, or draw funding and investment from the Victorian Government's BushBank program.



Biodiversity

Victoria is the most cleared state in Australia, with around 50 per cent of the state's native vegetation cleared since European settlement.¹⁴⁵ The scale of native vegetation protection and planting required to achieve Victoria's emissions reduction targets presents an unprecedented opportunity to improve biodiversity across the state. Careful and collaborative planning will be critical for realising this opportunity.

The Panel notes the Victorian Government commitment to a 'net gain' in biodiversity and acknowledges that the renewable energy infrastructure required to reach Victoria's emissions reductions targets will result in land use changes that impact the state's native flora and fauna. Strategic planning for the type and location of this infrastructure will be important for reducing biodiversity loss. Considering renewable energy infrastructure planning in conjunction with native vegetation protection and revegetation planning could support a strong overall gain in biodiversity for Victoria. This will help to provide the social license for Victoria's transition to net zero emissions. It may also be important for meeting environment legislative requirement changes committed to by the Australian Government.

The Victorian Government will need to work in collaboration with infrastructure planners, land managers, Traditional Owners, biodiversity experts and local communities to develop regionally tailored approaches to preserving and increasing vegetation across the state.

'There is a significant opportunity for the Victorian Government to leverage the emissions mitigation opportunity within the land use, land use change and forestry category through the sequestering of carbon twinned with biodiversity conservation and restoration.'

Australian Land Conservation Alliance

Informed decision making

Achieving more than 400,000 hectares of revegetation by 2035, while balancing different land uses, will require a step change improvement in the approach to land management. This will need to be informed by clear and timely measurement of changes to the state's environmental assets, including soils, water, trees and other vegetation, also known as natural capital. Victoria's State of the Environment Report identifies a strong need for improved data, monitoring, spatial information and analytics to inform decisions that impact Victoria's natural capital and systems.¹⁴⁶ The Australian Government made an announcement with the US Government in December 2022 that it would introduce natural capital accounting,¹⁴⁷ and the Victorian Government efforts will need to harmonise with this national push.

The Panel recommends the Victorian Government develop world-leading natural capital accounts for Victoria. In doing this they can use groundbreaking work in other jurisdictions as a guide and then scale it up to a state level, for instance the Queensland Burnett Mary Regional Group's Natural Capital Environmental Accounting Project.¹⁴⁸ Clear, comprehensive and public information about the state's natural capital creates a baseline that will facilitate private investment – investors are seeking a verifiable way to track improvements in an environmental area over time, and natural capital accounting provides that investable foundation.

To further support informed government decision making for government operations in the land sector, the Panel also recommends the Victorian Government take steps towards mandating nature risk disclosures. This will help to identify where nature loss may pose a risk to government assets and services. This will be increasingly important as climate change impacts many of the environmental services government operations depend on. The Panel recommends that the Victorian Government take steps to mandate Taskforce for Nature-related Financial Disclosures-style reporting for government operations, as it becomes available. This will build on Victorian Government climate risk disclosures to provide for world leading informed government decision-making and environmental risk management.

POTENTIAL BENEFITS: LAND AND FORESTRY

Protecting and increasing vegetation can bring a host of important co-benefits.¹⁴⁹ These include:

- Improving air and water quality. Research shows that trees help to remove pollutants like nitrogen dioxide and microscopic particles that harm our health. They also increase rainfall and improve water quality, reducing water treatment costs. Melbourne has some of the world's best quality drinking water because of the largely protected forest catchments.¹⁵⁰
- Reducing landslips and soil erosion from wind and water. Vegetation can use up excess water and encourage water retention, bind soil with roots, provide soil cover to reduce rain impact, and reducing wind velocity at the surface.¹⁵¹
- Buffering climate impacts and extreme weather events such as flooding, drought and heat. For example, native vegetation can reduce run-off following heavy rainfall and vegetation in urban areas can cool cityscapes while also reducing energy demands for cooling.¹⁵²

- Providing shelter on farms. Shelterbelts of vegetation can protect crops and livestock while also helping to control salinity.¹⁵³ By maximizing the habitat value of a shelterbelt it can also support critical pollinators and help to reduce farm pests.¹⁵⁴
- Increasing biodiversity in Victoria, of native plants and habitat for native animals. Strengthening ecosystems can bolster Victoria's nature-based tourism. Victoria's natural assets already attract millions of local, domestic and international visitors every year with \$1.4 billion in spending per year by visitors to parks alone.¹⁵⁵

Protecting and increasing vegetation across Victoria can provide an additional revenue stream for farmers and other landholders tapping into carbon markets. With the right policies and incentives, there is also significant potential private investment that could be tapped into. One study estimates that an orderly transition to net zero emissions Australia-wide could unlock private investment in carbon sequestration of \$72 billion to 2035, and Victoria should aim to capture a share of this investment.¹⁵⁶

PANEL RECOMMENDATION: PRIORITISE AND INVEST IN CARBON-RICH AND BIODIVERSE LANDSCAPES

Victoria's land sector has been a net carbon sink since 2013, absorbing around 25 per cent of Victoria's emissions in 2020. Increasing this natural carbon storage while at the same time increasing biodiversity must be a key part of achieving Victoria's emissions reduction targets. Green infrastructure also provides resilience benefits to the impacts of climate change. The Government should develop rigorous policy frameworks and innovative financial instruments that drive investment.

The Victorian Government should:

- Increase land covered by trees and native vegetation in Victoria by at least 400,000 hectares by 2035, a step change which is approximately double the existing commitments in Victoria's Biodiversity Strategy 2037. This must consider biodiversity at every stage, and could

include both new plantings and protection of existing native vegetation.

- Take steps towards mandating Taskforce for Nature-related Financial Disclosures-style reporting by government and the development of natural capital accounts for Victoria as soon as possible, building on its existing Taskforce for Climate-related Financial Disclosures-style reporting.
- In delivering its existing policy commitment to phase out commercial native timber harvesting in state forests by 2030, accelerate measures to cease native logging and build a leading sustainable plantation forestry industry while protecting Victoria's natural carbon stores, biodiversity, and the tourism potential of native forests.
- Work in partnership with Traditional Owners around management of Victoria's landscapes.

AGRICULTURE

THE CASE FOR ACTION: AGRICULTURE

Victoria's agriculture sector will need to play a critical role in achieving an ambitious 2035 target and ensuring the transition to net zero emissions by 2045 is orderly and fair. The sector currently accounts for almost a fifth of Victoria's emissions, which come primarily from methane emissions from livestock and manure management, and nitrous oxides from cropping and pasture lands. Without further action, agriculture's relative share of emissions will increase as emissions from other sectors such as electricity generation and transport fall.

Although research is advancing — such as at Victoria's Ellinbank Smartfarm — emissions reduction solutions for agriculture are not as advanced as solutions for other parts of the economy. This is particularly the case for addressing methane emissions from livestock, which make up almost 70 per cent of Victoria's total agriculture emissions. Of these, the majority are dairy and beef cows.¹⁵⁷

The meat, dairy and livestock industries are critical to the Victorian economy. Victoria is the largest dairy producer in Australia, while the state's beef cattle population is the third largest.¹⁵⁸ Overall, Victoria is Australia's largest agricultural producer by value, with a gross value of agricultural production of \$17.9 billion in 2020–2021.¹⁵⁹

If Victoria is to achieve its interim emissions reduction targets while maintaining the profitability and sustainability of this critical economic sector, significant action must be taken to reduce livestock emissions.

VICTORIA'S CURRENT ACTIONS: AGRICULTURE

Through Agriculture Victoria Research the Victorian Government has formed partnerships with industry, agribusiness, the education sector and communities to develop SmartFarms. These SmartFarms are located across key regional areas and provide a gateway to research, innovation and development. The Ellinbank SmartFarm in the Latrobe Valley region has an ambitious target of being the world's first carbon-neutral dairy farm by reducing methane emissions; generating electricity through a range of alternate options including solar, wind and bio-digestion; improved fertiliser and manure management practices.¹⁶⁰ The panel notes the importance of such facilities and critical role of research and development must still play in developing the technologies needed for commercial-scale deployment in the agriculture market.

There are also emissions reduction opportunities in the agriculture sector that do not rely on new or emerging technologies — for example changes in farming practices can reduce emissions right now. In many cases, actions to reduce emissions or increase carbon sequestration on farms yield multiple benefits for farm businesses, increasing farm health and profitability. The Victorian Government is providing \$5 million in grants to pilot up to 250 on-farm action plans to help farmers to understand, measure and reduce their on-farm emissions. The 'Making cent\$ of carbon and emissions on-farm' booklet also provides Victorian farm businesses with practical actions that can be taken now to reduce emissions.¹⁶¹

The Victorian Government also has a dedicated program to target on-farm energy use. The \$30 million Agriculture Energy Investment Plan supports farming businesses to improve energy efficiency, manage energy costs, improve energy reliability and develop

on-farm energy generation. This is done through a combination of on-farm energy assessments, grants to invest in energy-efficient and renewable energy technology, demonstrations, and linking farmers to information and education resources.¹⁶²

There are a range of voluntary initiatives and commitments across different parts of Victoria's agriculture sector that are recognising and responding to these market expectations. These initiatives and commitments to lower emissions, many of which are driven by the private sector, can build the momentum needed to drive deeper emissions reductions and promote sustainability in agriculture. Examples include Meat and Livestock Australia's commitment to net zero emissions by 2030, Dairy Australia's commitment to reduce emissions intensity by 30 per cent by 2030, Australian Pork's commitment to net zero emissions by 2025, and Coles Supermarkets' introduction of carbon neutral beef as part of its climate targets of 75 per cent reductions by 2030 and net zero emissions by 2050.

UNLOCKING OPPORTUNITIES: AGRICULTURE

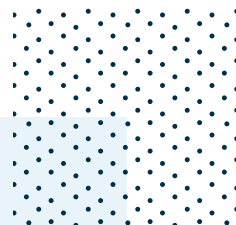
Addressing methane emissions from livestock is the most urgent, large-scale emissions reduction opportunity in the agriculture sector. Technological solutions are advancing, such as methane-inhibiting feed supplements, some of which are already commercially available. Others, such as a methane vaccine, are still in earlier stages of development. Additional measures being trialled include selective breeding, probiotics and respiratory devices.

Scaling up and coordinating efforts to reduce methane across the whole agriculture sector is critical. The Panel urges the Victorian Government to support acceleration of work on methane-inhibiting technologies with a focus on commercialisation and some deployment this decade, and substantial deployment by or before 2035.

'...to reduce the enteric (biogenic) methane emissions of their animals to achieve voluntary emissions reduction targets, it is recognised globally that livestock producers need new and economically viable technologies targeting this problem.'

Dairy Australia

Larger-scale livestock trials such as the Queensland-based 3-NOP trial (Case study below) are demonstrating the progress and growing ambition of the agriculture sector to take action on this significant yet challenging source of emissions. The success of such trials could be the critical enabler and catalyst for further, more widespread, action across the agriculture sector and livestock system, including in Victoria.



CASE STUDY: FEED ADDITIVES AND LIVESTOCK – 3-NOP TRIAL BY COLES IN QUEENSLAND

In Queensland, the supermarket chain Coles has partnered with Mort & Co Grassdale Feedlot and Royal DSM, the developer of the feed additive 3-Nitrooxypropanol (3-NOP), to commence the largest commercial feed additive feedlot trial in Australia.¹⁶³

3-NOP is an organic feed supplement. When added with the regular feed of ruminant livestock, it can inhibit the enzyme process that results in methane emissions. An Australian study published on 3-NOP indicated that a wheat-based diet high in oil and in conjunction with the feed additive can reduce methane emissions by an average of 78 per cent in certain cattle farming systems.¹⁶⁴

The trial with Coles and Mort & Co Grassdale Feedlot is expected to involve 9,800 cattle, providing a significantly larger study population than others to date and more robust and reliable trial outcomes. Specialised cattle veterinarians and researchers will produce a research paper outlining the findings of the trial which is expected to be published in a peer-reviewed scientific journal.¹⁶⁵

This industry-led feed supplement trial has the potential to greatly reduce the methane emissions of cattle, and could lead to a marked step-change in the sustainability of some types of Australian beef farming.

The urgency and importance of investing now in the foundational research and trialling to enable longer-term emissions reductions has also been recognised at the national level. The Australian Government has announced a three staged Methane Emissions in Livestock (MERIL) funding program to support research and development of methane-reducing livestock feed technologies.¹⁶⁶ Importantly, this fund includes investments for the development of low-emissions feed supplements for grazing and pasture livestock. Pasture-fed beef cattle account for almost half of Victoria's livestock emissions and are harder to administer methane-inhibiting feed additives to than feedlot cattle — meaning other options must also be explored.

Alternative proteins are growing in prominence worldwide and represent opportunities for emissions reduction, enhanced consumer choice and industry growth. Plant-based meat substitutes in particular also have the potential to increase the value-adding opportunities for agriculture, horticulture and food processing. While maintaining its traditional agricultural strengths, Victoria should foster its potential in plant-based and cultured proteins.

Improving fertiliser application efficiency can help reduce emissions associated with agricultural soils — the second largest source of emissions in the agriculture sector. In addition to reducing nitrous oxide emissions, farmers can save money and enhance pasture and crop production through planning and implementation of best crop management practices. This also has a range of important co-benefits for the environment, biodiversity and human health, as more efficient uses of fertiliser can decrease acidification of soils and improve water and air quality.¹⁶⁷

POTENTIAL BENEFITS: AGRICULTURE

Market opportunities and competitive advantages are emerging for agriculture industries that can demonstrate more emissions-efficient production systems or carbon neutrality. Meaningful action on climate change and demonstrating the environmental and sustainability credentials of agricultural products both for export and domestic markets will be critical to the long-term prosperity of Victoria's agriculture sector and wider economy. Four out of five of Victoria's top exports are animal products.¹⁶⁸ Increasingly, domestic and global export markets for agriculture sector products are signaling

that trading partners will need to demonstrate they are reducing greenhouse gas emissions.¹⁶⁹ For Victoria to remain a leading exporter of food and fibre, industry and government will need to work together to meet these consumer and commercial market expectations.

Already the EU is developing trading frameworks and partnerships that identify and preference sustainable production, which may begin to have serious impacts on Australian primary producers. For instance, the international trade deal between the EU and Japan, which established the largest open trade zone, is underpinned by a commitment by both parties to adhere to the principles and objectives of the Paris Agreement and strive towards facilitating low-emissions trade solutions.¹⁷⁰ Enhancing capacity-building tools and practices for farmers will assist in both reducing the sector's emissions and helping Victorian farmers respond to growing expectations from consumers, processors, supermarkets and

export markets to reduce the emissions associated with the production of agriculture products.

The banking and finance sector is also increasingly assessing and integrating the emissions intensity of the loans and investments in their business lending portfolios.¹⁷¹ For farming and agri-businesses that can demonstrate low-emissions on-farm activities and decarbonisation pathways, these practices may increase the likelihood of securing bank loans and investments in the future.

Commercial production of methane inhibiting feed additives in Victoria also has a range of wider potential economic benefits. Not only could locally-produced feed additives — like the seaweed asparagopsis — contribute significantly to reducing emissions within Victoria's agriculture sector, such new industries have the potential to support new local supply chains and create jobs and economic growth (see Case study below).

CASE STUDY: SEAWEED HARVESTING

Seaweed harvesting is an emerging emissions reduction opportunity which has a growing potential for both Australian and Victorian markets, due to its application as a methane-inhibiting feed additive for livestock.

In 2016, researchers at the CSIRO and James Cook University demonstrated that feeding livestock a diet incorporating small amounts of red seaweed native to Australian coastal water called asparagopsis had the capacity to significantly reduce the methane emissions associated with the enteric fermentation process.

The first commercial-scale asparagopsis farm in Victoria was developed by the technology business Immersion Group. The project, which began in March 2021, is in the process of establishing an Asparagopsis armata nursery in the Grassy Point Aquaculture Fisheries Reserve near Portarlington on Port Phillip Bay.¹⁷²

The early commercialisation of seaweed farming has the potential to ensure the local industry is well positioned to capitalise on increasing global demand. Not only does commercialised asparagopsis farming offer a potential step-change solution to a challenging source of Victoria's emissions, its success could lead to strong economic growth and jobs opportunities across the supply chain, support the restoration of ocean habitats and the deacidification of ocean and revitalise coastal communities.

The emissions reduction potential of asparagopsis is becoming increasingly understood. A growing scientific evidence-base continues to demonstrate its potential in the step-change required to reduce the agriculture sector's emissions. However, a critical element to this technology's industry-scale adoption is strengthening the evidence-base and confidence in its economic viability.

The Panel notes that work is still required to create the economic incentive for farmers to use asparagopsis. Large-scale trials must still play a role, to better understand not only the emissions reduction potential but the possible productivity and livestock weight advantages that asparagopsis can provide. If successful, an evidence base that demonstrates the economic advantage and increased productivity gained through asparagopsis could provide the incentive for widespread market adoption and fast-track emissions reductions in the agriculture sector.

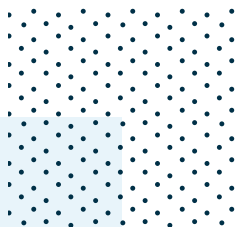
Conducting such trials in Victoria would provide ideal preparation for market-scale deployment and adoption and provide even greater certainty about its efficacy and productivity gains in a Victorian context. This could also lay the groundwork for Victoria to capitalise on the opportunities and co-benefits widespread market adoption of asparagopsis could create in areas such as infrastructure investment, employment and skills development, and education and training.

PANEL RECOMMENDATION: BEGIN A STEP CHANGE IN EMISSIONS FROM LIVESTOCK

Agriculture accounts for 19 per cent of Victoria’s total emissions, with beef and dairy cattle making up almost half of this. Addressing emissions from these animals is the most immediate large opportunity in this sector to reduce emissions. Action for dairy and feedlot cattle can be complemented where possible with other actions, including for example on-farm energy efficiency or transition from diesel to electric technologies.

The Victorian Government should:

- Prepare Victoria’s beef and dairy sectors for immediate large-scale deployment of methane reduction technologies - more than 80 per cent of feedlot beef and dairy cattle, and around a third of pasture-fed beef, will need to be treated with these technologies by 2035.
- Help the agricultural sector rapidly adopt technology to reduce livestock emissions by introducing policies that consider every part of the value chain, including incentives for farmers and buyers of goods and services.
- Accelerate deployment of methane-inhibiting technology for livestock through supporting commercialisation of promising options to enable demonstration under Victorian farming conditions, and rapid deployment across the sector.





CROSS-SECTOR ENABLERS

To achieve an 80 per cent emissions reduction target by 2035 and seize the benefits of the global transition to net zero, the Victorian Government will need to go beyond sector-based emissions reductions and look at enabling mechanisms that work across the economy. Victoria will need a strong economy backed by infrastructure investment, resilient supply chains, a skilled workforce, and new ways of collaborating. All players — federal and state, public and private — must work together to make the transition happen.

While these measures do not directly reduce emissions, they provide the critical enablers to support emissions reductions across the Victorian economy. The enablers relate to multiple sectors and require holistic management, as part of the whole of economy climate action delivery plan discussed at the beginning of this section.

INVESTMENT AND FINANCING

Securing the investment for Victoria's energy transition

The transformation of Victoria's economy to a prosperous and net zero future will require investment on an unprecedented scale,¹⁷³ including funding for new energy infrastructure.

Both the Australian and Victorian Government have committed record funding to support rapid energy transition, with Victoria investing \$1 billion in renewable energy projects through the revived State Electricity Commission. Given budget limitations, governments are not likely to be able to fund the transition entirely through public funds. The Panel sees an opportunity for the Victorian

Government to work with local and international private sector investors to leverage committed public spending to secure the necessary funds for the transition to reliable and affordable renewable energy for the state.

There is a growing opportunity for private sector investment in low-emissions economic activities as investors and businesses increasingly recognise climate change in their strategies and investment decisions. Companies representing 70 per cent of the ASX200's collective market capitalisation have net zero emissions commitments and investors are increasingly redirecting capital away from emissions-intensive assets. These trends are likely to be further accelerated by the Australian Government commitment to applying standardised climate-related financial disclosure requirements to large businesses.¹⁷⁴

The policy certainty provided by Victorian Government climate legislation, emissions targets and public investment puts Victoria in a good position to compete internationally for early investment in the capital-intensive energy sector transition. Analysis of 12 Member Countries from the Organisation for Economic Co-operation and Development (OECD) demonstrated that climate policy uncertainty is associated with economically and statistically significant decreases in investment.¹⁷⁵

The Victorian finance sector also has a role to play in the transition. The Australian Sustainable Finance Roadmap provides a plan for the Australian finance industry and individual financial institutions to align lending, insurance and investment with the transition to net zero emissions. It highlights the need for deep, constructive, and ongoing partnerships between all levels of government, community and other financial

system participants, to effectively drive systemic change. It also notes that Australia's financial system is integrated into the global financial system, with Australia playing a leading role contributing to global regulatory bodies.¹⁷⁶

This work is also gaining pace with the Australian Prudential Regulation Authority publishing its first Climate Vulnerability Assessment of Australia's five largest banks in 2022, looking at how climate change may test the resilience of the banking system in the coming years and how banks might react to and manage these impacts.¹⁷⁷

Innovative financing mechanisms can also support the transition. For example, many Victorian Councils provide Environmental Upgrade Financing where a building owner borrows money for environmental building upgrades from a financier and makes the repayments through the local council rates system. These can be for renewable energy generation, energy efficiency, waste reduction or climate change adaptation.

Supporting innovation for Victoria's economic transition

While funding to support the rapid roll-out of known technologies is important, it is also vital to invest in innovation, to ensure that solutions are developed in areas that do not yet have a clear path forward, and that emerging technologies can be tested and scaled up. For example, The US Inflation Reduction Act of 2022 includes tax credits designed to catalyse private investment in clean manufacturing capacity; jump-start research and development; and help rapid commercialisation of leading-edge technologies such as carbon capture and storage and clean hydrogen.¹⁷⁸ Similarly there have been longstanding efforts in Australia to support climate innovation. For example, the Australian Renewable Energy Agency (ARENA) has operated for more than ten years to support pre-commercial innovation. This is realised through funding projects that:

- Lower renewable energy generation costs, improve the economics of energy storage and enhance integration of large scale renewable energy into electricity network.
- Support viable clean hydrogen industry across the full value chain.

- Support the transition to low emissions 'green' metals' value chains including steel and aluminium.
- Decarbonise land transport.

The funding objectives of ARENA are to support emissions reduction projects across the entire innovation chain — from research to large-scale deployment. This intends to accelerate the affordability of new technologies and build investor confidence in renewable energy projects.¹⁷⁹

The Panel acknowledges that the Victorian Government has established Breakthrough Victoria — an independent company managing a \$2 billion investment fund with the intention of making Victoria a global innovation leader. One of the five focus areas of the fund is "clean economy", supporting the transition to net zero emissions through investments targeted at renewable energy generation; improved energy efficiency, transmission and storage; circular economy practices; fuel-switching in industry, transport and agriculture, and other activities such as carbon capture and storage and hydrogen.¹⁸⁰ The Panel commends the focus on emissions reductions by the fund and the intersection that it targets between reducing emissions and benefiting Victoria's economy, such as through new green jobs. The Panel encourages emissions reduction potential to also be considered when allocating funding in the other four areas of focus: advanced manufacturing, agri-food, digital technologies, and health and life sciences.

Network effects

The scale of change required presents an opportunity to build entire decarbonised economic ecosystems which link together different low-emissions activities. Victoria should be planning for the development of low-carbon industries with this in mind. An example of this could be a battery manufacturing ecosystem, starting with minerals processing, which could feed into battery production, which are in turn inputs into electric vehicle manufacturing, and then establishing processes for recycling batteries and their components at the end of their life. These industries could all be co-located with renewable energy generation infrastructure to ensure they are powered by zero-emissions electricity.

SECURE SUPPLY CHAINS

Supply chains will be central to Victoria's economic success in the transition to net zero emissions. Both access to global supply chains for in-demand materials, and the resilience of supply chains will matter. This includes securing a reliable supply of materials and products to support the transformation of the state's energy sector, in increasingly competitive globally markets. Current supply chain issues have been sparked by a range of factors including the pandemic, increasingly common extreme climate events, increasing trade restrictions and global conflicts. These factors have led to issues with labour shortages, equipment availability and ripple effects from global bottlenecks¹⁸¹ — from raw materials for solar PV manufacturing to specialised boats for offshore wind turbine installation.

The Victorian Government will need to plan carefully, together with the federal, interstate, and local governments as well as with the private sector, to ensure the supply of materials and products needed for the state's transition. It can look to international examples of how to do this. For instance, America's Strategy to Secure the Supply Chain for a Robust Clean Energy Transition provides several strategies to address supply chain risks.¹⁸² These include increasing domestic raw material production, expanding domestic manufacturing capabilities and diverse foreign supply chains. Victoria will need to consider these different options in light of its natural strengths and competitive advantages, and where the most significant bottlenecks to the local or global transition are or are likely to be. The Victorian Government's Low Carbon Manufacturing Grant Program and programs under Victoria's circular economy policy, Recycling Victoria, will play a role in securing supply, however more strategic and collaborative planning is required.

The Panel comments that while recent global events highlight the value of more diverse and secure supply chains, the gains from trade and the international division of labour remain important. Victoria and Australia do have opportunities to expand production, but may be better off focusing on products where Victoria can excel or address significant bottlenecks to local and global

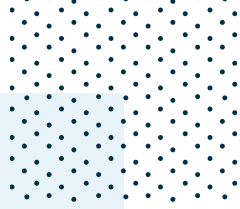
transitions. Pursuing 100 per cent local content in energy transition projects is unlikely to be possible, let alone economic. Since the cost of renewable energy is largely in the initial construction and finance, competitive project delivery costs will be central to future energy advantage.

SKILLS AND WORKFORCE FOR THE TRANSITION

Attracting, retaining and training the right workforce in Victoria will underpin the state's future success in a low-emissions global economy. Projections by Net Zero Australia found 1 to 1.3 million new workers will be needed across Australia to reach net zero. The interim results found most of this new workforce will need technical skills, including in renewable generation, transmission, and energy storage. There is also an expected increased need for professionals, managers and administrative workers.¹⁸³ Current jobs are expected to change too, with many existing jobs likely to require upskilling to adapt to roles in the clean economy.¹⁸⁴

HSBC's global report on this issue in 2021 found that although most of the skills needed for transition already exist, workers will need to learn new skills that are specific to working with low emissions technologies, such as installing solar, ground and air source heat pumps, installing building-integrated solar PVs, understanding and applying eco-design principles, carbon accounting, and knowledge of climate policy.¹⁸⁵ ASIC has also raised concerns on skills shortages in climate change risk management.¹⁸⁶

Workforce shortages are already being felt, both within and beyond sectors vital to the transition to net zero emissions. Australia is currently facing a workforce shortage, with unemployment at the lowest rates in nearly half a century.¹⁸⁷ Post-Covid 19 workforce shortages are widespread globally but are particularly serious in highly developed countries like Australia and the US.¹⁸⁸ In Victoria, there have been reports of shortages of skilled engineers and electricians for renewable energy, even before the widespread labour shortages after Covid-19 disruptions reported in 2021-22.¹⁸⁹ These current challenges only underline the need for serious planning around how to secure the skilled labour force needed for the transition.



Analysis by the Australian Government Productivity Commission highlights the importance of access to skilled labour from other countries, which can improve the quality and diversity of skills in the labour market.¹⁹⁰ Victoria will be competing internationally with other countries to attract the workforce to support the transition to a net zero economy. Coordination with the Australian Government will be central to establishing the right incentives for skilled labour, and the government could also consider other policy measures including marketing and connecting interested candidates with opportunities.

To compensate for likely labour shortages in some key sectors, there will also be important roles for increasing productivity, automation, assistive robotics and artificial intelligence alongside education, training and immigration.

In Victoria, the Clean Economy Skills and Jobs Taskforce was set up in 2021 to provide independent expert advice to the government on how to equip the Victorian workforce with these necessary skills. It has been part of a broader \$10 million initiative including grants funding to support Victorian industry, business and the TAFE and training system to develop the skills of their workforce and deliver relevant training, as the Victorian economy transitions towards a net zero emissions economy and a circular economy. The Latrobe Valley Authority also plays a role in skills development for the growing renewable energy industry. This is in addition to Australian Government funding of \$100 million for New Energy Apprenticeships and the New Energy Skills Program. Ongoing monitoring of skills needs and proactive planning to address these needs is likely to be a hallmark of a successful transition in Victoria to a low emissions economy.

There is a potential emerging opportunity for Victoria to position itself as an international leader in education for the global low emissions economy. Victoria is already the Australian leader in international education, with 31.7 per cent of total Australian enrolments contributing \$6.9 billion in revenue to the state's economy. International education has been Victoria's largest services export for over a decade.¹⁹¹ As an example, Victoria's Federation University has become a leader in

renewable energy education with Australia's first wind turbine training tower and able to deliver internationally recognised Global Wind Organisation training.

A WHOLE OF VICTORIAN GOVERNMENT APPROACH

Emissions targets considered in major government decisions

The Victorian Government has a key role to play in creating the transformative change needed to achieve strong emissions reduction targets. For maximum impact, climate change needs to be integrated into all decision-making across government.

The Panel understands the Victorian Government has made progress with mainstreaming climate risk management across government and establishing Ministerial guidelines for some decision makers to have regard to climate change, under Sections 17 and 18 of the Climate Change Act. However, a more coordinated approach is required to ensure climate change considerations and emissions targets are reflected in all major government policy, spending and investment decisions. This includes through creating investable policy frameworks that require the reduction of emissions and adoption of new technologies.

The Government could look to other jurisdictions for implementation. For instance, the UK's Net Zero Strategy establishes a series of commitments to help embed net zero in all government decision making. These include multiple forums (including Cabinet Committees) that bring together different perspectives on net zero and its interaction with other priorities, delivering climate skills and training across the Civil Service, and embedding net zero in a wider range of decision-making levers.

Government procurement to support the transition

The Victorian Public sector is major part of the Victorian economy, employing 345,866 people or around 10 per cent of the Victorian workforce.¹⁹² The Panel recognises the important progress the Victorian Government is making to reduce emissions directly from government operations, including the commitment for electricity used in government operations — such as schools, hospitals, metropolitan trains and trams and other public services — to be 100 per cent renewable by 2025.¹⁹³

The Panel suggests the Victorian Government also considers opportunities to further reduce emissions from government procurement, particularly from materials and construction for major government building and infrastructure projects. The Victorian Government's significant purchasing power has the potential not only to reduce emissions from these projects but to also help generate a step change in construction industry and supply chain emissions. For example, the UK requires suppliers who are bidding on central government contracts over £5 million per annum to commit to achieving net zero by 2050 and to detail their organisation's emissions in a Carbon Reduction Plan¹⁹⁴. NSW is partnering with commercial builders, the infrastructure construction industry, asset owners and government agencies to grow demand for low emissions building materials across the economy, such as low emissions steel and concrete.

While construction supply chain emissions often do not fall within Victorian boundaries for carbon accounting purposes, demand for low-emissions alternatives will be important to underpin investment in clean supply. Support for the better measurement of embodied emissions, and partnerships between suppliers, constructors and end-users will be important. If Victorian Government low emissions procurement policies were developed in close collaboration with the Australian Government, interstate government and local governments, it could support a step change in lower emissions across the Australian building sector and national supply chains. In Victoria, this could build on work to optimise the use of recycled and reused materials in all major transport projects and the state's circular economy policy Recycling Victoria.

Victorian Government procurement and investment can also be leveraged to unlock further private sector investment in emissions reductions activities. For example, Victorian Government investment in renewable energy infrastructure, through the revived State Electricity Commission, can be used to leverage private investment in the roll out of renewable energy infrastructure across the state, building on the successful VRET reverse auction scheme. The Panel notes the Victorian Government's Green Bonds scheme that is used to finance new and existing projects that offer climate and environmental benefits¹⁹⁵ and encourages the Government to consider further opportunities for innovative finance policies, in line with global best practice.

A CLIMATE RESILIENT VICTORIA TO SUPPORT THE TRANSITION

Climate adaptation measures are a cross-sectoral enabler to ensure that the opportunities created by reducing emissions are safeguarded and maximised. As Victoria experiences the impacts of climate change, including a decrease in average rainfall and a significant increase in fire danger, strategic adaptation measures will be needed, including to protect the sectoral changes that the state is relying on to reduce its emissions. For example, the land sector can be affected by carbon release events due to increasingly common bushfires, heatwaves or droughts. And green infrastructure can positively impact the resilience of hard infrastructure and local communities. The renewable energy sector can be affected by climate impacts on energy infrastructure. As noted above, a range of energy efficiency and thermal comfort upgrades in buildings have benefits both for lower emissions, lower bills, and greater resilience to increasingly severe temperature extremes.

The Panel notes the work the Victorian Government is doing through the Adaptation Action Plans and climate related risk disclosures. The Panel advises that the Victorian Government could consider further opportunities to build climate impact resilience into climate mitigation actions, as well as all government policy and spending decisions. Strategic investment by the Government now can prevent or reduce substantial future disruptions to emissions reductions trajectories and economic growth opportunities.

THE ROLE FOR NEGATIVE EMISSIONS TECHNOLOGIES AND OFFSETS

While clear opportunities exist for reducing emissions across the Victorian economy now, there are challenges to addressing emissions in 'hard-to-abate' sectors such as heavy industry and agriculture.

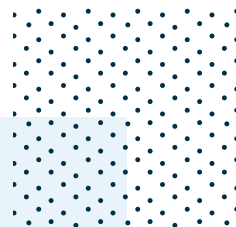
Negative emissions measures and offsets can help counterbalance residual emissions from sources that remain too difficult, expensive or not yet practicable to abate. This can provide additional flexibility to meet emissions reduction targets. Negative emissions refers to action within Victoria to remove greenhouse gases from the atmosphere within Victoria, while offsets refer to emissions reduction and sequestration occurring outside of Victoria which is purchased and counted towards emissions reductions in Victoria.

The less that each sector manages to prevent or reduce its emissions, the more negative emissions and offsets will be required to meet a target. Similarly, for any given emissions budget, slower progress to net zero implies greater reliance on net negative emissions later on. While negative emissions technologies and offsets have a role to play in compensating for emissions that cannot be prevented in other ways, the benefits that they offer must be considered against potential risks such as limited land availability for sequestration, high costs and uncertainties associated with negative emissions technologies (see [Box 7](#)) and the possibility that offsets may become scarcer over time.

In the Panel's consultation process, a range of stakeholders identified increased sequestration in the LULUCF sector as an important component of Victoria's decarbonisation journey. Other negative emissions measures featured only in discussions with Net Zero Australia, in whose draft modelling results engineered carbon removals in Victoria served an important role in the national achievement of net zero emissions. Victoria's carbon capture and storage project, CarbonNet, is scheduled to be operational by 2035 and will provide another negative emissions option for Victoria. The Panel, when considering these removals, notes the constraints on land use change in Victoria's intensively used landscapes.

Stakeholders expressed mixed views on the use of offsets to achieve Victoria's emissions reduction targets. Some supported the need for offsets to achieve a net zero emissions economy and the potential for offsets to generate valuable co-benefits. Others warned of issues around integrity, affordability and availability.

The Panel recognises that avoiding and reducing emissions is critical to Victoria's successful transition to net zero emissions, but also recognises that there will be a role for offsets and negative emissions technologies to address emissions that cannot be avoided. However the focus will be on offsets being appropriately priced, and we should not expect future access to relatively abundant and low-priced units as has been the case in the past decade. It is critical that Victorian Government actively works to engage in the national carbon market to ensure that high quality offsets will be available for the state's future needs.





SUMMARY OF RECOMMENDATIONS



1. SET A TARGET OF 80% EMISSIONS REDUCTIONS BELOW 2005 LEVELS IN 2035

This target continues Victoria's pathway to net zero emissions by 2045 in a way that is consistent with Victoria playing its part in keeping global temperature rise to 1.5°C and positions Victoria to reap the benefits of, and maintain competitiveness in, the global transition to net zero emissions.

2. CREATE A WHOLE-OF-ECONOMY CLIMATE ACTION DELIVERY PLAN

Victoria's transition to a low emissions economy involves all parts of the economy and will deliver maximum benefits if well coordinated, targeting clear and deliverable outcomes. The Victorian Government is due to deliver an update to its Climate Strategy by October 2025. However, earlier, additional guidance in the near term will help to clarify the scope and staging of implementation and investment requirements for decarbonisation.

The Victorian Government should:

- Develop a world-leading climate action delivery plan by June 2024 to guide the state's transition to a net zero economy by 2045. This plan must be a comprehensive implementation plan to transform Victoria's economy in line with the recommendations below to deliver all necessary measures to achieve the 80 per cent target.
- Demonstrate how the Government intends to unlock investment in the transition for all major sectors, including creating investable policy frameworks that require the reduction of emissions and adoption of new technologies; underwriting investment; or investing directly (as planned in the revived State Electricity Commission).
- Map out, through this plan, an approach to secure access to key supply chains and the skilled workforce needed for the transition.

- Involve, collaborate and coordinate with all levels of government, Traditional Owners, experts, community groups, industry, unions, the research community and the investment community in the development and execution of the plan.

3. RAPIDLY MANAGE TRANSITION OF VICTORIA'S ELECTRICITY SYSTEM

Victoria's transition to a zero emissions electricity sector is well underway, with commitments to coal retirement now largely in place. Deep decarbonisation of Victoria's electricity generation is core to the transition to a net zero emissions economy by 2045. Decarbonising the sector will both directly address Victoria's largest source of emissions, and will enable emissions reductions in other sectors such as in transport, industry, buildings and agriculture through electrification.

The Victorian Government should:

- Plan for and facilitate the full exit of coal power in Victoria by or before 2035.
- Accelerate well-planned and sequenced construction of renewable generation, transmission, and storage, sufficient to replace retiring capacity and prepare for forecast needs. Investment may also be needed into measures such as demand management, demand response and distributed energy resources. This will capture the full benefits including investment attractiveness, energy security, affordability and reliability.
- Ensure secure long-term funding and governance arrangements to coordinate and lead the broader transition to a net zero emissions economy for the whole state. This will enable a just transition for affected communities, and will help build and maintain social license.

4. ACCELERATE PHASE OUT OF NATURAL GAS USE WITH AN IMMEDIATE FOCUS ON VICTORIA'S BUILT ENVIRONMENT

Over two million Victorians use natural gas in their homes and businesses, and natural gas is also widely used across Victorian industry. The Victorian gas sector contributes around 17 per cent of the state's net emissions. The built environment sector is also a priority for action, given it is a significant emissions source, solutions are readily available, and have the potential to create numerous co-benefits for Victorians.

Building on the Gas Substitution Roadmap, the Victorian Government should:

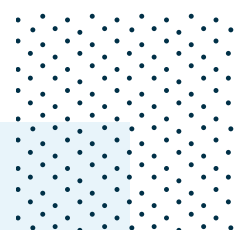
- Significantly step up the ambition, urgency and scope of actions to electrify homes and buildings and to electrify or deploy alternatives in other sectors to enable natural gas use across Victoria to be largely phased out by 2035.
- Accelerate the transition in the built environment through Victorian reforms including planning policies and through national changes, such as step changes to the National Construction Code.
- Substantially upgrade the energy efficiency of Victoria's built environment to deliver multiple benefits for energy affordability, emissions, energy system management, human health and comfort and public finances.

5. ACCELERATE UPTAKE OF ZERO EMISSIONS VEHICLES (ZEVs)

Transport is Victoria's second largest – and fastest growing – source of emissions. Reducing emissions from the transport sector will be critical. Coordination with the Australian Government is vital, since issues such as vehicle emissions standards fall within federal jurisdiction, and Victoria should be an advocate and champion for zero emissions vehicles at a national level as part of its actions in the transport sector.

The Victorian Government should:

- Phase out new sales of emitting road vehicles in Victoria by 2035. This should be facilitated by taking measures to urgently increase supply of ZEVs in Victoria including increasing ZEVs in the government fleet and measures to accelerate fleet turnover. Victoria should also advocate for and facilitate a national ZEV approach.
- Noting the approach in other jurisdictions such as California, invest in development of every part of the enabling ecosystem to support large-scale deployment of ZEVs in Victoria including finance and insurance, skills to maintain and repair electric vehicles, and charging infrastructure.



6. PRIORITISE AND INVEST IN CARBON-RICH AND BIODIVERSE LANDSCAPES

Victoria's land sector has been a net carbon sink since 2013, absorbing around 25 per cent of Victoria's emissions in 2020. Increasing this natural carbon storage while at the same time increasing biodiversity must be a key part of achieving Victoria's emissions reduction targets. Green infrastructure also provides resilience benefits to the impacts of climate change. The Government should develop rigorous policy frameworks and innovative financial instruments that drive investment.

The Victorian Government should:

- Increase land covered by trees and native vegetation in Victoria by at least 400,000 hectares by 2035, a step change which is approximately double the existing commitments in Victoria's Biodiversity Strategy 2037. This must consider biodiversity at every stage, and could include both new plantings and protection of existing native vegetation.
- Take steps towards mandating Taskforce for Nature-related Financial Disclosures-style reporting by government and the development of natural capital accounts for Victoria as soon as possible, building on its existing Taskforce for Climate-related Financial Disclosures-style reporting.
- In delivering its existing policy commitment to phase out commercial native timber harvesting in state forests by 2030, accelerate measures to cease native logging and build a leading sustainable plantation forestry industry while protecting Victoria's natural carbon stores, biodiversity, and the tourism potential of native forests.
- Work in partnership with Traditional Owners around management of Victoria's landscapes.

7. BEGIN A STEP CHANGE IN EMISSIONS FROM LIVESTOCK

Agriculture accounts for 19 per cent of Victoria's total emissions, with beef and dairy cattle making up almost half of this. Addressing emissions from these animals is the most immediate large opportunity in this sector to reduce emissions. Action for dairy and feedlot cattle can be complemented where possible with other actions, including for example on-farm energy efficiency or transition from diesel to electric technologies.

The Victorian Government should:

- Prepare Victoria's beef and dairy sectors for immediate large-scale deployment of methane reduction technologies - more than 80 per cent of feedlot beef and dairy cattle, and around a third of pasture-fed beef, will need to be treated with these technologies by 2035.
- Help the agricultural sector rapidly adopt technology to reduce livestock emissions by introducing policies that consider every part of the value chain, including incentives for farmers and buyers of goods and services.
- Accelerate deployment of methane-inhibiting technology for livestock through supporting commercialisation of promising options to enable demonstration under Victorian farming conditions, and rapid deployment across the sector.

APPENDIX I - INDEPENDENT EXPERT PANEL MEMBERS



MARTIJN WILDER AM (CHAIR)

Martijn is Founder and CEO of Pollination, a global climate change investment and advisory firm. In 2015 he chaired the Independent Review of Victoria's 2010 Climate Change Act. Martijn was Head of Baker & McKenzie's global climate law and finance practice for twenty years and played a key role with Australia's clean energy finance institutions. He was previously Chair of the Australian Renewable Energy Agency (ARENA), a former Founding Director of the Clean Energy Finance Corporation (CEFC), and he helped to establish and later Chair the Australian Government's Low Carbon Australia finance body. He is currently Chair of the Governing Board of the Renewable Energy and Energy Efficiency Partnership (REEEP) based in Vienna, President of WWF-Australia, Adjunct Professor of International Climate Change Law at Australian National University, and a Senior Adviser to Serendipity Capital. He is also a Member of the Wentworth Group of Concerned Scientists. Martijn was a Cambridge Commonwealth Trust Scholar and was awarded an Australian Honour (AM) for his contribution to climate change law and the environment. In 2018, Martijn was awarded the Financial Times Asia Pacific Legal Innovator of the Year.



EMMA HERD

Emma is a known figure in the Australian and global climate change arena having worked across industry, banking, finance, policy and advocacy. She is a regular media contributor on climate matters, and a respected voice on climate transition implications for business. Emma is currently Partner for Climate Change and Sustainability Services at advisory firm EY and a member of the Financial Reporting Council (FRC), the Green Building Council of Australian GreenStar Advisory Committee, and the Queensland Land Restoration Fund Investment Panel. Emma was the former Chief Executive Officer of the Investor Group on Climate Change (IGCC) and non-executive Director of the Carbon Market Institute.



TENNANT REED

Tennant understands the relationship between industry and climate policy. As Director – Climate Change and Energy at Ai Group, he has extensive experience across climate and energy policy design, industry and energy sector dynamics, and advocacy and engagement on behalf of industry. He has produced influential reports on energy prices, carbon border adjustments and business energy use. Tennant is also co-host of the Let Me Sum Up podcast.

APPENDIX 2 - THE PANEL'S TERMS OF REFERENCE

INTRODUCTION

The *Climate Change Act 2017* (the Act) provides Victoria with a world-leading legislative foundation to manage climate change risks; maximise the opportunities that arise from taking decisive action; and drive Victoria's transition to a net zero emissions, climate-resilient community and economy.

Section 10 of the Act requires the Premier and the Minister responsible for administering the Act (the Minister for Energy, Environment and Climate Change, hereafter the Minister) to set five-yearly interim targets to keep Victoria on track to meeting the Act's long-term target of net zero greenhouse gas emissions by 2050. The Government announced the first two interim targets – for 2021–25 and 2026–30 – as part of Victoria's Climate Change Strategy in May 2021. These targets are 28–33 per cent below 2005 levels in 2025, and 45–50 per cent below 2005 levels in 2030. The next interim target, for 2035, must be set by 31 March 2023. The Strategy also included Victoria's first round of "sector pledges" – emissions reduction policies and measures – under the Act, for the period 2021–25.

Section 12 of the Act requires the Minister to "obtain advice from one or more persons who are appropriately qualified, in the Minister's opinion, to act as an independent expert". This Interim Targets Independent Expert Panel (the Panel) is being established for this purpose. Section 14 of the Act requires the Premier and the Minister to have regard to this independent expert advice – alongside other factors – in determining an interim emissions reduction target.

Section 12 of the Act sets out the scope of advice to be provided by the independent expert(s) and the issues they must consider in formulating their advice. The scope of work detailed in the terms of reference has been framed according to the provisions of the Act.

ESTABLISHMENT AND DURATION OF THE PANEL

1. The Minister establishes the Interim Targets Independent Expert Panel as a Group D, Band 3 non-statutory ministerial advisory committee from the date of these Terms of Reference.
2. The Panel consists of the Chairperson and two other members, appointed by the Minister.
3. The term of the Panel will commence from 1 January 2022 and run until 30 June 2023.

FUNCTIONS

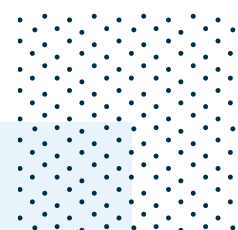
4. The functions of the Panel are to provide advice to the Minister on:
 - a. one or more recommended interim targets for reducing greenhouse gas emissions for the period 2031–2035. These must have the following characteristics:
 - Each interim target must constitute a greater reduction in greenhouse gas emissions than any previous interim emissions reduction target, as per Section 14(2) of the Act, and
 - Each interim target must be expressed against a 2005 base year, as per Section 11(1) of the Act.
 - b. indicative trajectories for Victoria to achieve the long-term emissions reduction target (net zero greenhouse gas emissions by 2050) based on each option identified under 8a).
 - c. potential opportunities across the Victorian economy as a whole to reduce greenhouse gas emissions in the most efficient and cost-effective manner in the 2031–35 interim target period.

CONSIDERATIONS

5. Under Section 12 of the Act, the Panel must consider the following in forming its advice:
 - a. Victoria's legislated long-term target of net zero emissions by 2050
 - b. relevant up-to-date climate science, including Victoria's Climate Science Report 2019
 - c. technologies relevant to climate change
 - d. economic circumstances – in particular the likely impact of the interim targets on the economy and the competitiveness of particular sectors of the economy
 - e. social circumstances – in particular the likely impact of the interim targets on the health and wellbeing of Victorians
 - f. environmental circumstances – in particular the benefits to the environment of emissions reduction
 - g. existing national and global action on climate change, including any undertakings relating to the reduction of greenhouse gas emissions that Australia has given under international climate change agreements, and
 - h. progress to date towards the reduction of greenhouse gas emissions in Victoria. This includes the government's 2020 emissions reduction target and trends in emissions reflected in annual greenhouse gas emissions reports such as State Greenhouse Gas Inventories while recognising the lags inherent in inventory data.
6. When forming its advice, the Panel must also have regard to the policy objectives and guiding principles of the Act.
7. The policy objectives of the Act, as laid out in Section 22 of the Act, are:
 - a. to reduce the State's greenhouse gas emissions consistent with the long term and interim emissions reduction targets
 - b. to build the resilience of the State's infrastructure, built environment and communities through effective adaptation and disaster preparedness action
 - c. to manage the State's natural resources, ecosystems and biodiversity to promote their resilience
 - d. to promote and support the State's regions, industries and communities to adjust to the changes involved in the transition to a net zero greenhouse gas emissions economy, including capturing new opportunities and addressing any impacts arising from the need to reduce greenhouse gas emissions across the economy, and
 - e. to support vulnerable communities and promote social justice and intergenerational equity.
8. The guiding principles of the Act, as laid out in Sections 23 to 28 of the Act, are:
 - a. informed decision making
 - b. integrated decision making
 - c. risk management
 - d. equity
 - e. community engagement
 - f. compatibility.

ACCOUNTABILITIES

9. The Panel is accountable to the Minister in the performance of its functions.
10. The Panel must provide its final advice as required by these Terms of Reference to the Minister by 1 March 2023.
11. The final report and recommendations will be tabled in Parliament and made publicly available in accordance with the requirements of Section 13 of the Act.
12. The Panel will not publish any form of the report before it has been published by the Government.



APPENDIX 3 - STAKEHOLDERS CONSULTED

The list presents stakeholders and experts that the Panel met individually, at roundtables, and that provided a submission to the Panel.

A Different Approach Community	City of Melbourne
Acciona	City of Port Phillip
ACF Community Chisholm	Clean Energy Council
AGL Energy	Climate Action Moreland
Air Conditioning and Heating (AIRAH)	Climate Action Team, Colac Otway Region
APA Group	Climate Council of Australia
AusNet Services	Climateworks Centre
Australian Energy Council	Co-operative Power Australia Ltd
Australian Gas Infrastructure Group	Committee for Gippsland
Australian Industry Greenhouse Network	Construction Material Processors Association
Australian Institute of Refrigeration,	Dairy Australia
Australian Land Conservation Alliance (ALCA)	Darebin City Council
Australian Nursing and Midwifery Federation (VIC)	Doctors for the Environment Australia
Australian Parents for Climate Action	East Gippsland Climate Action Network
Australian Petroleum Production & Exploration Association (APPEA)	East Gippsland Shire Council
Baw Baw Shire Council	Emergency Management Victoria
Bicycle Network	Energy Efficiency Council
Brotherhood of St Laurence	Energy Networks Australia
Business Council of Australia	Energy Users Association of Australia (EUAA)
Carbon Market Institute	EnergyAustralia
Cement Concrete & Aggregates Australia (CCAA)	Environment Victoria
Centre for Climate Safety	Environmental Institute of Australia and New Zealand
CFMEU, Mining and Energy Union	Environmental Justice Australia
CitiPower, Powercor and United Energy	ExxonMobil

Farmers for Climate Action
Federal Chamber of Automotive Industries
Federation University
Flow Power
Food and Fibre Gippsland
Friends of the Earth
Gas Energy Australia
Gippsland Environment Group
Gippsland Trades Labour Council
Gippsland Water
Grattan Institute
Green Building Council of Australia
Green Wedges Coalition
Health and Community Services Union
Hepburn Energy
Hydro Tasmania
Insurance Australia Group
Ivor Frischknecht
Jesuit Social Services
Knox City Council
Latrobe City Council
Latrobe Health Advocate
Latrobe Health Assembly
Latrobe Valley Authority
Lighter Footprints
Mine Land Rehabilitation Authority
Municipal Association of Victoria
Net Zero Australia
Nillumbik Climate Action Team
Opal (Australian Paper)
Origin Energy Limited
Orygen
Russell Northe, Member for Morwell
School Strike 4 Climate Australia
SmarterLite Group
St Vincent de Paul
Strata Community Association
TAFE Gippsland
The Community and Public Sector Union (Victorian Branch)
Trust for Nature (Vic)
United Workers Union
Vic Catchments
VicRoads Gippsland
Victorian Chamber of Commerce and Industry (VCCI)
Victorian Council for Social Services (VCOSS)
Victorian Energy Policy Centre
Victorian Environmental Law Student Network
Victorian Farmers Federation
Victorian Greenhouse Alliances
Victorian Trades Hall Council
Victorian Youth Expert Advisory Group on Climate Change
Viridian
Wangaratta Landcare & Sustainability
WestWind Energy
World Wildlife Fund Australia (WWF)

APPENDIX 4 - EMISSIONS BUDGETS

An important consideration for Victoria's interim emissions reduction targets is what contribution Victoria will make to meeting the temperature goals of the Paris Agreement. The majority of respondents to the Panel's consultation survey rank this as the number one consideration for setting Victoria's target for 2035. This point has also been reiterated by stakeholder organisations.

The Panel has decided to use emissions budgets as a tool to help link emissions targets and trajectories for Victoria with the temperature goals of the Paris Agreement.¹⁹⁶ Emissions budgets are important because the total accumulation of greenhouse gases in the atmosphere globally determines the amount of climate change that will occur, rather than emissions in any given year.

Just as fiscal budgets are critical to financial discipline in government decision-making, emissions budgets are crucial to discipline the setting of emissions reduction targets and the consideration of consequences in climate and economic policy making. Emissions budgets provide a tool for understanding trade-offs between earlier and later action. Given total cumulative emissions are constrained, less action in the short term means that steeper emissions reductions will be needed later on, and vice versa.

'Reducing cumulative emissions over the next 30 years is far more important for mitigating climate change than emissions in any one year.'

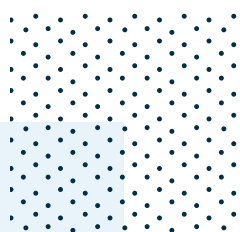
Energy Efficiency Council

'Assuming an appropriate level of understanding and caution is used to create [emissions] budget-based targets, they could offer an opportunity for Victoria to lead a push for all of Australia...to bring targets and policies into alignment with limiting warming to 1.5°C as required by the Paris Agreement.'

Environment Victoria

Emissions budgets are commonly used in other jurisdictions to inform target-setting – such as in the UK, New Zealand, and France. Emissions budgets were also an important input into the advice of the Combet Panel on interim targets for 2025 and 2030. In the Panel's consultation to date, there has been broad support for the use of emissions budgets as a mechanism to ensure that Victoria's 2035 target is underpinned by climate science.

There is no single, agreed global emissions budget – and nor has the Australian Government adopted an emissions budget for Australia beyond 2030.¹⁹⁷ The Panel has therefore worked closely with experts at the University of Melbourne to develop budgets for Victoria. These are the same experts that provided advice to the Combet Panel, and to the Australian Climate Change Authority to inform their Targets and Progress Review (2014).¹⁹⁸



Four different indicative budgets have been developed for Victoria, based on a series of judgements and assumptions, as outlined below. The Panel notes that while these budgets are an important component of the evidence base informing a decision on a target for 2035, they are not determinative of a particular target for 2035 and are being considered alongside stakeholder and public feedback, analysis of available emissions reduction measures and costs, and economic impact analysis.

The Panel's indicative emissions budgets for Victoria have been developed as follows.

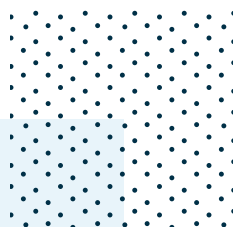
GLOBAL EMISSIONS BUDGETS

The Panel recognises that the international community's commitment to 1.5°C was strengthened at the most recent international conference on climate change (COP27) in November 2022. This included reaffirming the Glasgow Pact, endorsed by Australia, which states that the international community 'recognises that the impacts of climate change will be much lower at the temperature increase of 1.5°C compared with 2°C, and resolves to pursue efforts to limit the temperature increase to 1.5°C'. The IPCC AR6 also reinforced the distinction between the impacts of 1.5°C of warming versus higher temperature levels, as first presented in the IPCC's Special Report on 1.5°C in 2018.

A key factor in determining the size of a 1.5°C budget is whether this temperature goal will be achieved with or without 'overshoot' – which is discussed further in [Box 7](#).

The Panel started with the budgets published in the IPCC AR6, ensuring that the most up-to-date climate science was being used as a foundation. Two global emissions budgets have then been selected to use as a basis for developing indicative budgets for Victoria. These global emissions budgets reflect the two temperatures referenced in the Paris Agreement ('well below' 2°C and 1.5°C) and – given the increased focus on 1.5°C – the two different approaches available for the 1.5°C goal.

1. **Global emissions budget 1:** A 1.5°C budget with a 50 per cent chance of keeping global temperature rise to 1.5°C above pre-industrial levels. This is a 1.5°C budget without overshoot.
2. **Global emissions budget 2:** A budget consistent with a 50 per cent chance of global temperatures rising to 1.6°C above pre-industrial levels by 2050, with temperatures then declining to return to 1.5°C by 2100. This could be thought of as a '1.5°C budget with slight overshoot.' A budget of this size also provides an 83 per cent chance of keeping global temperature rise to 1.8°C above pre-industrial levels – and a slightly lower probability of limiting rises to 1.7°C. As such, while there is no international consensus on the precise temperature limit established by the Paris Agreement 'well below' 2°C goal, this could also be thought of as a 'well-below 2°C' budget.



BOX 7. TRADE-OFFS INVOLVED WITH ACHIEVING 1.5°C WITH AND WITHOUT OVERTHOOT

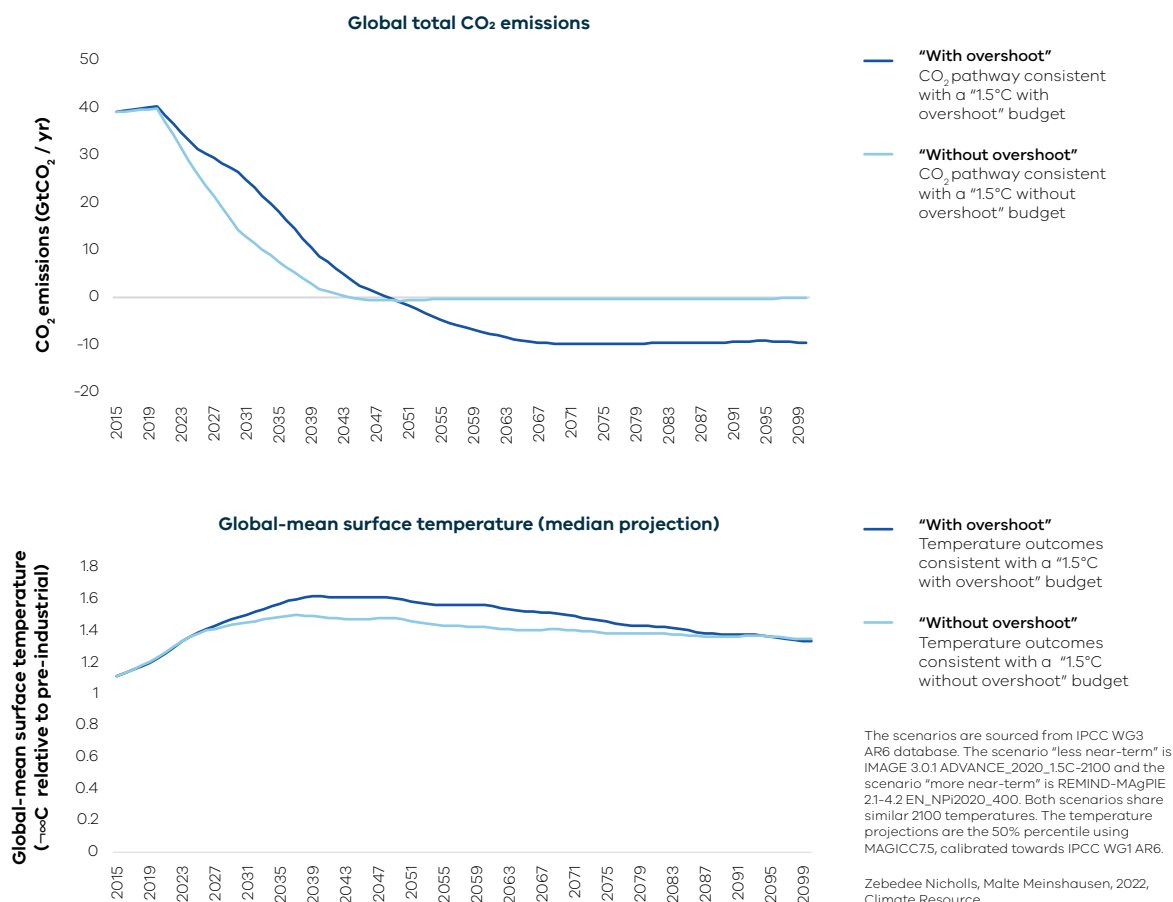
A key factor in determining the size of a 1.5°C budget is whether this temperature goal will be achieved with or without ‘overshoot’ – that is, whether temperatures will stay below 1.5°C (‘without overshoot’), or whether and how far they will rise above 1.5°C, then fall again to below 1.5°C by 2100 (‘with overshoot’).

These two approaches imply a different distribution of cost and risk over time. There are clear trade-offs in terms of the scale of action to cut emissions required in the near-term, the scale of emissions to be removed from the atmosphere

later in time, and the global temperature peak and associated climate impacts. Overshoot also implies greater risks, both in terms of the climate impacts potentially being greater than expected, and the availability of future mitigation options.

Figure 9 helps to demonstrate these points, with a blue line showing an illustrative global emissions trajectory consistent with a 1.5°C budget ‘without overshoot’, and the red line showing an illustrative global emissions trajectory consistent with a budget ‘with overshoot’.

Figure 9. Illustrating trade-offs between 1.5°C budgets with and without overshoot



Note: These two illustrative scenarios are drawn from the IPCC Sixth Assessment Report Working Group III scenario database.

Source: Graphs produced by Zebedee Nicholls and Malte Meinshausen (2022), Climate Resource.

A global emissions budget 'without overshoot' is smaller up to the point that the peak temperatures are reached around the middle of the century, meaning that steeper emissions reductions need to be made in the near-term to stay within it – as shown by the illustrative blue trajectory. Net negative CO₂ emissions may not be required. This smaller budget is associated with a lower temperature peak – as temperatures do not rise above 1.5°C – and therefore lower the risk of climate impacts compared to the '1.5°C with overshoot' budget.

A global emissions budget 'with overshoot' is larger, meaning that near-term emissions to do not need to reduce quite as steeply – as shown by the illustrative red trajectory. However, temperatures peak at a higher level, which

brings greater climate impacts and risk, even though temperatures then return to 1.5°C by 2100. Bringing temperatures back down relies on net negative CO₂ emissions at a significant scale, which may be risky and will certainly be costly given the uncertainties and constraints associated with negative emissions technologies and measures (see discussion on negative emissions above).

While a 1.5°C budget without overshoot carries fewer long-term risks, there are not many IPCC-assessed scenarios that show how global emissions could remain within such a budget. The expert advice received by the Panel notes that slight overshoot is now implicit in the majority of the 1.5°C pathways assessed by the IPCC.

EMISSIONS BUDGET SHARES FOR AUSTRALIA AND VICTORIA

The Panel then considered approaches to allocate a share of the global budget to Australia, and then a share of that notional Australian budget to Victoria. While there is a range of potential approaches which reflect different value judgements about fairness and responsibilities, the two approaches the Panel used were:

3. a 'modified contraction and convergence' approach for Australia as used in the Garnaut Climate Change Review (2008)¹⁹⁹ and subsequently adopted by the Australian Climate Change Authority in their Targets and Progress Review (2014),²⁰⁰ and then a 'contraction and convergence' approach for Victoria's share. Under this approach, emissions per person all converge to reach the same level at the same future point in time (e.g. all reach net zero in 2050).²⁰¹
4. an 'equal per capita' approach,²⁰² as adopted by Germany and the EU, for both Australia's and Victoria's share. Under this approach all jurisdictions have an equal per person share of the total emissions budget remaining at the time the budget is set.

Under the 'equal per capita' approach, Victoria's share of the two global emissions budgets have already been exhausted. The resulting Victorian emissions budget 1 (based on global emission budget 1) was exhausted in 2019, and Victorian emissions budget 2 (based on global emission budget 2) was exhausted in 2021. This only further emphasises the need for Victoria to undertake strong, rapid emissions reductions.

In contrast, Victoria's share of the two global emissions budgets using the 'contraction and convergence' approach have emissions remaining. The resulting Victorian emissions budgets 3 and 4 have been used to develop indicative trajectories and emissions levels in 2035 that sit on those trajectories²⁰³ (Figure 10 and Figure 11). The Panel notes that a range of different trajectories, and therefore 2035 targets, are possible under any given emissions budget for Victoria, and that these trajectories are purely illustrative.

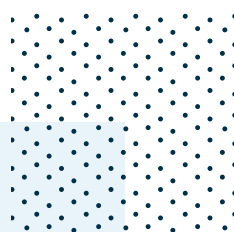


Figure 10. Two illustrative trajectories under Victorian emission budget 3: Victoria’s share of a 1.5°C budget without overshoot (global emissions budget 1), using a contraction and convergence sharing approach

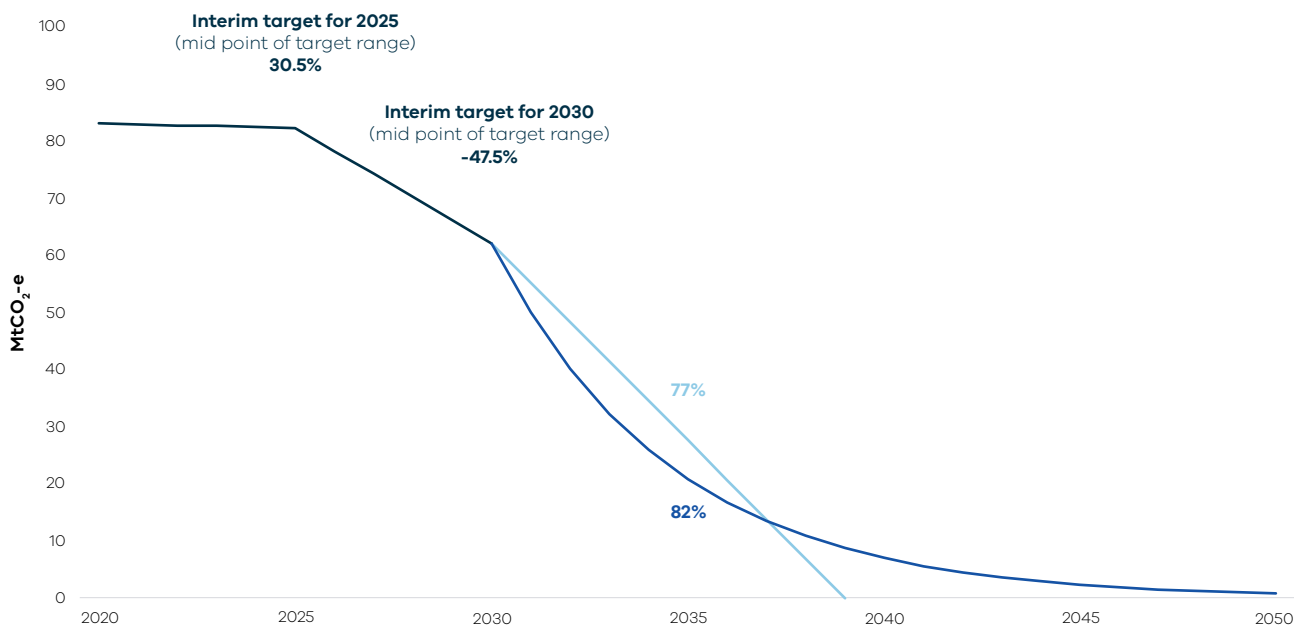
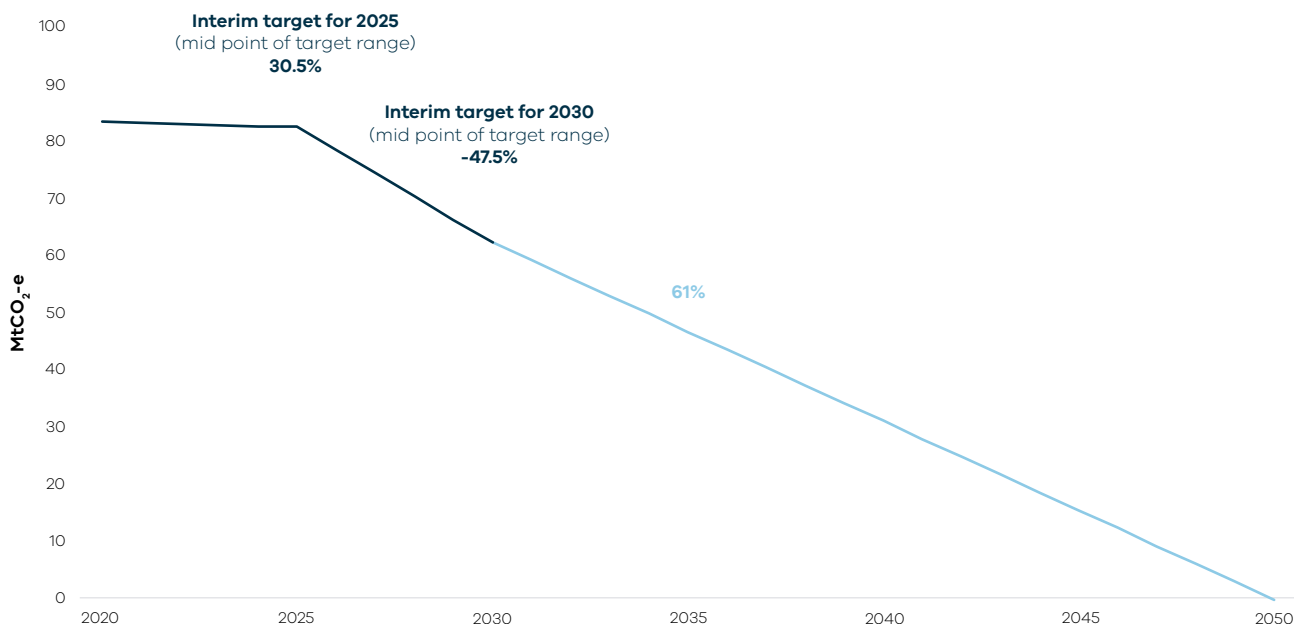


Figure 11. An illustrative trajectory under Victorian emissions budget 4: Victoria’s share of a 1.5°C budget with limited overshoot / ‘well-below 2°C’ budget (global emissions budget 2), using a contraction and convergence sharing approach



Note: For simplicity, linear emissions reductions are assumed between 2020 and 2030, meeting the midpoint of the target ranges in 2025 and 2030 set by the Victorian Government (28–33 per cent below 2005 levels in 2025 and 45–50 per cent below 2005 levels in 2030).

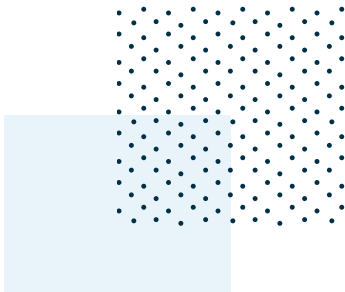
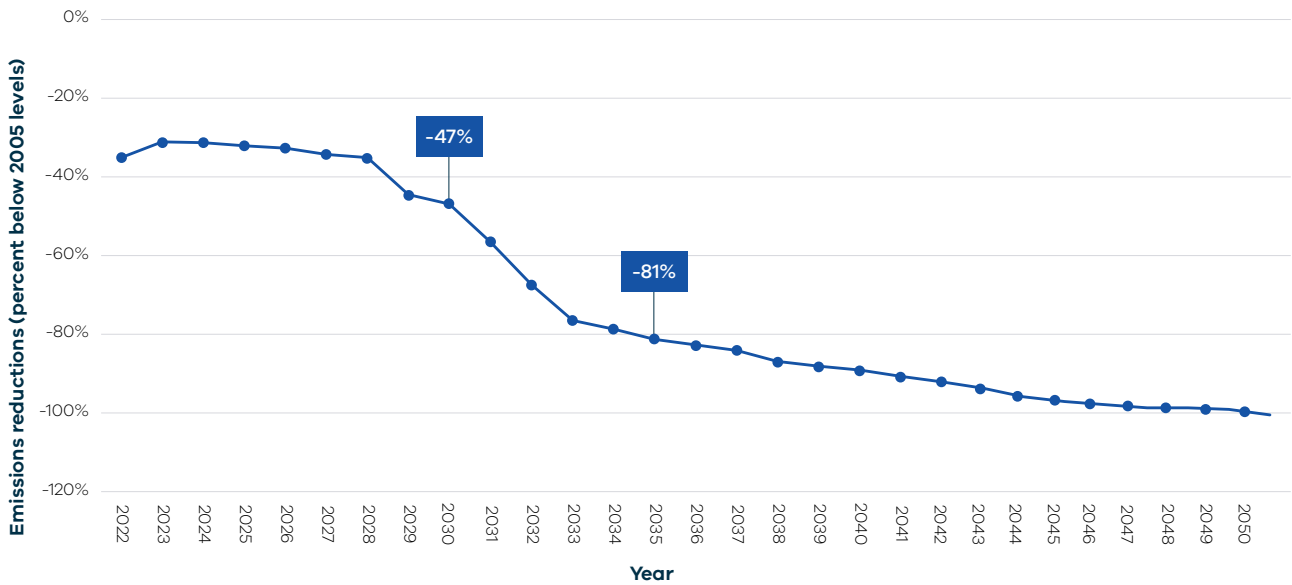
The emissions budget is the area under the curve. It covers all greenhouse gases controlled under the Kyoto Protocol and the Paris Agreement (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride). The trajectories show net emissions – gross emissions may be higher, and counterbalanced by emissions removals (for example, through sequestration in the land use, land use change and forestry sector).

APPENDIX 5 - PROJECTIONS OF A POSSIBLE NET ZERO EMISSIONS PATHWAY

The Department of Land, Environment, Water and Planning commissioned Jacobs Group Australia (Jacobs) to model a possible pathway for Victoria to reach net zero emissions, that also met existing interim targets. The result was a trajectory in which 2035 emissions reached 81 per cent below 2005 levels (Figure 12).

This pathway shows one possible scenario for reaching net zero emissions given a particular set of assumptions (Box 8) and is not a forecast or prediction of the future.

Figure 12. Projection of a possible net zero pathway showing Victoria at 81 per cent below 2005 levels in 2035



BOX 8. KEY MODELLING ASSUMPTIONS AND RESULTS

ASSUMPTIONS

The following assumptions were inputted into the model:

Emissions budget – Cumulative emissions are constrained to a level consistent with Victoria contributing to global efforts that provide a 50 per cent chance of keeping global temperature rise to 1.5°C above pre-industrial levels. This assumes emissions reductions take place before 2050 and negative emissions technologies are not required after that year (ie, no ‘overshoot’).

Fixed target levels – 2030 emissions constrained to meet a minimum of 45 per cent below 2005 levels. Net zero emissions by 2050.

Global context & technology costs – The world acts to reduce emissions at a level consistent with keeping emissions to well-below 2 degrees but there is an uneven global uptake of abatement technologies over next two decades so costs do not decline as fast as they could with more concerted and coordinated action.

Economic and population growth – Moderate growth over the next two decades. Long term population growth is assumed at 1.4 per cent per annum and long-term economic growth is assumed 2.4 per cent per annum.

Policy assumptions – All major Victorian policies and targets are assumed to be implemented (including those that are still under development currently). Certain Commonwealth Government policies are also modelled, including the Safeguard Mechanism.

RESULTS

Under this modelled emissions reduction pathway, the following transformations happen across key areas of the Victorian economy:

Coal power station closures – The modelling of the Loy Yang A and Loy Yang B power stations shows cost optimal closures in 2032 over two years and 2031 respectively. Note that the Yallourn Power Station is assumed to close by 2028, as per the announced closure schedule.

Residential gas phase out – The demand for residential gas decreases due to household electrification and gas is completely phased out by 2038.

Zero emissions vehicles – The sale of light ZEVs reaches 68 per cent in 2030 and 100 per cent by 2035.

Livestock – Methane inhibitors in cattle were deployed to 25 per cent of the herd (on average) by 2030 and 75 per cent of the herd (on average) by 2035.

Tree plantings – By 2030, there are 200,000 cumulative hectares of new plantings and by 2035, there are 470,000 cumulative hectares of new plantings. These are from softwood and hardwood plantations, environmental plantings and agroforestry.

THE SECTORAL EMISSIONS AND ABATEMENT MODEL (SEAM)

Jacobs uses a microeconomic model of emissions and abatement in Australia called SEAM to model Victoria's future emissions under various scenarios, calibrated to historical data from the 2020 State and Territory Greenhouse Gas Inventories.

Emissions are modelled as a function of activity levels (e.g., head of cattle or vehicle kilometres travelled). The activity levels are linked to exogenous macroeconomic (i.e., gross state product and commodity projections) and social-demographic variables (i.e., population and household formation projections) that form trends out to 2050. The model manages interactions between activities where these have an impact on emissions elsewhere in the economy. For example, an increase in the number of EVs, increases demand for electricity generation, resulting in more emissions where the extra generation is supplied by fossil fuels).

Abatement options for all sectors of the economy are included in the model. Some of these are widely available today, while others are proven but not yet commercialised. Assumptions about existing and future technologies and practices have been

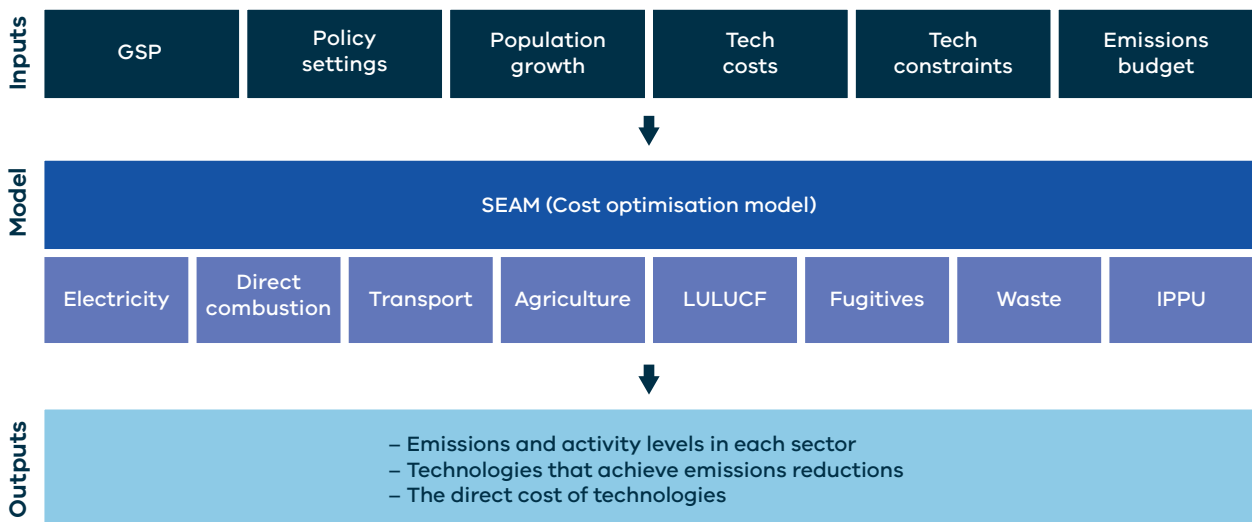
developed using best-available evidence while their cost trajectories are influenced by global trends, assuming that Australia is largely a 'technology taker'. The model determines the timing and level of adoption of abatement options by ranking the options from lowest to highest cost to generate a least-cost combination of abatement options to meet the emissions budgets and policy objectives, including targets in a given year.

The outputs of the model are the activity levels, associated emission levels, and any abatement options chosen, including their cost (capital, operating, and other costs) and level of abatement.

ACKNOWLEDGING THE UNCERTAINTY IN MODELLING

This modelling provides a useful estimate of what Victoria's emissions may be under a given set of assumptions but, as with any analysis of the future, remains subject to uncertainty. There is uncertainty around the price, availability and uptake of abatement technologies, as well as the various economic, demographic and price forecasts that are inputs to a model.

Figure 13. Overview of the Sectoral Emissions and Abatement Model used in the projection



*LULUCF = Land use, Land use change and Forestry; IPPU = Industrial Process and Product Use

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- 2 Unless the individual or organisation has requested that their submission not be made public.
- 3 Equivalent to 74 per cent below 2005 levels.
- 4 The Panel notes that while the national 2030 target has been strengthened, it is likely not consistent with Australia playing its part in global efforts to limit global temperature increases to 1.5°C. For example, analysis by ClimateWorks Centre shows that Australia's fair share to limit global warming to 1.5°C would require the nation to achieve a 75 per cent reduction below 2005 levels by 2030 and net zero emissions by 2035 – see <https://climateworkscentre.org/wp-content/uploads/2020/04/Decarbonisation-Futures-March-2020-full-report-.pdf>.
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- 7 Through the international Paris Agreement, signed by 196 countries including Australia since December 2015, the world committed to limit the global temperature increase to well below 2°C and pursue efforts to limit the increase to 1.5°C above pre-industrial levels. In November 2021, this commitment was strengthened through the Glasgow Pact, endorsed by Australia, which states that the international community 'recognizes that the impacts of climate change will be much lower at the temperature increase of 1.5°C compared with 2°C, and resolves to pursue efforts to limit the temperature increase to 1.5°C'.
- 8 Individual jurisdictions have also stepped up their ambitions in their 'Nationally Determined Contributions' (NDCs). The US set a 2030 target at Glasgow of 50–52 per cent below 2005 levels – joining other leading jurisdictions such as the EU (55 per cent below 1990 levels), Norway (50 per cent below 1990 levels) and Japan (46 per cent below 2013 levels). Germany then increased its 2030 target to 65 per cent below 1990 levels. In April 2021, the UK legislated a target to reduce its emissions 78 per cent below 1990 levels by 2035. With the announcement of more net zero commitments in 2021, including from India and Australia, around 90 per cent of global emissions are now covered by a net zero emissions target.
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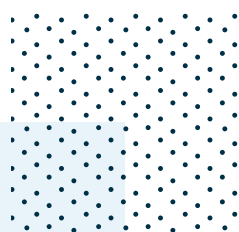
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- 201 Under a modified contraction and convergence approach, fast-growing developing countries are allowed additional growth in their per person emissions for a transitional period, and thus a larger share of the global budget, while developed countries' emissions reduce more quickly to compensate. In a global context with countries at different stages of economic development, this was seen by Professor Garnaut to be a more equitable approach than simple contraction and convergence. However, simple contraction and convergence is appropriate for sharing an Australian budget between its states and territories as all are roughly at the same level of economic development. For more information on these and other budget sharing approaches, see Climate Change Authority (2014) *Targets and Progress Review, Appendix C1*. Accessed: www.climatechangeauthority.gov.au/reviews/targets-and-progress-review-3.
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