Transport and Infrastructure Net Zero Consultation Roadmap

Take the survey

Department of Climate Change, Energy, Environment and Water

Response received at:
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2 Please indicate how and if you want your submission published.
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3 Published name
Infrastructure Victoria

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Yes

5 First name
Jonathan

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Not answered

9 Who are you answering on behalf of?

Organisation

10 Organisation name

Infrastructure Victoria

11 What best describes you or your organisation?

Government

12 What sector do you represent?

Infrastructure

13 What state or territory do you live in?

Victoria

14 Postcode

3000

15 What area best describes where you live?

City

16 1. Do you support the proposed guiding principles?

Yes

17 1.1 Please add details to your response.

see attached submission

18 2. Do you support the use of the avoid-shift-improve framework as a tool to identify opportunities for abatement?

Yes

19 2.1 Please add details to your response.

see attached submission

20 3. Do you agree the development of a national policy framework for active and public transport will support emissions reduction?

Not answered

21 3.1 Please add details to your response.

Not answered

22 4. What should be included in a national policy framework for active and public transport and how should it be developed?

Not answered

23 5. What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to ensure the movement of people contributes to transport emissions reduction?

Not answered

24 6.1 What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to ensure that the movement of goods contributes to transport emissions reduction?

Not answered

25 6.2. How would these actions address the identified challenges and opportunities for emissions reduction in the movement of goods?

Not answered

26 7. Do you agree with the proposed net zero pathway for light road vehicles?

Not answered

27 7.1 Please add details to your response.

Not answered

28 8. The Australian Government is currently developing an Australian New Vehicle Efficiency Standard and has already begun to implement actions in the National Electric Vehicle Strategy.8.1 What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to reduce light vehicle emissions?

Not answered

29 8.2 How would these actions address the identified challenges and opportunities to reduce light vehicle emissions?

Not answered

30 9. Do you agree with the proposed net zero pathway for heavy road vehicles?

Not answered

31 9.1 Please add details to your response

Not answered

32 10. The proposed pathway for heavy road vehicles relies on a mix of battery electric, hydrogen fuel-cell and low carbon liquid fuels.Rank from 1 to 3, the order in which these should be prioritised for emissions reduction.

Not answered

33 10.1 Please add details to your response. Why did you rank them in that order?

Not answered

34 11. What role should low carbon liquid fuels play in the heavy vehicle

decarbonisation?

Not answered

35 12. What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to reduce heavy vehicle emissions?

Not answered

36 13. Do you agree with the proposed net zero pathway for rail?

Not answered

37 13.1 Please add details to your response.

Not answered

38 14. The proposed pathway for rail relies on a mix of battery electric, hydrogen fuel-cell and low carbon liquid fuels.Rank from 1 to 3, the order in which these should be prioritised for emissions reduction.

Not answered

39 14.1 Please add details to your response. Why did you rank them in that order?

Not answered

40 15. What role should low carbon liquid fuels play in rail decarbonisation?

Not answered

41 16. What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to reduce rail emissions?

Not answered

42 16.1 How would these actions address the identified challenges and

opportunities to reduce rail emissions?

Not answered

43 17. Do you agree with the proposed net zero pathway for maritime?

Not answered

44 17.1 Please add details to your response.

Not answered

45 18. The Australian Government is engaging in consultation as part of the development of the Maritime Emissions Reduction National Action Plan and those consultations will also inform the final Roadmap and Action Plan. 18.1 What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to reduce maritime emissions?

Not answered

46 18.2 How would these actions address the identified challenges and opportunities to reduce maritime emissions?

Not answered

47 19. Do you agree with the proposed net zero pathway for aviation?

Not answered

48 19.1 Please add details to your response.

Not answered

49 20. The Australian Government has already engaged in consultation on aviation decarbonisation through the development of the Aviation White Paper and those consultations will also inform final Roadmap and Action Plan.

Not answered

50 20.1 What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to reduce aviation emissions?

Not answered

51 21. Do you agree with the proposed net zero pathway for transport infrastructure?

Yes

52 21.1 Please add details to your response.

see attached submission

53 22. What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to reduce transport infrastructure emissions and ensure that transport infrastructure is ready for and enables low-emission transport modes?

see attached submission

54 22.1 How would these actions address the identified challenges and opportunities to reduce transport infrastructure emissions?

see attached submission

55 23. What additional actions by governments, communities, industry and other stakeholders need to be taken now and in the future to ensure the energy mix is ready to support transport emissions reduction?

Not answered

56 24. How should the use of low carbon liquid fuels (LCLFs) be prioritised across different transport modes over time to achieve maximum abatement?

Not answered

57 25. What are the best ways for the Australian Government to work collaboratively with industry, business, governments and communities to implement the proposed pathways?

see attached submission

58 25.1 What are good domestic or international examples of partnership and collaboration on transport and transport infrastructure emissions reduction that could inform the final Roadmap and Action Plan?

see attached submission

59 25.2 What opportunities can Government leverage to show leadership in Australia and internationally?

see attached submission

60 26. What measures and metrics should be used to evaluate the final Transport and Infrastructure Net Zero Roadmap and Action Plan?

see attached submission

61 26.1 What other data and evidence could governments use and how could this offer further insights on the pace, scale and location of transport emissions reduction pathways?

see attached submission

62 27. Do you have any feedback on the proposed review process?

Not answered

63 28. Do you have any further feedback on the Consultation Roadmap and proposed pathways?

Not answered

64 28.1 Is there anything missing? Are the sections appropriately integrated? Is the Roadmap appropriately ambitious?

Not answered

65 29. Is there any further information or documentation that you wish to be considered with your submission?

see attached submission

66 Would you like to upload a document?

Yes

67 Have you removed any identifying information from your submission?

Yes

68 Upload a submission

Transport_and_Infrastructure_Net_Zero_Consulatation_Roadmap_Submission_signed.aaa594d6_Redacted.pdf

69 Upload a submission

Advice-on-opportunities-to-reduce-greenhouse-gas-emissions-of-infrastructure-_Final_2024-03-05-022223_vldi.pdf

70 Upload supporting file

WSP-Decarbonising-Vic-Gov-Infrastructure-Final-Report-24-August-2023-no-AMAF.pdf

71 Upload supporting file

Not answered

INFRASTRUCTURE VICTORIA

24 July 2024

Department of Infrastructure, Transport,
Regional Development, Communications and the Arts
Australian Government

Submission on the Transport and Infrastructure Net Zero Roadmap

I welcome this opportunity to provide Infrastructure Victoria's submission on the *Transport and Infrastructure Net Zero Consultation Roadmap*.

Infrastructure Victoria is an independent advisory body, and has the functions of:

- preparing a 30-year infrastructure strategy for Victoria, which we review and update every 3 to 5 years
- advising the Victorian Government on specific infrastructure matters
- publishing research on infrastructure-related issues.

In this submission we respond to elements of the consultation roadmap and introduce some of our related work. We also list relevant recommendations from *Victoria's infrastructure strategy 2021–2051*.

Infrastructure Victoria has published several reports relevant to the roadmap.

In February 2024, we published *Opportunities to reduce greenhouse gas emissions of infrastructure*. This includes decarbonising infrastructure in planning, design, construction, maintenance and at the end-of-life of Victoria's infrastructure. We explain how the Victorian Government can update policies, guidelines and procedures to reduce carbon emissions by changing infrastructure decision-making. We attach a copy of this report, and its accompanying material, for the department's consideration.

In addition to this work, Infrastructure Victoria identified ways to accelerate the uptake of low and zero-emission vehicles in *Driving down emissions: accelerating Victoria's zero emissions vehicle uptake*, published in 2021.

We also investigated the key infrastructure requirements for automated and zero-emission vehicles in our *Advice on autonomous and zero emission vehicles infrastructure*, published in 2018. This work outlined the ways that many different infrastructure sectors will be impacted by new vehicle technologies.

The Roadmap's approach

In principle, we agree with the roadmap's guiding principles: maximise emissions reduction; provide value for money; maximise economic opportunity; be inclusive and equitable; and be evidence based. We also support the use of the avoid-shift-improve framework, which can be used to identify opportunities for abatement.

Our advice to the Victorian Government on decarbonising infrastructure highlights the need to prioritise solutions that maximise the use of existing infrastructure and seek to pursue low or no build solutions whenever possible. When new infrastructure is necessary, projects should aim to reduce emissions at every stage. This requires leadership, consistency and clear guidance from

governments. Our research shows that this can both enhance productivity and reduce carbon emissions, as per the consultation roadmap's principles.

Infrastructure's net zero pathways

Our work emphasises the need for immediate and sustained action to reduce emissions by 2030, and to achieve Victorian targets. Effective management of emissions requires measurement, supported by national standards for data collection and consistent measurement and reporting of embodied emissions. Key elements of our recommendations include:

- Adoption of a carbon management standard like UK PAS 2080 to clarify the government's approach to decarbonising throughout the infrastructure lifecycle.
- Use of a nationally consistent set of carbon values for infrastructure projects, as approved by Australia's Infrastructure and Transport Ministers (ITMM) in June 2024.
- Implementation of the ITMM's in June 2024 approved *Embodied Carbon Measurement for Infrastructure: Technical Guidance for consistent measurement across projects* to achieve a consistent approach to measuring embodied emissions in infrastructure projects nationally.

Carbon reduction also needs to be embedded into business case development and assessment processes, procurement methods, project standards, and assurance. Once the government has implemented carbon measurement, our research recommends that government work to address the knowledge and skills gap of government staff and industry partners to realise emissions reductions.

Achieving net zero together

Collective action in partnership with industry can help governments address climate change.

Our work identifies that harmonising approaches between jurisdictions can help to reduce the administrative burden on industry, allowing businesses to focus on implementing effective decarbonisation strategies.

Governments should also collaborate and support industry to develop zero or low emission solutions by testing alternative materials and adopting performance-based standards. This includes using low-build design strategies and promoting recycled materials. This can help to lower barriers to adopting alternative materials by testing and piloting materials and achieve emissions targets. We identify that industry support is crucial to making zero and low-carbon materials competitive and widely available in the long term.

Victoria's infrastructure strategy 2021-2051

Previously, in *Victoria's infrastructure strategy 2021-2051*, we identified climate change as a long-term challenge and made recommendations to address climate change mitigation and adaptation. Those recommendations included:

- Recommendation 11: Specify climate scenarios and carbon value in assessing infrastructure

In the next year, update and expand practical instructions for government agencies on integrating climate-related risks into infrastructure assessments. This should include high, medium and low future climate change scenarios, transitional risks and valuing emission reductions.

- Recommendation 12: Strategically review climate consequences for infrastructure

Strategically review the climate change consequences for Victoria's infrastructure needs and priorities, beginning in November 2021 after delivering the adaptation plans under the Climate Change Act 2017.

Thank you again for the opportunity to respond to the Infrastructure Victoria's submission on the *Transport and Infrastructure Net Zero Consultation Roadmap*. If you would like to discuss any of the information in Infrastructure Victoria's submission, please contact Jonathan Spear at [redacted].

Yours sincerely,

[redacted]

Dr Allison Stewart

Acting Chief Executive Officer

Encl.

INFRASTRUCTURE VICTORIA

September 2023

Opportunities to reduce greenhouse gas emissions of infrastructure

Advice to the Victorian Government

About us

Infrastructure Victoria is an independent advisory body with 3 functions:

- preparing a 30-year infrastructure strategy for Victoria, which we review and update every 3 to 5 years
- advising the government on specific infrastructure matters
- publishing research on infrastructure-related issues.

Infrastructure Victoria also helps government departments and agencies develop sectoral infrastructure plans.

Infrastructure Victoria aims to take a long-term, evidence-based view of infrastructure planning, and we inform community discussion about infrastructure provision.

Infrastructure Victoria does not directly oversee or fund infrastructure projects.

Front page: Image of the Bolte Bridge and two buildings in Melbourne.

Acknowledgement

Infrastructure Victoria acknowledges the Traditional Owners of Country in Victoria and pays respect to their Elders past and present, as well as Elders of other First Peoples' communities. We recognise that Victoria's infrastructure is built on land that has been managed by Aboriginal people for millennia.

Contents

Summary

Why decarbonising infrastructure matters

If changes are not made to reduce the greenhouse gas emissions of future public infrastructure investments, achievement of the Victorian Government's emission reduction targets will be at risk. This will require a big shift in how the government thinks about meeting the state's infrastructure needs. The government should first look to solutions which get more out of Victoria's existing infrastructure. When building new infrastructure is unavoidable, projects should aim to reduce emissions at every stage.

Up to 70% of Australia's annual greenhouse gas emissions relate directly or indirectly to the lifecycle of infrastructure through operational, enabled, and embodied emissions. The scale of the climate challenge, the cost of inaction, and the risks of more extreme weather require a swift and system-wide change in how governments and businesses plan, build, maintain and repurpose infrastructure.

Valuing carbon emissions can lead to better productivity outcomes in addition to reducing carbon. If Victoria gets this right, it has opportunities to achieve its emission reduction ambitions, save money, deliver infrastructure more efficiently, promote innovation in the economy and grow jobs. But if it doesn't, Victoria's infrastructure will cost more than necessary, it will not be fit-for-purpose in future decades, and Victoria will miss the opportunity for a more diverse economy with high quality jobs. It will also put Victoria's global competitiveness at risk as countries introduce restrictions on high emissions materials and sustainability disclosure requirements for businesses.

Action to limit or eliminate infrastructure-related greenhouse gas emissions, also known as decarbonising infrastructure, is a complex task. To create change, government's guidelines and procedures need to make carbon emissions count in infrastructure decision-making. All Victorian Government departments and agencies need consistent policies to account for, reduce and manage carbon emissions.

Government and industry stakeholders are looking for leadership, consistency and guidance on how to proceed. The Victorian Government has significant purchasing power that can influence the types of materials used in infrastructure, the way infrastructure is designed, and how – or whether – it is built. Industry bodies are ready to respond to clear direction from the Victorian Government about the level and pace of infrastructure decarbonisation. This will allow them to innovate and make appropriate investment decisions.

Other jurisdictions in Australia are making rapid progress to decarbonise infrastructure. Alignment and consistency are helpful in this rapidly evolving area. Victoria can match their pace and align its decarbonisation approach to these jurisdictions.

Our advice

In March 2023, the Victorian Government requested Infrastructure Victoria's advice on opportunities to reduce greenhouse gas emissions of future public infrastructure investments the government will plan, own, or manage.

The request asked us to consider how policies and guidelines can better account for greenhouse gas emissions produced in the design, investment, construction, maintenance, and decommissioning of Victoria's infrastructure.

In addressing the terms of reference of the advice request, this report identifies 3 overarching principles and makes 10 recommendations, each with clear actions, to guide how the Victorian Government plans, sources, delivers and maintains its infrastructure on the path to net zero.

Three overarching principles should guide decarbonisation efforts in Victoria

Drawing on the experience of leading jurisdictions and the current state in Victoria, we propose 3 principles to guide decarbonisation efforts:

Prioritise non-build or low build solutions. Aim to get better use from existing infrastructure or modify it to meet changing needs before considering a new build. Use construction techniques like offsite or modular construction wherever possible in new builds.

Non-build or low build solutions which minimise new construction can avoid emissions associated with constructing and operating new infrastructure, and usually have lower lifecycle carbon emissions. For example, the Department of Transport and Planning's Smarter Roads project is improving operation of the traffic light network to optimise road performance rather than building new roads.[1] When undertaking new construction, options to build more efficiently by using offsite or modular construction can reduce both cost and carbon while improving productivity.

Victorian guidelines already require departments and agencies to consider non-build options when developing business cases. However, project teams in government agencies told us that the business case stage is often too late for thorough consideration of alternatives. The existing culture prioritises new build solutions and does not incentivise these teams to thoroughly prepare options that meet service needs while avoiding a new build project.

Ministers and senior executives of Victorian Government departments and agencies should explore and fully consider viable, non-build or low build alternatives well before business case development. Clear direction from ministers about more intensely searching for non-build or low build solutions, supported by a demonstrated willingness to select and fund these options, would give departments and agencies confidence to bring more of these options forward.

Align approaches with other governments and industry best practices.

Victoria can reap many benefits by aligning its approach with other Australian governments and industry best practices. Victoria can more rapidly adopt proven approaches and move quickly towards meeting decarbonisation targets. Using existing tools, research and administrative resources reduces the need for more investment in developing new solutions.

Harmonising these approaches between jurisdictions also reduces the administrative burden on industry, allowing businesses to focus on implementing effective decarbonisation strategies. By promoting consistency between jurisdictions, Victoria is also helping to build capability and expertise within industry.

There may be some situations in which a Victorian-specific approach is useful, however these should be considered carefully and weighed against the benefits of broader alignment.

Clarify the scale and pace of infrastructure emissions reduction to give confidence to industry.

Immediate and sustained action is needed to reduce greenhouse gas emissions produced by Victorian Government infrastructure. While the government has set ambitious emissions reduction targets for the economy, industry and government representatives that we consulted were not clear on the government's commitment to, or timeline for, decarbonising infrastructure.

Without this clarity, it is difficult for either to propose or take up options to reduce carbon in the significant pipeline of infrastructure projects underway. Industry is willing to act but requires policy certainty. Immediate engagement with industry on decarbonisation timelines will provide certainty and facilitate a smoother transition, minimising potential disruptions to projects. By involving suppliers in the early stages of policy development, the government can gather valuable insights and proactively address concerns.

Our 10 recommendations create the foundation for decarbonising infrastructure

Building on these principles, Infrastructure Victoria makes 10 recommendations for the Victorian Government. If fully implemented, these recommendations allow the Victorian Government to reduce the carbon footprint of public infrastructure further, faster and with more benefits than business as usual.

1. Adopt a carbon management standard like *PAS 2080:2023 Carbon management in buildings and infrastructure* to measure and manage carbon emissions and modify as needed to embed in Victoria.

The Victorian Government has minimal guidance for infrastructure projects on carbon reduction. The guidance does not address the lifecycle of infrastructure assets. And it addresses carbon emissions as one sustainability opportunity among many, such as reducing water use and waste.

A carbon management standard would clarify Victoria's approach to decarbonising infrastructure, and how existing and new Victorian guidelines, requirements and frameworks will collectively reduce emissions throughout the infrastructure lifecycle.

The United Kingdom's PAS 2080 *Carbon management in buildings and infrastructure* standard is a globally recognised approach to managing carbon. Adopting a carbon management standard like PAS 2080 in Victoria will clarify the state's direction, including carbon governance and responsibilities, to drive consistent practice in government infrastructure programs and projects. It will also allow tracking of emissions reductions in all projects by consistently quantifying and reporting them throughout the infrastructure lifecycle. Victoria will need to fill gaps in existing government guidance to implement a standard. An adopted standard may also need some modification to the local context to be fully embedded in Victoria.

2. Implement the same carbon measurement approach as New South Wales and deliver training across the Victorian Government.

Our research found that where departments and agencies have started to estimate carbon emissions, they use different methods and data sources to do so. There is no single source for

reliable emissions data in Victoria, so they use data that is inconsistent and sometimes inaccurate, or not sufficiently detailed. Easy-to-use, non-proprietary tools, including a comprehensive open-source database of standard values for embodied emissions in materials can help government and industry to consistently quantify and report emissions. This will also allow accurate and comparable emissions data across government to better inform decisions.

Our research has not clearly identified a single tool that is the best option to adopt in Victoria. Existing tools, such as the Transport for New South Wales' Carbon Emissions Reduction Tool (CERT), Green Star, the National Australian Built Environment Rating System (NABERS), and the Infrastructure Sustainability (IS) rating tool, can be used. Each have their own advantages and drawbacks, and many are evolving rapidly to address limitations raised. As there is not a single leading tool, the Victorian Government should apply the principle of aligning the carbon quantification approach with other governments and industry best practices.

Infrastructure New South Wales is identifying key areas of alignment for carbon measurement and developing a measurement guidance approach that will be used as the basis for a national approach. Adopting their recommended carbon quantification approach will support both large and small companies operating in both jurisdictions to understand and use their preferred tools consistently. This guidance is expected to be available by the end of 2023.

Victorian departments and agencies should use the tool that best meets their needs at the time of assessment, as long as it meets the requirements of the agreed carbon quantification approach.

Once the government has implemented an approach to carbon measurement, including adopting a comprehensive database of emission factors, it must address the knowledge and skills gap of government staff and industry partners to realise emissions reductions.

3. Initially adopt a carbon value of *at least* $123 per tonne and then update to reflect values required to achieve Victorian emissions reduction targets.

Carbon emissions impose costs on the community. Valuing emissions will ensure that infrastructure project decisions account for climate change impacts alongside other costs and benefits.

Adopting a target consistent approach to carbon valuation as many other jurisdictions have done will align carbon values with Victorian emissions reduction policy objectives. To adopt this approach, the Victorian Government will need to calculate the carbon values that align to Victoria's specific targets.

While this work is in progress, it can adopt an interim carbon price. We recommend that the Victorian Government use the average European Union Emissions Trading Scheme 2023–24 market spot price converted to Australian dollars. This is *at least* $123 per tonne. The New South Wales Government adopted this carbon value and an escalating forward value for cost benefit analysis in February 2023 while it completes its evaluation of a target consistent carbon value.

4. Update business case guidelines and templates to integrate emissions reduction.

Considering carbon impacts at the early investment appraisal stages provides the greatest opportunity to reduce emissions. Infrastructure Victoria reviewed existing business case guidance for Victorian infrastructure projects and found it provides minimal direction on carbon emissions.

Incorporating lifecycle carbon estimation, assessment and valuation into existing business case guidelines and templates will address this gap. The guidance should define how to set an emissions baseline, how to measure carbon, and how to identify carbon reduction strategies.

Updating the *Investment lifecycle high value high risk guidelines* will enable project teams to better incorporate carbon considerations in developing options and designs and select materials that will contribute to meeting the government's legislated targets.

In Victoria's 2024–25 budget cycle, projects should be required to include a descriptive assessment of carbon in their business cases that explains how emissions have been estimated, with evidence provided. The estimates should include a high-level quantification of scope 1 and scope 2 emissions over the project's lifecycle and high-level estimates of scope 3 emissions. The descriptive assessment should include a carbon estimate using $123 per tonne to inform strategic planning and optioneering.

This approach of using an interim carbon value will help projects to better consider options to avoid, reduce and minimise carbon emissions.

5. Measure carbon in infrastructure cost benefit analysis and make decisions that reduce emissions.

The Victorian Government should integrate the measurement and value of carbon emissions into decision-making processes. This will ensure that cost benefit analyses adequately consider all impacts of carbon alongside other monetised impacts.

As Victorian Government departments, agencies, contractors and suppliers become familiar with carbon estimation and quantification, all projects with emissions that meet the materiality threshold identified when implementing recommendation 1 should be required to include carbon in their cost benefit analyses.

When infrastructure cost benefit analyses exclude carbon emissions, project proponents focus on reducing financial costs, and de-prioritise opportunities to reduce carbon emissions. It also means Victoria is not adequately measuring its climate impacts.

6. Update procurement frameworks and guidance to embed carbon reduction in tenders.

Current procurement guidance for major infrastructure projects lacks detail about emissions reduction. It is combined with other sustainability and social procurement guidance in the government's *Social procurement framework*, diluting the focus on reducing carbon. Staff at some departments and agencies are unsure of the best approaches to encourage carbon reduction in procurement documents.

Even when project proponents understand and include these approaches in tendering documents, tender evaluation teams are not clear on how to evaluate proposals that include carbon reduction measures.

The government should update the Department of Treasury and Finance's *Investment lifecycle and high value high risk guidelines: Procurement* and associated procurement templates to clearly specify a requirement to reduce carbon emissions. The updated guidelines should require projects to integrate minimum decarbonisation requirements, communicate carbon reduction expectations and request alternative carbon reduction offers in tender documents.

Carbon emissions reductions should be removed from the *Social procurement framework* when procurement guidance is updated, to avoid duplication

7. Update standard form contracts to include carbon reporting, abatement requirements and further reduction opportunities.

The government should include requirements in standard form contracts to set clear expectations for suppliers, ensuring that they align their practices with decarbonisation goals. These requirements should initially include mechanisms for suppliers to consider additional carbon reduction options, establish descriptive carbon management plans and carbon reporting requirements.

Over time, the government should create a baseline performance level that all suppliers must meet to create a level playing field and require the development of quantitative carbon management plans to drive progress towards decarbonisation. The government should design mechanisms to provide incentives within contracts for suppliers who exceed baseline performance, with appropriate checks and balances to avoid suppliers creating inflated baseline estimates. For example, contracts can include a positive obligation on the supplier to propose variations where new innovations and technologies facilitate further emissions reductions.

Enforcing these commitments through legally binding contracts provides a foundation for new approaches within the industry, encouraging suppliers to seek out, use and adopt low carbon materials and methods.

8. Establish carbon management prequalification requirements for government contracts.

Prequalification requirements for government projects encourage industry to align with the Victorian Government's decarbonisation goals. This will help to promote a market that consistently works towards lowering carbon emissions in government infrastructure projects.

As industry suppliers and contractors become more familiar with the Victorian Government's carbon reduction requirements, the government should establish prequalification requirements that show contractors have the necessary experience for, knowledge of, and commitment to decarbonisation. It should engage with industry stakeholders to identify appropriate prequalification requirements related to decarbonisation and determine what level of prequalification requirements should apply to projects of different sizes. A similar approach in the UK applies to contracts with an estimated value exceeding £5 million (about AUD$9 million). Signalling future changes to industry will give suppliers time to adapt and prepare for the new criteria.

9. Support industry to develop zero or low emissions solutions by testing alternative materials and adopting performance-based standards.

Projects with short timelines can find it challenging to test and pilot new materials and solutions. The Victorian Government can help to lower barriers to adopting alternative materials by testing and piloting materials. The government should collaborate with industry to update the way it describes and uses standards and specifications to reflect the required performance or outcome. This will support the use of alternative low carbon materials in infrastructure projects.

Expanding demand for sustainable materials can lead to economies of scale, reducing the cost of low carbon materials and increasing contractor familiarity with alternative materials and construction techniques.

10. Update assurance processes to include carbon emissions.

The government should update project assurance checks in the Department of Treasury and Finance's *High value high risk framework.* The update should incorporate the changes introduced through recommendations 1 to 9 and require carbon emissions to be reported in benefit management plans.

Experts external to the project carry out assurance checks to review plans and progress at important decision points. Aligning assurance processes means projects monitor and manage the impact of carbon emissions and evaluate carbon emission reduction benefits after completion. Including carbon emissions in assurance processes makes infrastructure investment decisions more transparent and accountable.

Implementation timing

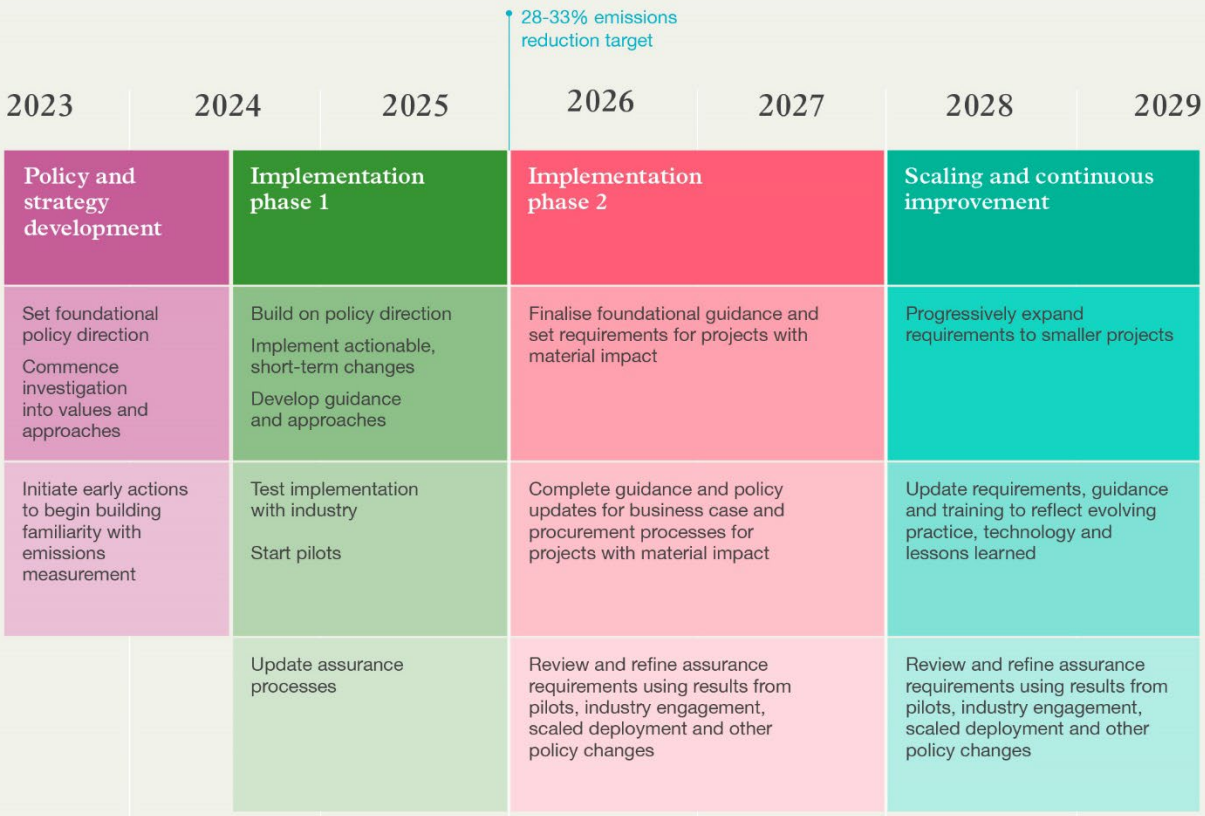
We recommend the Victorian Government clearly communicate its intent to align its approach with other jurisdictions' timing in reducing carbon emissions of future public infrastructure through new policies and practices.

During our consultations, government and industry stakeholders were clear that one of the most helpful things the Victorian Government could do is to set out an achievable and defined timeline for reducing carbon emissions related to the public infrastructure it plans, commissions, or operates.

Work is already underway in other jurisdictions. To catch up with the leaders in Australia, the Victorian Government will need to take decisive action within 6 to 12 months of receiving this advice. The proposed timing will allow Victoria to join with and progress at the same pace as other jurisdictions.

Figure 1

Proposed implementation timeframe towards infrastructure decarbonisation



The Victorian Government can take the following immediate actions to develop policy, requirements and guidance.

Immediate actions for an aligned approach

1.1 Identify the preferred carbon management standard for Victoria.

1.2 Adopt PAS 2080 as interim guidance on carbon management for voluntary use by Victorian Government departments and agencies. (optional)

2.1 Agree to adopt carbon measurement approach and standard emissions factors.

2.2 Evaluate skills gap and training requirements for government and industry.

2.3 Establish a Victorian Government community of practice on infrastructure decarbonisation to facilitate knowledge-sharing and collaboration. (optional)

3.1 Initially adopt interim carbon value of $123 per tonne.

3.2 Calculate the carbon values required to achieve Victoria's specific emissions reduction targets by using a target consistent approach.

4.1 Require business cases to include a descriptive estimate of carbon emissions, assess the impact using the interim carbon value and outline emission reduction options in line with the carbon reduction hierarchy.

6.1 Determine how to change the current public infrastructure procurement frameworks to effectively consider carbon emissions.

Terms of reference

In March 2023, the Treasurer formally requested that Infrastructure Victoria provide advice on the opportunities to reduce greenhouse gas emissions of Victorian Government infrastructure.

The Victorian Government asked for advice on options to help reduce greenhouse gas emissions caused by future infrastructure investment, or in business case assessment and procurement processes. When developing the advice, the government asked Infrastructure Victoria to consider:

- the Victorian Government's options to reduce the greenhouse gas emissions of the public infrastructure it plans, commissions and/or operates
- opportunities to reduce the costs and/or increase the productivity of infrastructure while also reducing emissions
- the Victorian Government's ability to influence emissions reduction by private firms that design, construct and operate public infrastructure — such as designers, suppliers, manufacturers, construction companies and capital markets.

The scope of the advice requested included the following areas:

- Opportunities to identify, prioritise, quantify, incentivise, and track reductions in embodied, operational and enabled infrastructure emissions at early strategic planning and investment decision-making stages including business case assessment.
- Options to update the Victorian Government's existing investment guidelines, procurement policies, regulatory tools, standards, frameworks and/or guidelines to reduce emissions.
- Innovative approaches that the Victorian Government can use to incentivise private industry to increase production and adoption of low carbon materials and/or methods in procurement.
- Enablers and barriers to implementation of any recommendations and their ramifications for reducing the emissions of infrastructure delivery, increasing productivity and reducing costs. This could include any impacts on costs and benefits, and how these could be equitably distributed across stakeholders and over the life of infrastructure.
- Timing and stages to implement options for the best long-term outcomes which minimise transitional costs for the government, the industry and the community.

Glossary

In this report, we use the terms ‘carbon emissions’, ‘carbon’ and ‘carbon pollution’ to refer to greenhouse gas emissions, which is measured in tonnes of carbon dioxide equivalent (tCO_2e). Greenhouse gases are made up of carbon dioxide (68%), methane (27%) and other gases (5%).[2]

Carbon dioxide equivalent (CO_2e) is a measure used to compare the emissions from different greenhouse gases by converting amounts of other gases to the equivalent amount of carbon dioxide with the same potential to contribute to global warming.

We also use the terms ‘decarbonisation’ and ‘decarbonising infrastructure’ throughout this advice. Decarbonisation refers to actions that can be taken to reduce carbon emissions.

Decarbonisation of infrastructure involves reducing or eliminating greenhouse gas emissions during the life of infrastructure assets, including the materials used, how the infrastructure is designed, constructed, operated and maintained, and how it is eventually decommissioned.

Other terminology used in this report includes:

Term	Definition
assurance	A process or system designed to make sure intended outcomes are achieved from solutions proposed.
benefit management plan	A document which specifies the benefits expected from a project, how they will be delivered and measured, and when they will be realised.
carbon footprint	The total amount of greenhouse gas emissions produced directly or indirectly by an individual, organisation, or activity.
carbon management	A systematic approach to identify, avoid, track, and reduce carbon emissions.
digital engineering	Using digital tools and processes to design, analyse and optimise the asset lifecycle, from design and development to testing and maintenance.
discount rate	A percentage rate used to convert future costs and benefits into present values to allow costs and benefits occurring at different points of time to be compared.
embodied emissions	The type of greenhouse gas emissions associated with materials used in construction, maintenance and disposal of infrastructure. This includes the emissions from the extraction, manufacturing, transportation, installation, maintenance, renovation and disposal of the materials used in these processes.
emissions factor	A representative value of a pollutant (such as greenhouse gas) that is released into the atmosphere associated with an activity or product.
enabled emissions	The greenhouse gas emissions created when people use an infrastructure asset, for example, driving a petrol-fuelled vehicle on a road.
environmental product declaration	An independently verified and registered document summarising the lifecycle environmental impact of a product.
global warming	A long-term gradual increase in the average global surface temperature,

	particularly one associated with an increase in greenhouse gases.
infrastructure lifecycle	The process from the beginning of design through to the end of the asset's life, including planning, development, construction, use, and decommissioning.
low build options	Infrastructure project delivery alternatives that involve constructing or developing infrastructure or assets to a lesser extent, such as smaller scale projects, reduced building or materials footprint, or using more efficient design.
low carbon solutions	Options that include technologies or resources that produce minimal greenhouse gas emissions or have a significantly reduced carbon footprint compared to conventional alternatives.
materiality test	A process to determine if the impacts of a project or program meet a pre-determined threshold of a financial or non-financial nature (such as greenhouse gas emissions). Impacts exceeding the threshold are considered significant enough that they need to be quantified accurately and valued in decision-making.
net zero emissions	A state where the amount of greenhouse gas emissions produced by human activities is equal to the amount of emissions removed from the atmosphere.
non-build options	Opportunities to resolve service delivery issues that do not involve constructing new infrastructure or assets, but instead focusing on utilising or optimising existing infrastructure.
operational emissions	The greenhouse gas emissions produced by operating an asset, primarily from energy usage.
scope 1 emissions	The direct greenhouse gas emissions from sources that are owned or operated by the organisation reporting the emissions, for example, burning diesel fuel in company-owned vehicles or in on-site generators.
scope 2 emissions	The indirect greenhouse gas emissions associated with using energy from another source, for example, using coal-fired electricity from the grid.
scope 3 emissions	All other indirect greenhouse gas emissions that are a consequence of the activities of an organisation but occur from sources that are not owned or controlled by the organisation, for example, greenhouse gas emissions from the extraction and production of metals and plastics used to build the asset, or from shipping and distributing those materials.
standard form contract	A contract often used by government to set a range of standard contractual requirements that need to be met by contractors.
supply chain	A network of industry participants, resources, and processes involved in the creation and delivery of a product or service, from raw material sourcing to the final delivery to customers.
target consistent approach	An approach for valuing carbon emissions that uses a relevant policy target and determines the cost of emissions abatement required to achieve that target.
value engineering	A systematic, organised approach to analyse the functions of various components and materials in a project design to lower the cost of goods, products and services used.

Why decarbonising infrastructure matters

Why decarbonising infrastructure matters

Climate change threatens Victoria's future

Long-term trends show that Victoria's climate and water resources are changing due to the influence of both natural variability and global warming.

Victoria is already experiencing the early effects of a more severe climate, including more frequent heatwaves, droughts, floods, and an increase in the length and severity of dangerous fire conditions.[3] The latest Commonwealth Scientific and Industrial Research Organisation and Bureau of Meteorology's *State of the Climate 2022* report finds that extreme climate events are happening at an increasing pace in Australia.[4]

Extreme climate events are expensive. The Climate Council estimates that the financial, economic and social costs of extreme weather events were $10 billion in Victoria between 1970 and 2019.[5] If extreme climate events keep increasing in future, these costs will rapidly escalate.

A 2019 study estimated that with no further global action, the cost of damages caused by climate change in Victoria would be $150 billion by 2050 and $986 billion by 2100.[6] These estimates include the costs of lower agricultural and labour productivity, loss of arable land due to sea level rise, some health impacts and infrastructure damage.[7] They do not include all the costs associated with floods, bushfires, biodiversity loss and pollution. As such, they may understate the potential costs to Victoria.[8]

Victoria has a strong policy commitment to emissions reduction

Victoria is one of Australia's leading states in targeting reductions to address the climate challenge. The Victorian Government has existing policies to deliver more renewable energy, better energy efficiency measures and sustainable transport initiatives. For example, the Victorian Renewable Energy Target and programs such as Solar Homes increased renewable energy from 5% of Victoria's electricity generation in 2009 to 35% in 2022.[9]

It was one of the first jurisdictions in the world to legislate a net zero emissions target. In 2017, the Victorian Parliament passed the *Climate Change Act 2017*, which set in law a net zero emissions target by 2050. By 2021, the state's emissions had fallen by 32% below 2005 levels.[10]

And in May 2023, the Victorian Government committed to emissions reduction targets of 80% compared to 2005 levels by 2035 and net zero emissions by 2045.[11] These are the most ambitious emissions reduction targets in Australia.

Reducing embodied emissions will become increasingly important

Up to 70% of Australia's annual emissions can be directly or indirectly attributed to the lifecycle of infrastructure.[12] We can classify infrastructure emissions as operational, enabled, and embodied emissions:

- **Operational emissions** are generated when an asset is in use, such as electricity to power a building. Operational emissions were estimated to be 9.1% of Australia's emissions in 2018.
- **Enabled emissions** are generated when people or organisations cause emissions by using infrastructure. For example, roads enable people to drive vehicles powered by petrol or diesel. Enabled emissions were estimated to be 55% of Australia's emissions in 2018.

- **Embodied (also known as embedded) emissions** are generated by the activities and materials used in infrastructure construction, maintenance and disposal. Embodied emissions were estimated to be 5.9% of Australia's annual emissions in 2018.

The preferred method to quantify infrastructure-related emissions is still evolving in Australia, particularly for embodied emissions. Most jurisdictions are in the early stages of developing approaches to measure carbon. Infrastructure Australia is currently leading efforts to estimate embodied carbon in the existing project pipeline. We expect that this will produce estimates for both national and Victorian emissions by the end of 2023.

However, a 2021 study reported that the embodied carbon emissions of all materials used in Australian buildings and infrastructure amounted to 30 to 50 million tonnes of carbon dioxide equivalent (Mt CO_2e) per year.[13] This is 5 to 10% of the total national emissions, consistent with above estimates.

Over time, operational and enabled emissions are likely to decline due to the increasing uptake of renewable energy and energy efficient technologies, such as electric vehicles.[14] As Australia's electricity grid decarbonises and transport moves away from internal combustion engines, embodied carbon will replace operational and enabled carbon as the dominant source of emissions.[15]

Reducing infrastructure emissions requires global solutions

The Victorian Government cannot reduce infrastructure-related emissions alone.

Victoria's emission reduction targets do not include emissions originating from materials manufactured outside Victoria, known as scope 3 emissions in the *National Greenhouse and Energy Reporting Act 2007*.[16] Estimates from one of Victoria's major transport projects indicate that only 4.6% of the total embodied emissions are from materials sourced in Victoria. About 95% of the embodied emissions are from materials sourced in other parts of Australia (91%) and overseas (4.4%).[17] The most emission intensive parts of cement and steel production are not located in Victoria. The state's emissions reduction targets consequently do not capture a significant proportion of embodied emissions generated by Victoria's infrastructure construction program.

Similarly, Australia's national greenhouse gas accounting does not include carbon emissions from overseas processing of materials mined and exported from Australia. Domestic greenhouse gas emissions were 464.8 million tonnes of carbon dioxide equivalent in 2020–21. But Australia's global carbon footprint is much greater.[18] For example, in 2022, emissions from offshore processing of exports in metallic iron ore alone were more than 900 million tonnes of carbon dioxide equivalent, or about 180% of Australia's total domestic emissions.[19]

Climate change is a global issue and requires global solutions. Because of this, other jurisdictions have started to introduce carbon tariffs to avoid importing products that have a large carbon footprint and account for economic impacts of imported carbon.

The European Union has implemented a carbon border adjustment mechanism, which adds fees to imported goods based on their greenhouse gas emissions.[20] From 1 October 2023, it will apply to a wide range of carbon intensive goods, such as cement, iron, steel, aluminium and fertilisers.[21] The fee will be determined from the market price of the European Union Emissions Trading Scheme.[22]

In August 2022, the United States Government also passed legislation to introduce a tax on imports from countries without aggressive climate change policies.[23] Australia's major trading partners in Asia have also set net zero targets for either 2050 or 2060 and, in early 2022, Japan was also reported to be considering a carbon tariff for imported carbon intensive goods.[24] As of 31 March 2023, 73 global carbon pricing initiatives have been implemented including carbon taxes and emissions trading systems.[25]

As even more countries introduce policy initiatives to decrease their emissions, jurisdictions that do not respond to and control carbon emissions are increasingly at risk of losing international competitiveness in trade and investment.[26]

Products manufactured in Australia and exported to other jurisdictions will increasingly be subject to extra fees if they have high embodied emissions. Some experts warn that these changes will impact Australia's resource industry and advise that the government and business community must plan for them now.[27] The Victorian Government can help reduce infrastructure's carbon emissions, regardless of source, by introducing clear policies on emissions reduction in its infrastructure projects.

There are clear benefits of avoiding carbon now before it becomes more costly

Global and local efforts to reduce carbon are gathering pace. In Victoria, major projects are already required to report scope 1, 2 and 3 emissions in their Environmental Effects Statements, and to demonstrate how they will reduce carbon in their construction and operational stages.[28,29] The Environment Protection Authority is becoming more focused on greenhouse gas emissions. A new general environmental duty has been included in the *Environment Protection Act 2017*. It is an offence to breach the general environmental duty. Recent guidance suggests that projects and their delivery partners may be at risk of delays and rework if they do not take reasonably practicable action to reduce the risk of pollution from carbon emissions.[30]

Careful consideration of carbon reduction strategies at the outset of a project offers a much greater potential to reduce carbon impact, before materials and contracts have been locked in. As infrastructure projects are typically constructed and operated over a long period of time, they need to consider how evolving regulatory requirements will impact on their projects. For example, infrastructure projects are not currently required to offset carbon in Australia. But if this changes, projects will need to find new budget funding to offset carbon emissions that are already committed in their plans.

Implementing strategies to reduce carbon in infrastructure as quickly as possible can help projects to be ready for future regulatory changes.

Construction and materials businesses and other governments are preparing to decarbonise

Industry and business sectors are calling for governments to address embodied carbon in infrastructure as the next step to achieve net zero emissions targets.[31]

Industry bodies recognise the urgency of action because they fear their members will become uncompetitive, as governments and markets increasingly demand low carbon products. In 2022, the Business Council of Australia, among others, called for governments and infrastructure advisory bodies to identify and assess embodied carbon emissions in business case development and procurement of infrastructure projects. They also recommended finding ways to use more low carbon materials in public infrastructure projects.[32]

Infrastructure Partnerships Australia[33] and the Infrastructure Sustainability Council of Australia[34] also released policy papers calling for a nationally consistent approach to reducing greenhouse gas emissions in infrastructure projects. The Australasian Procurement and Construction Council also released *Pathway to green construction procurement*, a best practice guide advocating for carbon assessment across all project phases.[35] And in August 2023 the Infrastructure Net Zero initiative was launched, a national collaboration of industry peak bodies and the federal government committed to decarbonising Australia's infrastructure.[36]

The Australian Government's *Climate Change Act 2022* set national greenhouse gas emissions reduction targets. This means that all jurisdictions seeking federal funding for infrastructure projects must now address carbon emissions. To clarify this requirement, Infrastructure Australia issued interim guidance in September 2022.[37] Final guidance is expected in 2024.

In October 2022, Infrastructure New South Wales released guiding principles and timelines for action on decarbonisation, with a particular focus on embodied emissions.[38] A policy roadmap followed, setting out detailed actions the government will complete by 2026.[39]

In June 2023, state and national infrastructure and transport ministers set up a Decarbonisation of Transport Working Group to oversee development of a national transport decarbonisation work plan.[40]

Capital markets are prioritising investment in businesses that demonstrate sustainability-related performance

Globally, capital markets are also responding rapidly to sustainability and climate change.

In June 2023, the International Sustainability Standards Board (ISSB) issued two new standards designed to enable companies to publicly report on the sustainability and climate-related risks. The Australian Accounting Standards Board (AASB) will be responsible for formally establishing the detailed disclosure standards in Australia, which is expected to align as far as practicable with the final standards developed by the ISSB. The AASB's consultation on climate disclosure standards is expected to take place in the second half of 2023.[41]

These sustainability standards are likely to be incorporated into the Australian Accounting Standards and Commonwealth regulation of financial disclosures under the *Corporations Act*. Corporate regulators will require companies to credibly and accurately report upon their sustainability credentials, including the emissions impacts of infrastructure they fund, build or operate.

The Australian Department of Treasury's *Climate-related financial disclosure consultation paper,* released in June 2023 proposes a three-phased approach for mandatory reporting on greenhouse gas emissions. It would first apply to a relatively limited group of very large entities in the 2024–25 financial year and would expand over the next two years to apply to progressively smaller entities.[42]

These requirements will not apply to government directly but will have implications for companies that build infrastructure on behalf of government. The government should carefully consider how selected tools and guidance for measuring carbon emissions will be implemented in private sector disclosure of carbon emissions. It is desirable that there be rigour and consistency in the tools and guidance used for measuring and reporting on emissions. If this can be achieved in the efforts of Australian Governments to decarbonise infrastructure and implement climate-related disclosure standards for companies, this will assist the objectives of both reforms and reduce regulatory burdens on industry.

In coming years, capital markets are likely to become increasingly reluctant to allocate capital to companies or projects that do not disclose satisfactory sustainability-related performance. Businesses which cannot demonstrate sustainability outcomes may incur higher borrowing rates, higher operating costs, and increasing challenges in raising capital. For example, major institutions including the Australian Prudential Regulation Authority, Reserve Bank of Australia and Moody's have recently raised the issue of worsening capital situations for businesses with assets at risk of stranding or rapid devaluation.[43] This may hinder the growth of Victorian companies, their ability to partner with the government to deliver infrastructure, and the willingness of investors to be involved in emissions-intensive projects.

If the Victorian Government fails to provide clear policy direction and a timeline for reducing emissions from the infrastructure it commissions, companies involved in delivering infrastructure may struggle to fulfill their sustainability-related financial disclosure obligations.

The Victorian Government can help build more low carbon infrastructure sooner

The Victorian Government has significant purchasing power in the infrastructure supply chain. In its 2023–24 budget, the Victorian Government's total infrastructure project portfolio was estimated at $201 billion for current and new infrastructure projects.[44] With capital expenditure forecast to reach $22.5 billion in both the 2022–23 and 2023–24 financial years there is a significant opportunity for the government to influence emissions in the supply chain.[45]

New infrastructure projects usually consume enormous amounts of energy and materials. Mining, manufacturing, and construction are directly responsible for around 34% of Australia's emissions. This increases to 50% if electricity use is included.[46] Carbon emissions generally increase with the amount of materials and energy used to build an infrastructure project. Every stage of the infrastructure design and delivery process can potentially reduce energy and materials use, and carbon emissions.

Collaboration from the public and private sectors can consider carbon emissions at each decision point and during the life of an asset. Reducing embodied emissions in a systematic way considers avoiding and reducing material use by using innovative upfront design solutions, re-using and recycling materials and reducing waste at the end of an asset's life. This includes embodied emissions generated in processing and transporting minerals, materials, and other goods.

Australia has a significant opportunity to develop low or zero carbon construction materials. This is especially attractive for Victoria because it is a major importer of construction materials. Low carbon construction materials are usually manufactured in a different way to standard materials, and produce fewer emissions by using renewable energy, using different material inputs, or using different manufacturing processes.

For example, Brickworks Tasmania have manufactured Australia's first certified carbon neutral bricks. The zero carbon building material uses sawdust, a timber industry by-product, as a renewable fuel source instead of fossil gas in kiln firing. Remaining operational emissions are reduced by efficiency upgrades and offsets.[47]

Some materials, like cement and steel produce emissions that can be difficult to reduce. Producing these materials is energy intensive and involves chemical reactions that release carbon emissions.[48] Alternatives, such as using hydrogen in processing iron ores to make steel are being tested but are not widely available. Until alternative technology becomes available at a commercial scale, it can be very expensive to use substitutes for these materials.[49]

Cement manufacturing is estimated to be responsible for 7% of global emissions.[50] Most cement is used to make concrete. Concrete that contains approximately 70% less embodied carbon than traditional cement-based concrete is commercially available.[51] Builders are also using timber as a low carbon alternative to steel and concrete in Australian buildings, producing up to an 85% reduction in emissions in the material supply, transport and construction stages.[52]

Reducing carbon can reduce cost and improve productivity

The Victorian Government noted in the 2023–24 budget that the economy is 'navigating a challenging period with high inflation, rising interest rates, and weakening national and global growth.'[53] In this context, reducing carbon emissions from infrastructure can lead to cost savings by design and material innovation.

The United Kingdom Treasury's *Infrastructure carbon review* concluded that 'reducing carbon reduces cost' when decarbonisation is prioritised early and over the long term.[54] The 2013 study concluded that carbon reductions are not only achievable but have a substantial commercial upside. It found that reductions in carbon of up to 39% by supply chains achieved average reductions in capital expenditure of 22%.[55] Research by the Clean Energy Finance Corporation suggests that material and design innovation can reduce costs by up to 3% and achieve a 5% to 18% reduction in embodied carbon.[56]

Our research identified that stakeholders from both government and private sectors are concerned that decarbonisation will add another layer of complexity to infrastructure delivery, potentially leading to a further decline in productivity in the construction sector. However, the evidence we reviewed demonstrates that decarbonising infrastructure opens new opportunities to improve infrastructure-related productivity.

Higher productivity means creating more outputs with the same inputs or maintaining the same output with fewer inputs; in simple terms: doing more with less.[57] Higher productivity can also be framed as achieving the same outcomes with lower costs, as cost is a good proxy for the inputs of labour, materials and time.

Australian infrastructure sector's productivity in the global context

The Australian infrastructure and construction sector's productivity growth has been lower than other sectors for several decades.[58] This is significant, given the infrastructure sector accounts for nearly 20% of Australia's gross domestic product.[59]

During the 30 years since 1990, the construction industry experienced productivity growth of 6.2%.[60] In the same period, other industries including agriculture, mining and financial services, have experienced productivity growth of 31.4%.[61]

Globally, low productivity growth in the infrastructure sector is not isolated to Australia.[62]

Case study

Upgrade of Elephant and Castle Station planned with emissions in mind

Redesign reduces costs and carbon

An underground station in the Elephant and Castle neighbourhood in London is being upgraded to improve public transport access. The upgrade will accommodate an extra 27,000 commuters at peak time each day.[63]

The carbon impact of the station upgrade was considered in the project planning. This led to a redesign of the escalators, overbridges, and retaining walls. The redesign achieved a 25% reduction in emissions and a 27% projected cost saving compared to the original design.[64]

Image below: Elephant and Castle Station design Source: Transport for London Press images

A 2013 review by McKinsey & Company identified 3 key actions to improve infrastructure productivity that could lower global infrastructure spending by 40%, saving up to US $1 trillion a year. These actions align closely with the good practice for infrastructure decarbonisation, such as:[65]

- choosing the right combination of projects to address clearly defined needs
- streamlining delivery by investing heavily in the early stages of project planning and design and structuring contracts to encourage time and cost savings
- making the most of existing infrastructure by boosting asset utilisation, optimising maintenance planning, and using more demand management measures.

Reducing carbon emissions can be a catalyst to drive these actions and achieve associated productivity gains. The United Kingdom's Department of Transport notes in its *Whole life carbon management* guidance that better strategic planning that prioritises avoiding carbon emissions should first explore alternative solutions to building new infrastructure.[66] Infrastructure Australia has also identified better strategic planning as a reform to improve infrastructure productivity.[67]

McKinsey's work notes that using viable alternatives such as demand management, better asset management and optimising network performance is often more productive than addressing capacity problems by building new physical capacity.[68]

The Productivity Commission, Infrastructure Australia and Australian Constructors Association have all identified several procurement processes to improve productivity that would also benefit decarbonisation, including:

- adopting a standardised contract approach that provides certainty about the government's requirements[69]
- adopting standard forms of contract and minimising bespoke contracts and clauses[70,71]
- moving away from a heavily weighted price criteria in procurement and focusing on outcomes and value[72]
- promoting delivery innovation such as by using a digital engineering approach[73]
- collaborating with industry to identify innovations earlier in planning.[74]

While new carbon management requirements may add costs and time for government and industry before requirements become the norm, fit-for-purpose procurement processes can save projects time, labour and costs.[75] Conventional procurement approaches can constrain collaboration and innovation.[76] The greater use of performance-based specifications helps focus on project outcomes, which avoids waste in design and materials and thus improves productivity.[77,78] Similarly, this approach can avoid conservative designs that use extra materials, cost more and emit more carbon.

Using recycled materials can reduce carbon and benefit the economy

Using recycled materials can reduce demand for new materials and avoid the associated carbon emissions from extracting and processing them. For example, crushed recycled concrete recovered from demolition sites produces 65% fewer embodied carbon emissions than quarried materials.[79]

> "The use of recycled products in concrete reduces the need for natural resources and carbon emissions. The supply chain would benefit from greater visibility of where recycled product is available."

> Cement, Concrete and Aggregates Australia, submission to Infrastructure Victoria[80]

Infrastructure Australia estimates that, based on current technology and standards, about 27% of conventional road construction materials can be replaced with recycled alternatives.[81] They estimate that this could increase to between 43% and 59% with technological advancements and updates to the standards that govern what materials and methods are used to plan and construct roads.[82] Similarly, the National Transport Research Organisation has found that there are significant environmental benefits for most recycled material applications in road and rail infrastructure, with greenhouse gas emission reductions of 47% to 98%.[83]

Victoria has made significant progress in using more recycled materials in infrastructure projects. The Victorian Government set up EcologiQ to identify options for recycled materials to be used in major transport projects.[84] It also created the *Recycled first policy* to require contractors building Victorian transport projects to maximise their use of recycled and re-used materials.[85]

Reducing carbon by improving recycling can also benefit the Victorian economy, especially if recycled materials are sourced locally.

Infrastructure Victoria's previous *Advice on recycling and resource recovery infrastructure* found that recovering and re-using resources is more productive and higher-value than disposing of these resources. For every 10,000 tonnes of waste recycled, 9.2 jobs are generated compared to 2.8 jobs for landfill. Increasing Victoria's resource recovery rate to 90% could create 2,400 jobs by 2039 compared to business as usual.[86]

EcologiQ promotes recycled content in Victoria's infrastructure

EcologiQ is a Victorian Government initiative to integrate recycled and re-used content into Victoria's Big Build. Its priorities are to[87]:

- optimise the use of Victorian recycled and re-used materials on Victorian major transport projects
- pursue market development opportunities
- change the approach to technical standards and specifications.

By June 2023, Victoria's Big Build projects had committed to use over 2.5 million tonnes of recycled and reused materials.[88]

Deploying digital technology can enable significant carbon savings

Digital engineering is a more streamlined and productive way of planning, designing, constructing, operating, and maintaining assets during their lifecycle.[89] The Victorian Government's *Digital asset policy* and *Digital build* program aim to increase the use of digital engineering in infrastructure planning and delivery.[90]

Infrastructure planners can use digital engineering tools to model and cost alternative materials, including embodied carbon emissions. Engineers already use value engineering to identify options to reduce or substitute materials to lower build costs. The same approach can be deployed to examine carbon intensive areas of design and focus on options to reduce carbon.

Digital engineering improves project design and drives carbon savings

By visualising data from engineers, environmental specialists and construction planners on a common platform, the project team working on the $1 billion Cranbourne Line Upgrade in the Level Crossing Removal Project did a 'virtual launch' of a 63-metre, 340-tonne steel bridge structure.

The team was able to check every element of the design and construction before the real bridge launch occurred. This helped them to plan, identify conflicts between different teams, and resolve these virtually before they happened on site.[91]

In the Central Station Project in Sydney, the project team used a digital engineering model to reduce concrete use. This reduced the project's concrete use by 465 cubic meters, which significantly lowered the project's costs and emissions.[92]

Using a digital engineering model that proposed alternative materials and included new design options, the project team for the Timber Square Building in London reduced embodied carbon by 30%.[93]

Case study

Carbon Twin

Calculating and visualising embodied carbon

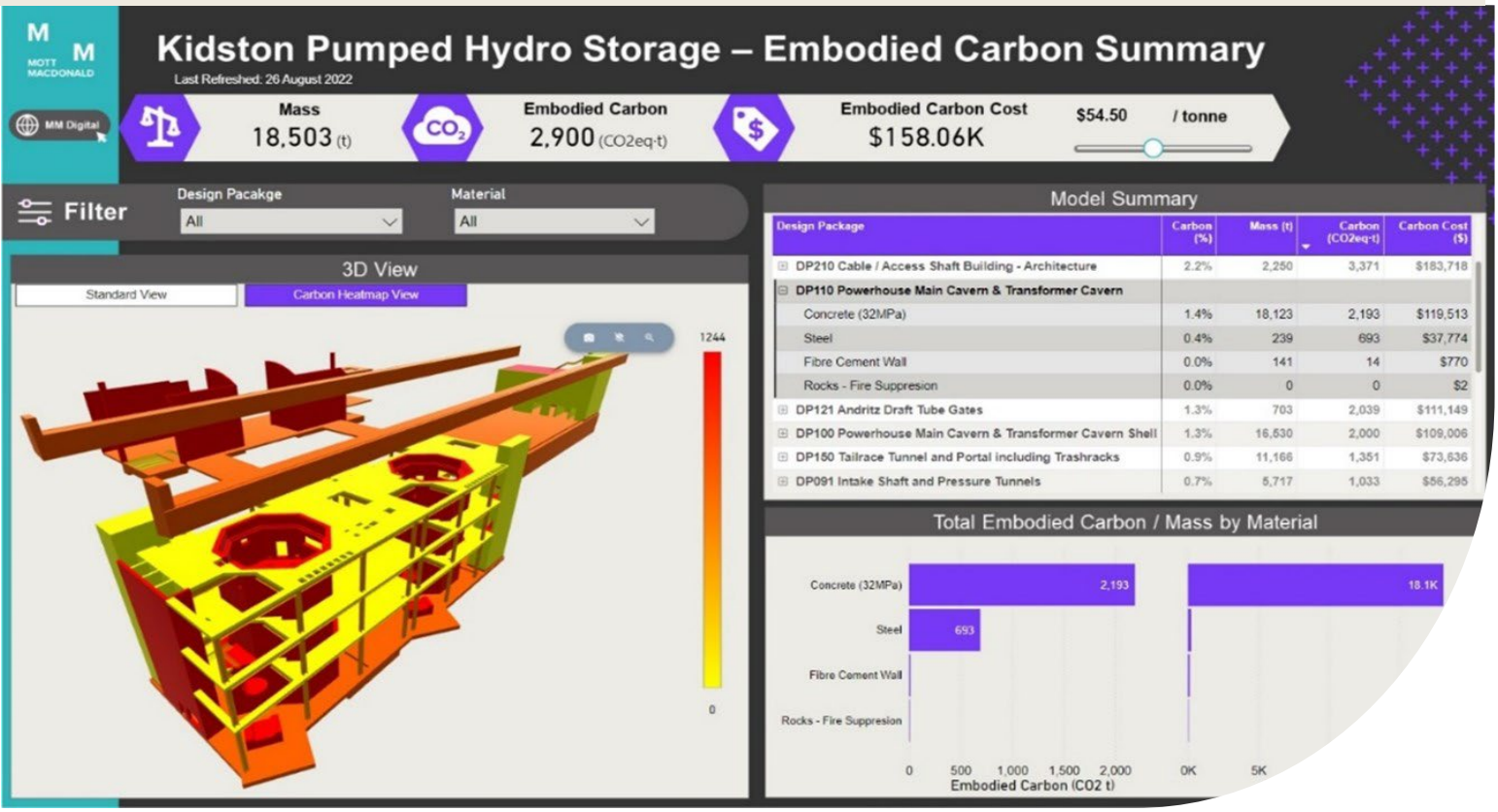
The energy supplier Genex commissioned McConnell Dowell and John Holland to create the Kidston pumped storage project as a component of a renewable energy hub.

The project is repurposing a redundant gold mine into a pumped-hydro storage facility to support co-located solar, and planned wind generation. The project, now under construction, will help Queensland achieve its target of 50% electricity from renewable resources by 2030.

Kidston is being used as a template to refine Mott Macdonald's Carbon Twin tool, which can visualise an infrastructure project's carbon intensity in the project design phase. The tool provides detailed information on different construction materials, their carbon emissions, and the costs involved. It reveals 'hidden' carbon within a design and offers interactive 3D visualisations to identify areas with significant carbon emissions.

Users can explore the entire asset and see the emissions associated with each part of the project.[94]

Image below: Kidston pumped storage hydro project *Carbon Twin Dashboard* (data is for demonstration purposes only)[95]



Our findings: the priorities for change in Victoria

Our findings: the priorities for change in Victoria

Our approach to the advice

Infrastructure Victoria undertook research and met with stakeholders between February and May 2023 to inform this advice. We:

- reviewed national and international policy and technical guidance, specifications and emissions requirements
- assessed existing guidance, specifications and requirements related to emissions in Victoria
- talked to other infrastructure bodies and agencies and attended joint consultation sessions with industry
- worked with consulting firm WSP Australia to produce a technical report which is published on our website
- interviewed Victorian Government departments and agencies and major stakeholders, who we list in Appendix A
- tested and refined our draft policy options with government and industry bodies in a series of 4 workshops
- received public submissions from 14 April 2023 to 14 May 2023
- reviewed the 14 submissions we received from industry and the community, and published them on our website if the author gave us permission. We list a summary of these submissions in Appendix B.

Current views on decarbonising infrastructure in Victoria

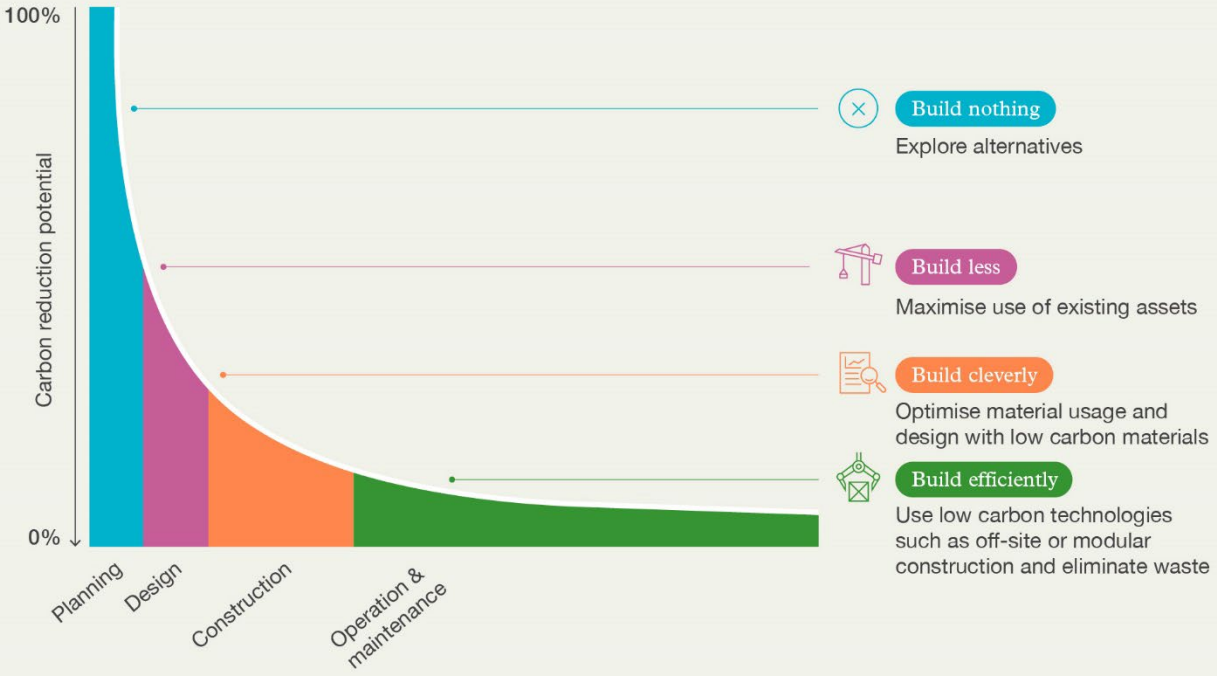
Stakeholders told us that:

- most staff working on infrastructure in Victorian Government departments and agencies are at an early stage of understanding how they can reduce carbon emissions in their day-to-day work
- while they understand government's ambition to reduce emissions, they do not have consistent and transparent ways to quantify, value, monitor and track carbon emissions at a project or portfolio level
- they are not clear about how their individual efforts are contributing to reducing the state's total emissions
- the Victorian Government's emissions reduction targets and policy statements have not yet clearly been translated into project decisions
- carbon reduction options put forward by contractors are often not agreed to by decision-makers due to concerns over cost implications
- they have concerns over potential resource pressures of complying with extra decarbonisation requirements in their project within existing budgets.

Getting more use from existing infrastructure can reduce carbon

The World Green Building Council, among other organisations, has argued that the greatest potential to reduce carbon emissions comes in the early planning stage of new projects. This can be done by applying the carbon reduction hierarchy (see Figure 2) [96].

Figure 2
Carbon reduction potential across different project stages



Governments should thoroughly and seriously investigate other options before deciding to build new infrastructure, including building less by getting better use from existing assets. Portfolio-wide planning can help to better explore service delivery solutions and asset management options ahead of new construction projects.

If governments decide to proceed with new infrastructure, it can then be designed to avoid and reduce emissions during its lifecycle. Building cleverly and efficiently through a combination of innovative designs, low carbon materials and low carbon construction methods can reduce carbon emissions associated with new projects. [97]

Infrastructure Victoria's earlier research shows that demand management can feasibly and effectively solve capacity problems, thereby avoiding carbon emissions from new infrastructure. For example, our work has shown that changing the way people pay for transport, such as introducing cheaper off-peak fares for public transport, can promote better use of Victoria's existing public transport infrastructure. This is because cheaper off-peak pricing encourages people to travel outside of peak hours if they are able. This then reduces the requirement for new capacity at peak times. [98]

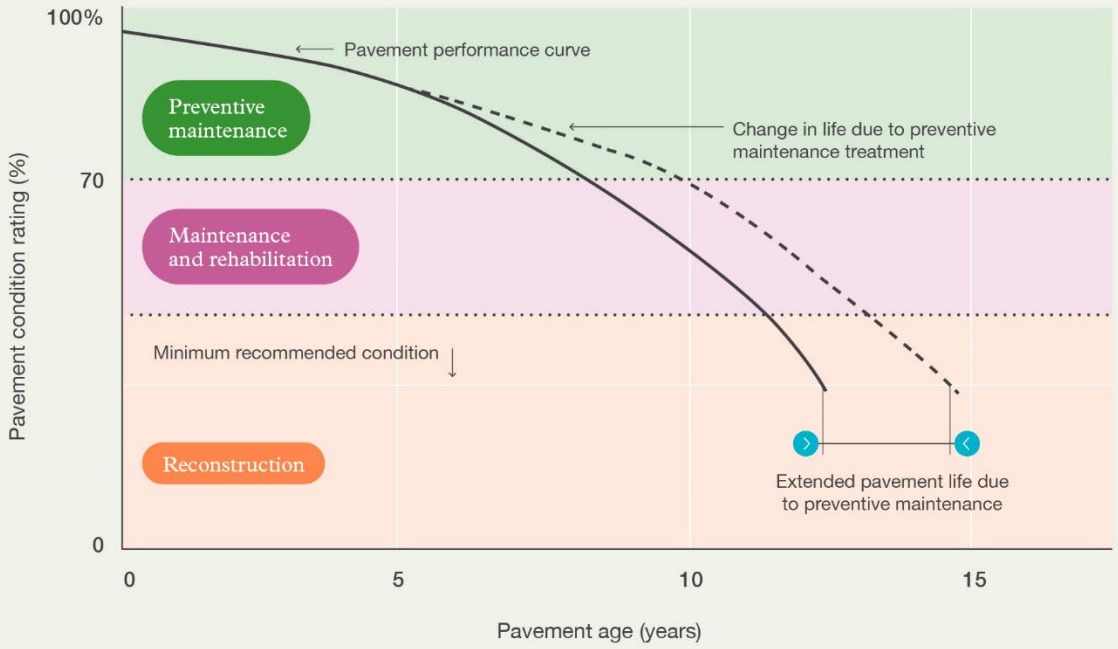
Places that introduce transport network pricing policies, such as London and Stockholm, realise multiple benefits, such as containing or even reducing traffic congestion despite growing populations. [99]

Government might find it challenging to seriously consider and implement non-build or low build solutions. But the Welsh Government has shown that prioritising non-build solutions that reduce carbon emissions can be done. In 2023, they cancelled 9 major road projects [100] and committed to

only consider future road investments that reduce carbon emissions and support a shift to sustainable transport modes.[101]

Extending the life of existing infrastructure can also reduce carbon and costs by avoiding new construction. For example, regular preventative maintenance of road surfaces can extend the number of years the roads can be used, as Figure 3 shows.[102]

Figure 3
Benefits of preventive maintenance to extend pavement life



In the United Kingdom, Anglian Water has continuously improved its asset planning and management.[103] For example, it avoided building new infrastructure by upgrading an existing water pipeline.[104]

Anglian Water – better use of existing assets to reduce carbon and cost

The United Kingdom water company Anglian Water planned to construct a new 37-kilometre pipeline. They expected it to cost £60 million and generate embodied emissions of 43,468 tonnes of carbon dioxide equivalent.

Using an innovative technique called flow reversal modelling, Anglian Water found that they could reverse the direction of flow in an existing pipe to supply water from another area.[105] By improving the use of existing assets using innovative and clever design, Anglian Water was able to reduce embodied carbon by 61%. This also reduced the cost of the project by £32 million.

In Victoria, the Department of Treasury and Finance's *Investment lifecycle and high value high risk guidelines* require projects to consider alternatives to building new infrastructure when developing business cases. However, in our discussions with senior staff at major Victorian Government agencies, there was clear feedback that strategic planning needs to happen much earlier and at a portfolio level to fully consider non-build solutions.

By business case stage, project teams told us that their task is to build a case for the new project, so it is too late for thorough consideration of non-build alternatives. The existing culture prioritises new build solutions and does not incentivise these teams to thoroughly prepare options that meet service needs while avoiding a new build project. This cultural change needs to be led by ministers and senior leaders in government.

Building efficiently can deliver productivity and carbon reduction benefits

Building efficiently, or using a low build approach, includes a range of offsite and modular methods of construction that involve assembling building components or modules in a controlled manufacturing setting.[106] This approach can deliver multiple benefits, such as:

- time savings: between 20% and 50% faster delivery than traditional techniques has been reported due to a more streamlined production[107]
- cost savings: 20% lower costs than traditional building techniques can be achieved due to reduced labour costs, efficient material procurement through centralised procurement and production, minimised on-site rework, and improved quality in a controlled manufacturing setting[108]
- carbon savings: a United Kingdom study found carbon emissions were reduced by 45% compared to onsite construction. This was a result of designing with less concrete and steel, and lowering emissions through reduced material transportation to the site. Prefabrication factories optimise material movements through assembly line robotics and other automated tools, improving efficiency and reducing both carbon and waste for the project as compared with onsite construction[109]
- waste reduction: waste reduction of greater than 40% was reported compared to onsite construction[110]
- productivity gains: more efficient material procurement through centralised procurement, coupled with streamlined and predictable pace of supply, delivery and installation.[111]

Globally, the modular and prefabricated construction market is expected to grow at a rate of 7.5% from 2023 to 2032 and reach USD$285 billion (around AUD$ 443 billion) by 2032.[112]

Victoria leads Australia's development of offsite construction, with more than 50% of industry capacity housed in the state.[113] The Office of Projects Victoria's *Offsite construction guide* aims for all projects to use offsite construction techniques where it is feasible and efficient to do so.[114]

Barriers that have been identified to introducing more offsite and modular construction include:

- the need for significant upfront investment in establishing manufacturing facilities and challenges in securing financing[115]
- the challenges in integrating this new construction method into the supply chain, such as logistical complexities involving transportation and site coordination[116]
- that current design practices often follow traditional building standards without considering the potential structural demands of modular construction[117]
- the absence of clear design guidelines for modular buildings[118]
- the shortage of skilled workers experienced in offsite and modular construction.[119]

Addressing these limitations will help Victoria reap the full potential in offsite and modular construction which delivers both productivity gains and decarbonisation benefits.

Case study

Fast delivery and reduced environmental impact

Permanent modular school buildings

Construction of the Warragul North Primary School's modules took just 8 weeks — 4 for factory build and 4 for installation.[120] The modular construction prioritised students' safety and well-being and was completed with minimal on-site work. These modular structures integrate technology and sustainability, leading to an overall reduction in environmental impact and costs.[121]

Image below: Two separate but connected modular buildings with an integrated courtyard replaced an old block of the Warragul North Primary School Source: Grove Group

Efforts to reduce carbon across the lifecycle are inconsistent

The Victorian Government currently has no integrated approach to manage carbon emissions over the infrastructure lifecycle.

Existing sustainability guidelines and frameworks, such as the *Social procurement framework* and the *Sustainable investment guidelines* consider carbon emissions among other sustainability considerations such as reducing water use and waste. As a result, carbon emissions reduction is considered one of many sustainability priorities, which is often overlooked in attempting to meet cost, quality and time requirements. While all sustainability considerations are important, reducing carbon emissions has clearly been identified as an urgent and immediate priority for all governments.

Infrastructure assessment and appraisal should include identifying, measuring, reducing and managing carbon over an asset's life.[122]

Existing infrastructure projects typically focus on reducing the carbon emissions of operating an asset[123] or energy use in building the asset, rather than the emissions generated through materials use, transportation of materials, asset maintenance or end-of-life decommissioning.[124]

Current guidance does not explain how to consider and manage carbon emissions throughout the infrastructure lifecycle.

Many stakeholders in our research identified PAS 2080 *Carbon management in buildings and infrastructure* as a leading example of a unifying approach to reducing carbon emissions.[125] PAS 2080 covers all parts of an asset's lifecycle carbon emissions.

The Royal Institution of Chartered Surveyors' *Whole life carbon assessment for the built environment* is another example of a consistent and detailed method for managing carbon emissions.[126]

PAS 2080:2023 – Carbon management in buildings and infrastructure

PAS 2080 is a globally recognised standard for managing carbon in buildings and infrastructure. It aims to help reduce carbon and costs through better design, construction and operations.[127]

PAS 2080 provides a framework for reducing carbon throughout the infrastructure lifecycle. It sets requirements for infrastructure projects, such as governance, planning or monitoring, and reporting, and offers practical guidance on meeting those requirements using various tools and techniques to quantify carbon, evaluate design and construction options, and manage project risks.[128]

Its key principles include:[129]

- **Carbon management:** Implementing a carbon management strategy that includes setting targets, monitoring emissions, and reporting progress.
- **Collaboration**: Encouraging collaboration between all stakeholders involved in an infrastructure project, including designers, contractors, and operators.
- **Lifecycle thinking**: Adopting a whole life approach to carbon management, considering emissions at all stages of the project lifecycle.
- **Performance-based approach**: Using a performance-based approach to carbon management, with targets and metrics that are linked to the specific infrastructure project and its intended purpose.

Quantifying carbon emissions needs standardised tools

Consistent carbon management guidance needs a unified approach to quantify carbon emissions.

Currently, carbon management approaches in Australia use different terminology, standards, and tools. The Materials and Embodied Carbon Leaders' Alliance has identified over 143 standards and tools used to manage embodied carbon in materials, buildings or infrastructure.[130] These are based on different methodologies, vary in complexity, and have numerous overlaps. Some tools, developed by industry, are proprietary and not publicly accessible. The use of different data sources and methods to estimate carbon emissions makes it hard to compare emissions reductions between projects.[131]

Government agencies currently use multiple approaches to estimate and report carbon emissions, in the absence of consistent carbon management guidance.[132] In Victoria, individual infrastructure projects have elected to use sustainability rating tools to help improve projects' sustainability performance, including reducing carbon emissions. For example, as part of its project-based sustainability approach, the agency for the Level Cross Removal Project applied the Infrastructure Sustainability (IS) Rating Tool developed by the Infrastructure Sustainability Council and included

minimum carbon reduction rates between 5% to 15% as key performance indicators and tender evaluation criteria.[133] Table D-3 in Appendix D shows a range of sustainability rating schemes and tools used by some of the Victorian major projects.

Infrastructure New South Wales has been leading work across Australia to develop a consistent measurement approach for all infrastructure types. This is expected be available by the end of 2023.[134] Victoria can align its approach with the outcomes from this assessment to remove unnecessary inconsistency and inefficiency across jurisdictions.

Infrastructure Sustainability (IS) Rating Scheme

The Infrastructure Sustainability Council developed the IS Rating Scheme to inform sustainability considerations in the design, construction and operation of new infrastructure.[135] In current practice, the IS rating tool has been predominantly used to assess a project's sustainability performance.[136]

In June 2023, the Infrastructure Sustainability Council released an updated version of their tool which supports project proponents in considering sustainability options and benefits in the strategic planning phase.[137]

Green star

Green Star is widely adopted by the private sector across all building classes and is also adopted by public sector agencies for government owned buildings and developments. Predominantly adopted in concept design, opportunities exist in the business case and planning phases for fundamental decision-making, such as eliminating fossil fuels and embodied carbon reductions through fundamental design and funding decisions.[138]

National Australian Built Environment Rating System (NABERS)

NABERS is a sustainability rating scheme for the built environment. It provides a rating from 1 to 6 for building efficiency in energy, water, waste and indoor environments. In December 2022, NABERS released a consultation paper for incorporating embodied emission in its rating.[139] This development is funded by the New South Wales Government and it is expected that the trial and release of this new rating tool will be over 2023 and early 2024.[140]

Carbon estimating and reporting tool (CERT)[141]

Transport for New South Wales has developed the CERT to consistently measure and report greenhouse gas emissions in compliance with its sustainable design guidelines. The excel-based tool includes in-built emissions factors for construction materials and processes that help streamline data entry and reporting.

The CERT is intended for use in all new transport projects in New South Wales with a value of at least $15 million to capture relevant scope 1, 2 and 3 emissions as identified through an emissions materiality assessment.[142]

Stakeholders want government to commit to decarbonisation

Industry stakeholders want governments to provide clear and consistent decarbonisation guidance for business case development, and to better consider it during procurement.

> "Many within industry and government have been calling for consistent cost benefit analysis and business case processes to better consider carbon and mitigation efforts."
>
> Green Building Council of Australia, submission to Infrastructure Victoria

Current procurement guidelines do not have clear carbon reduction targets.

Industry stakeholders that we spoke to want procurement processes to be open to considering offers to support carbon abatement, particularly by adding incentives into contracts that allow for and encourage further emissions reductions.

> "…setting minimum performance requirements related to outcomes and solutions will influence private industry to adopt low carbon products and services. Clients could identify opportunities to pay suppliers via advance payments with requirements in place that ensures part of the payment goes into investing in the production or adoption of new low carbon materials and services."
>
> Laing O'Rourke, submission to Infrastructure Victoria

Some major infrastructure project procurements have considered decarbonisation outcomes, although this varies between government departments and agencies. Stakeholders reported that when tender proponents identified carbon reduction opportunities, they found that decisions ultimately prioritised minimising financial costs and limiting changes to project scope. They felt that procurement processes did not seriously consider carbon reduction opportunities.

Industry desires greater policy certainty. But it is already acting to make carbon management more consistent in Australia. For example, the Materials and Embodied Carbon Leaders' Alliance is using innovative materials and systems to reduce embodied carbon.[143] Similarly, the infrastructure sector has widely adopted sustainability rating tools that include carbon management tools and frameworks (see Appendix D, Table D-3).

Infrastructure investment evaluation needs clear carbon values

Consistently using a suitable carbon value in investment decision-making is one of the most economically efficient mechanisms to achieve rapid decarbonisation for the lowest cost, especially in the construction and maintenance sector.

The Victorian Government's *Investment lifecycle and high value high risk guidelines* apply to all capital investments over $10 million.[144] The guidelines require major infrastructure project business cases to conduct a cost benefit analysis that estimates the project's economic, social, and environmental costs and benefits in monetary values. They do not specify carbon values for the analysis. They also do not advise on how to estimate, measure and report on emissions in infrastructure projects during the business case phase, or to account for carbon impacts during the infrastructure lifecycle.[145]

Victorian Government guidance on carbon values is out of date. The government's *Economic evaluation for business cases technical guidelines* refer to the repealed Australian Government's national carbon pricing scheme to estimate the monetary value of carbon emissions. The Department of Treasury and Finance has not updated the guidelines since 2013.[146]

Our research found that Victorian infrastructure business cases do include carbon emissions in their cost benefit analyses, but they use different monetary values in different projects. For example, the Suburban Rail Loop used a value of $46 per tonne carbon dioxide equivalent, but the

North East Link used a value of $52.40.[147] Other governments use much higher values, as shown in Table 1.

Victorian projects use fixed carbon values for the life of the project. International leading practices in cost benefit analysis use carbon values that escalate over time. This accounts for rising carbon abatement costs over time, after initial 'low cost' opportunities have been exhausted. For example, the Canadian Government started with a carbon price of CAD$20 per tonne in 2019 and increased it by $10 per tonne a year to CAD$50 in 2022. The Canadian carbon value will further increase by CAD$15 per tonne a year between 2023 and 2030.[148]

A mandatory requirement to use updated, escalating values for carbon in business cases would be a major change to Victoria's current practice. But leaving them out means infrastructure project decisions do not effectively and consistently evaluate options to reduce Victoria's carbon emissions. This makes the emissions reduction task more difficult.

Table 1: Examples of carbon values used in transport projects[149]

Jurisdiction	Body	Cost (AUS$/t CO_2-e) – indexed to FY2021-22	Indexation	Greenhouse gas policy commitments
European Union	European Commission	$150 (short term) $403 (long term)	N/A	55% reduction by 2030 on 1990 levels and net zero by 2050
United Kingdom	UK Government	$447 (2022) $681 (2050)	1.5% per annum	68% reduction by 2030 on 1990 levels and net zero by 2050
New Zealand	New Zealand Transport Agency	$88 (2022) $164 (2050)	2.25% per annum	50% reduction by 2030 on 2005 levels and net zero by 2050
United States of America	US Federal Government	$70	N/A	50 to 52% reduction by 2030 on 2005 levels and net zero by 2050
	New York State Government	$175	N/A	
Australia	Australian Government Department of Infrastructure (commonly known as ATAP[1] guidelines)	$65	0%	26 to 28% reduction by 2030 on 2005 levels and net zero 2050 (New South Wales is committed to 50% reduction by 2030)

The New South Wales Government updated its guide to carbon value in cost benefit analysis in February 2023 and requires the carbon values in Table 2 be used for cost benefit analyses between 2023 and 2032.[150] This approach uses the average European Union Emissions Trading Scheme market spot price, converted to Australian dollars using the average EUR/AUD exchange

[1] Australian Transport Assessment and Planning Guidelines

rate over the 2022 calendar year. The value for the 2022 calendar year is then increased by 2.25 per cent per annum for each year after FY2023.

Table 2: AUD carbon values (per tonne) for use in cost-benefit analysis by the New South Wales Government[151]

FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032
$123	$126	$128	$131	$134	$137	$140	$144	$147	$150

Transport for New South Wales and New South Wales Treasury are currently collaborating on research to identify carbon values using a target consistent approach, which they expect to complete by September 2023.[152] We expect the New South Wales Government will revise their carbon values after the research is finished.

Inconsistent guidance on carbon valuation in cost benefit analyses can misrepresent project benefits and disbenefits to decision-makers.

How carbon values impact on benefit cost analyses

Applying different carbon values changes benefit cost ratios and may change the project from a non-viable investment to a viable investment. For example, imagine two projects.

The first is estimated to create $1 million of economic value and emit 5,000 tonnes of CO_2e.

The second is estimated to create $2 million of economic value and emit 20,000 tonnes of CO_2e.

Using existing appraisal methods, the second project would be selected as the economic value is greater. But with a carbon value of $100 per tonne of CO_2e, the first project will create $500,000 of value ($1,000,000 economic value – 5,000 tCO_2e x $100 carbon value) and the second will create $0 of value.

The value used to evaluate carbon emissions ideally reflects their cost to society or society's willingness to pay to avoid the impact of emissions. Clear policy direction on carbon values that reflect the true economic cost of abating emissions can help Victoria prioritise decarbonisation in investment decision-making.

Our advice to the Victorian Government

Our advice to the Victorian Government

Reducing carbon emissions requires a fundamental shift in infrastructure decisions

Reducing emissions and achieving net zero requires the Victorian Government to fundamentally rethink how it decides to invest, build and manage infrastructure.

The scale of the climate challenge, including the cost of inaction and the risks of more extreme weather, calls for a swift and substantial shift in how infrastructure is planned and designed. This shift also presents opportunities to create new high value jobs in recycled or low carbon materials and increase productivity.

To reduce infrastructure costs and maintain competitiveness as other economies reflect carbon prices in the supply chain, decarbonising Victoria's infrastructure must start now.

Leading governments, including the United Kingdom and New South Wales, show that rapid policy development is achievable. Victoria can align its approach to these jurisdictions, to quickly build on their practices and accelerate the decarbonisation of its infrastructure.

Ministers and leaders of relevant portfolios need to show strong leadership and demand clear accountability to embed decarbonisation into infrastructure decisions. Clear Victorian Government direction about the level and pace of decarbonisation for infrastructure will also encourage private industry to make new choices and different investment decisions.

The Victorian Government has already set clear emissions reduction targets. But stakeholders report that the government has not yet clearly translated these targets into different decisions about infrastructure projects. To do so, the government must build capability and capacity, quantify and measure carbon emissions, and encourage emissions reduction in procurement.

The government will need to make hard choices at each decision point of the infrastructure lifecycle to prioritise decarbonisation outcomes among many competing considerations. It cannot avoid these decisions if it is committed to acting on climate change and realising the benefits this can bring, including meeting its own emission targets.

Three overarching principles should guide decarbonisation efforts in Victoria

This advice makes 10 recommendations with clear actions. These recommendations will be best supported if guided by an overarching commitment to 3 overarching principles.

Drawing on the experience of leading jurisdictions and the current state in Victoria, the 3 principles we propose are:

- **Prioritise non-build or low build solutions. Aim to get better use from existing infrastructure or modify it to meet changing needs before considering a new build. Use construction techniques like offsite or modular construction wherever possible in new builds.**

  Non-build or low build solutions which minimise new construction can avoid emissions associated with constructing and operating new infrastructure, and usually have lower lifecycle carbon emissions. For example, the Department of Transport and Planning's Smarter Roads project is improving the operation of the traffic light network to optimise road performance rather than building new roads.[153] When undertaking new construction, options to build more efficiently

by using offsite or modular construction can reduce both cost and carbon while improving productivity.

Victorian guidelines already require departments and agencies to consider non-build options when developing business cases. However, project teams in government agencies told us that the business case stage is often too late for thorough consideration of alternatives. The existing culture prioritises new build solutions and does not incentivise these teams to thoroughly prepare options that meet service needs while avoiding a new build project.

Ministers and senior executives of Victorian Government departments and agencies should explore and fully consider viable, non-build or low build alternatives well before business case development. Clear direction from ministers about more intensely searching for non-build or low build solutions, supported by a demonstrated willingness to select and fund these options, would give departments and agencies confidence to bring these options forward.

- **Align approaches with other governments and industry best practices.**

  Victoria can reap many benefits by aligning its approach with other Australian governments and industry best practices. Victoria can more rapidly adopt proven approaches and move quickly towards meeting decarbonisation targets. Using existing tools, research and administrative resources reduces the need for more investment in developing new solutions.

  Harmonising these approaches between jurisdictions also reduces the administrative burden on industry, allowing businesses to focus on implementing effective decarbonisation strategies. By promoting consistency between jurisdictions, Victoria is also helping to build capability and expertise within industry.

  There may be some situations in which a Victorian-specific approach is useful, however, these should be considered carefully and weighed against the benefits of broader alignment.

- **Clarify the scale and pace of infrastructure emissions reduction to give confidence to industry.**

  Immediate and sustained action is needed to reduce greenhouse gas emissions produced by Victorian Government infrastructure. While the government has set ambitious emissions reduction targets for the economy, industry and government representatives that we consulted were not clear on the government's commitment to, or timeline for, decarbonising infrastructure.

  Without this clarity, it is difficult for either to propose or take up options to reduce carbon in the significant pipeline of infrastructure projects underway. Industry is willing to act but requires policy certainty. Immediate engagement with industry on decarbonisation timelines will provide certainty and facilitate a smoother transition, minimising potential disruptions to projects. By involving suppliers in the early stages of policy development, the government can gather valuable insights and proactively address concerns.

Our 10 recommendations can deliver actionable change

Infrastructure Victoria makes the following 10 recommendations to reduce greenhouse gas emissions in Victorian Government infrastructure:

1. Adopt a carbon management standard like *PAS 2080:2023 Carbon management in buildings and infrastructure* to measure and manage carbon emissions and modify as needed to embed in Victoria.

2. Implement the same carbon measurement approach as New South Wales and deliver training across the Victorian Government.

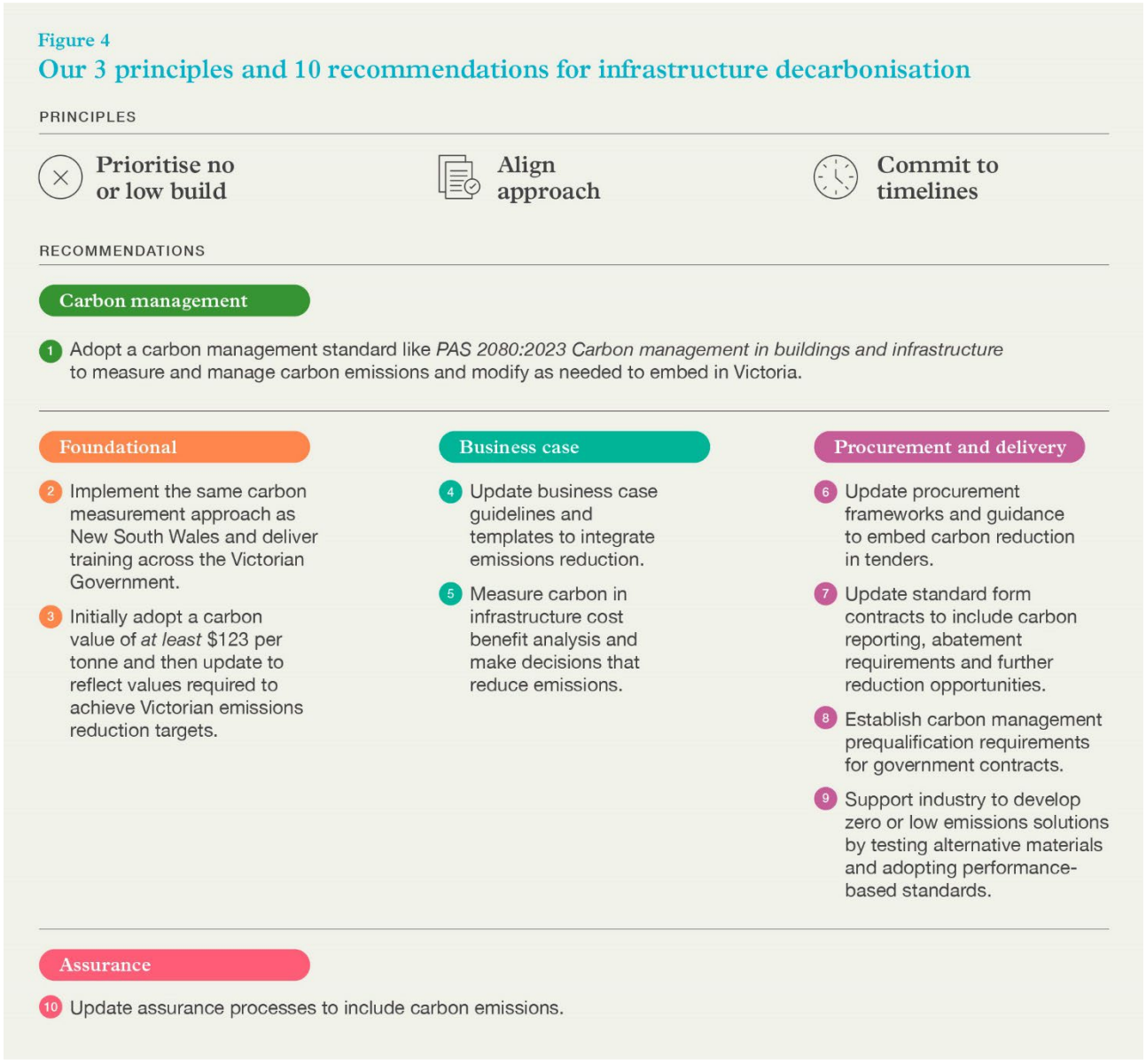
3. Initially adopt a carbon value of *at least* $123 per tonne and then update to reflect values required to achieve Victorian emissions reduction targets.

4. Update business case guidelines and templates to integrate emissions reduction.
5. Measure carbon in infrastructure cost benefit analysis and make decisions that reduce emissions.
6. Update procurement frameworks and guidance to embed carbon reduction in tenders.
7. Update standard form contracts to include carbon reporting, abatement requirements and further reduction opportunities.
8. Establish carbon management prequalification requirements for government contracts.
9. Support industry to develop zero or low emissions solutions by testing alternative materials and adopting performance-based standards.
10. Update assurance processes to include carbon emissions.

Figure 4 summarises the 3 overarching principles and 10 recommendations.

Figure 4

Our 3 principles and 10 recommendations for infrastructure decarbonisation



Staging of delivery

Each of our 10 recommendations has clear actions.

These include *critical actions*, which are crucial for Victoria to achieve its decarbonisation objectives, and *supplementary actions* which can enhance outcomes and enable faster emissions reduction.

These actions build on each other.

The government can start by making the most important decisions about its approach to decarbonisation and issue foundational guidance in a first stage of policy and strategy development. These include:

1.1 Identify the preferred carbon management standard for Victoria.

1.2 Adopt PAS 2080 as interim guidance on carbon management for voluntary use by Victorian Government departments and agencies. (optional)

2.1 Agree to adopt carbon measurement approach and standard emissions factors.

2.2 Evaluate skills gap and training requirements for government and industry.

2.3 Establish a Victorian Government community of practice on infrastructure decarbonisation to facilitate knowledge-sharing and collaboration. (optional)

3.1 Initially adopt interim carbon value of $123 per tonne.

3.2 Calculate the carbon values required to achieve Victoria's specific emissions reduction targets by using a target consistent approach.

4.1 Require business cases to include a descriptive estimate of carbon emissions, assess the impact using the interim carbon value and outline emission reduction options in line with the carbon reduction hierarchy.

6.1 Determine how to change the current public infrastructure procurement framework to effectively consider carbon emissions.

Actions in implementation phase 1 include developing detailed guidance and starting to apply recommendations for pilot projects.

In implementation phase 2, the government can expand and refine decarbonisation practices, and then scale and continuously improve these practices through ongoing application and extension.

Appendix F shows the implementation and interdependencies of actions for all 10 recommendations in 4 implementation stages.

Our recommendations and actions

Recommendation 1: Adopt a carbon management standard like *PAS 2080:2023 Carbon management in buildings and infrastructure* to measure and manage carbon emissions and modify as needed to embed in Victoria.

Identify a carbon management standard to use across the infrastructure lifecycle.

The Victorian Government has minimal guidance for infrastructure projects on carbon reduction. The guidance does not address the entire lifecycle of infrastructure assets. And it addresses carbon emissions as one sustainability opportunity among many, such as reducing water use and waste.

The main business case policies, guidance and frameworks relevant to infrastructure are summarised in Appendix C. An overview of standards, rating schemes, tools, and carbon values commonly used in procurement and delivery can be found in Appendix D.

Victorian Government departments and agencies cannot systematically and consistently consider reducing carbon emissions of infrastructure without an endorsed standard approach.

Our research found industry and government stakeholders strongly support a carbon management system in Victoria, such as PAS 2080.[154] The United Kingdom's *PAS 2080 carbon management in buildings and infrastructure* standard is a globally recognised approach. PAS 2080 includes guidance to identify, measure, and report carbon reduction actions throughout an asset's lifecycle.[155] It outlines responsibilities at each step in the supply chain and establishes governance mechanisms to reduce carbon emissions using a common management process.[156]

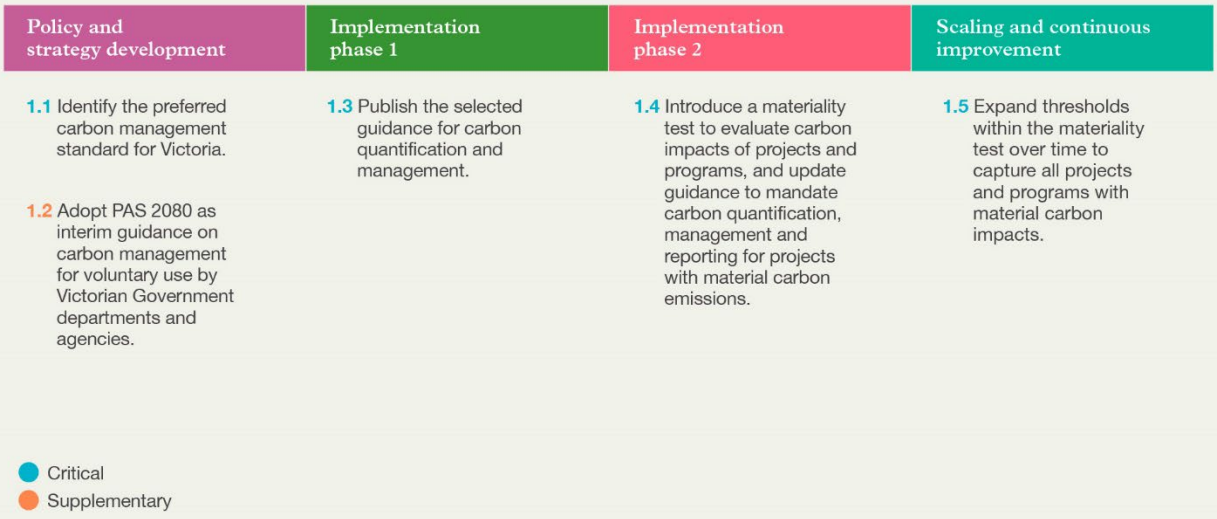
Adopting a carbon management standard such as PAS 2080 will clarify Victoria's direction, including carbon governance and responsibilities, to drive consistent practice in government infrastructure projects. It will also allow tracking of emissions reductions by consistently quantifying and reporting them throughout the infrastructure lifecycle.

Infrastructure development and delivery over its lifecycle involves many participants. If roles and responsibilities are duplicated or not clearly allocated, delivery costs may be higher and decarbonisation efforts may be less effective. The Department of Energy, Environment and Climate Action and Department of Treasury and Finance can lead in setting consistent requirements, guidance and policy for other departments and agencies to follow.

We recommend the Victorian Government adopt a carbon management standard like PAS 2080 to measure and manage carbon emissions and modify as needed to embed it in Victoria. Figure 7 shows the actions required to do this.

Figure 5

Action plan for recommendation 1



The Victorian Government should identify the preferred carbon management standard for Victoria (action 1.1). Our research identified PAS 2080 as a suitable standard to use as a model for Victoria. The United Kingdom's Department of Transport has mandated that PAS 2080 be adopted for all National Highways projects by the end of 2023.[157] The New South Wales Government, Australian Government, and industry bodies (such as the Materials and Embodied Carbon Leaders' Alliance) are currently reviewing carbon quantification and management standards, with PAS 2080 as a leading candidate for adoption.

Initially, the government can adopt PAS 2080 as interim guidance on carbon management for voluntary use by Victorian Government departments and agencies (supplementary action 1.2).

Once the government determines the preferred standard for Victoria, it should openly publish the selected guidance for carbon quantification and management (action 1.3). Updates to existing guidance should reference the new standard. The standard should specify the methods for measuring, managing, and reporting carbon emissions at each stage of the project. It should clearly articulate how any new and existing guidance will reduce carbon emissions.

Requirements for all new public infrastructure projects to measure and report carbon emissions will need additional effort as projects and suppliers develop familiarity with the approach. The Victorian Government should first consider applying the new standard only to projects with large carbon impacts by using an emissions materiality assessment (action 1.4). This materiality test should identify projects that are sufficiently large and have substantial carbon reduction opportunities. The materiality test could apply to a level of carbon emissions or to a financial threshold, of a project or a program of smaller projects as a group. For example, road repairs or upgrades might not meet a materiality threshold individually but could be material as a group. Another approach that could be used is a tiered framework, with projects having to meet a cost and emissions threshold to be considered material. The tiered framework could also set out timeframes within which the emissions thresholds would reduce over time as departments, agencies and industry become more familiar with carbon emissions reduction requirements.

United Kingdom Department for Transport has adopted materiality tests for carbon impacts

The United Kingdom government applies specific thresholds to transport projects in assessing carbon impacts for their business case stages. They monitor these estimates against actual figures during construction and operation. The thresholds include:

- estimated lifecycle carbon impacts of greater than 1 million tonnes of carbon dioxide equivalent
- values exceeding certain thresholds in specific project categories, for example, highway or rail projects of greater than GBP£500 million (approximately AUD$940 million) and maintenance projects of greater than GBP£100 million (approximately AUD$188 million).[158]

The Victorian Government can gradually broaden the scope of the materiality test to apply the standard to more projects, including new build and asset maintenance projects **(action 1.5).**

Recommendation 2: Implement the same carbon measurement approach as New South Wales and deliver training across the Victorian Government.

Assess the suitability of carbon quantification tools and adopt an approach to effectively measure carbon emissions at all stages of infrastructure planning and delivery.

Our research found that where departments and agencies have started to estimate carbon emissions, they use different methods and data sources to do so (see Appendix D, table D-1 and D-2). There is no single source for reliable emissions data in Victoria, so they use data that is inconsistent and sometimes inaccurate, or not sufficiently detailed.[159]

Easy-to-use, non-proprietary tools and standard values for embodied emissions in materials can help government and industry to consistently quantify and report emissions. This promotes better decision-making and enables effective progress tracking.

Our research identifies that leading decarbonisation tools include:[160]

- a comprehensive open-source database of emissions estimates for materials (also known as emissions factors)
- lifecycle assessment software
- carbon footprint calculators
- emissions monitoring and reporting tools.

Tools should rely on standard emissions factors that infrastructure managers can use consistently in different projects. Although the Australian Department of Climate Change, Environment, Energy and Water publish the National Greenhouse Account Factors each year, these do not include emissions factors for construction materials and products or for transport of these materials.[161]

Many different carbon measurement tools are available for use in Victoria, such as Transport for New South Wales' Carbon Emissions Reduction Tool (CERT), the Infrastructure Sustainability Council's IS Rating Scheme[162] and the National Australian Built Environment Rating System (NABERS).[163] Our research has not clearly identified a single tool that is best to adopt in Victoria. Each tool has its own advantages and drawbacks, and many are evolving rapidly to address limitations raised.

But there are many advantages to governments and industry in adopting a consistent approach in using carbon measurement tool across jurisdictions. A consistent approach would allow government decision-makers, project teams, and industry to use any tool and have confidence that the emissions estimates produced will be robust and comparable. A standardised approach to measuring carbon emissions should include:

- consistent inputs, including scopes of emissions considered and emission factors used
- clearly defined data quality expectations throughout the project's lifespan
- defined outputs and reporting mechanisms to promote improved practices and facilitate future benchmarking.

As the level of detail increases during a project's design, the project team can be more accurate about the expected emissions from the project. For example, at the business case stage, the project team are unlikely to know which specific products they will use. However, the early strategic planning and optioneering stage is the best time to make decisions that avoid carbon emissions. Project teams should use the most appropriate emissions calculation approach for the level of design detail available at each stage.

Emission factors can be obtained from a range of specific to general sources, including:[164, 165]

- product-specific emission factors, which apply to specific products used in construction assets (for example, a product-specific environmental product declaration)
- industry-average emission factors, which are relevant for a group of producers working with the same material type or manufacturing region (for example, an industry-average environmental product declaration)
- generic values from life cycle assessment tools (for example, Transport for New South Wales' Carbon Emissions Reduction Tool) or databases (for example, Australian National Life Cycle Inventory Database)[166]
- generic emission factors from global literature sources.

See Appendix D table D-2 for more examples of emissions factor sources.

Infrastructure New South Wales is identifying key areas of alignment and creating measurement guidance as a foundation for a national approach. As there is not a single leading tool, the Victorian Government should adopt the same approach as New South Wales based on the outcome of this assessment. This guidance is expected to be available by the end of 2023.

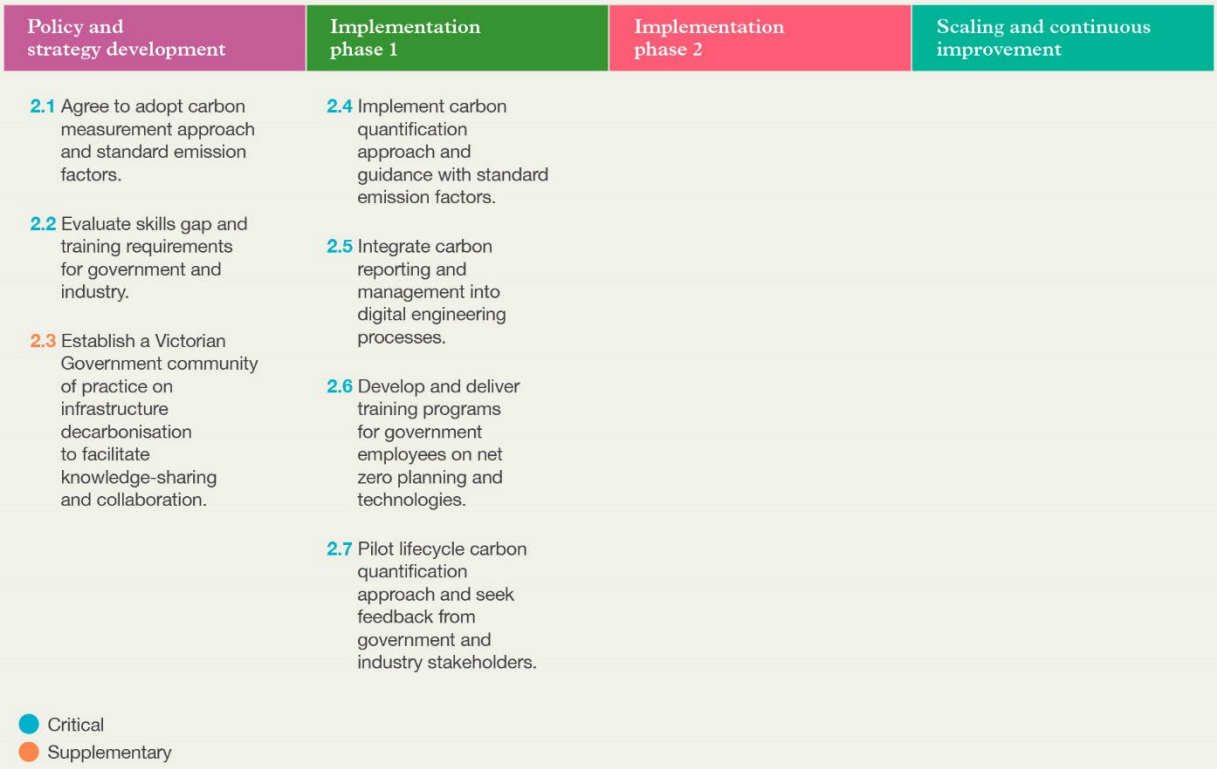
Government and industry staff working on infrastructure projects may not be able to adopt new practices if they do not have training about the new practices, or enough resources to support the staff in using them. Many stakeholders told us that their current awareness of carbon measurement tools is limited.[167]

> "Policy implementation and delivery of projects will be impacted by industry capacity to meet demand. Identifying the skills and knowledge gaps and creating pathways for professional development, training and resources will be critical for ensuring agencies can address gaps in capability, as well as other barriers to decarbonising infrastructure delivery."
>
> Green Building Council Australia, submission to infrastructure Victoria

Government should invest in building the capability of public sector staff and industry partners to use selected tools successfully.

Figure 6 shows the actions required to deliver this recommendation.

Figure 6
Action plan for recommendation 2



The Victorian Government should first agree to adopt the same measurement approach and standard emissions factors as New South Wales (action 2.1). Victorian departments and agencies should use the tool that best meets their needs at the time of assessment, as long as it meets the requirements of the agreed carbon measurement approach.

The Victorian Government should reflect the agreed approach and implement guidance on use of the approach and emission factors (from action 2.1) in the existing processes and systems, including sections of the *Sustainable investment guidelines*, *Investment lifecycle and high value high risk guidelines* and *Victoria's social procurement framework* (action 2.4).

After this, integrating carbon reporting and management into digital engineering tools can rapidly advance their use (action 2.5). The Victorian *Digital asset policy* applies to all projects over $20 million.[168] It defines the required asset and project information needed to support decision-makers during an asset's life. This could be updated to include requirements for carbon emissions data.

Using digital platforms to manage and report carbon emissions will achieve better consistency and lower the costs of carbon emissions reporting. This involves using emissions data and measurement methods in digital platforms. Stakeholders report that visualising carbon 'hot-spots' during the initial design stage allows designers to target the most promising areas for emissions reduction.[169]

Once the carbon measurement approach is adopted by government, each department and agency can assess the current knowledge and skills of their staff to document decarbonisation training priorities (action 2.2). This assessment should focus on improving skills in deploying carbon quantification tools and ensuring staff understand how to use these tools to help contribute broader carbon reduction efforts.

Stakeholders raised the idea of establishing a community of practice to facilitate knowledge sharing, innovation, and coordination, ultimately promoting best practices, lessons learned, and emerging strategies (supplementary action 2.3).[170] The Victorian Government can build on existing successful examples. For example, EcologiQ promotes awareness of how infrastructure projects can use recycled materials by publishing case studies on its website and hosting annual conferences.[171] The Materials and Embodied Carbon Leaders Alliance is another example of a joint government and industry initiative that helps to share case studies and leading practices through their website and forums. The Victorian Government could consider expanding the role of either of these platforms with associated resourcing.

Stakeholders also suggested improving internal capacity about net zero planning and technologies. Training on these topics can supplement staff knowledge and skills, so they can understand and implement decarbonisation strategies in Victorian public service projects (action 2.6).

Pilot projects can test industry acceptance and understanding of the new requirements, methods and approaches, providing valuable lessons and opportunities for refining them. Using pilot projects to test new requirements, such as carbon measurement approaches, can ensure that they are effective and well understood by industry and government before adopting them widely (action 2.7).

Recommendation 3: Initially adopt a carbon value of *at least* $123 per tonne and then update to reflect values required to achieve Victorian emissions reduction targets.

Incorporate carbon valuation into investment decision-making to reflect the impact of carbon emissions on the community.

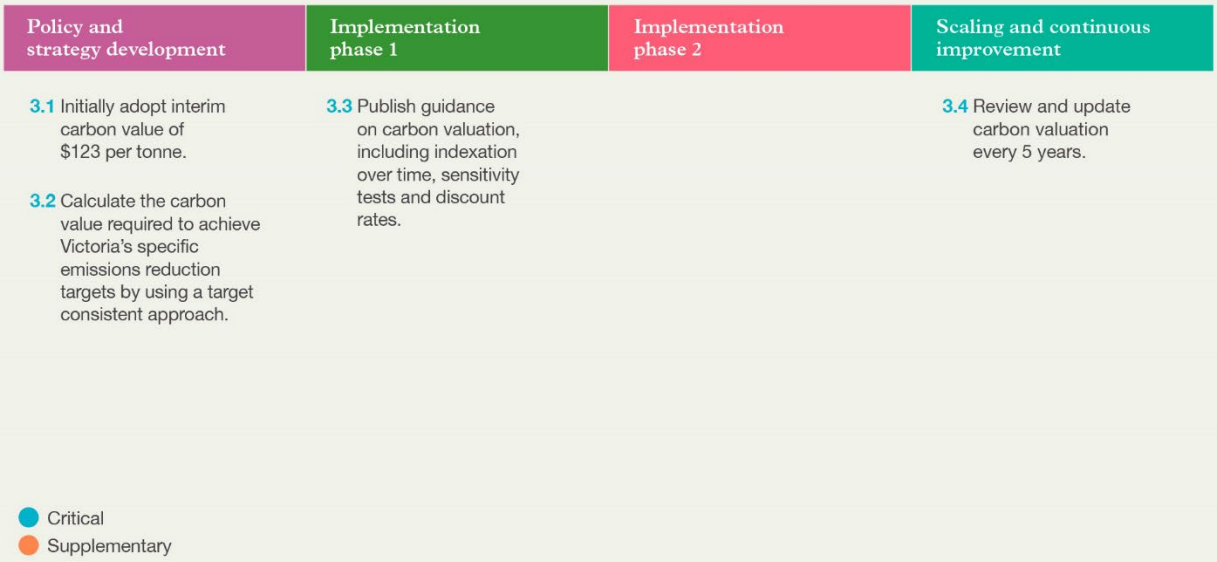
Valuing emissions will ensure that infrastructure project decisions account for climate change impacts alongside other costs and benefits. Infrastructure decision-makers and owners have little incentive to reduce carbon emissions that are not costed.

Leading jurisdictions in climate action place a monetary value on carbon emissions so they are measured to inform policy and investment decisions.[172] Victorian Government infrastructure investments either do not measure carbon emissions or use differing values for carbon that are much lower than those of leading jurisdictions.[173]

The Victorian Government should release clear, consistent, and regularly updated guidance on how it will value carbon emissions to measure the impact of its infrastructure investments.

Figure 7 shows the actions required to do this.

Figure 7
Action plan for recommendation 3



As a first step, the government should initially adopt an interim carbon value of $123 per tonne (action 3.1).

Victoria should use a minimum value of $123 per tonne in 2023, which is the European Union Emissions Trading Scheme market spot price converted to Australian dollars. This is the approach that the New South Wales Government has adopted while completing their evaluation of target consistent values[174] (see Table 2).

We recommend the Victorian Government update this carbon value by using a target consistent approach to calculate the carbon values required to achieve Victoria's specific emissions reduction targets (action 3.2). This should be done as soon as practicable.

A target consistent approach uses a policy target, such as net zero by 2045, and determines the scale and cost of emissions abatement required to achieve the target. A carbon value approach consistent with emissions reduction targets is already use in other jurisdictions,[175] such as the United Kingdom and European Union.[176]

A target consistent approach in Victoria would align with other Australian jurisdictions' emerging practices. Infrastructure Australia recommends using a target consistent approach and is engaging with stakeholders on a national carbon value.[177] Transport for New South Wales and New South Wales Treasury are currently collaborating on research to identify carbon values using a target consistent approach, due in September 2023.[178]

Approaches to valuing carbon[179]

There are 3 main approaches to carbon valuation:

- **Damage costs** (social cost): Damage costs are an evaluation of the total costs of climate change under the assumption that no efforts are taken to reduce the pace of climate change. They are estimated as the net present value of climate change impacts of one more tonne of carbon emitted today.

  This approach, in theory, provides a first-best estimate of the economic, social, and environmental impacts of climate change, if underlying data is reliable and accurate. This approach is extremely challenging in practice, such as modelling physical impacts,

securing accurate data in many cost categories, and determining a reliable assessment of a baseline scenario.

- **Target consistent approach** (avoidance cost): The target consistent approach uses a relevant policy target, such as 'net zero by 2050', and determines the scale and cost of emissions abatement required to achieve that target over a given timeframe.

  This approach does not measure and value all impacts of climate change. The outcomes are highly dependent on the adopted policy target, the price of the least-cost options (marginal abatement costs curve), and the chosen baseline scenario.

- **Market prices**: A market price approach bases the carbon values on the observed and expected traded price of carbon in each carbon market. Carbon valuations based on market prices have the advantage that they can represent 'actual' prices of carbon or abatement at a given time. The two most relevant carbon markets are the Australian Emission Reduction Fund and the European Union Emissions Trading System.

  Carbon markets can result in low carbon prices due to market imperfections, including market structure, political influences, and supply and demand factors, leading to disadvantages such as volatility and supply fluctuations.

After identifying carbon values for the Victorian context, the Victorian Government should publish clear guidance on the use of consistent carbon valuation in infrastructure projects including timeframes, sensitivity tests and discount rates (action 3.3). Regularly updating carbon valuations will ensure that they remain relevant, accurate, and aligned with Victoria's emission reduction targets (action 3.4).

Discount rates affect the value of future costs and benefits

What are they?

Analysts use discount rates to compare the value of future costs and benefits relative to current costs and benefits.[180] They use this rate to 'discount' or reduce the value of future costs and benefits. This is based on the observation that people prefer to consume goods and services today rather than in the future.

Why are they important?

Higher discount rates drive decisions that favour benefits to current generations over future generations.

How are discount rates related to climate change?

Carbon abatement benefits accrue far into the future. As climate change intensifies over time, we expect future generations to benefit more from projects that avoid and reduce emissions. This means that lower discount rates can be used to assess projects with carbon reduction potential.

The Organisation for Economic Co-operation and Development (OECD) notes in their 2018 *Cost benefit analysis and the environment report* that in the context of intergenerational issues like climate change, there is strengthening theoretical and empirical support for the use of discount rates that decline with time.[181]

Some governments set tapering discount rates over time for projects with clear emission reductions outcomes. For example, the United Kingdom uses a discount rate of 3.5% for years 0 to 30, 3% for years 31 to 75 and 2.5% for years 76 to 125.[182]

What is the Victorian Government's current approach?

The Victorian Government recommends using a discount rate of 7% when the costs and benefits can be easily translated into monetary terms, such as for public transport, housing and roads. They recommend a rate of 4% when the costs and benefits are more difficult to convert to monetary values, such as in public health, justice and education.[183]

Setting meaningful carbon values and discount rates would support rapid decarbonisation

There are many good reasons for the Victorian Government to review discount rates.[184] The long-term effects of climate change are yet another reason to re-evaluate these arguments.

This advice does not explicitly recommend changing discount rates.

But in our view, further investigation by governments is warranted to understand the implications of discount rates for decarbonisation. In the meantime, business cases should better inform decision-making by undertaking sensitivity tests on the effects of lower discount rates for projects with substantial carbon reduction potential.

Recommendation 4: Update business case guidelines and templates to integrate emissions reduction.

Incorporate lifecycle carbon estimation, assessment and valuation into existing business case guidelines and templates. Define in the guidance how to set an emissions baseline, how to measure carbon, and how to identify carbon reduction strategies.

Infrastructure Victoria reviewed existing business case guidelines for Victorian infrastructure projects. For an overview of guidelines and frameworks see Appendix C, table C-1. Existing guidelines such as the *Investment lifecycle and high value high risk guidelines* and processes such as gateway reviews should verify that infrastructure projects consider greenhouse gas emission reductions in line with the *Climate Change Act 2017*. However, the guidance lists carbon emissions as one consideration in a list of broader sustainability requirements such as reducing water use, energy consumption, and waste.[185] While the Office of Projects Victoria's *Sustainable investment guidelines* provide good suggestions on how to consider sustainability (including scope 3 emissions) in project planning and delivery,[186] the guidelines do not set any emissions reduction requirements or mechanisms to prioritise emissions reduction.

In summary, current business case guidelines and processes:[187]

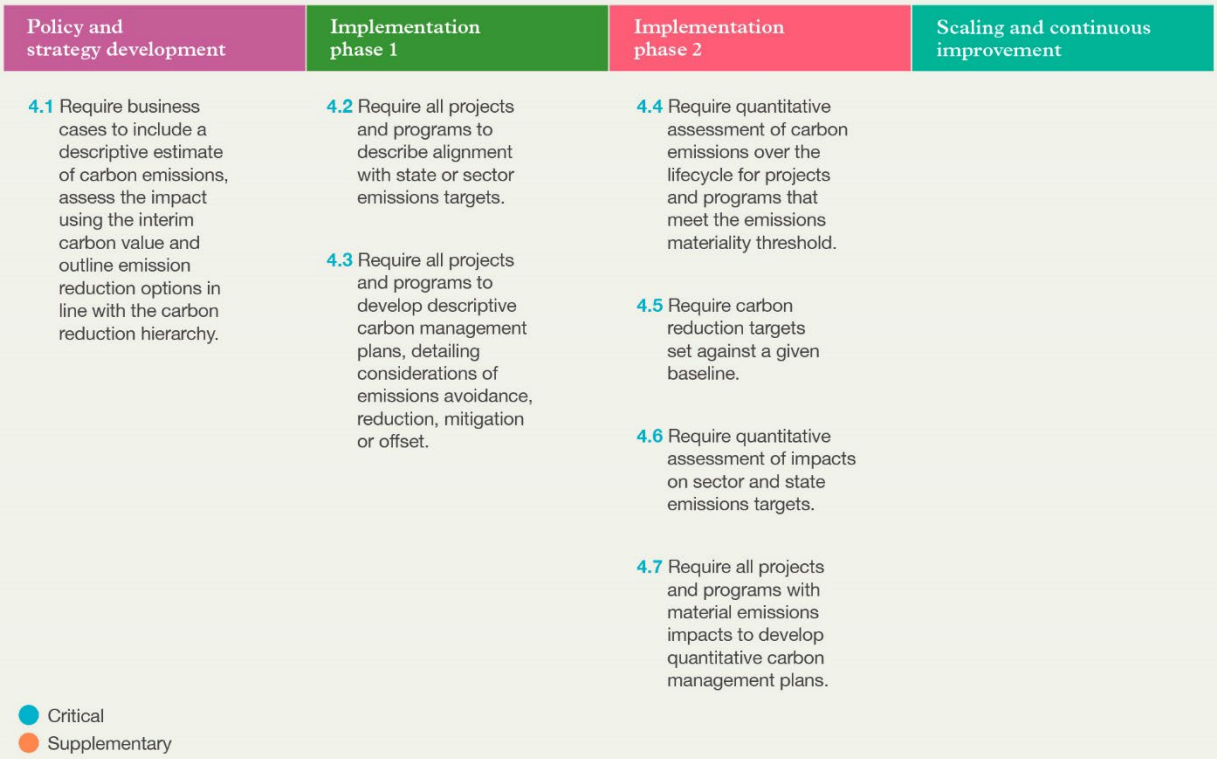
- have no specific advice on how to estimate, measure and report on carbon emissions in projects
- do not place a financial (monetary) value on carbon to account for emission reductions in decision-making.

This means business case proposals often overlook carbon reduction considerations, and instead favour meeting more tangible cost, quality and time requirements.

We recommend the Victorian Government update business case guidelines, such as *Investment lifecycle and high value high risk guidelines,* and templates to clarify requirements to quantify, value and reduce carbon emissions. Figure 8 shows the actions required to do this.

Figure 8

Action plan for recommendation 4



As an initial step, for the 2024–25 budget process, business cases should include a descriptive estimate of carbon emissions, assess the impact using the interim carbon value and outline emission reduction options in line with the carbon reduction hierarchy (action 4.1).

The description should include a high-level estimate of scope 1 and scope 2 emissions over the project's lifecycle, and scope 3 emissions where feasible, such as for concrete and steel, in line with Infrastructure Australia's interim guidance.[188] Project teams should use the most appropriate emissions calculation approach for the level of detail available (recommendation 2). Project teams should describe the approach used to complete the estimation.

The description should also apply the carbon value of $123 per tonne (action 3.1) to the emissions estimate to inform strategic decisions.

For emissions estimates that are calculated using the Australian Transport Assessment and Planning Guidelines (ATAP), projects should include a sensitivity test using $123 per tonne. This is consistent with the ATAP guideline which 'recommends that practitioners use a range of values for the $ per tonne of CO2-e via sensitivity testing'.[189]

The government can require business cases to describe projects' alignment with state emissions targets. This can include strategies, initiatives, and design choices that align a project with Victoria's emissions reduction targets (action 4.2).

The government can then require all projects and programs to develop descriptive carbon management plans and consider options to avoid, reduce or offset emissions (action 4.3). Including aspects of emissions management in business case development gives the government a view of the project's impacts and encourages the adoption of early strategies to limit carbon emissions.

In implementation phase 2, for projects and programs that meet the emissions materiality threshold (from action 1.4), the government can require quantitative assessment of carbon emissions over

the lifecycle (action 4.4). This action should happen after the government has developed carbon management guidance (action 1.3), adopted a carbon quantification approach (actions 2.4 and 2.6) and piloted the lifecycle quantification approach (action 2.7).

The government can provide guidance and specify these additional requirements in the *Investment lifecycle and high value high risk guidelines* section 2.6.6 'Environmental impacts'. This will allow for more accurate comparison of emissions impacts between projects that have material carbon impacts.

Projects and programs should also be required to set a minimum carbon reduction target against a baseline (action 4.5). Project proponents can then reduce these emissions, for example, through alternative design and the use of low-carbon materials and construction technologies (such as modular construction). Project teams in procurement and delivery stages should be required to monitor and regularly report on progress toward the target (action 6.3).

Building on this, the government can quantitatively assess the impacts of carbon emissions reduction in individual projects on Victoria's emissions reduction targets (action 4.6). Although the Victorian Government has legislated emission reduction targets, individual projects bear no direct responsibility to contribute to the state's emissions reduction targets. The Victorian Government develops sector pledges every 5 years which outline the actions they will take to cut emissions from each sector and from their own operations to achieve these targets.[190] Projects may not see how their actions to reduce carbon emissions can contribute to a broad sector pledge. Connecting their emissions reduction efforts more clearly can help to drive coordinated action.

As familiarity with carbon emissions reductions evolves, government should require all projects and programs with material emissions to develop quantitative carbon management plans, covering all scopes of emissions across the infrastructure's lifecycle (action 4.7).

Introducing carbon management plans

What are they?

A carbon management plan is a roadmap for managing a project's carbon impacts over its lifecycle. It documents:

- the carbon reduction goals over timelines and milestones
- its strategies for avoiding, reducing, mitigating and offsetting emissions
- the mechanisms for identifying, quantifying, monitoring and reporting emissions
- the roles and responsibilities of parties involved in implementing various carbon reduction measures.[191]

When should a carbon management plan be developed?

Developing a carbon management plan in the early stages of a project's development is a critical component in carbon management standards such as PAS2080. It can provide valuable insights into aspects of the project that has material carbon impacts. It can also allow early consideration of strategies to avoid, reduce, minimise and offset carbon emissions. It is critical that early project optioneering can consider carbon impact.

Carbon management plans may form part of environmental and sustainability management plans.[192]

Over time, the level of detail and comprehensiveness of a project's carbon management plan should be expected to improve as project proponents obtain more information on the project design.

An example of a comprehensive carbon management plan

The United Kingdom's National Highways agency developed an advanced carbon management plan for their A57 Link Roads project in line with the PAS2080.[193] The plan:

- considers the carbon reduction hierarchy and management processes at the preliminary design stage. For example, the plan uses value engineering to explore options to build minimum (the 'build less' principle); the plan then integrates 'build cleverly' and 'build efficiently' principles into the design as the detailed carbon management plan is developed.
- engages all parties involved in the value chain to consider low carbon ideas, including the principal designer and contractor, subcontractors, subconsultants, material suppliers, and National Highways management.
- integrates carbon into cost estimates, and monitors carbon as part of regular cost and performance reporting.

Recommendation 5: Measure carbon in infrastructure cost benefit analysis and make decisions that reduce emissions.

Integrate the measurement and value of carbon emissions into decision-making processes. This means the impacts of carbon are considered alongside other monetised components of a cost benefit analysis.

In Victoria, cost benefit analyses do not consistently or adequately consider carbon emissions.[194] This means infrastructure project business cases do not adequately consider the impacts of carbon emissions on society, the economy and the environment. Projects have little incentive to reduce emissions. Consequently, project teams tend to emphasise reducing financial costs instead of integrating emissions reductions in business cases.

We recommend the Victorian Government measure carbon emissions in infrastructure cost benefit analysis and make decisions that reduce emissions. Figure 9 shows the action required to do this.

Figure 9
Action plan for recommendation 5

This recommendation integrates the carbon management standard (recommendation 1), carbon measurement approach (recommendation 2), and carbon value in business cases (recommendations 3 and 4). Once these practices are established, the Victorian Government should require infrastructure projects and programs with material emission impacts (action 4.3) to value the lifecycle carbon emissions in their cost benefit analyses (action 5.1). This will help to align investment decisions with Victoria's climate change objectives and emissions reduction targets.

At this point of implementation, the projects and programs are required to apply the emissions materiality test established under recommendation 1 (action 1.4), and if they meet the materiality threshold, to measure lifecycle emissions (from action 4.3).

Evaluation guidelines should be incorporated into the *Investment lifecycle and high value high risk guidelines*' *Economic evaluation for business cases.* Projects can initially use interim values to account for carbon emissions in their cost benefit analysis (action 3.2) until the Victorian Government adopts a consistent carbon value for infrastructure projects (action 3.3).

This will help to align investment decisions with Victoria's environmental objectives.

Recommendation 6: Update procurement frameworks and guidance to embed carbon reduction in tenders.

Update Department of Treasury and Finance's *Investment lifecycle and high value high risk guidelines: Procurement* and associated procurement templates to clearly specify the requirements for decarbonisation. Require projects to integrate minimum decarbonisation requirements, communicate carbon reduction expectations and request alternative carbon reduction offers in tender documents.

The Victorian Government has the opportunity to use its purchasing power to set clear signals for industry and business on how it will reduce carbon emissions of the infrastructure it commissions. It can do so by providing clear and consistent guidance on how to reduce emissions through government procurement policy.[195]

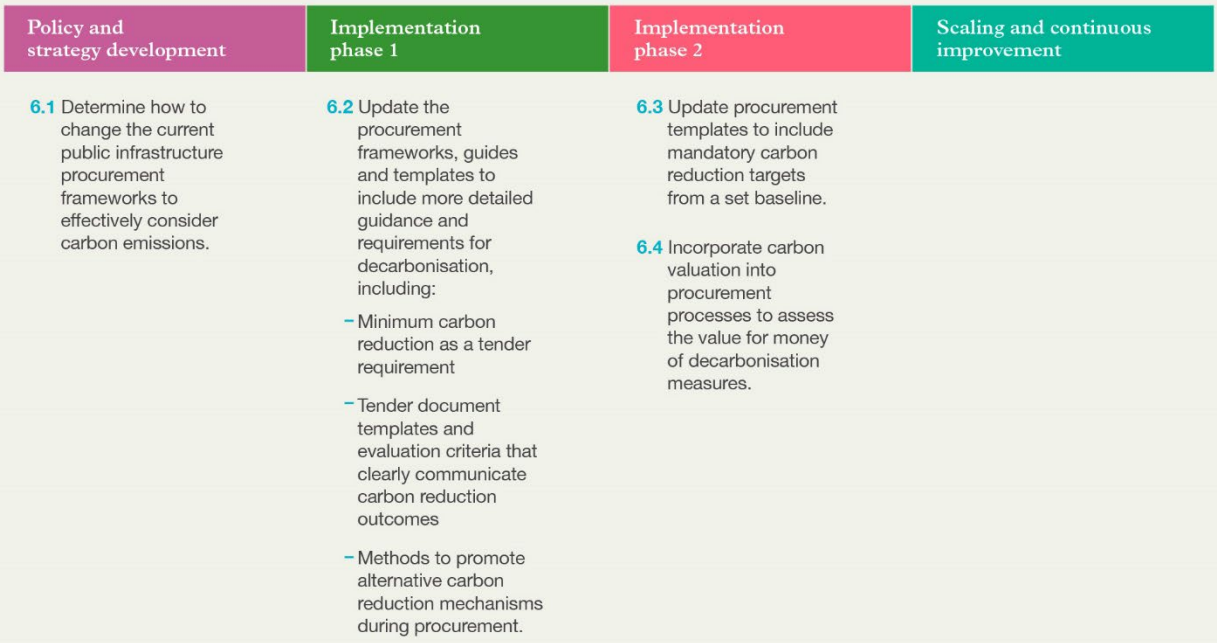
Guidance for major infrastructure projects in the Department of Treasury and Finance's *Investment lifecycle and high value high risk guidelines* has no detail about reducing emissions. Instead, emissions reduction is listed with other sustainability and social procurement guidance, diluting the focus on reducing carbon emissions. *Victoria's social procurement framework* mentions climate change policy objectives to minimise greenhouse gas emissions.[196] Evaluation criteria direction and instruction 3.7 advises how to evaluate a tender for government construction projects. It includes 'value for money' and 'occupational health and safety' as mandatory evaluation criteria but does not name climate change or carbon emissions reduction as mandatory.[197]

Stakeholders advise that multiple guidance documents on carbon emissions create increased administrative burden in the public and private sectors. Adopting a carbon management standard like PAS 2080 will clarify the role of individual guidance documents. But most government staff are uncertain about the most effective way to promote carbon reduction through procurement. Even when project teams understand and incorporate these approaches in procurement processes, tender evaluation teams are unsure about how to evaluate proposals that include measures for carbon reduction.[198]

We recommend the Victorian Government update procurement frameworks and guidance to embed carbon reduction in tenders. The government procurement policy should support the industry to make the decarbonisation transition as efficiently as possible. Figure 10 shows the actions required to do this.

Figure 10

Action plan for recommendation 6



The government should immediately review major procurement frameworks and decide how to integrate decarbonisation actions (action 6.1). We recommend updating Department of Treasury and Finance's *Investment lifecycle and high value high risk guidelines: Procurement* guidelines section 3.8. 'Climate Change Act 2017 and related climate change initiatives' and associated procurement templates to clearly specify the decarbonisation requirements.[199] An updated framework used by all government agencies will provide more precise and streamlined guidance compared to a new separate guideline.

We do not recommend updating the *Social Procurement Framework* to include this guidance. This framework is an important component of Victoria's approach to sustainability and fairness in procurement. But including carbon emissions in this framework dilutes other social opportunities while at the same time failing to effectively incorporate emissions reduction in decision-making.

Updating *Investment lifecycle and high value high risk guidelines* should consider (actions 6.2):

- specifying a minimum carbon emission reduction as a tender requirement in procurement
- communicating carbon reduction expectations in tender document templates provided for Victorian Government infrastructure projects
- including carbon emissions in tender evaluation criteria, for example by assessing the relative size of embodied carbon estimates or emissions reduction commitments
- seeking alternative carbon reduction mechanisms in procurement, enabling tenderers to suggest other carbon reduction actions in their tender response (this is also known as a bid-back process)
- offering guidance on how emissions reduction can be achieved in different procurement models.

The example of the 'CO_2 performance ladder' approach in the Netherlands demonstrates how suppliers can be incentivised to reduce emissions.[200]

Netherlands government procurement rewards industry innovation

The Dutch Government requires organisations to reduce their carbon emissions using its procurement policy.

It has introduced a 'CO_2 performance ladder' in its procurement processes. The ladder has 5 levels, each representing a different commitment to reducing carbon. Organisations that achieve a certification at level 1 to 3 commit to reducing emissions in all of their projects. Those certified at level 4 or 5 also strive to reduce emissions in the sector and supply chain.[201]

During the tender process, organisations submit proposals and their current CO_2 performance ladder certification. Organisations with a ladder certification receive a hypothetical discount on their tender price, with higher discounts given to those at higher ladder levels.[202]

The CO_2 performance ladder creates a competitive advantage, incentivising organisations to actively reduce their carbon emissions. If an organisation has both the highest tender price and the highest level on the CO_2 performance ladder, they can still win the contract due to the significant discount offered.

Table 3: fictitious example of contract award with CO_2 ladder

Company	Entry price	Level on CO_2 ladder	Fictitious discount/ award advantage	Fictious rate	Award the contract
A	€ 9.7 million	none	0%	€ 9.7 million	NO
B	€ 10 million	3	4%	€ 9.6 million	NO
C	€ 10.3 million	4	7%	€ 9.58 million	YES: € 10.3 million

The procurement framework should include mandatory carbon reductions from a set baseline (action 6.3). These can then be relied upon in evaluating tender responses and can be incorporated into contracts. Project teams can set the initial carbon baseline using simple metrics like cement and steel volumes that are ordinarily estimated in development of the reference design at business case stage. These estimates can use carbon measurement tools and emissions factors introduced by responding to recommendation 2. The project team should periodically refine reduction targets as the project progresses and more data is available.

Procurement processes can use the published carbon valuation guidance (from action 3.3) to assess and compare the economic return on possible emission reduction actions (action 6.4). This will allow decision-makers to decide whether carbon reduction actions generate a positive economic return. This is particularly relevant when low carbon solutions cost more to the project upfront but may reduce financial costs and risks in the longer term. Decision-makers can use this information to maximise benefits throughout the life of the asset.

Recommendation 7: Update standard form contracts to include carbon reporting, abatement requirements and further reduction opportunities.

Integrate minimum requirements into contracts to set clear expectations for suppliers, ensuring their practices deliver emissions reductions consistent with government decarbonisation commitments. Establish carbon reporting requirements and include

mechanisms for carbon abatement and reduction opportunities within standard form contracts.

Procurement and contracting practices that encourage, enable and require emissions reduction should be complementary and mutually reinforcing. The right contractual terms help ensure the emission reductions agreed to in the procurement process (Recommendation 6) will actually be implemented during delivery of the project and throughout the infrastructure's operating life.

The Victorian Government can provide certainty and set clear expectations for suppliers by including emissions reduction requirements in standard form contracts. Binding contractual mechanisms that mandate emissions reduction across standard form contracts will incentivise suppliers to seek out and implement low carbon methods, materials, and practices. It will stimulate innovation as industry gains clarity on government expectations and commitments.

> "Supporting industry and sending the right signals to support low embodied carbon solutions is an important role for government."
>
> Materials and Embodied Carbon Leaders' Alliance, submission to Infrastructure Victoria

We recommend the Victorian Government update contracts to include minimum carbon reporting and reduction requirements, and incentives for carbon abatement. Figure 11 shows the actions required to do this.

Figure 11
Action plan for recommendation 7

The government can start by designing mechanisms to include carbon abatement in the approved standard form contracts within the Department of Treasury and Finance's suite of commercial deeds, contracts and schedules, such as the *Practitioner's Toolkit*[203], *Ministerial Directions and Instructions for Public Construction Procurement*[204] or other department based approved standard forms (action 7.1).

Standard form contracts should include mechanisms for additional carbon abatement (action 7.1) and minimum carbon reduction requirements (action 7.5). By updating government standard contracts to integrate minimum carbon reduction requirements, the Victorian Government can set

clear expectations for suppliers to reduce carbon emissions. This will drive investment in upskilling and innovation across the sector as participants are clear about the government's expectations. This is consistent with Infrastructure NSW's recommendation in its recent Government discussion paper to update standard contracts to enforce carbon reductions.[205]

Different mechanisms for carbon abatement and reduction can be applied, depending on the capacity and maturity of industry in carbon management and low carbon technologies. Standard form contracts can initially include 'soft' mechanisms to encourage industry to provide their best offers to achieve carbon reduction requirements set by government. Over time, as carbon management and low carbon technologies become widely established across industry, standard form contracts can include 'hard' obligations. The 'hard obligations' will be applicable when there is an established practice in using a consistent carbon quantification approach, and performance in carbon reductions can be reliably monitored.

Mechanism	Early stage application	Mature stage application
A carbon baseline or carbon reduction target set by government	Initially as a part of 'continuous improvement' requirement, to encourage best effort.	'Hard' emission reduction obligations as part of contractor's performance.
Contract variations initiated by suppliers	Not applicable	Suppliers can propose variations to facilitate further emission reductions as new innovations and technologies become available (similar to the 'value engineering variations' mechanism).
Contract variations initiated by government	Not applicable	The supplier is required to comply with increases in emission reduction, in line with government policy objectives, over the life of the project, with relief available via the variation mechanism for time and cost impacts (similar to the 'change in law' mechanism).

Over time as 'hard' obligations on carbon abatement are included in standard form contracts, incentives for contractors who exceed baseline performance should also be included (supplementary action 7.2). For example, this can be done with a gain-share regime where performance is monitored against key performance indicators. Adopting 'hard' obligations will require first adopting a standardised carbon emission approach, so that the carbon calculation in a project's proposal is transparent to both project proponents and the bidders. This can minimise risks of creating inflated baseline estimates in the tender process.

As a more progressive step, suppliers can also be contractually incentivised to monitor carbon emissions throughout a project, based on performance benchmarks as compared to the market. If the contractor generates excess emissions compared to the benchmark in the market, it will trigger the benchmarking mechanism under which the contractor could be required to engage with experts to accelerate emissions reduction measures on the project.[206]

Examples of carbon reductions requirements in contracts

The Chancery Lane Project is a global legal initiative which produces precedent clauses to assist organisations in delivering net zero through contracts. This can serve as a peer-reviewed resource that informs updates to standard Victorian Government contracts. The Chancery Lane Project[207] suggests the following clauses to integrate minimum carbon reduction requirements into standard form contracts:

- The contractor is required to carry out the works so that the carbon budget is not exceeded.
- The contractor is required to provide monthly management information on its ongoing compliance to enable the employer to assess the progress of the works towards meeting the carbon budget and provide input to the contractor on further progress.
- If the carbon budget of the works (excluding changes issued in accordance with clause x) is exceeded due to a breach by the contractor of its obligations under this clause, then liquidated damages at the rate of $[X] per tonne of carbon dioxide equivalent of greenhouse gas over and above the carbon budget, shall be due and payable from the contractor to the employer. To avoid doubt, liquidated damages payable under this clause represent the reasonable commercial concerns of the employer and its costs of offsetting the excess greenhouse gas emissions.

The standard form contract should also require suppliers to develop carbon management plans, which specify how they will manage, measure and deliver on emission reduction requirements under the contract. These requirements will vary depending on the type of project and opportunities for emissions reduction. The contract can initially require suppliers to develop descriptive carbon management plans first, with some measurement and reporting (action 7.3), and then quantitative carbon management plans later for projects and programs with material carbon impacts (action 7.6). While actions 4.3 and 4.7 describe guidance and requirement for carbon management plans, in practice, the parties may be required to meet periodically to discuss carbon reduction measures and opportunities for further abatement.

An important step in driving emissions reduction through contracting is mandating carbon reporting requirements in the approved standard form contracts within the Department of Treasury and Finance's suite of commercial contracts, such as *Practitioner's Toolkit* or other department based approved standard forms (action 7.4). Reporting requirements should embed measures such as:

- embodied and operational carbon throughout the performance of the contract (at intervals as appropriate for the size and duration of the project)
- measures taken to reduce carbon throughout the performance of the contracts (at appropriate intervals)
- performance of the supplier against any carbon reduction targets for the project, summarised within a compliance table showing the status of compliance with the requirements and specified targets
- data to support reporting on carbon and performance against targets
- analysis of trends including actions to be undertaken to improve carbon reduction performance.

Consistent reporting requirements in standard form contracts will necessitate accelerated upskilling across the sector, which is integral to delivering recommendation 2. This is an important incremental step in implementing more ambitious carbon reduction measures as sector capability improves.

We have summarised these proposed contractual reporting and governance measures in Table E-1 of Appendix E. Key considerations for implementing this recommendation 7 are set out in Table E-1 of Appendix E and further detail on suggested contractual mechanisms to deliver emissions reduction is set out in Table E-2 of Appendix E.

Contractual incentives for innovation in carbon reduction

The Chancery Lane Project suggests a specific 'Net zero aligned construction modifications' clause that could provide incentives for contractors to propose innovative approaches that reduce carbon in projects.[208] The contractor will have access to a shared 'gain share' arising from cost savings or other financial incentive from introducing the modification. Such a clause provides that:

- The contractor may propose a net zero modification to the works, by giving a written notice (the net zero modification proposal) to the principal and superintendent, setting out:

  (a) the proposed net zero modification

  (b) the reason for the proposed net zero modification, including how the net zero modification will assist in delivering the net zero objectives or, alternatively, how the net zero modification will improve the [carbon footprint/ carbon intensity] of the [project/ asset]

  (c) the time within, and the manner in which, the contractor proposes to implement the proposed net zero modification

  (d) the effect the proposed net zero modification will have on the construction program (including any extension of time required to the date for practical completion

  (e) any approvals required to implement the proposed net zero modification, and the effect of the proposed net zero modification on any existing approvals

  (f) the effect the proposed net zero modification will have on the contractor's ability to satisfy its obligations under the contract

  (g) the financial impact on the employer arising from the net zero modification, including but not limited to: cost savings or increases to the [contract sum]; costs savings to the ongoing operation and maintenance of the completed [project/ asset] (including reduced energy costs arising from the net zero modification); reduced [costs of GHG Emissions obligations/ offsets and carbon price etc]; reduced financing costs of the project, and

  (h) any other relevant information reasonably required by the employer to assess the proposed net zero modification.

Recommendation 8: Establish carbon management prequalification requirements for government contracts.

Establish requirements ensuring that contractors possess the necessary experience, knowledge, and commitment to decarbonisation.

The Victorian Government already has prequalification requirements for suppliers involved in construction works. It is a key mechanism designed to streamline public construction procurement.[209] These requirements mean suppliers must adhere to the Victorian Government supplier code of conduct. This code focuses on ethical standards, including for health and safety, and labour rights. It includes general expectations for suppliers to minimise their environmental

impact, such as by maintaining policies and practices that reduce carbon emissions and the risk of pollution, and for the efficient use of energy and natural resources.[210]

Setting pre-qualification requirements for government contracts for decarbonisation requires careful design, including developing supporting technical standards and specifications, training for contractors, processes to assess supplier capacity, capacity, and contractor behaviour. Setting clear prequalification requirements is an effective way to streamline government procurement processes and help the market consistently work towards lowering carbon emissions in Victorian Government infrastructure projects.

The government can determine the suitability of suppliers based on specific criteria related to decarbonisation. Suitable contractors would possess sufficient experience, knowledge and commitment to decarbonise infrastructure projects.[211] It can set prequalification requirements in contracts based on this suitability, before engaging a supplier in a project.

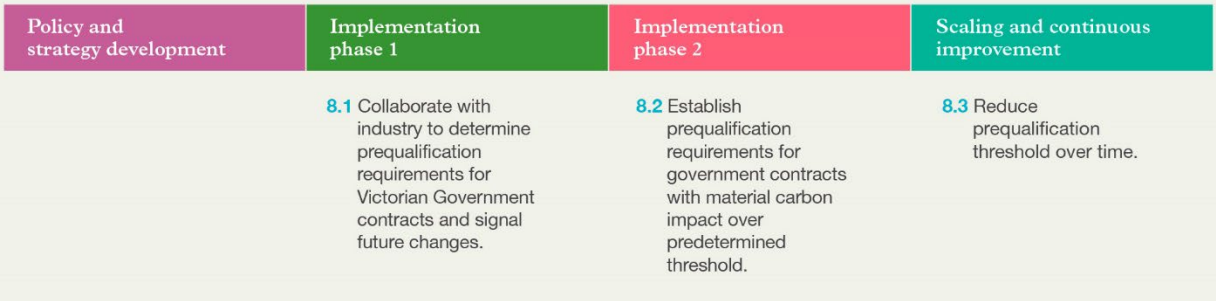
For example, the United Kingdom Government only accepts bids from suppliers who commit to achieving net zero by 2050, for government contracts worth over £5 million a year (around AUD$9 million).[212] Successful businesses detail their emissions in a carbon reduction plan, which lists their emissions sources and their current or planned environmental management measures.[213]

Prequalification requirements for Victorian suppliers could include:[214]

- demonstrating a commitment to reducing carbon emissions on infrastructure projects in line with Victoria's emissions targets
- possessing relevant experience in implementing low-carbon technologies and practices
- submitting a carbon reduction plan outlining the supplier's approach to decarbonisation and their emissions reduction targets (which should align with standard form contract requirements as outlined in recommendation 7)
- employing a dedicated sustainability or carbon reduction team or expert
- setting an organisational emission reduction target and creating a credible climate transition plan.

We recommend the Victorian Government establish carbon prequalification requirements for government contracts. Figure 12 shows the actions required to do this.

Figure 12
Action plan for recommendation 8



The Victorian Government should consult with industry to inform proposed decarbonisation prequalification requirements for government projects (action 8.1). This will create a shared expectation of the experience, knowledge and commitment to decarbonisation required for government contracts. Signalling future changes gives suppliers time to adapt and prepare for any new requirements.

The United Kingdom' prequalification requirement applies to government contracts exceeding GBP£5 million annually. In Victoria, prequalification requirements could apply only to projects of significant carbon impact such as high value high risk projects with capital investments over $10 million initially (action 8.2). Over time, prequalification can be extended to projects of all sizes as systems and processes are established (action 8.3).

Recommendation 9: Support industry to develop zero or low emissions solutions by testing alternative materials and adopting performance-based standards.

Drive demand by using infrastructure projects to motivate industry stakeholders to invest in producing and improving use of sustainable materials and practices. The Victorian Government can help to lower the barriers to adoption of alternative materials by testing and piloting materials. Collaborate with industry to update standards and specifications in support of low carbon materials across infrastructure projects.

Some materials, like cement and steel, create a high level of emissions that are hard to reduce. Before low carbon options for these materials become commercially viable, using alternative materials can be more expensive.[215] Developing a new product requires significant investment from industry, which is where government can support the industry's innovation and market transition. Government support will also help with rigorous testing and widespread acceptance of the new materials.

The Australian construction material industry is worth over $65 billion per year.[216] More infrastructure projects in other states are demanding low carbon and recycled materials.[217] For example, WestConnex is a 33 km motorway network that focused on reducing the embodied carbon in materials. The project team replaced 32% of the Portland cement they needed with cementitious alternatives, such as waste fly ash from power generation, to reduce the concrete's embodied carbon emissions. This approach reduced carbon emissions during construction and operation of the tunnels by around 400,000 tonnes or 28% of forecast emissions throughout the project lifecycle.[218]

Industry stakeholders told us that current government procurement practices tend to lock out innovative low carbon approaches. Projects prescribe materials and design specifications, rather than performance outcomes.[219] Prescriptive government specifications and standards can unnecessarily prohibit the use of low carbon materials and practices.

The Victorian Government is currently reviewing the approach to standards in Victoria. Acciona, a global engineering and construction firm, report in their submission to this review that many projects are using the Australian standard for bridge structures (AS5100) to construct underground structures, tunnels and rail viaducts. Using this standard rather than other standards for specific elements like concrete structures (AS3600) requires designers to interpret how to apply the standard in this context, and can lead to conservative design choices. Acciona estimates that materials and costs could be reduced by 10% to 20% if suppliers could nominate suitable standards.[220] Less material usually equals lower carbon emissions.

Industry stakeholders we spoke to also expressed their preference for performance-based standards. They told us that projects often include their preferred standards and specific materials requirements in tender documentation. This constrains the ability of suppliers to suggest alternative standards or materials and risk their bid being non-compliant. Acciona estimates that a performance-based procurement approach could lead to a 10% to 25% reduction in materials for temporary structures and a 5% to 15% reduction in materials for permanent structures. It could also create cost and time savings.[221]

Another challenge is that new materials and practices have a brief performance history, meaning they face challenges in demonstrating long-term performance or may not have been considered when writing specifications and standards.[222]

Projects with short timelines can find it challenging to test and pilot new materials. Stakeholders report that approving new materials for infrastructure projects takes a long time. When suppliers bid on projects, they may propose innovations in low carbon materials. But securing necessary approvals for these materials may take longer than the time available for a supplier to begin construction. It can also be time-consuming to achieve consensus on using new materials among different infrastructure project professionals such as designers, engineers, contractors, and asset owners. Project teams can engage in early and structured collaboration with industry to identify opportunities to use low carbon materials initiate requests for approvals to use these to eliminate schedule risks.[223]

Industry must navigate the profusion of different regulations and requirements in different jurisdictions to secure approval to use new low carbon materials and practices. This adds complexity and increases compliance costs for industry.[224]

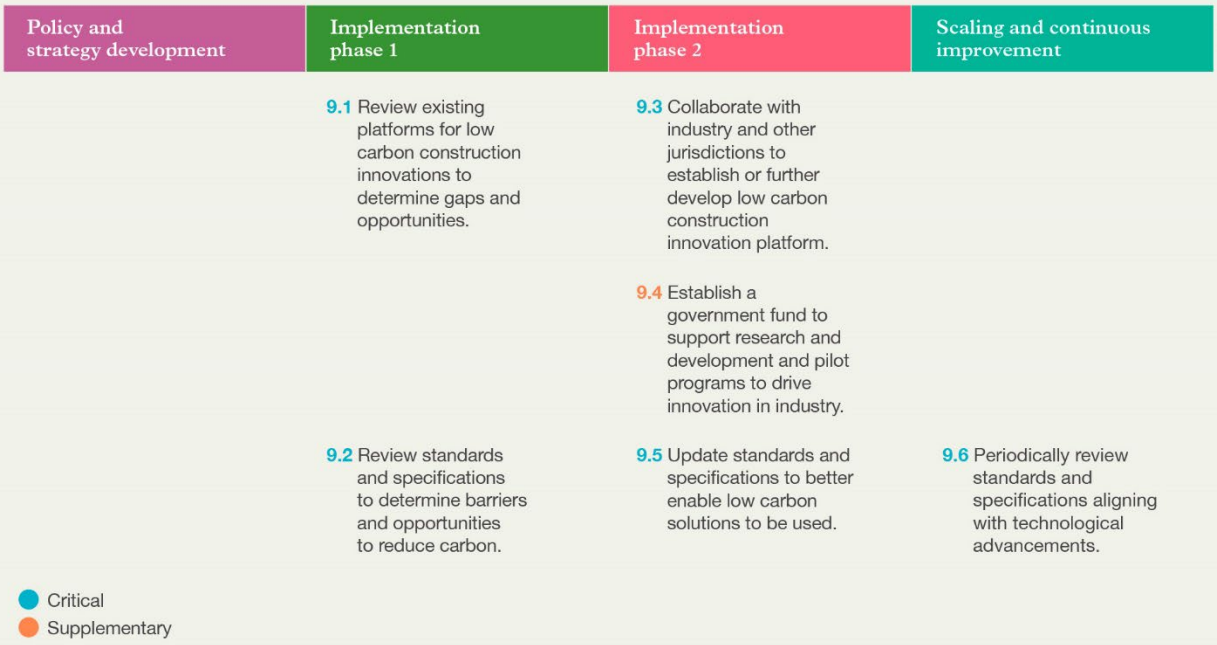
The Victorian Government can stimulate demand for sustainable materials and practices by using the purchasing power of its large infrastructure pipeline. This can motivate industry stakeholders to invest in producing, using and devising better sustainable materials. Building demand for low carbon materials can generate economies of scale, which drive down their cost and make contractors more familiar with using alternative materials and construction techniques.

Emerging materials with lower carbon profiles can be more expensive than conventional materials. However, projects that use a carbon value in cost benefit analysis and use performance-based standards may use less materials and therefore low carbon materials can still be cheaper overall for the project. The Victorian Government can also encourage the use of lower carbon materials by supporting further research and development, which helps make them more affordable, accessible and financially feasible. This will further boost their market demand.

We recommend the Victorian Government support decarbonisation innovation across industry by testing new materials and adopting performance-based standards. Figure 13 shows the actions required to do this.

Figure 13

Action plan for recommendation 9



The government can begin implementing this recommendation by reviewing existing sharing platforms for low carbon construction innovations (action 9.1). It can also establish or further develop a low carbon materials register in collaboration with industry and other governments (action 9.3).

Creating a sharing platform for low carbon solutions encourages the transfer of knowledge between different firms in the supply chain. Both EcologiQ and the Materials and Embodied Carbon Leaders' Alliance platforms have strengths and limitations. The EcologiQ platform is currently focused on the building industry's practices in recycled materials. It is limited to users within Victoria. The Materials and Embodied Carbon Leaders' Alliance is an industry-led platform driving knowledge sharing of low-carbon materials Australia-wide. With appropriate funding, governance and reporting arrangements, the Victorian Government could leverage either of these platforms to help facilitate knowledge sharing and speed up dissemination of low carbon construction practices.

The Materials and Embodied Carbon Leaders' Alliance (MECLA)

As a not-for-profit organisation funded by the New South Wales Government and Government of South Australia, MECLA provides resources and case studies for industry stakeholders looking to adopt sustainable practices in their projects. Their website provides:[225]

- information on sustainable materials and their specifications
- industry-led research for materials, such as steel, cement and aluminium
- case studies demonstrating the implementation of low-emission construction practices across different sectors and project types.

The government should then extend the Office of Project Victoria's review of current standards and specifications to identify any barriers and opportunities they impose on using low carbon materials (action 9.2). Using this review's findings, the government can change the standards and specifications, or the approach to defining or making exceptions to standards, to allow more low carbon solutions to comply (action 9.5). The Victorian Government can test and pilot low carbon materials in infrastructure projects to lower the barriers to their uptake. This can take time. Project teams often cannot test these new materials in the required decision timeframes. Even if they do, they may not make their insights available to other projects, which a sharing platform can support. Government should periodically review standards and specification to align with technological advancements (action 9.6).

The Victorian Government can also engage with industry and other governments to improve and align standards and specifications for low carbon solutions with current best practices. For example, Transport for New South Wales is set to develop a *Zero carbon materials innovation program* in 2024, which aims to fast-track research, develop updates to standards and specifications and broaden uptake of low carbon materials in procurement.[226]

Austroads provides a national example of aligning standards. Austroads develops and updates technical guides and tools to promote a consistent approach to the design, maintenance and operation of road networks in Australia and New Zealand. Austroads' technical specifications are a comprehensive set of best-practice construction guidelines for roads and bridges.[227] The specifications aim to consider reusing materials, reducing emissions and mitigating the impacts of climate change.[228] For example, Austroads technical specification ATS 3050 sets out the minimum requirements for manufacturing and supplying recycled crushed glass for pavements.[229]

The Victorian Government can leverage current resources with EcologiQ's work for recycled materials. EcologiQ collaborates with the industry to develop reference guides that show designers, contractors, and infrastructure asset owners how to use recycled materials in line with existing design and construction standards.[230]

The Victorian Government can invest in research and development to support introducing new materials into the construction sector. The government could consider a dedicated fund to support research, development, and pilot programs for low carbon construction materials and techniques (supplementary action 9.4). For example, it could build on the existing $7 million *Low carbon manufacturing grant* program. However, this funding is relatively small when compared to other jurisdictions like New South Wales, which has a $300 million fund for developing and manufacturing low carbon products and materials.[231]

Recommendation 10: Update assurance processes to include carbon emissions.

Update project assurance checks in Department of Treasury and Finance's *High value high risk framework* to incorporate the changes introduced in recommendations 1 to 9 to require carbon emissions to be reported and managed in benefit management plans. Assurance checks are carried out by experts external to the project to review plans and progress at important decision points.

Governments use established processes and systems to ensure that solutions achieve their intended purpose. A good project assurance process, aligned with common project management principles, involves clear objectives, detailed planning, efficient execution, ongoing monitoring and successful closing. It integrates effective management of scope, time, cost, quality, resources, risk, and communication, ensuring stakeholder alignment and project success.[232]

Experts outside government carry out assurance checks to review complex projects at important decision points.[233] Including carbon emissions in assurance processes makes infrastructure

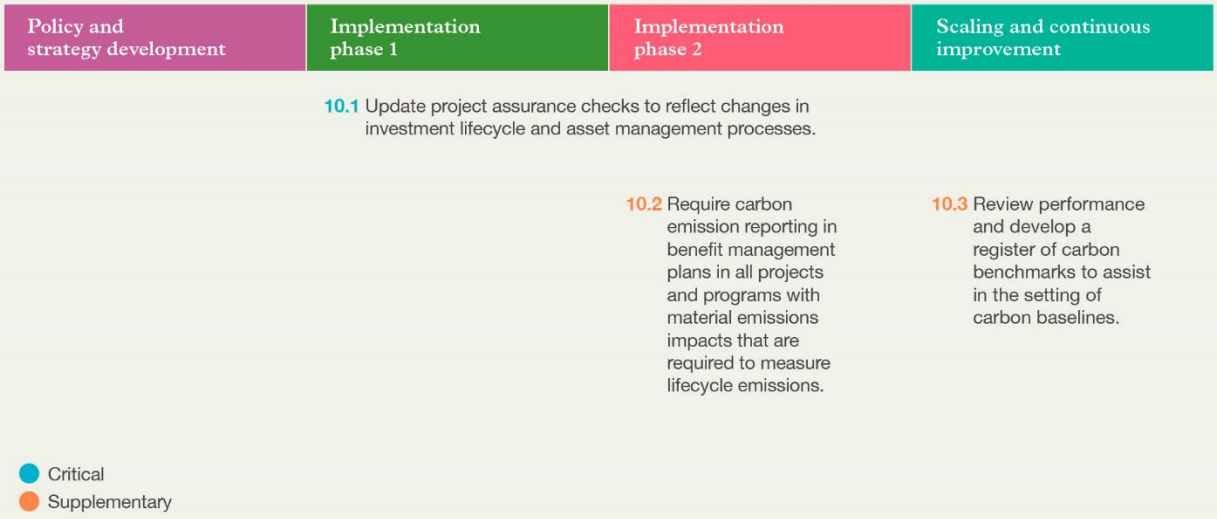
investment decisions more transparent and accountable. A model for good benefit management includes:[234]

- clearly defining objectives, outcomes, benefits and measures
- assessing the quality and consistency of a benefit management process to understand, plan, manage and report and evaluate benefits throughout a project's lifecycle.

By improving assurance processes, the government can effectively monitor their carbon emissions reduction actions, evaluate the benefits of emissions reduction and enhance overall accountability and transparency in reducing carbon emissions.[235]

We recommend the Victorian Government update assurance processes to consider carbon emission reductions. Figure 14 shows the actions required to do this.

Figure 14
Action plan for recommendation 10



To ensure carbon impacts are identified, quantified, managed and reported in infrastructure's lifecycle, carbon emission requirements should be clearly delineated from other sustainability requirements. The Victorian Government should update project assurance checks in existing business case and procurement frameworks, guides and templates to reflect the changes in recommendations 1 to 9. This should include updating asset management processes such as the *Gateway review* process and asset management responsibilities such as the *Asset management accountability framework* and individual project assurance review guidance (action 10.1).

Strengthening assurance processes should also require benefit management plans to report on and track carbon emissions (supplementary action 10.2). The Victorian Government should update the *Investment management standard to* require that carbon emission reduction be considered as part of benefit management plans.

Similar to developing carbon management plans (actions 4.3 and 4.7), the level of details and completeness of the assurance process is expected to mature over time, commensurate with project's materiality and with the public sector's capability in carbon quantification. The supplementary action 10.2 should also leverage the digital data collection as part of action 2.5.

Reviewing completed projects and gathering feedback on contractor performance can produce valuable information for future projects (supplementary action 10.3). It can improve estimates of embodied emissions and support the creation of consistent carbon footprint models. The government can use historical data to make informed decisions and establish reliable benchmarks for carbon emissions reductions.

Timing and implementation considerations

The Victorian Government must decide on the preferred timing to decarbonise infrastructure

Confirming its commitment and establishing clear timelines will be important as the Victorian Government works to decarbonise its infrastructure. By setting priorities and expectations, all stakeholders can focus their efforts on the most impactful measures and ensure that progress is made at an appropriate pace.

We identified 3 potential pathways to support decarbonisation of public infrastructure – leading, measured and lagging – each with varying timeframes for implementation and delivery.[236] The sequencing of recommendations and actions identified earlier in this advice is consistent across all 3 pathways.

While the Victorian Government needs to consider the recommendations in this advice from Infrastructure Victoria, other jurisdictions are already progressing quickly. Infrastructure New South Wales has already released guiding principles and timelines for action on decarbonisation, as well as a policy roadmap setting out detailed actions the government will complete by 2026.[237] New guidance has been issued by the New South Wales Department of Finance, and efforts are underway to adopt new carbon management guidance soon. Commonwealth Government agencies are also undertaking similar work. Australian Transport and Infrastructure Ministers have agreed that progressing decarbonisation is a priority.

Infrastructure Victoria recommends government adopt timing that is aligned with other jurisdictions

Aligning the timing of Victoria's approach with other jurisdictions offers the greatest potential to proactively reduce emissions. The proposed timing will allow Victoria to catch up with, and then progress at the same pace as, other jurisdictions.

This approach proposes that key decisions in the policy and strategy development phase to be completed within 6 to 12 months of receipt of this advice. Implementation stage 1 would follow within 18 months, with a stage 2 of up to 24 months before moving to a steady state within 4 years of this advice.

This approach allows Victoria to align its efforts with other leading jurisdictions and best responds to current and pressing issues identified by both government and industry stakeholders. However, it requires strong commitment and swift decision-making by government.

The timing and phases for implementing our recommendations aim to achieve the best long-term outcomes while minimising transitional costs for the government, industry, and the community.

The scale of decarbonising Victoria's economy, including in the infrastructure sector, requires immediate and sustained action to be able to meet Victoria's net zero emission targets by 2045.

Our research demonstrates that reducing carbon emissions from infrastructure can expedite infrastructure delivery and save cost through design and material innovation. Victoria can benefit from the increased demand for low carbon materials and technologies, which would stimulate the development of new markets, foster the growth of new skills and capabilities, and create job opportunities.

However, if the Victorian Government fails to take swift action, it may fall behind in reducing emissions, resulting in infrastructure that is more expensive and less productive as well as missed chances to have a dynamic low carbon economy.

Work is already underway in other Australian jurisdictions, such as:

- the South Australian Government released the *Sustainable procurement policy* incorporating an embodied carbon target as a minimum tender requirement for government work in August 2023.[238]
- the Queensland Government is developing a carbon budget and refining strategies for a climate positive and sustainable Olympic and Paralympic Games in 2032.[239]
- Infrastructure Australia's final guidance on decarbonising infrastructure is anticipated in 2024.
- Infrastructure New South Wales and Transport for New South Wales are addressing key activities and milestones from the decarbonising infrastructure delivery roadmap for 2023 to 2026.[240]
- The New South Wales Government, Australian Government, and industry bodies such as the Materials and Embodied Carbon Leaders' Alliance are currently reviewing carbon quantification and management standards, with PAS 2080 as a leading candidate for adoption.
- state and national infrastructure ministers initiated a Decarbonisation of Transport Working Group in June 2023, with the next meeting scheduled for December 2023.[241]
- the Australian Accounting Standards Board plans to hold a consultation on climate disclosure standards by the end of 2023.[242]

We recommend the Victorian Government initiate clear and quick actions to catch up to and align better practices with other jurisdictions.

Victoria can learn from New South Wales' decarbonising infrastructure roadmap

The New South Wales *Decarbonising infrastructure delivery roadmap* sets out the key initiatives from 2023 to 2026 to decarbonising infrastructure delivery.[243] It follows the discussion paper *Decarbonising infrastructure delivery*.[244]

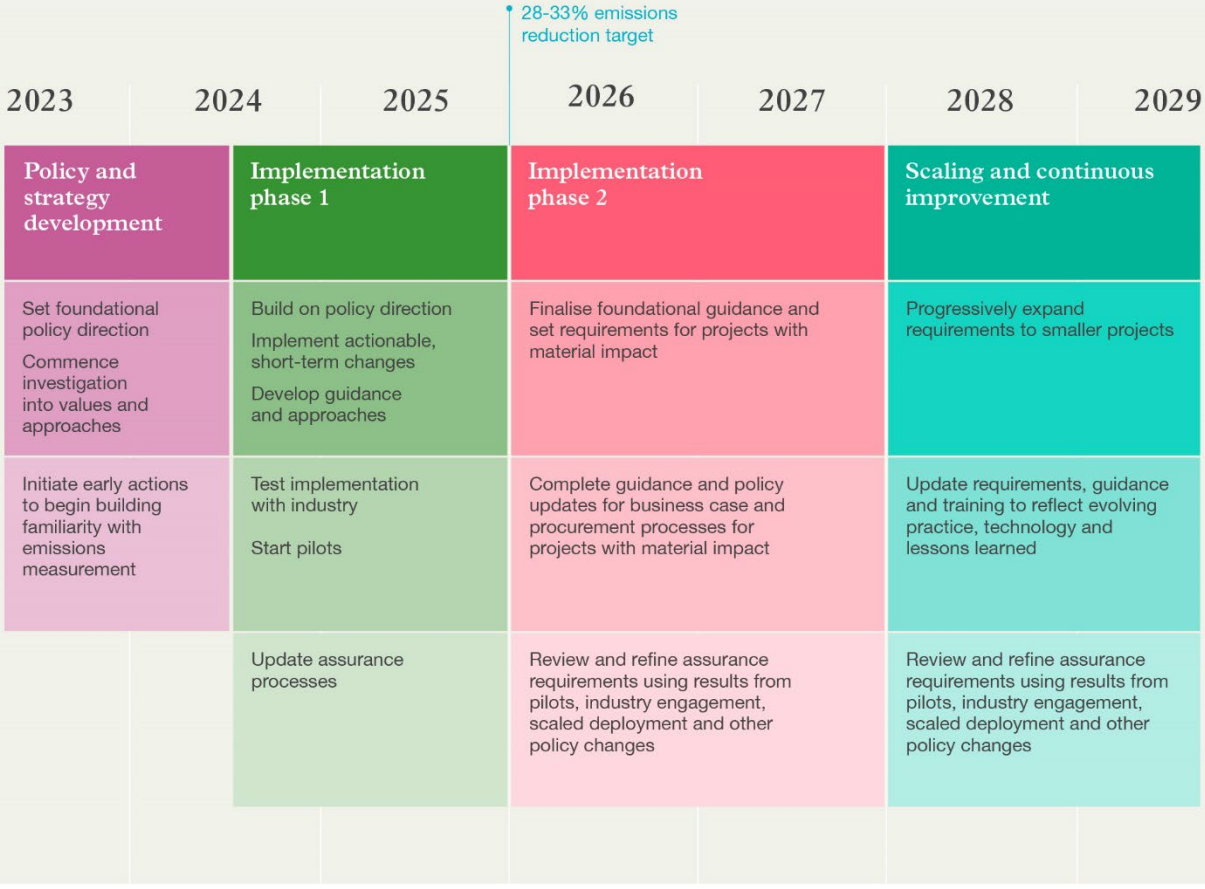
Prepared by Transport for New South Wales (TfNSW) and Infrastructure New South Wales it contains the activities and milestones for reducing embodied emissions in New South Wales.[245]

Examples of key activities and milestones include:[246]

- implement a sustainable procurement framework including minimum emissions reduction target incorporating embodied emissions across TfNSW major projects in 2023
- establish carbon measurement guidance for all government infrastructure in 2023
- introduce whole-of-life carbon estimates into TfNSW strategic decision-making and optioneering phases in 2024
- develop consistent carbon footprint models by asset type that use historical data to inform early decision-making in 2024
- implement a certified carbon management system by TfNSW in 2025
- introduce incentives for low carbon TfNSW projects in 2025
- establish a certified carbon management system in 2026.

The leading pathway entails an implementation plan from 2023 to 2027. Figure 15 illustrates the timeline for implementing our recommendations for infrastructure decarbonisation.

Figure 15
Proposed implementation timeframe towards infrastructure decarbonisation



Guidance for projects already underway

This advice focuses largely on projects that are in early decision-making stages. But it is not too late for the Victorian Government to apply some of these recommendations to projects already in delivery.

Significant amounts of materials, valued at $75 billion,[247] will be consumed in the existing five-year infrastructure pipeline, offering ample opportunities to consider carbon reductions in procurement and construction phases. Of these materials, steel and concrete account for 34% and 33%, respectively,[248] and their production accounts for over 50% of all industrial emissions globally.[249] Seeking to identify opportunities in construction and operation stages of these infrastructure projects would help reduce the risks of 'locking in' significant emissions for infrastructure built in the coming decade.

Project teams should use the emissions materiality test (action 1.4) to evaluate their carbon emissions reduction potential. Where possible, they can use digital engineering tools to identify opportunities to reduce carbon in their designs (action 2.5).

The government can also require projects to identify opportunities to introduce alternative materials by using set carbon values (action 3.1) in their evaluation of materials choices at key decision points. Testing and piloting materials and reforming standards review processes (recommendation 9) can benefit existing projects. In some cases, introducing incentives for decarbonisation innovations within existing contracts may be suitable (recommendation 7).

But more than any specific recommendation, the Victorian Government's clear and firm commitment to decarbonising infrastructure will set an example for projects to follow. Projects can work with existing contractors to identify opportunities to decarbonise proactively if they understand that this is the government's direction.

Decarbonisation creates costs and benefits for stakeholders across the supply chain

Industry stakeholders told us they are ready to increase their efforts to reduce carbon emissions in government infrastructure projects.

Reducing carbon emissions can reduce costs and improve productivity, especially if a lifecycle carbon management approach, such as PAS 2080, is used. There may be a tipping point between cost reduction and carbon reduction when the supply and demand for low carbon materials are out of balance. If the supply of low carbon or 'green' materials are not available at the scale required, decarbonisation efforts may come with rising costs. This further points to the need to act across the supply chain.

Meeting new carbon management requirements is likely to add costs for government and industry before systems and processes are embedded.

Costs may be incurred as part of:

- developing standards and carbon management plans, which involves setting up datasets and tools and ongoing maintenance
- any incentives that the government makes to promote low carbon materials and construction methods
- identifying, developing and conducting new training needed to upskill both government and industry, and knowledge sharing through open and accessible platforms.

The actual cost impact is likely to vary across the supply chain, with government and large industry players absorbing the upfront investments in establishing datasets tools, guidelines, and capability building, but also sharing in the benefits of early gains in driving decarbonisation outcomes.

A key consideration is how to reduce the cost impact on infrastructure delivery associated with low carbon materials and construction methods. Industry stakeholders note that low carbon materials:

- may not be available at competitive prices while quantities are low
- require trials and testing before they can be accepted as business-as-usual, which typically needs approvals at various governance levels and can be time-consuming
- may behave differently than high carbon alternatives which means training and upskilling is required to facilitate their wider use.

These cost factors are similar to the use of recycled materials in Victorian major projects. The Victorian Government has achieved substantial progress in this area by setting clear policy direction and developing a responsive procurement approach. EcologiQ facilitates testing of new recycled materials in major projects and builds capacity through conferences, case studies and an open-sourced supplier register.

Several actions can help reduce the cost impacts of decarbonisation:

- establish a Victorian Government community of practice on decarbonisation of infrastructure to facilitate knowledge-sharing and collaboration (supplementary action 2.3)
- identify areas for improvement and collaboration (action 9.1)

- apply a materiality threshold to focus on projects with the greatest carbon reduction impacts. Early decarbonisation requirements will initially affect larger firms, reducing unnecessary compliance costs on both the government and smaller businesses (actions 1.4, 1.5, 4.4, 4.7).

Achieving equitable distribution of costs and benefits across the infrastructure supply chain

Industry stakeholders indicated that larger suppliers are likely to lead the supply chain in innovations in low carbon solutions. With more resources and capability to invest in research and development, they tend to be better positioned to respond to government's decarbonisation requirements.

Industry stakeholders expressed concern that smaller players will likely miss out on the opportunity from government projects in the transition to decarbonisation. This may be problematic for small suppliers in rural and regional areas, particularly when low carbon materials may be difficult to source at affordable costs.

There is a broader economic interest for the Victorian Government to enable suppliers of all sizes and capabilities to compete freely in the market. The government should aim to remove market entry barriers to get the best outcomes from genuine competition.

To minimise the likely adverse effect on smaller players or players in remote areas, we recommend the Victorian Government consider capability building, gradual and specific requirements targeting smaller players and provide additional incentives to support smaller players.

Our recommendations are structured so that certain actions first apply to larger projects and programs through a materiality test to focus on projects of high impact (action 1.4). As both government and industry improve capability to embed emissions reduction, we recommend progressively lower thresholds to apply to smaller projects and programs (actions 1.5 and 8.3).

When determining how and when to lower thresholds, we recommend government agencies collaborate closely with industry to:

- avoid imposing unnecessary administrative burdens on smaller projects
- build capacity together to help smaller players compete in the low carbon economy
- provide time and financial incentives to support smaller players.

We recommend the government consider a range of incentives, such as monetary rewards, funding of innovation or research and development initiatives, contract extensions, or preferential treatment in future procurement processes (supplementary action 7.2). These incentives should encourage suppliers to continuously enhance their whole-of-life sustainability performance.

Continue measuring progress to decarbonise infrastructure

This advice offers principles, recommendations and actions the Victorian Government can adopt to step up the transition to net zero across the lifecycle of new infrastructure projects.

More work is needed to quantify the potential costs and benefits of reducing the greenhouse gas emissions of future public infrastructure investments.

As of August 2023, Infrastructure Australia is developing research to estimate the embodied carbon intensity of Australia's buildings and infrastructure pipelines from 2022–23 to 2026–27. It will assess the potential emissions savings from substituting low emissions building materials into these projects, including from Victoria. The work may help quantify the amount of embodied carbon in Victoria's infrastructure pipeline and identify opportunities for reducing emissions under different scenarios. The work is expected to be published late 2023.

Determining the amount of carbon emissions embodied within the existing infrastructure pipeline is important for tracking emissions in Victoria and assessing progress. Adopting a similar standardised framework or tool as undertaken by Infrastructure Australia can help to consistently measure emissions. This approach can help identify hard-to-abate sectors and projects that may have limited emissions reduction capacity, as well as sectors and projects that are comparatively easier to address. By gaining a better understanding of the infrastructure sector's emissions, focused efforts can be directed towards low carbon, recycled and re-used construction materials.

Appendices

Appendix A: Stakeholder engagement summary

Our stakeholder engagement helped us develop our advice and refine our recommendations. We would like to thank all organisations that engaged with us during the development of this advice.

We had discussions with stakeholders throughout the formulation of our advice and held an open submissions process. We also held 6 interviews with Victorian Government stakeholders and 4 workshops with government and industry stakeholders.

Discussions

During the development of our advice, we had discussions with:

- BIS Oxford Economics
- Department of Energy, Environment and Climate Action (DEECA)
- Department of Treasury and Finance
- Climateworks Centre
- Infrastructure Australia
- Infrastructure Sustainability Council
- Melbourne Water
- Nation Partners
- Office of Projects Victoria
- Rail Projects Victoria
- Sustainability Victoria
- Transport for New South Wales
- Yarra Valley Water.

Interviews and workshops

We consulted with Victorian Government and industry stakeholders through 6 interviews and 4 workshops. These stakeholders are listed below.

Table A-1: Overview of Victorian Government and industry stakeholders

Victorian Government	
Department of Education	Department of Treasury and Finance
Department of Energy, Environment and Climate Action	Development Victoria
Department of Health	EcologiQ
Department of Justice and Community Safety	Major Transport Infrastructure Authority
Department of Premier and Cabinet	Office of Projects Victoria
	Victorian Health Building Authority

Department of Transport and Planning	Victorian School Building Authority

Industry

Acciona	Engineers Australia
Australasian Procurement and Construction Council	Green Building Council of Australia
Arcadis	Infrastructure Partnerships Australia
Arup	Infrastructure Sustainability Council
Aurecon	Jacobs
Australian Constructors Association	John Holland
Australian Flexible Pavement Association	KPMG
Australian Steel Institute	Laing O'Rourke
Business Council of Australia	Lendlease
Civil Contractors Federation Victoria	Materials and Embodied Carbon L'aders' Alliance
Cement Concrete and Aggregates Australia	Mott MacDonald
Climateworks Centre	Royal Institution of Chartered Surveyors
Consult Australia	Slattery
CPB Contractors	Transurban
Deloitte	Victorian Chamber of Commerce and Industry

Public submissions

We held a public submission process to help inform our advice. Submissions were open from 14 April 2023 to 14 May 2023.

Those who consented to their submission being published are listed below:

- Australian Steel Institute, in conjunction with BlueScope Steel and InfraBuild Steel
- Cement, Concrete and Aggregates Australia
- Cement Industry Federation
- Engineers Australia
- Green Building Council Australia
- Materials and Embodied Carbon Leaders' Alliance.

A summary of the submissions we received can be found in Appendix B. If we were given permission to do so, the submissions we received have also been published and can be found at our website.

Appendix B: Submissions summary

Infrastructure Victoria received 14 public submissions in relation to the Victorian Government's opportunities to reduce the greenhouse gas emissions of future public infrastructure investments. Of these 14 submissions 8 came from peak bodies and industry groups in fields such as construction and transport. A further 3 were from private companies involved in infrastructure development, the remaining three submissions were from a government organisation, an advocacy group, and a private individual. We would like to thank all organisations that engaged with us and provide submissions during the development of this advice.

Table B-1: Summary of submissions

Theme	Summary
Leadership	The Victorian Government has a leadership role in commissioning large-scale construction projects. Supporting industry and sending the right signals to support low embodied carbon solutions is an important role for government. The lack of whole-of-government action is a barrier to meeting its own stated policy goals. Government engagement with industry is an opportunity to develop and communicate policy intent, collaboratively design technical guidance, and apply carbon targets in early project phases. Public procurement can play a key leadership role here given public investment provides a major part of infrastructure spending.
Confirm commitment	The Victorian Government should align decarbonisation commitments with the existing Climate Change Pledge and Adaptation Plan. A new infrastructure emission reductions pledge could set targets, timelines and specify when net zero carbon will become mandatory in infrastructure. The government could also encourage industry pledges and self-monitored targets to create industry-wide commitment to decarbonisation.
Aligning practices	Most submissions from national and international organisations' recommend that policies and regulations align with national and global standards to reduce the cost burden of compliance across multiple contexts. However, some noted harmonised standards risk failing to account for Victoria's unique needs and context.
Circular economy (Whole-of-life)	The Victorian Government can reward and incentivise circular economy principles. Circular economy practices are the most effective pathway to reduce material-related emissions. Circular economy policies should include goals and incentives for reduced consumption of materials. These could be achieved with a 'Reduce First Policy' rather than the 'Recycle First Policy'. The government can prioritise non-build options and give greater consideration…to opportunities that reuse and repurpose existing infrastructure…Mitigating the need for new infrastructure builds is paramount. Victorian Government procurement and cost benefit analysis needs to consider the whole-of-life cost of decarbonisation. Procurements systems could accept higher upfront costs to achieve long term reduced emissions.

	The government can consider increasing project budgets to factor in the costs of innovative decarbonisation solutions. But accounting for lower carbon materials at the procurement stage can also reduce contractors' expenses. The government can build on the Australian Government's circular economy incentives such as the Recycling Modernisation Fund. It can also draw on interstate frameworks such as the South Australian Government's current circular economy work.
Pre-planning and whole of project planning	The Victorian Government can begin pre-planning for carbon risks and opportunities at the strategic planning stage of projects. Pre-planning and design phases can consider sustainable materials and techniques, providing sufficient lead time for delivery. This is an effective and cost-effective opportunity. The absence of sustainability considerations in current planning for road contracts is a barrier "preventing the realisation of sustainability initiatives across many forms of procurement and transport modes". Successful delivery is also more likely if the private sector is engaged in early project conception and pre-design. A lack of industry engagement in pre-planning and restrictive government standards or building specifications can constrain innovation. Interactive sessions during tender processes can help government and industry to work through sustainable and innovative modifications.
Clarity and consistency	Clear and consistent frameworks to quantify and monitor decarbonisation are important: "Provision of frameworks, tools and training could empower or incentivise planners to consider carbon in the early stage". Well-defined frameworks, tools, and training can incentivise private organisations and help them demonstrate they are meeting policy objectives. Consistent reporting standards can include shared data collection and auditing requirements, defined metrics and centralised data. Government tenders could include a pre-requisite for contractors to have their own decarbonisation pledge with published targets: "By being in the public realm…the head contractor is motivated to provide a credible and robust target and verifiable progress against it". Improved measurement and low carbon infrastructure key performance indicators could show the potential cost effectiveness of sustainable materials and encourage their adoption in private development.
Standards and specifications	The Victorian Government could publish low carbon emission project approvals and materials. This public knowledge sharing could encourage private industry to replicate innovative solutions and reduce the effort required to access information. Regulation and government procurement policies can "hinder the optimal use" of sustainable alternatives and make Victoria a more challenging development context. Overly restrictive targets can have unintended consequences such as an increased demand for imported rather than locally produced recycled steel. In high-cost contexts, the government could require contractors to identify their own alternative lower carbon materials. This may be more effective than targets. Performance-based specifications are another option.
Training and capacity building	Higher demand for decarbonisation will impact costs and industry capacity. The lack of industry capability, available information, skills and resources could be a

	barrier to wide-scale decarbonisation. The Victorian Government can support and drive market readiness through professional development and training.
Cost of decarbonisation	Cost effective solutions for reduced embodied carbon in infrastructure already exist. The Victorian Government can support research and awareness to improve quality and access to existing reduced carbon products. However, “the availability of low carbon products and services is limited in the Victorian region and the majority of low carbon products and services available comes at an extra CapEx cost." The government can consider ways to support the “supply-side issue of these products and services” in anticipation of increased demand and to reduce costs.
Incentives	Financial incentives such as tax relief and rebates are potential tools for collaboration and innovation. The Victorian Government can encourage best practice examples through awards. The government can use its purchasing power as an incentive for locally produced sustainable products.

Appendix C: Victorian policy and guidelines on carbon emissions

Key policies and guidelines

Multiple guidelines, policies and processes concerning investment decision-making, procurement and sustainability exist, see Table C-1. Our advice looks to expand and improve on these where appropriate.

Table C-1: Existing investment guidelines, policies and processes

Organisation	Policy	Rationale
Department of Treasury and Finance	*Investment Lifecycle and High Value High Risk Guidelines* (ILHVHR) [250]	The guidelines are applicable to any investment proposal (asset or output) and mandate the development of business cases for capital investments over $10 million. They apply to all government departments, corporations, authorities, and other bodies falling under the Financial Management Act 1994.
Department of Treasury and Finance	*Gateway Review Process* [251]	The assurance process examines projects and programs at 6 key decision points in their lifecycle. This process is mandatory for all projects deemed to be high value and high risk. The gateway review process involves: Gate 1: concept and feasibility Gate 2: business case Gate 3: readiness for market Gate 4: tender decision Gate 5: readiness for service Gate 6: benefit analysis.
Department of Treasury and Finance	*Economic Evaluation for Business Cases. Technical Guidelines* [252]	The guidelines supplement the ILHVHR guidelines and provide high level guidance for incorporating general environmental impacts. The guidelines state that a cost benefit analysis, where possible, should capture all welfare costs and benefits to society, including changes in carbon dioxide emissions generated by an activity or investment. The guidelines also provide recommendations on the specific discount rates that correspond with the category of investment.
Department of Treasury and Finance	*FRD24. Reporting of environmental data by government entities* (June 2022) [253]	The guidance requires reporting of scope 1 and scope 2 emissions for office-based government activities. It does not require mandatory reporting for scope 3 emissions.
Office of Project Victoria	*Sustainable Investment Guidelines* [254]	The guideline provides 'good practice' advice on how to incorporate sustainable investment considerations into project planning and delivery throughout the investment

		lifecycle.
Department of Treasury and Finance	*Investment Management Standard*[255]	The investment management standard is a comprehensive approach to investment decision-making. It involves a structured process of workshops that support organisations to identify evidence-based problems, evaluate the potential benefits of addressing those problems, establish meaningful key performance indicators, assess the feasibility of proposed solutions, and ensure adaptability to changing conditions. By following the standard, organisations can make sound investment decisions that align with their strategic goals and deliver valuable outcomes.
Department of Treasury and Finance	*Asset Management Accountability Framework*[256]	The framework outlines asset management requirements and responsibilities across the entire asset lifecycle. It includes mandatory requirements such as developing strategies, governance frameworks, and performance standards. It provides general guidance for agencies managing assets, including maintenance systems, performance monitoring, and addressing failures. The soon to be updated *Impact of Climate Change Guidance Note* will detail climate change considerations in line with the Victorian climate change related policy.
Department of Treasury and Finance	*Victoria's Social Procurement Framework*[257]	The framework aims to ensure that Victorian Government procurement considers social and sustainable outcomes that benefit the Victorian community. In the framework, the Victorian Government commits to achieving positive environmental outcomes through sustainable procurement. This helps to achieve value for money while minimising the impact on the environment.
Department of Treasury and Finance	*Evaluation Criteria* (Direction and Instruction 3.7)[258]	The guidance explains the requirement to prepare a tender evaluation plan and how to determine the tender evaluation criteria for public construction.
Victorian Government	*Recycle First Policy*[259]	The policy requires all tenderers on Victorian major transport projects to demonstrate how they will optimise the use of recycled and reused materials at the levels allowed under current standards and specifications.

Appendix D: Standards, rating schemes, tools and carbon values

Carbon emissions standards

Our research identified multiple standards that are adopted in Victoria, see Table D-1.

Organisational standards generally focus on emissions that organisations can directly control (scope 1 and 2). Project or asset level standards provide clear guidance on defining and measuring carbon emissions associated with infrastructure delivery. Product level standards quantify and measure carbon for materials in infrastructure projects.

Table D-1: Examples of carbon standards adopted in Victoria[260]

Type	Standards adopted in Victoria
Organisational standards	• The GHG Protocol Corporate Standard • ISO 14064-1 GHG Assessment Part 1 (Organisational level quantification) • The Climate Active Carbon Neutral Standard for Organisations
Project or asset level standards	• 14064-1 GHG Assessment Standard Part 2 (Project level quantification) • Climate Active Carbon Neutral Standard for Buildings • EN 15978 Sustainability in Construction Works (adopted for Green Star Lifecycle Assessments)
Product level standards and environmental labels	• The Climate Active Carbon Neutral Standard for Products • EN 15804 Sustainability of Construction Works

Carbon measurement and assessment tools

Our research identified various tools that are used in Victoria, see Table D-2.

Table D-2: Examples of lifecycle emission assessment tools adopted in Victoria[261]

Type	Tools commonly adopted in Victoria	Tools from other jurisdictions
GHG conversion / emissions factors	• DCCEEW National Greenhouse Account Factors • Australasian EPD Programme (product specific) • EPiC Database – Melbourne University	• UK GHG Conversion Factors • UK Transport Appraisal • Intergovernmental Panel on Climate Change Emission Factor Database

Guidance	• Transport Authorities Greenhouse Group (TAGG) GHG Assessment Workbook for Road Projects (2013)	• UK Department for Transport Quantifiable Carbon Reduction Guidance
Building and infrastructure specific tools	• Transport Authorities Greenhouse Group (TAGG) Carbon Gauge (2013) • IS Materials Calculator • Green Building Council of Australia Upfront Carbon Calculator	• Transport for NSW Carbon Estimate and Reporting Tool (CERT) • Waka Kotahi (NZ) Project Emissions Estimation Tool (PEET) • National Highways Carbon Tool (UK) • Klimatkalkyl “carbon calculation” (Sweden) • InfraLCA (Denmark)
Lifecycle assessment tools and databases	• Tool LCD* • OneClick LCA* • Tally* • Sima Pro Ecoinvent databases* **Offer BIM integration*	• OpenLCA • NorEnviro (database) • ICE database • CO2data.fi (database)

Table D-3: Sustainability rating tools used in Victorian infrastructure projects[262]

Sustainability rating tool / guidelines	**Adoption in Victorian public sector**
Infrastructure Sustainability Rating	• North East Link Project (NELP) • West Gate Tunnel Project • Suburban Rail Loop (SRL) • Projects CAPEX > $100million • Preliminary review for adoption by Victorian Water Corporations • LXRP, MRPV and Metro Tunnel projects
Green Star (Design and As Built, Building and Communities)	• Railway stations (LXRP and Metro Tunnel) • NELP and SRL operational control centres • Development Victoria • Office accommodation, social housing and used to benchmark institutional buildings (courts, police stations)
NABERS	• Office accommodation, hospitals

Carbon values and discount rates

Our research identified that Victorian delivery agencies use different carbon values and discount rates, see Table D-4.

Table D-4: Carbon values and discount rates used in Victorian infrastructure projects [263]

Project	Carbon value and discount rate	Source
Suburban Rail Loop, 2021	• $46/t CO2-e • 4% discount rate	• Austroads, Updating environmental externalities unit values, 2014
Evaluation of the Victorian 6-star housing standard, 2019 (DELWP)	• 2020: $28/t CO2-e • 2030: $71/t CO2-e • 2050: $213/t CO2-e • 7% discount rate	• The World Bank Carbon Pricing Dashboard • IPCC Fifth Assessment Report
North East Link, 2018	• $52.40/t CO2-e • 7% discount rate	• Austroads, Guide to Project Evaluation Part 4: Project Evaluation Data, 2012

Note: Values listed are in terms of the year of publication of the source document and are not adjusted to 2023 values

Appendix E: Contractual mechanisms to reduce carbon

In Recommendation 7, we recommend that government update standard form contracts to include minimum carbon reduction requirements for infrastructure projects. Table E-1 sets out key matters which government must consider when implementing carbon reduction mechanisms in contracts. Table E-2 sets out suggested contractual mechanisms to deliver emissions reduction.

Table E-1: Key considerations for inclusion of carbon reduction mechanisms in standard form contracts

Key consideration	Carbon reduction mechanism in standard form contracts
Alignment with business case, procurement frameworks and tender documentation	Contractual mechanisms included in standard form contracts must align with each of the recommendations in this report as implemented, most specifically recommendations 1, 2, 4, 6 and 8. For example, government must update pre-contract documents to align with decarbonisation objectives of the project so that bidders can accurately assess these matters from both a commercial and technical standpoint, for these matters to successfully flow through to the contract.
Alignment with technical and commercial requirements	Technical and commercial teams must be aware of, and collaborate with the legal team on, the proposed carbon reduction requirements for the project. Guidance of this nature should be included in the draft contract documents. For example, the commercial framework should embed carbon reduction matters in the pre-contract stage so that any financial incentives or Key Performance Indicators (KPIs) can appropriately be tied to performance. This is particularly important as enforcement of carbon related obligations may be difficult in practice.
Incremental steps and nuance for different project types	Some of the proposed carbon reduction contractual mechanisms may require significant upskilling and costs to comply (for example, for investment in new reporting systems and technology). It is therefore important that government takes appropriately incremental steps to assist suppliers to meet these new requirements. This does not mean that government should delay implementation of these updates to contracts, but rather should adapt the clauses as appropriate for the ambition of the project and current market capability.
Increased emissions data collection, reporting & project governance	Increasing data collection and more robust project reporting and governance structures relating to emissions reduction is often a first step in increasing decarbonisation ambition in infrastructure projects and to allow government to collect accurate and consistent emission data across projects. It is important to align these requirements with recommendations 1 and 2 in relation to carbon measurement. This will assist with upskilling the sector and allow organisations to invest in upgrading their reporting systems to meet this elevated expectation. It is important that these matters are included in contracts, even where

	there may not be a 'hard' emissions reduction obligation.
Mechanisms for further abatement as technology and practices evolve	The speed at which decarbonisation commitments and solutions are accelerating means that the decarbonisation ambitions of a project and technical solutions, when it is first being procured, may have significantly shifted by the time the project is under construction or being operated. As such government should ensure that contracts include mechanisms to rachet up ambition (without commercial disadvantage to the supplier, for example, through modifications to the project works) which prevent government from being locked into long term high-emitting contracts which may be inconsistent with updated commitments or elevated climate-related risks.
Risk allocation and enforcement mechanisms	The infrastructure sector has entrenched risk allocation practices, especially in respect of design and performance warranties that may extend for decades. Decarbonisation requires suppliers to innovate and so government must be prepared to adopt more collaborative testing and acceptance process, in addition to amended warranties for these innovations in the short term. Government should consider a range of appropriate enforcement and incentive mechanisms for carbon reduction in contractual obligations including liquidated damages, additional conditions to practical completion, enhanced defects regimes – and bonus, abatement and pain/gain share regimes.

Table E-2: Table of suggested contractual mechanisms

Contractual mechanism	Description	Recommendation for government
Reporting & governance measures		
Periodic emissions reporting (Delivery & Operations Phase)	This clause requires the supplier to provide periodic information on carbon emissions and emissions reduction matters during project delivery and operations. This clause should be included in all contracts – including where there are no specific emission reduction measures. Government should consider proactively setting a standard reporting format across projects so that data is gathered in consistent format and comparable across projects. This is a critical baseline requirement to enable government to track real emissions across infrastructure projects and assist with benchmarking projects across the sector. Additionally, this will enable suppliers to upskill in measurement and management of emissions. For example, see the Chancery Lane Project's *Olivia's Clause (Net Zero Obligations in FIDIC Engineering, Procurement and Construction (EPC) Contracts* (drafted for England & Wales law)*):*[264] The drafting mechanism in Olivia's Clause imposes obligations on	Mandatory – recommended for all projects

Contractual mechanism	Description	Recommendation for government
	contractors to, among other things, measure and calculate projected and total emissions in respect of the project, provide emissions reports to the principal annually and to engage an independent consultant to provide climate impact assessments and emissions reporting services to verify the contractor's measurements. Infrastructure NSW has also recommended in its NSW government discussion paper *Decarbonising Infrastructure Delivery* that embodied emissions reduction form part of contractor performance reporting to inform future target setting (see action 5.2).[265] See also the UK government's 2022 guidance note on *Promoting Net Zero Carbon and Sustainability in Construction*, which outlines mechanisms for carbon monitoring and reporting as part of broader emissions reductions strategies (in particular, see chapter 3.7).[266]	
Decarbonisation Management Plans (Delivery & Operations Phase)	This clause requires the supplier to prepare and submit a 'Carbon Management Plan' to government which sets out their proposed plan to manage and measure carbon during the project delivery / operations phase (depending on the type of supplier). This is an important governance mechanism to ensure that the supplier has an appropriately detailed plan to manage and abate carbon during the project. For example, see The Chancery Lane Project's *Rose's Clause (GHG Emissions Management Plans in Infrastructure and Construction Project Finance)* (drafted for England & Wales law):[267] The drafting mechanism in Rose's Clause makes the infrastructure or project finance conditional upon the principal or borrower developing and implementing a whole-of-life decarbonisation plan (which covers both the construction and operational phases). Infrastructure NSW has also recommended that, as part of the updates to standard contracts, contractors should be required to prepare carbon management plans to demonstrate how carbon reduction targets will be achieved (as a Key Performance Indicator with associated financial incentives) (action 4.2).[268]	**Mandatory** – recommended for all projects
Decarbonisation working group (Delivery & Operations Phase)	This clause requires the government and suppliers to establish a working group to meet to evaluate carbon reduction performance and to discuss opportunities for further carbon abatement on the project. This is an important mechanism to promote collaboration between the parties on carbon matters, as well as to provide a forum to discuss the performance against targets or	**Mandatory** – recommended for all projects

Contractual mechanism	Description	Recommendation for government
	other obligations (that is, with a view to manage and assess before significant issues arise). For example, see The Chancery Lane Project's *Zoe and Bea's Clause (Green Supplier Agreement Terms)* (drafted for England & Wales law):[269] This clause provides that the principal will establish a 'Greenhouse Gas and Carbon Emissions Group', being a forum for discussions between the parties in relation to emissions, reduction targets and other strategies for the achievement of carbon emissions reduction. While not a specific contractual mechanism, in the HS2 (High Speed 2 railway), a 'carbon collaboration group' has been established and is chaired by HS2 and attended by supply chain partners (chapter 6.3.20).[270] The carbon collaboration group is a forum for civil engineering and construction supply chain partners to discuss carbon reduction strategies and to drive continuous improvement for project outcomes.	
Emissions reduction measures		
Acknowledgement of government's emission reduction target & project emission reduction objectives (Delivery & Operations Phase)	This obligation may be included as an operative clause or as a recital to the contract to signal the importance of the government's decarbonisation objectives for the project and broader policy commitments. This clause does not necessarily impact on risk allocation under the contract, but assists in steering performance under the contract is a manner which is aligned with those emission reduction goals. For example, see The Chancery Lane Project's *Eddie's Recitals (Climate Recitals)* (drafted for England & Wales law):[271] This clause sets out relevant climate change-related and net zero recitals. While non-binding, the recitals elevate climate change-related issues as a key consideration and signifies the parties' overarching intentions for the performance of their contractual obligations.	**Mandatory** – recommended for all projects
Broad obligation to assist progress toward the government's emission reduction targets (Delivery & Operations Phase)	This clause requires the supplier to perform its obligations under the contract in a manner that assists the government to meet its broad emission reduction objectives. This clause can either be a broad obligation from the supplier to perform activities under the contract in a manner which promotes emissions reduction or can include a specific list of carbon reduction measures the supplier will employ to assist with meeting such targets. For example, see The Chancery Lane Project's *Owen's Clause (Net Zero Target Supply Chain Cascade)* (drafted for England & Wales law):[272] Whilst the clause	Mandatory – recommended for all projects

Contractual mechanism	Description	Recommendation for government
	is directed to passing through the principal's net zero targets and obligations to their supply chain and contractors which contribute to the principal's own carbon emissions (e.g. such as the materials procured for a construction project which would be considered scope 3 emissions), the clause also sets out a number of reduction measures which the supplier must take to achieve its net zero target date (being tied to the principal's own net zero target). Additionally, the UK Environment Agency's (EA) Thames Estuary Asset Management Programme (TEAM2100), an integrated delivery team focussing on flood management, has implemented contractual mechanisms (inspired by The Chancery Lane Project clauses) to require contractors to deliver against sustainability objectives, including carbon reduction and the use of circular economy materials.[273]	
Carbon baseline (budget) (Delivery phase)	This clause requires the supplier to carry out the project (applicable to design, construction and operations, as appropriate) so that the specified 'Carbon Budget' is not exceeded. For example, for the construction phase, this clause would require the parties to establish a genuinely ambitious baseline for carbon across the delivery phase which covers embodied carbon up to completion (which can be on an absolute or intensity basis depending on the type of services). It is important include appropriate incentivisation mechanisms in the contract to motivate the suppliers to meet the baseline. This can be achieved through pain/gain share mechanisms, linking the performance against the budget to the KPI framework or the financing arrangements (for example, through a green loan with a margin adjustment trigger for performance against the baseline). For example, see the Chancery Lane Project's *Tristan's Clause (Construction Materials: Procurement)* (drafted for England & Wales law):[274] Tristan's Clause sets a 'carbon' budget for the materials procured for a construction project. Tristan's Clause can be used alongside the financial 'budget' for the project to incentivise contractors to reduce the embodied carbon emissions across the project lifecycle.	Optional to begin then mandatory across all projects over time as capacity and capability increases
Modifications and enforcement matters		
Modifications for Emissions Reduction (Delivery &	This clause would introduce a positive obligation on the supplier to propose variations where new innovations and technologies facilitate further emissions reductions	Mandatory – recommended for all projects

Contractual mechanism	Description	Recommendation for government
Operations Phase)	(similar to the 'value engineering variations' mechanism). This would follow the typical process under the contract for a variation which would allow the supplier to price the variation and propose an adjustment to the time for completion accordingly for the government's approval). A regime should also be included that requires the supplier to comply with any increases to government ambition on emissions reduction, in line with elevated policy measures, over the life of the project with relief available via the variation mechanism for time and cost impacts (similar to the 'change in law' mechanism). For example, see The Chancery Lane *Project's Luna's Clause (Net Zero Aligned Construction Modifications)* (drafted for England & Wales law):[275] The drafting mechanism in Luna's Clause provides a specific framework for contractors to propose sustainable net zero aligned modifications to the project works. Luna's Clause can be used to encourage contractors to propose and implement sustainable construction solutions during the delivery phase. UK law firm Foot Anstey has introduced Luna's Clause for its clients to incentivise 'Net Zero Modifications' to project works, particularly those with a longer delivery schedule.[276]	

Appendix F: Complete action plan

Figure F-1 shows the actions and interdependencies for all 10 recommendations across the four implementation stages: foundational, business case, procurement, assurance.[277]

Figure F-1
Complete action plan

Foundational

Recommendation	Policy and strategy development	Implementation phase 1	Implementation phase 2	Scaling and continuous improvement
1 Adopt a carbon management standard like *PAS 2080:2023 Carbon management in buildings and infrastructure* to measure and manage carbon emissions and modify as needed to embed in Victoria.	1.1 Identify the preferred carbon management standard for Victoria. 1.2 Adopt PAS 2080 as interim guidance on carbon management for voluntary use by Victorian Government departments and agencies.	1.3 Publish the selected guidance for carbon quantification and management.	1.4 Introduce a materiality test to evaluate carbon impacts of projects and programs, and update guidance to mandate carbon quantification, management and reporting for projects with material carbon emissions.	1.5 Expand thresholds within the materiality test over time to capture all projects and programs with material carbon impacts.
2 Implement the same carbon measurement approach as New South Wales and deliver training across the Victorian Government.	2.1 Agree to adopt carbon measurement approach and standard emission factors. 2.2 Evaluate skills gap and training requirements for government and industry. 2.3 Establish a Victorian Government community of practice on infrastructure decarbonisation to facilitate knowledge-sharing and collaboration.	2.4 Implement carbon quantification approach and guidance with standard emission factors. 2.5 Integrate carbon reporting and management into digital engineering processes. 2.6 Develop and deliver training programs for government employees on net zero planning and technologies. 2.7 Pilot lifecycle carbon quantification approach and seek feedback from government and industry stakeholders.		
3 Initially adopt a carbon value of *at least* $123 per tonne and then update to reflect values required to achieve Victorian emissions reduction targets.	3.1 Initially adopt an interim carbon value of at least $123 per tonne. 3.2 Calculate the carbon values required to achieve Victoria's specific emissions reduction targets by using a target consistent approach.	3.3 Publish guidance on carbon valuation, including indexation over time, sensitivity tests and discount rates.		3.4 Review and update carbon valuation every 5 years.

Critical
Supplementary

Business cases

Recommendation	Policy and strategy develoment	Implementation phase 1	Implementation phase 2	Scaling and continuous improvement
4 Update business case guidelines and templates to integrate emissions reduction.	4.1 Require business cases to include a descriptive estimate of carbon emissions, assess the impact using the interim carbon value and outline emission reduction options in line with the carbon reduction hierarchy.	4.2 Require all projects and programs to describe alignment with state or sector emissions targets. 4.3 Require all projects and programs to develop descriptive carbon management plans, detailing considerations of emissions avoidance, reduction, mitigation or offset.	4.4 Require quantitative assessment of carbon emissions over the lifecycle for projects and programs that meet the emissions materiality threshold. 4.5 Require carbon reduction targets set against a given baseline. 4.6 Require quantitative assessment of impacts on sector and state emissions targets. 4.7 Require all projects and programs with material emissions impacts to develop quantitative carbon management plans.	
5 Measure carbon in infrastructure cost benefit analysis and make decisions that reduce emissions.			5.1 Require projects and programs with material emissions impacts to value lifecycle carbon emissions in the cost benefit analyses.	

Critical
Supplementary

Procurement and delivery

Recommendation	Policy and strategy development	Implementation phase 1	Implementation phase 2	Scaling and continuous improvement
6 Update procurement frameworks and guidance to embed carbon reduction in tenders.	6.1 Determine how to change the current public infrastructure procurement frameworks to effectively consider carbon emissions.	6.2 Update the procurement frameworks, guides and templates to include more detailed guidance and requirements for decarbonisation, including: – Minimum carbon reduction as a tender requirement. – Tender document templates and evaluation criteria that clearly communicate carbon reduction outcomes. – Methods to promote alternative carbon reduction mechanisms during procurement.	6.3 Update procurement templates to include mandatory carbon reduction targets from a set baseline. 6.4 Incorporate carbon valuation into procurement processes to assess the value for money of decarbonisation measures.	
7 Update standard form contracts to include carbon reporting, abatement requirements and further reduction opportunities.		7.1 Include mechanisms for additional carbon abatement in standard form contracts. 7.2 Add incentives within standard form contracts for suppliers to further reduce emissions. 7.3 Develop requirement for descriptive carbon management plans within standard form contracts, with some measurement and reporting.	7.4 Establish carbon reporting requirements within standard form contracts for projects and programs with material carbon impacts. 7.5 Update government standard form contracts to include minimum carbon reduction requirements. 7.6 Develop requirement for quantitative carbon management plans within standard form contracts for projects and programs with material carbon impacts.	
8 Establish carbon management prequalification requirements for government contracts.		8.1 Collaborate with industry to determine prequalification requirements for Victorian Government contracts and signal future changes.	8.2 Establish prequalification requirements for government contracts with material carbon impact over predetermined threshold.	8.3 Reduce prequalification threshold over time.
9 Support industry to develop zero or low emissions solutions by testing alternative materials and adopting performance-based standards.		9.1 Review existing platforms for low carbon construction innovations to determine gaps and opportunities. 9.2 Review standards and specifications to determine barriers and opportunities to reduce carbon.	9.3 Collaborate with industry and other jurisdictions to establish or further develop low carbon construction innovation platform. 9.4 Establish a government fund to support research and development and pilot programs to drive innovation in industry. 9.5 Update standards and specifications to better enable low carbon solutions to be used.	9.6 Periodically review standards and specifications aligning with technological advancements.

Critical
Supplementary

Assurance

Recommendation	Policy and strategy develoment	Implementation phase 1	Implementation phase 2	Scaling and continuous improvement
10 Update assurance processes to include carbon emissions.		10.1 Update project assurance checks to reflect changes in investment lifecycle and asset management processes.	10.2 Require carbon emission reporting in benefit management plans in all projects and programs with material emissions impacts that are required to measure lifecycle emissions.	10.3 Review performance and develop a register of carbon benchmarks to assist in the setting of carbon baselines.

Critical
Supplementary

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Sustainability note

Infrastructure Victoria is committed to reducing its impact on the environment. This report is available in PDF and Word format only.

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Infrastructure Victoria

Opportunities to decarbonise Victorian Government infrastructure

/ DESIGN FOR A BETTER FUTURE

SUBMITTED BY WSP // MAY 2023

Question today
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Opportunities to decarbonise Victorian Government infrastructure

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Table of contents

Abbreviations

AMAF	Asset Management Accountability Framework
ATAP	Australian Transport Assessment and Planning
BCR	Benefit cost ratio
CBA	Cost benefit analysis
DEECA	Department of Energy, Environment & Climate Action
DfT	Department for Transport (United Kingdom)
DTF	Department of Treasury and Finance
EES	Environment effects statement
EPR	Environmental performance requirements
EU	European Union
FRD	Financial Reporting Directions
GHG	Greenhouse gas
HVHR	High value, high risk
ILHVHR	Investment lifecycle and high value high risk
INSW	Infrastructure New South Wales
KPI	Key performance indicator
LXRP	Level Crossing Removal Project
MRPV	Major Road Projects Victoria
MTIA	Major Transport Infrastructure Authority
NABERS	National Australian Built Environment Rating System
NELP	North East Link Program
NPV	Net present value
NSW	New South Wales
NZ	New Zealand
RICS	Royal Institution of Chartered Surveyors
RPV	Rail Projects Victoria
SOCC	Social Opportunity Cost of Capital
SRL	Suburban Rail Loop
SRTP	Social Rate of Time Preference
t CO2-e	Tonnes of carbon dioxide equivalent
TfNSW	Transport for New South Wales
UK	United Kingdom
VHBA	Victorian Health Building Authority

Overview

BACKGROUND AND PROJECT CONTEXT

The Victorian Government has committed to achieving net zero greenhouse gas (GHG) emissions by 2050, as legislated in the *Climate Change Act 2017* [1], and has stated ambitions to achieve net zero even earlier by 2045 [2]. It has set interim targets to reduce emissions by 28-33% below 2005 levels by 2025 and by 45-50% below 2005 levels by 2030.

Infrastructure Victoria is advising the Victorian Government on how best to decarbonise the emissions associated with public infrastructure to support the state's net zero targets.

PURPOSE OF THIS REPORT

This report serves as an input to Infrastructure Victoria's advice to government, and identifies opportunities to consider carbon emission reductions at the business case and procurement stages of infrastructure projects commissioned by the Victorian Government.

This report consists of three parts as shown in Figure 1.

Figure 1: *Project approach*

THE NEED TO DECARBONISE PUBLIC INFRASTRUCTURE

Re-shaping infrastructure for a net zero emissions future (2020) [3] shows that up to 70% of Australia's annual GHG emissions are directly or indirectly attributed to infrastructure across its lifetime comprising:

- Embodied or capital emissions - often referred to as embodied carbon and released during the manufacture, transport, construction, maintenance and renewal and end of life phases of all built assets.
- Operational emissions – released through the activities to operate an asset, for example when using non-renewable energy in operational activities.
- User or enabled emissions – released when customers use assets and generate carbon emissions (e.g., driving petroleum-fuelled vehicles on a public road).

User emissions have for some time been a focus for decarbonisation efforts, in part because they account for about 78% of infrastructure-related emissions compared to 13% for operational and 9% for embodied.

Until recently embodied emissions commanded little attention, however this is changing as jurisdictions move to deeper, targeted reductions in carbon. Unlike enabled emissions most embodied emissions are released before operation and preventing them requires action early in the lifecycle of infrastructure.

There is also a need for a framework designed to comprehensively measure carbon emissions associated with infrastructure and historically frameworks oriented around an organisation do not achieve this.

STATE OF PLAY SUMMARY

Table 1 summarises Victoria's current state of play in decarbonising infrastructure across a number of key themes, and identifies limitations compared to leading practices from national and international jurisdictions.

Table 1: *Leading examples compared to Victoria's state of play*

Theme	Leading examples	Victorian state of play
Leadership 	The United Kingdom *Climate Change Act 2008* demonstrates strong leadership in climate action and decarbonisation, with a comprehensive legislative framework that holds the government accountable for meeting emissions reduction targets and forces the government to demonstrate how its current policies and investments will put them on track to meet those targets. Prioritisation of decarbonisation from senior levels of government has driven change at the department and agency level, leading to a coordinated and effective approach to emissions reductions.	In Victoria, there are emissions reduction targets and sector pledges established by legislation, which demonstrate the state's commitment to reducing the risks of climate change. In Victoria various departments and agencies are working on emissions reduction measures within their respective domains. While there is some level of coordination and collaboration, the overall implementation of measures is not fully consolidated, resulting in a more fragmented approach.
Non-build and low-carbon solutions 	The Welsh Government exemplifies strong commitment to non-build solutions in infrastructure planning. In 2023, the Welsh Government announced the scrapping of nine major road projects in favour of more carbon-friendly alternatives after a year-long review. This decision demonstrates a clear prioritisation of low-carbon transport options, including public transport, walking, and cycling. The Welsh Government has committed to only considering future road infrastructure investments that reduce carbon emissions and support shift towards sustainable transport.	Non-build and low-build solutions are considered in the planning process for infrastructure projects, but the extent to which they are prioritised varies across different agencies and projects. Although guidance for assessing non-build and low-carbon solutions exists, it's introduced too late in the evaluation process. Effective consideration requires exploring alternative service delivery solutions at the strategic level or concept and feasibility stage, broadening the range of options before the business case. Additionally, stronger leadership commitment is needed for consistent evaluation and implementation of these solutions.
Carbon quantification guidance 	The United Kingdom's *PAS 2080 Carbon Management in Infrastructure Standard* and Royal Institution of Chartered Surveyors *Whole-of-Life Carbon Assessment for the Built Environment* both provide a consistent and detailed methodology for assessing carbon emissions across the lifecycle of infrastructure projects. Both are based on the European Standard, EN 15978 Sustainability in Construction Works Standard, which is already adopted for Green Star Life Cycle Assessments in Victoria.	Victorian projects and agencies have adopted a range of guidance and standards relating to carbon quantification, but these do not always consider whole-of-life carbon and are inconsistently applied. Standards are also not mandated but voluntarily adopted, such as those referred to in sustainability rating tools like Green Star and the IS Rating tool. Different agencies use different methodologies or datasets, leading to varying levels of accuracy and comparability in emissions estimates.
Capability and tools 	Globally, the UK demonstrates best practice in capability and tools with a range of resources available for central government (GHG conversion factors), UK Department for Transport *(Quantifiable Carbon Reduction Guidance)* and National Highways (Carbon Emissions Reporting Tool, industry webinars, e-learning training programme). Within Australia, Transport for New South Wales has developed suite of tools, guidelines, and training programs to build capability in carbon management. These include the Sustainable Design Guidelines and supporting tools, the Carbon Estimate Reporting Tool, and the Climate Risk Assessment tool.	Victoria has made progress in building capabilities and tools for carbon management, but the availability and adoption of these resources are not yet consistent across all agencies and sectors. Government stakeholders identified the need for upskilling across all levels of government to ensure policy makers, project developers and procurement officers are more effective in driving decarbonisation outcomes. The state will benefit from development and standardisation of tools, training programs, and knowledge-sharing initiatives.

Theme	Leading examples	Victorian state of play
Carbon valuation 	The UK's Department for Business, Energy & Industrial Strategy published a policy paper [4] providing a consistent approach to valuing carbon emissions across all government departments and agencies in cost-benefit analysis. This guidance includes a specific list of time series values for projects, ensuring accuracy and consistency in carbon valuation. The guidance is based on a target consistent approach which aligns the value of carbon with the cost of abatement to achieve its legislated emissions targets. Periodically updated, it serves as a model for Australia and Victoria to adopt a uniform approach for effective climate change mitigation efforts.	In Victoria, there is no government-wide approach to valuing carbon emissions in infrastructure projects. The DTF *Economic Evaluation Guidelines* do not provide specific guidance on carbon valuation for business cases, and other available resources, such as the Australian Transport Assessment and Planning (ATAP) economic parameters, are outdated relative to the latest evidence and practice. As a result, the methodologies and assumptions used for carbon valuation may vary across different projects and agencies, leading to discrepancies in the perceived costs and benefits of emissions reduction measures.
Business case guidelines 	NSW Treasury updated the NSW *Government Guide to Cost-Benefit Analysis (TPG23-08)* to provide guidance on including carbon emissions in CBAs and business cases. The guidelines provide a clear framework for incorporating carbon emissions into CBAs and business cases, ensuring that the environmental impacts of projects are consistently considered.	Victoria's business case guidelines do not explicitly require comprehensive whole-of-life carbon quantification, valuation, and management considerations. While the *Sustainable Investment Guidelines* (SIGs) provide 'good practice' advice on considering decarbonisation in investment decisions, they do not set any requirements. As a result, the degree to which emissions reduction measures are integrated into project development and decision-making processes is not consistent across projects and agencies.
Procurement frameworks and templates 	The EU's *Green Public Procurement framework* provides detailed guidance and criteria for public authorities to consider when making procurement decisions, specifically addressing emissions reduction and management. It includes recommendations for consulting the market for zero or low-carbon materials, specifying embodied emissions criteria for materials used in construction, and evaluating tenders based on emissions reductions alongside cost and risk.	*Victoria's social procurement framework* and associated templates provide some consideration of environmental sustainability factors (e.g. energy efficiency, water conservation, waste management, GHG emissions, and the use of recycled materials). However, they do not consistently address or prioritise emissions reduction and low-carbon solutions.
Standard contracts 	Well-resourced delivery agencies for major transport projects, such as those managed by Transport for NSW and Sydney Metro Authority, have clear targets and requirements are embedded in contracts to drive reductions. Contractors are required to align procurement practices with sustainable procurement standards (such as ISO 20400) and include carbon considerations in tender evaluation. Contract mechanisms also exist to allow for and incentivise carbon reductions.	Some contracts for transport agencies and VHBA include clauses with carbon reduction targets, such as those for the Level Crossing Removal Project and Rail Project Victoria projects. These are generally voluntary and nominated by the delivery agencies, and often linked to sustainability ratings. However, specific requirements for reducing emissions are not universally incorporated or enforced to drive the required decarbonisation outcomes.

PROPOSED INTERVENTIONS

This report, informed by contributions from government and industry stakeholders, proposes 10 interventions to address the gaps identified in the state of play review.

Foundational interventions

Intervention 1
Develop consistent guidance on whole-of-life carbon quantification and management
Standardise procedures for quantifying and reporting carbon emissions, providing the information needed to monitor progress and improve the understanding of the emissions associated with public infrastructure.

Intervention 2
Develop decarbonisation capability and tools
Equip government agencies and industry with the knowledge, skills, and tools needed to effectively reduce the emissions in public infrastructure.

Intervention 3
Adopt a Victorian Government approach to valuing carbon across the project lifecycle
Establish a consistent, evidence-based carbon valuation approach and provide guidance for its application throughout the project lifecycle.

Business case interventions

Intervention 4
Consider carbon emissions in business case guidelines and templates
Require business cases to estimate whole-of-life carbon emissions, detail alignment with Victoria's decarbonisation objectives and targets, and describe carbon avoidance, reduction, mitigation, and offset strategies.

Intervention 5
Value carbon in cost benefit analysis
Ensure that the full impacts of carbon emissions are adequately considered alongside other economic costs and benefits by requiring projects and programs to value emissions in their CBAs.

Procurement and delivery interventions

Intervention 6
Update procurement frameworks and guides to better consider decarbonisation outcomes
Provide more specific direction on decarbonisation requirements (e.g setting minimum carbon reductions from a baseline) and establish a more robust approach to consider decarbonisation in procurement through tender evaluation criteria and bid-back processes.

Intervention 7
Update standard contracts to include minimum carbon reduction requirements and other incentives
Promote sustainable infrastructure development by integrating carbon reduction requirements into contracts, setting clearer expectations for suppliers, and ensuring that they align their practices with government objectives.

Intervention 8
Establish prequalification requirements for government contracts
Ensure that contractors possess the necessary experience, knowledge, and commitment to decarbonisation, promoting a competitive market that consistently works towards lowering carbon emissions in government infrastructure projects.

Intervention 9
Support the development of decarbonisation innovations across industry
Expand the use of low-carbon materials and practices in government commissioned infrastructure through the update of standards and specifications (performance-based standards) and learning from the successful implementation of low carbon solutions.

Assurance intervention

Intervention 10
Update assurance processes to include carbon emissions
Improve accountability and transparency in investment decision-making by incorporating carbon emissions considerations into assurance processes and by monitoring emissions across the project lifecycle.

IMPLEMENTATION FRAMEWORK

Figure 5 (next page) provides a framework for the implementation of the interventions proposed in this report. The framework conceptualises how the proposed interventions can be categorised and implemented in stages over time, as well as the overarching principles that should be followed to promote the effective decarbonisation of Victorian Government infrastructure.

Overarching principles serve as guiding themes and are applicable to all proposed interventions across all implementation stages.

Figure 2: *Overarching principles*

Intervention categories include four clearly defined types: foundational, business case, procurement and delivery, and assurance. Foundational interventions impact the entire project lifecycle, while the others focus on specific project stages.

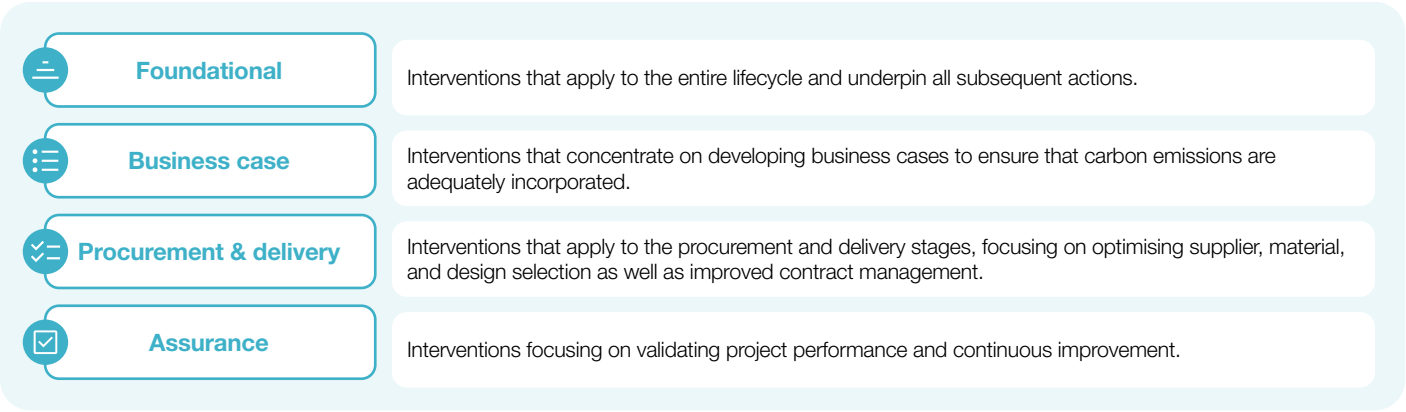


Figure 3: *Intervention categories*

Implementation stages guide the logical sequencing of actions over time.

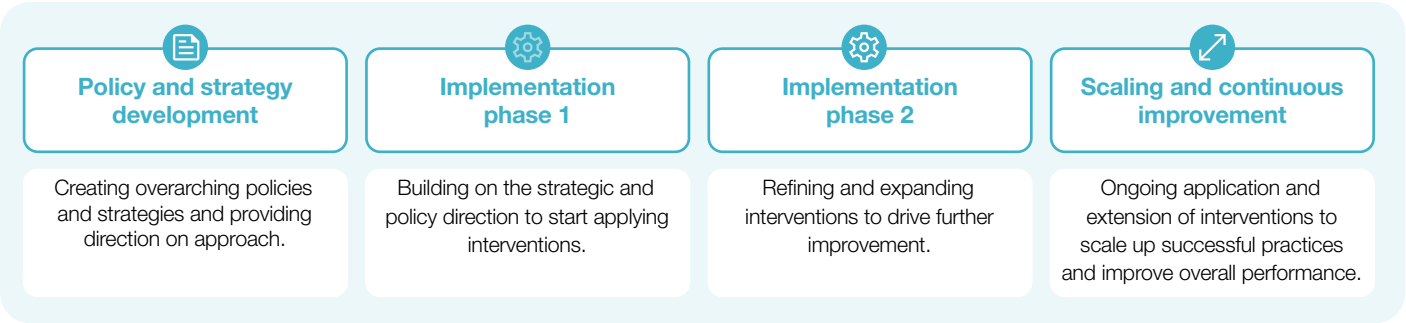


Figure 4: *Implementation stages*

Figure 5 illustrates the implementation framework and summarises the nature of the activities that occur within each intervention category and across the implementation stages.

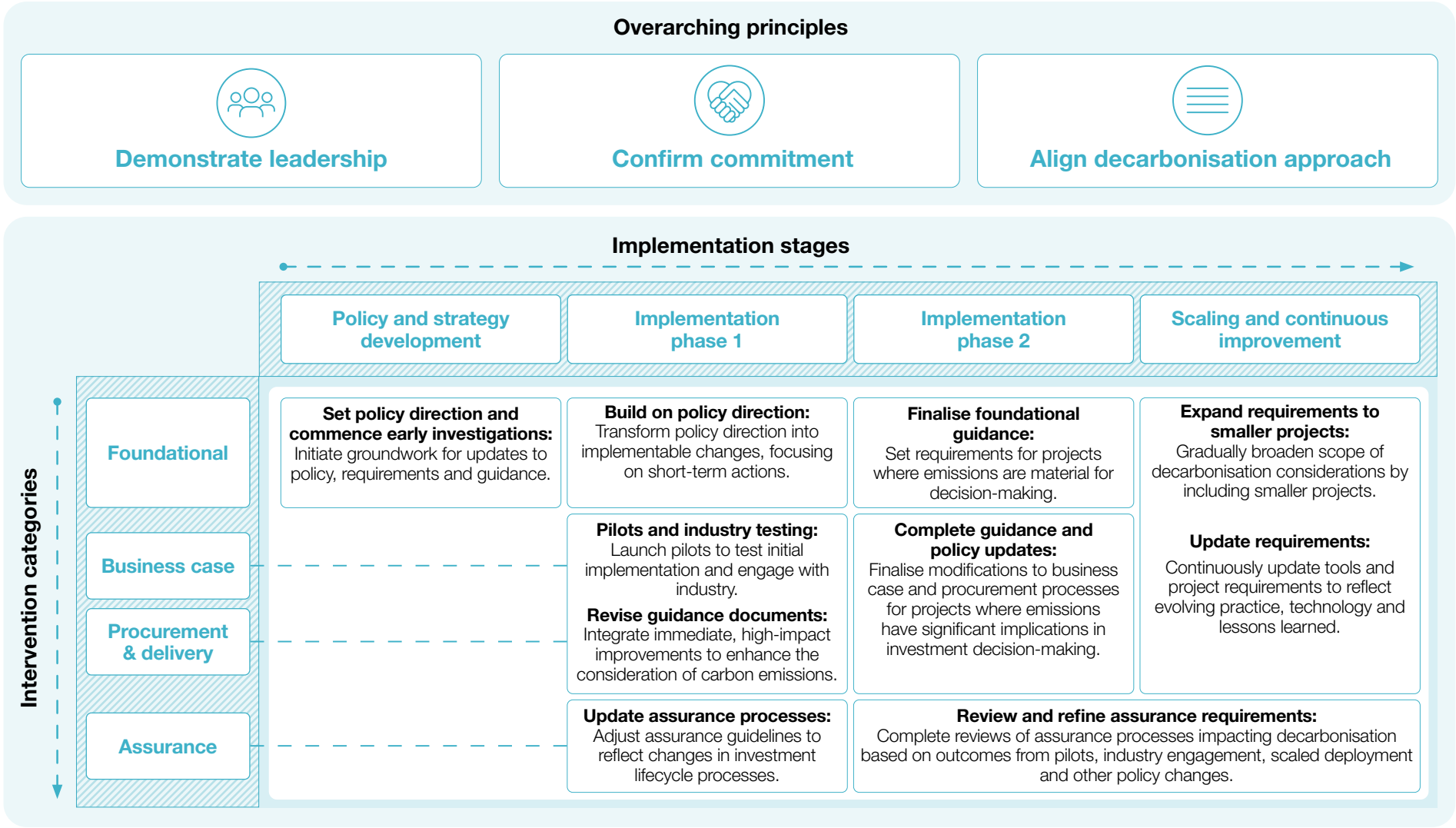
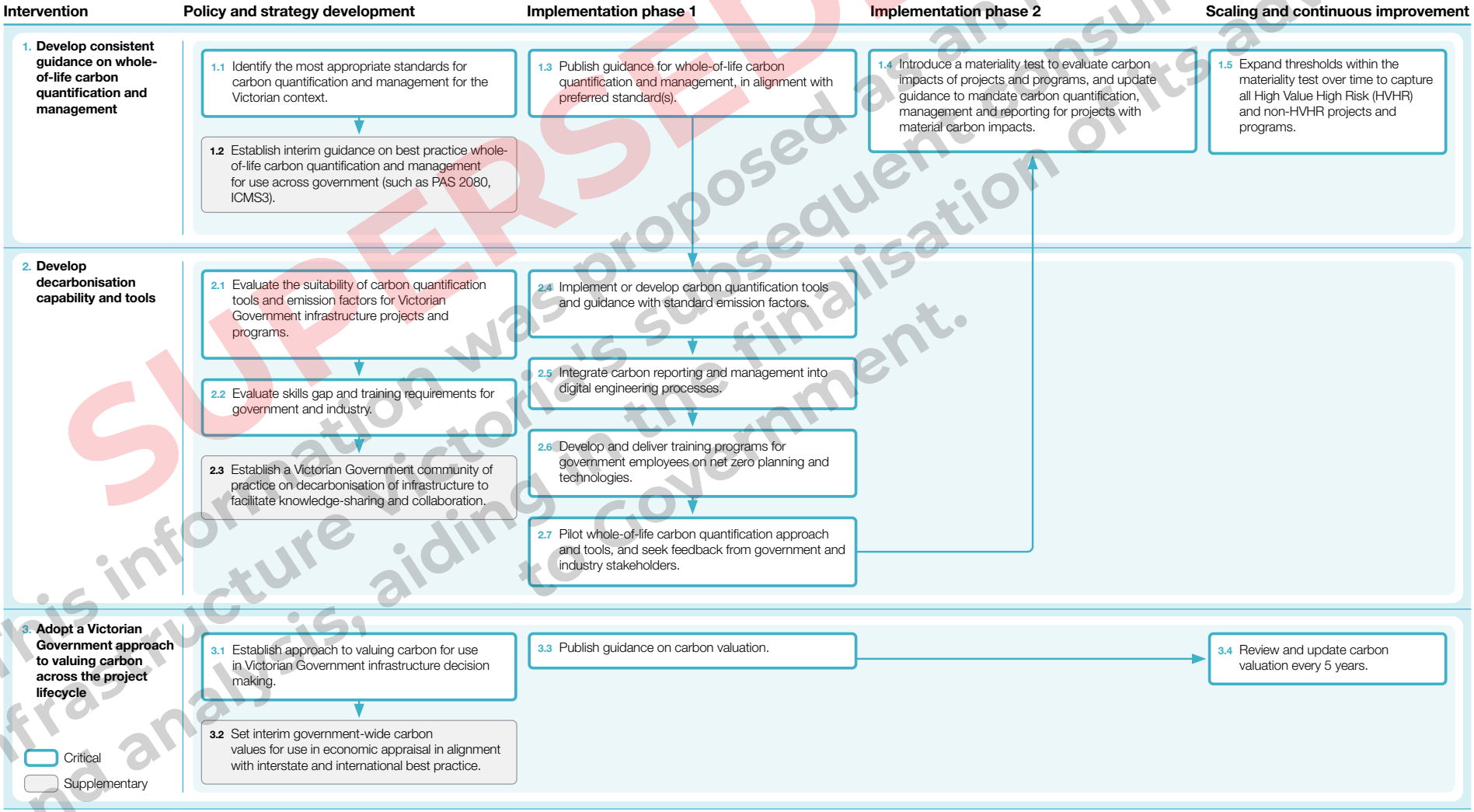


Figure 5: *Implementation framework*

PROPOSED IMPLEMENTATION PLAN

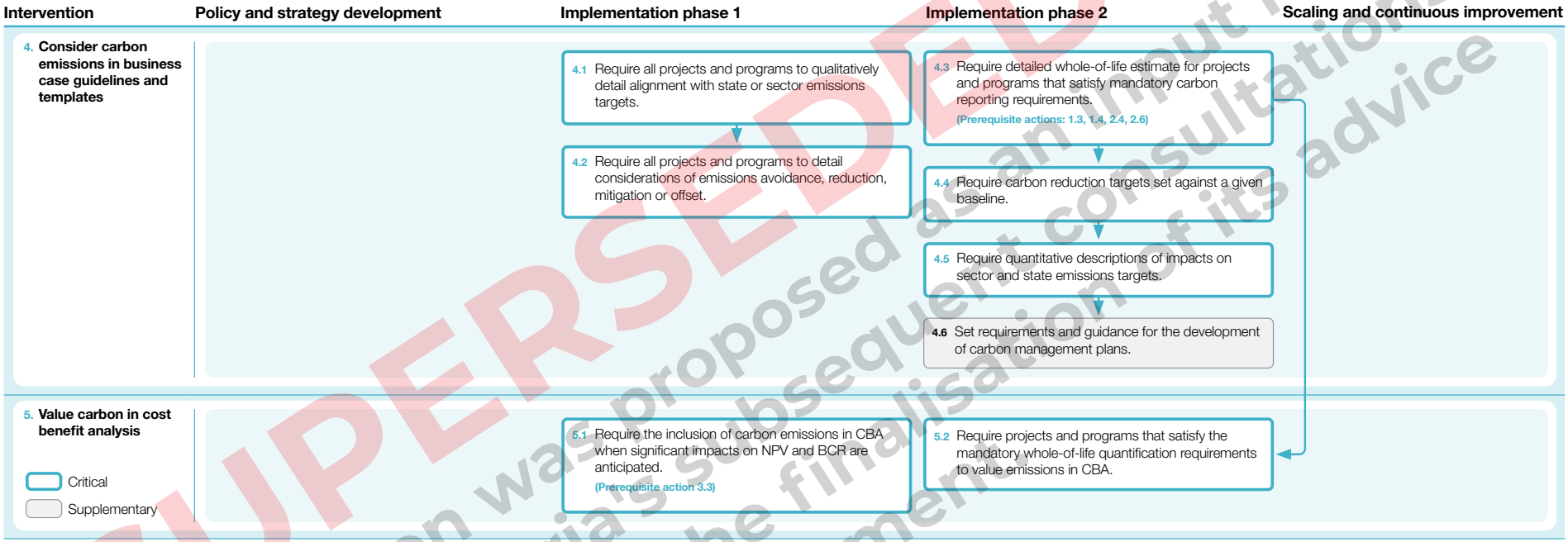
The implementation plan provides a detailed sequence of actions for the 10 proposed interventions across four implementation stages. The figures below highlight critical actions, which are crucial for Victoria to achieve its decarbonisation objectives, and supplementary actions that, although not on the critical path, will offer additional support and accelerate Victoria's decarbonisation efforts. For more information, refer to the detailed intervention descriptions in Section 4.5, which outlines the scope of the interventions and their corresponding actions, associated opportunities and challenges, and leading examples from other jurisdictions.

Foundational interventions



PROPOSED IMPLEMENTATION PLAN

Business case interventions



IMPLEMENTATION PLAN

Procurement interventions

Intervention	Policy and strategy development	Implementation phase 1	Implementation phase 2	Scaling and continuous improvement
6. Update procurement frameworks and guides to better consider decarbonisation outcomes	6.1 Determine how to change the current public infrastructure procurement framework to effectively consider carbon emissions.	6.2 Update the procurement framework, guides and templates to include more detailed guidance and requirements for decarbonisation, including: – Tender evaluation criteria – Methods to promote alternate carbon reduction offers during procurement (e.g bid-back processes) – Tender document templates that clearly communicate carbon reduction outcomes.	6.3 Update procurement templates to include mandatory carbon reduction targets from a set baseline. (Prerequisite actions: 1.3, 2.4, 2.6, 4.5) 6.4 Incorporate carbon valuation into procurement processes to assess the value for money of decarbonisation measures. (Prerequisite actions: 3.3)	
7. Update standard contracts to include minimum carbon reduction requirements and other incentives		7.1 Include mechanisms for additional carbon abatement offers to be considered in standard form contracts. 7.2 Add incentives within contracts for suppliers to further reduce emissions.	7.3 Establish carbon reporting requirements within standard form contracts for projects and programs with material carbon impacts. 7.4 Update government procurement contracts to include minimum carbon reduction requirements. 7.5 Require carbon management plans for projects and programs with material carbon impacts.	
8. Establish prequalification requirements for government contracts		8.1 Collaborate with industry to determine prequalification requirements for Victorian Government contracts and signal future changes.	8.2 Establish prequalification requirements for government contracts over predetermined threshold.	8.3 Reduce prequalification threshold over time.
9. Support the development of decarbonisation innovations across industry		9.1 Review existing platforms for low carbon construction innovations to determine gaps and opportunities (e.g. supplier registers/products forums). 9.2 Determine barriers and opportunities to reduce carbon in standards and specifications.	9.3 Collaborate with industry and other jurisdictions to establish or further develop low carbon construction innovation platform. 9.4 Establish a government fund to support R&D and pilot programs to drive innovation in industry. 9.5 Update standards and specifications to better enable low carbon solutions to be used (i.e., performance based standards).	9.6 Periodically review standards and specifications aligning with technological advancements.

Critical

Supplementary

IMPLEMENTATION PLAN

Assurance interventions

Intervention	Policy and strategy development	Implementation phase 1	Implementation phase 2	Scaling and continuous improvement
10. **Update assurance processes to include consideration of carbon emissions**		10.1 Update assurance requirements to reflect changes in investment lifecycle and asset management processes.	10.2 Require carbon emission reporting in benefit management plans in all projects and programs that satisfy the mandatory whole-of-life quantification requirement.	10.3 Review performance and develop a register of carbon benchmarks to assist in the setting of carbon baselines.

Critical

Supplementary

IMPLEMENTATION TIMING

In recognition of the challenges associated with implementing the proposed interventions, various timelines have been developed to accommodate the necessary consultation with different levels of government.

These timelines are crucial in ensuring thorough and effective implementation, as well as providing the opportunity to align with other leading jurisdictions, such as New South Wales, to offer consistent guidance for industry stakeholders operating across state boundaries.

The three implementation scenarios, **Leading, Measured, and Lagging**, represent distinct approaches to the implementation timeline:

- **Leading:** entails an implementation plan from 2023 to 2027, allowing Victoria to rapidly align with other progressive jurisdictions.
- **Measured:** involves a more conservative approach, spanning 2023 to 2028, permitting additional time for planning, trialling, and gradual implementation.
- **Lagging:** covering 2023 to 2030, entails a delayed response, as Victoria adopts the development of practices in other jurisdictions.

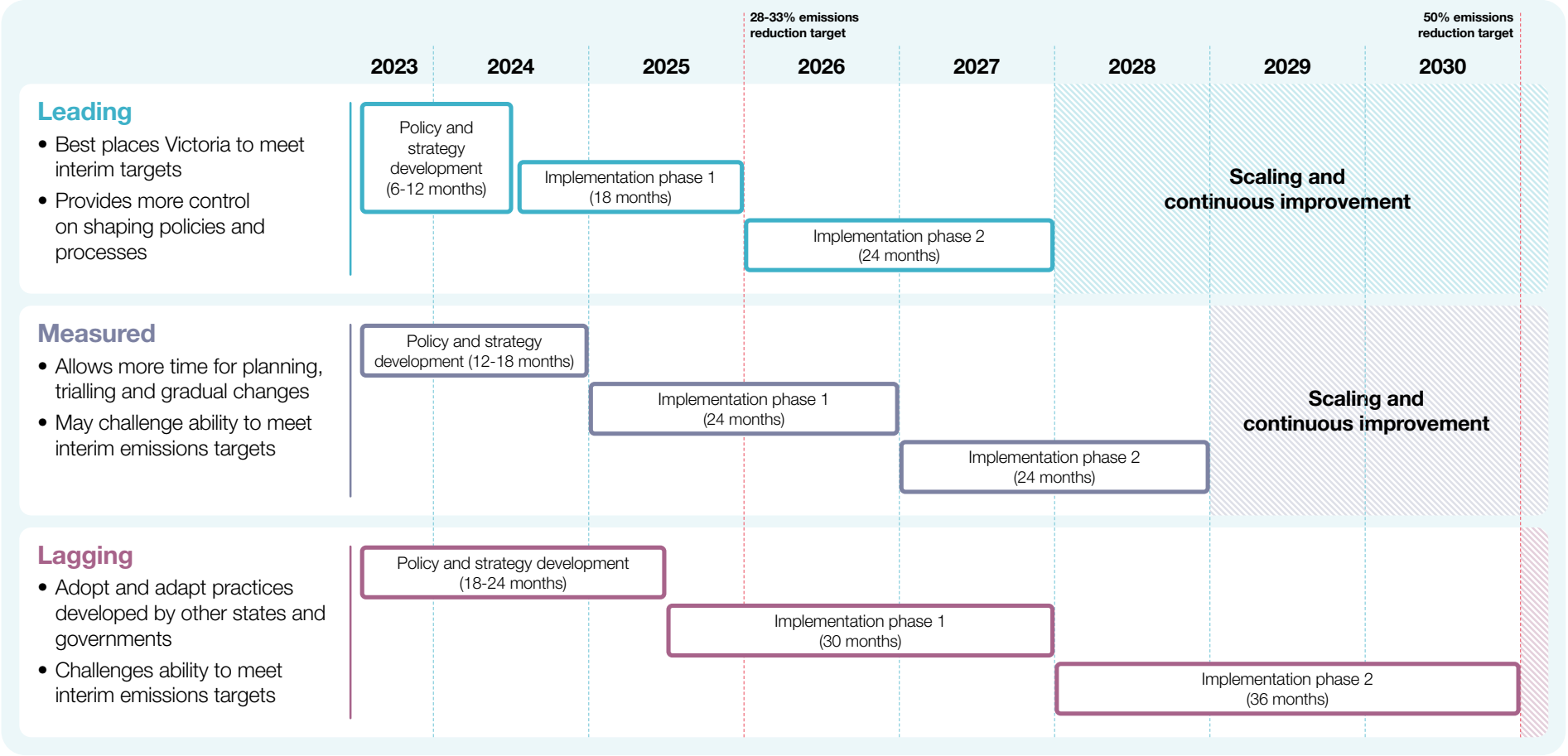


Figure 6: *Implementation timing*

Introduction

1 Background and context

1.1 Purpose of this report

Infrastructure Victoria is advising the Victorian Government on how best to decarbonise the emissions associated with public infrastructure to support the state's net zero targets.

This report serves as an input to Infrastructure Victoria's advice to government, and identifies opportunities to consider carbon emission reductions at the business case and procurement stages of infrastructure projects commissioned by the Victorian Government.

This report consists of three parts as shown in Figure 1.1.

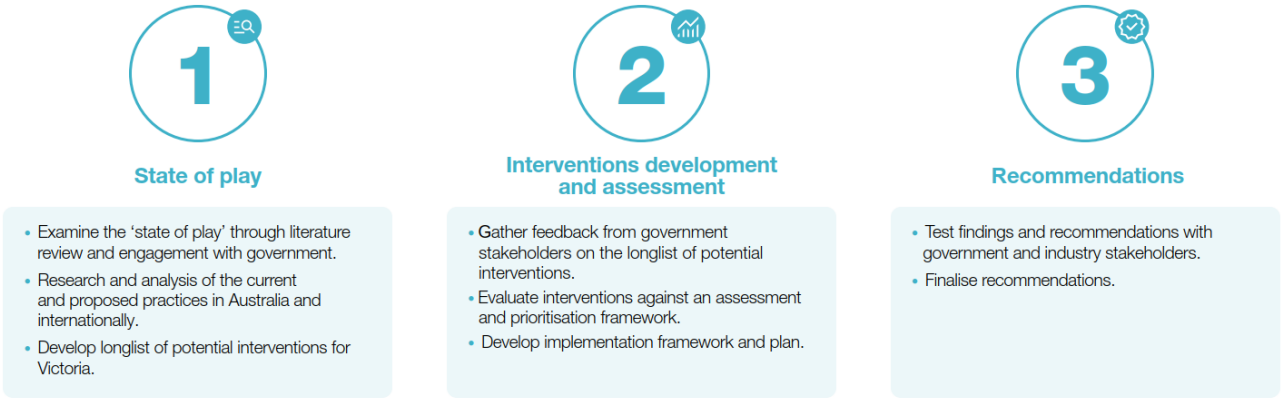


Figure 1.1: Project approach

1.2 Legislative and policy landscape

The Victorian Government is committed to meeting the requirements of the Paris Agreement, which includes their legislated target of achieving net zero greenhouse gas (GHG) emissions by 2050, as stated in the *Climate Change Act 2017* [1]. Further, the government has stated ambitions to achieve net zero even earlier, with commitments to reach net zero emissions by 2045 [2]. To ensure a steady progression towards this goal, interim emissions reduction targets for 2025 and 2030 have been set, and targets for 2035 are set to be released in 2023.

The interim targets aim to reduce emissions by 28-33% below 2005 levels by 2025 and 45-50% below 2005 levels by 2030. They serve as milestones to help guide the state towards the goal of net zero emissions while allowing for periodic assessment and adjustment of strategies.

To support these targets, the Victorian Government has also developed sector pledges, outlining the specific actions that will be taken to cut emissions from various sectors as well as from its own operations. The first pledge period covers the years 2021 to 2025, with subsequent pledges to be made every five years. These commitments recognise the urgent need to reduce emissions and mitigate the impacts of climate change.

1.3 The case for change

1.3.1 The need to act quickly

The path to achieving the Victorian Government's decarbonisation policy goals and net zero target is challenging. The initial moves towards net zero have been achieved through simpler policy and process changes, leading to a nearly 30% reduction in Victoria's emissions by 2020 compared to 2005 levels, exceeding initial carbon reduction targets. However, it is important to recognise that reaching future targets will become more difficult, as increasingly complex, and ambitious changes will be needed to decarbonise.

The UK has implemented a strong decarbonisation agenda and has ambitious legislated targets. However, the UK experience is showing that keeping on track with the path to net zero beyond the next few years is likely to be increasingly difficult as decarbonisation of easy to abate sectors progresses, and attention turns toward infrastructure in more difficult to abate sectors such as heavy transport, agriculture and construction.

UK GOVERNMENT IS OFF-TRACK TO MEET ITS CARBON BUDGET COMMITMENTS

The UK Climate Change Committee, an independent advisor to government found that the UK:

- was on track to meet a 37% target reduction in emissions in 2022 compared to 1990 levels [5]
- but is not on track to meet its targets outlined by the fourth and fifth carbon budgets — a 51% reduction compared to 1990 levels by 2025 and a 57% reduction compared to 1990 levels by 2030. Recent estimates predict that the policies and investments undertaken in the UK will only meet 92% of the emissions reductions needed to meet the 2030 target [6], and further investment will be needed in sectors that are more challenging to abate.

This example highlights that despite the significant steps the UK Government has taken to prioritise decarbonisation in its policies, processes, and investment decisions (as detailed and referred to throughout this report), it remains off-track to meet its interim emissions targets. In this context, acting quickly to reduce emissions is imperative to prevent Victoria from facing severe risks of failing to meet its own climate commitments.

By acting swiftly, Victoria can capitalise on the momentum and lessons learned from other jurisdictions, aligning its strategies with global best practices, and better position itself to meet its climate commitments.

1.3.2 Net zero transition risks

The Victorian Government will face significant climate change related risks through physical climate impacts, as well as through the transition to a net zero economy. It will be important for transition plans to consider these risks and adequately prepare government and the economy for them.

For example, there have been recent international cases of legal action being taken against governments for breaching climate commitments. In June 2020, lawyers acting for the Transport Action Network launched a class action against the UK Department of Transport, over plans for a multibillion-pound road-building scheme on the grounds that it is in breach of the country's climate commitments [7].

The Taskforce on Climate related Financial Disclosures definitions of climate related risks, under transition and physical risk categories, are becoming widely adopted by the private sector and governments (Figure 1.2). The Victorian Government released a first disclosure statement for 2022 outlining the Government's actions to understand, manage and monitor climate-related risks and opportunities for Victoria, as well as the government's own operations [8].

Figure 1.2: Climate change related risks

1.3.3 Emissions in infrastructure

Re-shaping infrastructure for a net zero emissions future (2020) [3] shows that up to 70% of Australia's annual GHG emissions are directly or indirectly attributed to infrastructure across its lifetime. Decarbonising infrastructure, or reducing infrastructure-related missions, is therefore important to achieving the government's legislated interim emissions targets by 2030 and a net zero future by 2050.

The *PAS 2080 Carbon Management in Infrastructure Standard* [9] measurement framework captures all emissions associated with the complete lifecycle of an asset:

- **Embodied or 'capital' emissions** – created in producing the materials needed for construction through the supply chain (e.g., mining and manufacture of products) and in all the activities and materials used in constructing, maintaining, and disposing of infrastructure assets. Embodied emissions accounted for 6% of Australia's emissions in 2018.
- **Operational emissions** – created in operating an asset and covering emissions directly resulting from operations (e.g., the use of fuel) and more indirectly where non-renewable energy is used. Operational emissions accounted for 9% of Australia's emissions in 2018.
- **User or 'enabled' emissions** – created by the activities of people or customers using an asset (e.g., where petrol vehicles use road infrastructure and generate carbon because of the activity). Enabled emissions accounted for 55% of Australia's emissions in 2018.

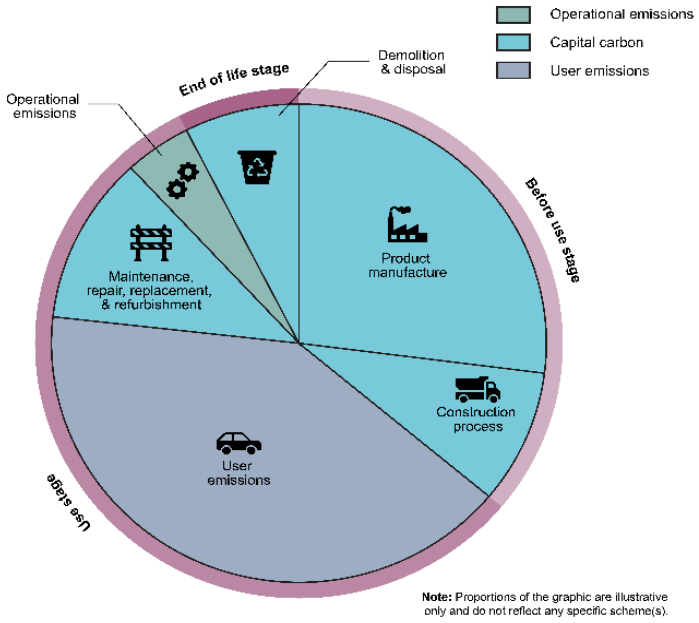


Figure 1.3: Sources of carbon emissions over the infrastructure lifecycle (PAS 2080)

These lifecycle emissions are shown in Figure 1.3 and need to be considered when deciding if and how to invest in infrastructure.

SCOPE 1, 2 AND 3 EMISSIONS

The preferred way of classifying infrastructure emissions is the use of 'embodied', 'operational' and 'user' emissions following the PAS 2080 standard. This taxonomy captures all emissions associated with the construction, operation, use and decommissioning of an asset.

However, a common approach has been to use organisation (not asset) focused definitions where:

- **scope 1** refers to direct GHG emissions from sources that are owned or operated by the organisation reporting the emissions. Examples of scope 1 emissions include the combustion of diesel in company-owned vehicles or used in on-site generators.
- **scope 2** refers to indirect GHG emissions associated with the import of energy from another source. Examples of scope 2 emissions include the import of electricity from the grid or heat from an external source.
- **scope 3** refers to all other indirect emissions that are a consequence of the activities of the organisation but occur from sources that are not owned or controlled by the organisation. Examples include emissions from the extraction and production of purchased materials such as metals or plastics, emissions from transportation-related activities in the value chain such as shipping and distribution and emissions from the disposal of waste generated by the organisation.

While using scope definitions for classifying emissions can be useful, it has limitations as it focuses on emissions that are within an organisation's direct control and can miss other emissions that are associated with an organisation's broader activities (scope 3 emissions). For example, Victoria's Financial Reporting Direction (FRD) currently requires reporting of scope 1 and scope 2 emissions for office-based government activities. However, the FRD doesn't require mandatory reporting for scope 3 emissions, which could be a significant part of an organisation's carbon footprint.

Scope 3 emissions of infrastructure are included in the government's net zero targets where they occur within Australia. However, GHG emissions have a global impact on climate change, regardless of where they are produced or who is responsible for their release. Emissions originating from materials produced internationally and subsequently imported to Australia contribute equally to climate change impacts in the country, just as if they were generated within Australia itself. Reducing whole-of-life carbon emissions, regardless of source, is required to achieve Victoria's climate objectives. Given this, the asset-based emissions categories detailed in PAS 2080 offer a more accurate approach to carbon accounting and are increasingly being recognised as the preferred method for characterising emissions.

PAS 2080 – a global standard for carbon management in infrastructure

PAS 2080 is a globally recognised standard for managing infrastructure carbon, authored to meet World Trade Organisation requirements [10]. It aims to reduce carbon as well as costs using more intelligent design, construction, and operations through the entire value chain. PAS 2080 achieves this by ensuring carbon is consistently and transparently quantified at key points in infrastructure delivery, promoting the sharing of data along the value chain (Figure 1.4).

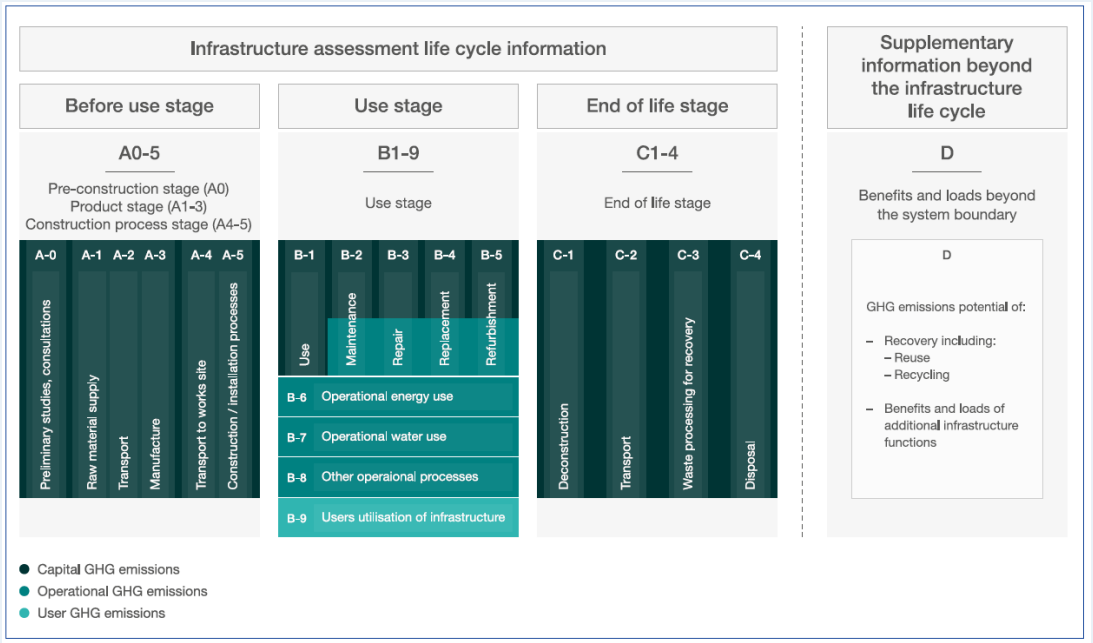


Figure 1.4: PAS 2080 framework for classifying GHG emissions in the infrastructure lifecycle

PAS 2080 is summarised in three main topics: principles, requirements, and guidance.

- **Principles** – PAS 2080 outlines the overarching values and objectives of the standard, including minimising emissions, enhancing sustainability, and promoting transparency and accountability throughout the infrastructure lifecycle.
- **Requirements** – PAS 2080 provides specific criteria that must be met for an infrastructure project to be considered compliant with the standard. These criteria are organised into six main categories: governance and leadership, planning, design and construction, operation and maintenance, measurement and monitoring, and reporting.
- **Guidance** – PAS 2080 provides practical guidance on how to meet the requirements of the standard, including examples of tools and techniques that can be used to quantify carbon, evaluate design and construction options, and manage project risks.

By following the principles, requirements, and guidance set forth in PAS 2080, infrastructure stakeholders can effectively manage carbon across the entire value chain and monitor decarbonisation performance.

1.3.4 The importance of upfront decision making

To achieve Victoria's emissions reduction commitments and decarbonise infrastructure, it is crucial to consider the concept of whole-of-life carbon. By taking a comprehensive approach to carbon accounting, it becomes possible to identify and pursue opportunities for reducing carbon emissions at each stage of a project's lifecycle, from initial planning through to end-of-life considerations.

Figure 1.5 shows that the opportunities to reduce or eliminate whole-of-life emissions are greatest at the outset of a project. The largest reductions happen when building infrastructure is avoided, eliminating the embodied, operational, and enabled emissions. As a project progresses, it becomes more difficult and expensive to reduce embodied and operational carbon. It is important for carbon to be fully considered at the earliest stages of a project increasing the scale of potential emission savings.

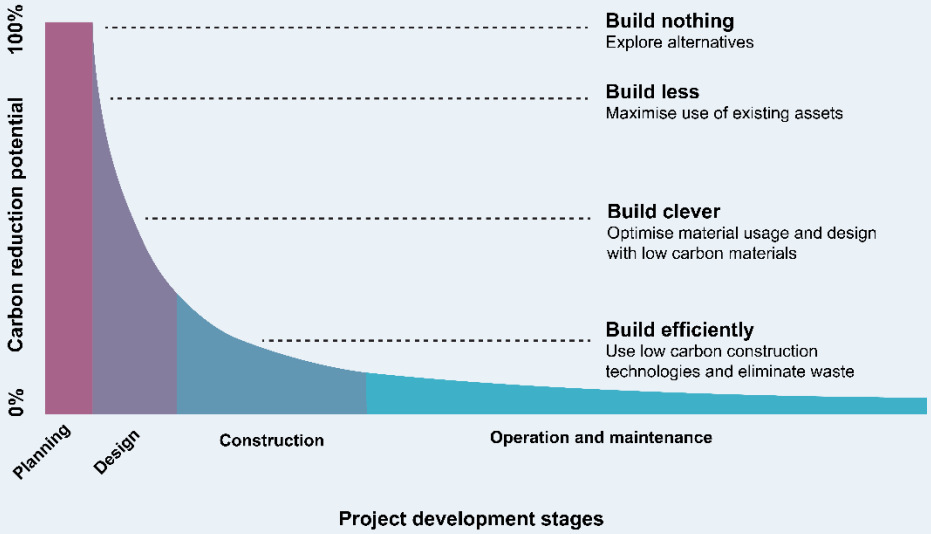


Figure 1.5: Carbon reduction potential across project development stages [11].

In Victoria, the Gateway Review process examines projects and programs at six key decision points in their lifecycle [12]. This process is mandatory for all projects deemed to be of high-value high-risk (typically over $100 million cost) [13]. These gates are shown below in Figure 1.6:

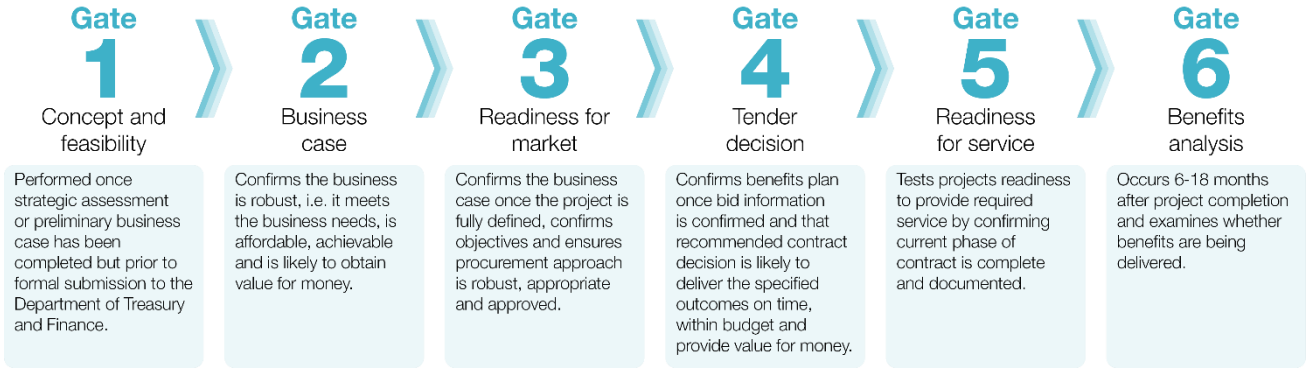


Figure 1.6: Victoria State Government Department of Treasury and Finance Gateway Reviews

To date, carbon reduction measures have primarily targeted operational and enabled emissions. The Suburban Rail Loop East case study (on the next page) illustrates the increasing relative importance of embodied emissions as government operations and user-enabled road emissions decrease during their transition to green energy.

Case study

Suburban Rail Loop East – The importance of carbon emissions in the infrastructure lifecycle

The Suburban Rail Loop Authority assessed GHG emissions from SRL East as part of the Environment Effects Statement. The assessment measured the potential positive and adverse GHG emission impacts associated with construction and operation of the project and highlighted the following trends.

Infrastructure investment is a significant contributor to Victorian emissions

SRL East is estimated to use 2.2 million t CO2-e across construction and operation, representing 0.14% of Victoria's total estimated emissions up to 2050 (1.55 Gt CO2-e) [14]. This is significant given the number of other infrastructure projects in the forward pipeline and their cumulative impact on achieving net zero targets.

Embodied emissions are the major source of emissions

- Construction phase GHG emissions total 1.9 million t CO2-e (85% of total emissions).
- Embodied carbon within construction materials, such as concrete in the tunnels, is identified as the largest source of GHG emissions (37% of total emissions).
- Emissions from electricity consumption to power tunnel boring machines, construction equipment, site offices and lighting would be another major contributor to GHG emissions during construction (32% of total emissions).
- Emissions associated with plant and equipment fuel are also significant (13% of total emissions).

Operational and enabled emissions are less significant given the transition to renewables

- With the Victorian Government's commitment to using 100% renewable electricity by 2025 [15], the project's operation accounts for only 15%, or 336,813 t CO2-e of total emissions, and is mainly associated with air conditioning, heating, and refrigerants.
- Average annual operating emissions would be less than 0.01% of the state's emissions (before offsets).
- User or 'enabled' emissions are estimated to decrease by 14,200 t CO2-e for the first year of operations, resulting from direct emissions savings from reduced private vehicle trips, as well as corresponding emissions savings from reduced car production and maintenance. These potential savings from the project's operation are equal to less than 1% of its estimated construction stage emissions.

Image below: Suburban Rail Loop – Environment Effects Statement

State of Play

2 State of play

KEY POINTS

Victorian state of play

- There is a need for more consistent guidance on how to estimate, measure and report on carbon emissions throughout the infrastructure project lifecycle.
- Aside from major transport projects, carbon is not being considered quantitatively in cost benefit analyses undertaken during business cases. The review also identified a need for clarity on how project-based or portfolio-based decarbonisation relates to the state's GHG reduction targets.
- In cases where carbon is estimated and monetised in business cases, the value applied in Victoria is not consistent, and does not accurately represent the most recent advancements in economic and climate change policy or research. This leads to carbon values that have minimal impact on decision making.
- There are a range of different carbon measurement tools and resources being used in Victoria. However, access and licensing constraints have created inconsistency in assumptions and emission factors across agencies.
- Current practices tend to award contracts without adequately taking carbon into account.
- Non-build and low-carbon solutions are being considered in Victoria, but their prioritisation varies across agencies and projects, and often occurs too late in the project lifecycle to impact decision making.
- Collaboration and coordination among central government departments, such as the Department of Energy, Environment and Climate Action (DEECA) and Department of Treasury and Finance (DTF), can ensure consistent requirements, guidance, and policy are established for other departments and agencies to follow.

National and international leading examples and developments:

- National and interstate entities such as Infrastructure Australia, Infrastructure NSW, and TfNSW are currently leading in the development of decarbonisation policies, frameworks, guidelines, and plans.
- Stronger leadership commitment and internal capability development, as demonstrated by the NSW and the UK Government, are needed to effectively drive decarbonisation initiatives, address concerns regarding project delivery costs, and provide resources for implementation.
- Leading practices from national and international jurisdictions, such as the UK's PAS 2080 Standard, NSW's business case and CBA guidelines, and the EU's Green Public Procurement framework, demonstrate successful implementation of decarbonisation strategies and can serve as models for addressing Victoria's key issues.
- Alignment with other Australian states and international jurisdictions can promote a cohesive approach, encouraging collaboration and facilitating knowledge-sharing initiatives.

2.1 Victorian state of play

As Victoria continues to pursue decarbonisation, several initiatives and standards have been established across government agencies, departments, and industries. While these efforts represent a positive step forward, there remains an inconsistency in the application of these practices within Victoria. The remainder of this section provides an overview of how carbon emissions are considered across the project lifecycle in Victoria.

2.1.1 Planning, development, and business case (Gate 1-2)

Investment Lifecycle and High Value High Risk Guidelines

The DTF *Investment Lifecycle and High Value High Risk Guidelines* (ILHVHR) apply to all government departments, corporations, authorities, and other bodies falling under the *Financial Management Act 1994* [13]. The guidelines are applicable to any investment proposal (asset or output) and mandate the development of business cases

for capital investments over $10 million. The business case guidance states that projects should consider GHG emission reductions and the *Climate Change Act 2017*, with additional environmental requirements highlighted.

High-level guidance for incorporating general environmental impacts into business cases has been in place for many years in documents such as the *Economic Evaluation for Business Cases: Technical Guidelines (2013)* and ILHVHR Guidelines. However, the practical implementation of carbon specific impacts has been directed by individual projects and has not been enforced across the infrastructure sector.

The absence of specific guidance and requirements has meant that current business case practices tend to:

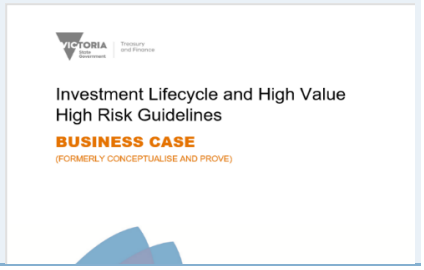
- have an inconsistent approach to estimating, measuring, and reporting carbon emissions
- focus on meeting legislated sustainability measures (e.g., building energy standards and requirements) rather than considering the value of additional emission reduction measures
- select preferred options without adequate weight given to carbon considerations.

At present, there is no specific advice within the ILHVHR guidelines or templates on how to estimate, measure and report on emissions in infrastructure projects during the business case phase.

BUSINESS CASE – ENVIRONMENTAL REPORTING REQUIREMENTS:

The guidance includes the following high-level reporting requirements:

- the extent of short- and long-term environmental consequences.
- opportunities to deliver environmental benefits (or address risks) relating to government objectives (e.g., through the incorporation of sustainability).
- the measurable and non-measurable impacts
- uncertainties and strategies to address them.



Sustainable Investment Guidelines

The Office of Project Victoria *Sustainable Investment Guidelines (SIGs)* [16] provide 'good practice' on how to incorporate sustainable investment considerations into project planning and delivery throughout the investment lifecycle.

Without clear requirements the SIGs are not as useful as they could be, and as a result when Victorian Government projects and programmes incorporate carbon reduction initiatives, they are often value managed out to meet the more tangible cost, quality, and time requirements that are more strongly required. Additionally, their limited adoption across the sector hinders their overall impact on decarbonisation efforts. Table 2.1 summarises the suggested measures during business case development.

Table 2.1:Sustainability assessments in business cases

Category	All projects	Larger projects (including HVHR)	Priority or flagship projects, or projects seeking to demonstrate improved efficiency or performance
Project objectives	• Sustainability objectives are identified from context of project delivery.		
Cost benefit analysis	• Consider energy and carbon emissions in value for money assessment. • Improve energy efficiency and productivity over the life of investment, including those associated with construction, materials, and operation. • Budget is allocated to identify, develop, design, and deliver sustainable outcomes • Appropriate expertise is engaged early in options, and solution development.	• Model whole-of-life costs to justify sustainability benefits and value for money. • Option evaluation considers emissions from construction and operation.	• Consider whether project objectives should include scope 3 emissions. • Innovation is scoped and costed with whole-of-life benefits considered, including impact on capacity and capability.

Category	All projects	Larger projects (including HVHR)	Priority or flagship projects, or projects seeking to demonstrate improved efficiency or performance
Policy	• Expenditure on sustainability is linked to quantified benefits or policy. • Meets climate pledge requirements.		• Project considers and minimises scope 3 emissions.
Risk	• Sustainability risks are linked to objectives and not rating scheme accreditation.	• Risk analysis considers sustainability trends over the expected asset life.	

Economic evaluation and technical guidelines

A cost benefit analysis (CBA) is an appraisal technique that estimates the economic, social, and environmental costs and benefits of a project in monetary terms. Under the current CBA guidance, GHG emissions are an unpriced social impact, known as an externality.

A government action or investment can lead to an increase or reduction in GHG. To include the cost of climate impacts within a CBA, a monetary value needs to be assigned to a unit of GHG emissions ($/t CO2-e) that best reflects the cost to society, or society's willingness to pay to avoid the impact of GHGs. The economic cost (or benefit) of the expected change in tonnes of CO2-e can then be estimated across the life of a project.

The DTF *Economic Evaluation for Business Cases Technical Guidelines* [17] state that a CBA, where possible, should capture all welfare costs and benefits to society, including changes in carbon dioxide emissions generated by an activity or investment. The guidelines published in 2013 refer to the valuation of GHG emissions:

- under the repealed Commonwealth Government national carbon pricing scheme; and
- for GHG emissions not covered under the national carbon pricing schedule, recommend the use of values from the 2005 National Guidelines for Transport System Management [18] [19]. The 2005 report, recommends $10/t CO2-e, and has since been superseded by Austroads Guidelines (2012 [20] and 2014 [21]) and more recently ATAP Guidelines which recommend $65/tCO2-e [22] (adjusted to $FY2022 terms).

The ATAP valuation of $65/tCO2-e is sourced from prior Austroads publications (2014, 2012, 2003) and references European studies dating back to 1999. A WSP review of these underlying studies found that Australian guidance was consistently based on the 'low estimates' provided by source material and had not been revised to reflect updates of source studies. The guidance does not reflect current policy targets included in the Paris Agreement, nor latest evidence and science that underpin international valuations.

Persistent use of low GHG emission parameters hampers justification of GHG reduction investments via a CBA approach. Ensuring parameters accurately reflect current evidence for valuing economic impacts of GHG changes is vital. Any disparity between applied values and evidence compromises the departments' capacity to inform government decisions effectively towards policy goals.

The guidelines also provide recommendations on the specific discount rates that correspond with the category of investment. For investment projects involved in traditional core service delivery areas such as public health, justice and education, the recommended appropriate discount rate is 4%. Projects in traditional core service delivery where the benefits are more easily translated into monetary terms (e.g., public transport, housing, and roads) use 7% as the appropriate discount rate.

Without the provision of clear up-to-date carbon valuation guidance, business cases have used a range of different valuations and discount rates, with some recent examples provided in Table 2.2. There is a need to refine and clearly communicate an appropriate monetary value for GHG emissions across the Victorian public sector to ensure that the impacts are adequately incorporated in economic appraisals. Appendix 1 describes the carbon valuation research on carbon valuation approaches and discount rates, explains the limitations of existing Australian guidance, and provides international examples.

Table 2.2: Carbon valuation in Victorian projects

Project	Carbon value and discount rate	Source
Suburban Rail Loop, 2021	• $46/t CO2-e • 4% discount rate	• Austroads, Updating environmental externalities unit values, 2014
Evaluation of the Victorian 6-star housing standard, 2019 (DEECA)	• 2020: $28/t CO2-e • 2030: $71/t CO2-e • 2050: $213/t CO2-e • 7% discount rate	• The World Bank Carbon Pricing Dashboard • Intergovernmental Panel on Climate Change Fifth Assessment Report
North East Link, 2018	• $52.40/t CO2-e • 7% discount rate	• Austroads, Guide to Project Evaluation Part 4: Project Evaluation Data, 2012

Investment Management Standard - benefit management and reporting

DTF's *Investment Management Standard* requires the creation of a Benefit Management Plan in the business case stage of projects which should:

- outline the tracking and management of a project's quantified and monetised benefits, including carbon emissions, throughout its lifecycle
- specify the key performance indicators (KPIs), measures, baselines and targets
- determine the responsible parties, expected delivery dates, and reporting procedures for the benefits.

2.1.2 Readiness for market and tender decision (Gate 3-4)

Consideration of carbon in procurement

DTF's Evaluation Criteria (Direction and Instruction 3.7) explains the requirement to prepare a tender evaluation plan and how to determine the tender evaluation criteria for public construction [25]. Value for money and occupational health and safety are among mandatory evaluation criteria provided, while climate change or environmentally sustainable outputs are not specifically mentioned.

Table 2.4 shows how climate change is considered within *Victoria's Social Procurement Framework* [26] as part of sustainable procurement objectives and outcomes. These provide voluntary and non-prescriptive sustainable procurement guidance on considering climate outcomes in tender evaluation, contract management and reporting. Agencies' responses vary with some not focusing on these, others asking for a specific response and some including specific GHG targets linked to sustainability ratings.

Table 2.4: Victorian Government sustainable procurement objectives

Sustainable procurement objectives	Outcomes sought
Environmentally sustainable outputs	• Project specific requirements to use sustainable resources and to manage waste and pollution • Use of recycled content in construction
Environmentally sustainable business practices	• Adoption of sustainable business practices by suppliers to the Victoria Government
Implementation of the climate change policy objectives	• Project specific requirements to minimise GHG emissions • Procurement of outputs that are resilient to the impacts of climate change

Recycled First Policy

One area where clear and consistent requirements are being included in procurement is recycled content:

- Since March 2020, in line with the *Recycle First Policy*, all tenderers on Victorian major transport projects have had to demonstrate how they will optimise the use of recycled and reused materials at the levels allowed under current standards and specifications.
- Responses are considered within the sustainability evaluation criteria in major tenders within Major Transport Infrastructure Authority delivery bodies – Rail Projects Victoria, Level Crossing Removal Authority, West Gate Tunnel Project, North East Link Program and Major Roads Projects Victoria.
- More recently the Suburban Rail Loop Authority and Victorian Health Building Authority projects have also included these evaluation criteria.

Table 2.5 on the following page summarises a range of carbon targets and requirements being used by Victorian Government delivery agencies during the procurement and delivery of infrastructure.

Victorian Government delivery agency carbon commitments in procurement

Table 2.5 summarises Victorian Government delivery agency procurement-based policies and targets.

Table 2.5: Victorian Government delivery agencies and carbon commitments in procurement

Delivery agencies	Carbon policies or strategies	Key carbon targets and requirements
Major Transport Infrastructure Authority (MTIA)	• Level Crossing Removal Project – Sustainability Framework (2019-2022) • Rail Projects Victoria – 2020 Sustainability Framework • North East Link Program – Sustainability Policy • Major Roads Projects Victoria – Success in sustainability [27] [28] [29] [30]	• The framework and policies apply minimum carbon reduction rates (generally 5-15%) into project requirements and incentivise further reductions as KPIs or tender evaluation criteria. • GHG emissions are evaluated against a base case of standard methods and technologies – applying various modelling approaches and emissions factors to evaluate these.
Suburban Rail Loop Authority	• SRLA Sustainability Policy [31]	• Commitments with the EES to utilise low carbon fuels, energy in construction and materials
Victorian Health Building Authority	• Guidelines for sustainability in capital works (2020) [32]	• Business-as-usual requirements incorporated into capital works programs, including operational energy efficiency and passive design measures. • Additional contestable budget of up to 2.5% may be allocated for measures such as renewable energy use, energy efficiency provisions and the use of low embodied emission building materials.
Victorian School Building Authority	• Building Quality Standard Handbook (2022) [33]	• The handbook nominates a set of minimum passive design and energy efficiency provisions to be implemented within all projects. • Provisions above these requirements, such as renewable energy or energy efficiency measures, are subject to payback analysis for shortlisting and potential adoption.
Victorian water corporations	• Statement of Obligations – Emissions Reduction 2022 [34]	• Each water corporation must reduce its annual reportable nominated GHG emission levels by 2025 (42.4%), 2030 (93.7%) and be net zero by 2035. CAPEX expenditure is assessed to support these outcomes.
Development Victoria	• Sustainability Strategy [35]	• Alignment to private sector and governmental sector partners to achieve carbon neutral developments by 2030
Homes Victoria	• Nationwide House Energy Rating Scheme	• All social housing to be 7-star Nationwide House Energy Rating Scheme Minimum
Government Accommodation	• Victorian Government Emissions Reduction Sector Pledge - 2021-2025 [36]	• All new government office buildings and tenancy fit-outs will have a minimum 5-Star NABERS energy efficiency rating from 2021 and a 6-Star NABERS rating from 2025.

The case study on the following page provides an example of how the Victorian Health Building Authority is implementing sustainable standards and lifecycle assessment of carbon emissions through their 'Guidelines for sustainability in capital works'.

Consideration of carbon in planning approvals

In Victoria, assessment of the potential environmental impacts or effects of a proposed development may be required under the *Environment Effects Act 1978*. If the Minister for Planning decides that an environment effects statement (EES) is required, the project proponent is responsible for preparing the EES and undertaking the necessary investigations. An EES is likely required for state significant infrastructure.

These statements generally include a GHG assessment that responds to the *Climate Change Act 2017*, for example the Suburban Rail Loop East EES included an evaluation objective to "avoid and minimise greenhouse gas emissions and capitalise on opportunities to reduce waste and use resources efficiently".

There is no mandated standard applied across these assessments, however the ISO 14064 set of GHG standards are mostly used, either part 1 (for organisations) or part 2 (for projects). These standards give significant flexibility to the scope of emissions to be assessed, for example indirect scope 3 emissions are optional. Mitigation measures are incorporated through environmental performance requirements (EPR) that must demonstrate, in a qualitative way, the efficiency measures or use of lower emission construction materials to reduce GHG emissions during project delivery.

The box below describes how the West Gate Tunnel Project has defined EPRs to demonstrate a minimum reduction in GHG emissions for construction and operational energy and from embodied emissions in materials of 15%. The projects including EPRs with quantifiable carbon reduction targets are generally defining these against a baseline, or "reference project" using the Green Star or Infrastructure Sustainability rating tools. This is an isolated example within Victoria and EPRs and quantitative targets are not routinely included.

WEST GATE TUNNEL – ENVIRONMENTAL PERFORMANCE REQUIREMENTS

In the West Gate Tunnel Project, EPRs require the project to demonstrate reductions in GHG emissions in line with credits within the IS v1.2 Rating tool: a minimum 15% reduction in embodied GHG emissions related to materials (Mat-1 credit) and a minimum 20% reduction in operational GHG emissions [37] (Ene-1 credit). The Infrastructure Sustainability Rating Scheme is used to verify outcomes [38]

Case study

Designing sustainable health infrastructure – Victoria Health Building Authority

The Victorian Health Building Authority (VHBA) is a key player in delivering health infrastructure projects.

Sustainability in hospitals

The VHBA's 'Guidelines for sustainability in capital works' provides advice on how to implement sustainability practices in VHBA healthcare capital works and include a set of mandatory requirements for tenderers to follow [32]. Examples of requirements included to help drive reductions in carbon emissions are integrated waste reduction systems, use of recycled and natural materials, energy-efficient windows, gardens and green spaces, and solar panels in its holistic approach to sustainability that blends health and the environment.

Path to net zero

As part of its commitment to net zero by 2050, VHBA aims to transition to all electric heating and sterilisation, retrofit regional facilities with solar generation infrastructure, and build new hospitals with 60 per cent solar coverage. Frankston Hospital Redevelopment is an example of how these guidelines are being applied with a plan to be all electric and net zero ready by 2050, improve energy efficiency and provide an 800kW rooftop solar photovoltaic system. Another is Torquay Community Hospital which will be a 100% electric facility (no gas for air conditioning or hot water), including rooftop solar photovoltaic and electric vehicle charging.

Image below: Victorian hospital with solar coverage

2.1.3 Readiness for service and benefits analysis (Gate 5-6)

Monitoring and reporting of carbon reductions in project delivery

Over the project delivery phase, delivery agencies adopt a range of mechanisms to track and monitor the GHG emissions attributable to the project. This includes regular tracking of carbon emission reduction commitments for scope 1 and scope 2 emissions and embodied emissions in construction activities.

Many Victorian delivery agencies also voluntarily adopt sustainability ratings in line with their own policies and strategies to show how projects contribute to its sustainability commitments. The adoption of these ratings varies between agencies with many choosing to benchmark but not adopt a formal certification. These rating tools provide a framework to measure and verify carbon reductions on projects but are not consistently applied.

In 2022, the National Australian Built Environment Rating System (NABERS) worked with the Green Building Council of Australia and collaborated with industry to understand if there is a desire for an embodied emissions standard and NABERS Embodied Emissions tools. Feedback from industry advised there was an urgent need for this standard. In December 2022, NABERS released a consultation paper that contains 10 foundational proposals for feedback [39].

Table 2.6 shows how a selection of Victorian public sector infrastructure projects have made use of the rating tools described above. Currently, processes and practices have not developed to a point where all such projects adequately and consistently account for the carbon they embody, generate in operation, or enable.

Table 2.6: Sustainability rating tools adopted by Victorian public sector projects

Sustainability rating tool / guidelines	Adoption in Victorian public sector
Infrastructure Sustainability Rating	• North-East Link Project and West Gate Tunnel Project [40] [37] • Suburban Rail Loop Project • Projects Capital expenditure > $100million • Preliminary review for adoption by Victorian Water Corporations • LXRP, MRPV and Metro Tunnel projects [41].
Green Star (Design and As Built, Building and Communities)	• Railway stations (LXRP and Metro Tunnel) • NELP and SRL operational control centres • Development Victoria [35] • Office accommodation, social housing and used to benchmark institutional buildings (courts, police stations) [42]
NABERS	• Office accommodation [43], hospitals (with bed days)

2.1.4 Standards and tools across the investment lifecycle

Application of carbon standards and guidance

Table 2.7 shows a summary of the key standards and guidance being used for the quantification of carbon emissions in Victoria, with each unique in their scope and purpose.

Delivery agencies under MTIA such as LXRA and RPV are leading the way, and the standards used are generally dictated by the voluntary sustainability ratings tools being adopted (e.g., IS Rating tool and Green Star) rather than government policy.

There is an absence of clear Victorian Government guidance on the use of carbon standards and so a lack of clarity and consistency across agencies about the requirements. Appendix C provides a more detailed comparison of the range of most adopted standards in Victoria, along with those emerging or adopted internationally. This comparison highlights some of the limitations and gaps in coverage of whole of life carbon emissions, for example embodied or scope 3 emissions from construction materials and road user emissions. Many of these adopted standards have an organisational perspective and control boundaries that fail to consistently measure and manage whole of life carbon for infrastructure assets.

The best example of clear and consistent guidance for the use of whole of life carbon measurement standards was found was in the UK, where lifecycle assessment based standards that take an asset or project perspective have been adopted. Released in early 2023, the latest version of *PAS 2080 Carbon management in infrastructure* [44] provides the most comprehensive guidance covering both buildings and infrastructure assets. It also provides guidance on a carbon management and verification process, considering the unique roles of government, asset managers, designers, constructors, and the supply chain.

The *RICS Whole of Life Carbon Assessment for the Built Environment guidance* [45] is also suitable but focused on buildings. Both these examples are based on the same underlying EN 15643 *Sustainability of construction works* framework and lifecycle assessment-based calculation rule standards (EN 15978, EN 17472 and EN 15804). These underlying standards supports a more complete assessment of infrastructure related emissions which can better inform decision-making.

Table 2.7: Hierarchy of carbon standards

Type	Purpose and examples	Most adopted in Victoria
Organisational standards	• Generally, focus on emissions that organisations can directly control (scope 1 and 2) • Recommends organisations to consider upstream and downstream emissions (scope 3) • Most applicable to organisation operating infrastructure assets	• The GHG Protocol Corporate Standard • ISO 14064-1 GHG Assessment Part 1 (Organisational level quantification) • The Climate Active Carbon Neutral Standard for Organisations
Project or asset level standards	• Provide clear guidance on defining and measuring carbon emissions associated with infrastructure delivery • *PAS 2080 Carbon management in infrastructure* is an emerging standard for whole of life carbon management, first released in 2016 and updated in 2023 (based on EN 15978 and EN 17472) • *RICS Whole of Life Carbon Assessment for the Built Environment* is another whole of life carbon standard more focused on buildings (also based on EN 15978)	• 14064-1 GHG Assessment Standard Part 2 (Project level quantification) • Climate Active Carbon Neutral Standard for Buildings • EN 15978 Sustainability in Construction Works (adopted for Green Star Life Cycle Assessments)

Type	Purpose and examples	Most adopted in Victoria
Product level standards and environmental labels	• Quantification of carbon for individual products, for example concrete and steel • Measure and transparently communicating the carbon emissions for materials on infrastructure projects • Aid in procurement of carbon neutral products through offsetting	• The Climate Active Carbon Neutral Standard for Products • EN 15804 Sustainability of Construction Works

Carbon measurement tools and resources

There are a range of lifecycle assessment tools being commonly used in Victoria and more widely in Australia. These are shown in Table 2.8 below, along with some tools being used in other jurisdictions. Few are free to access and available publicly, which creates inconsistency in modelling assumptions and emission factors.

Appendix C provides a more detailed comparison of the range of most adopted tools in Victoria, along with those emerging or adopted internationally. This comparison highlights challenges with several tools which often have a specific sector focus and limited coverage of emission sources. There are also trade-offs to consider, for example simple spreadsheet tools being the most accessible and easy to use but have limitations in data and reporting functionality.

The most comprehensive tools, such as GaBi and SimaPro, require expensive subscriptions and advanced training. The planned NABERS Embodied Emissions tool will be an additional resource for the buildings sector, however the NABERS rating benchmarking approach is challenging for the varied asset types in government infrastructure, including social infrastructure (e.g. schools, hospitals, museums).

A range of tools and resources are likely to be needed by industry moving forward, and agencies and industry groups will likely continue to develop sector specific tools to meet specific project needs. Considering resources available in other jurisdictions and gaps for Victoria, the desirable features of a suite of resources to best support consistent carbon measurement are:

- open access and flexibility - the best examples being the provision of emission factors and modelling assumptions that can be used to develop sector and agency specific calculation tools
- coverage of emission sources to support whole of life carbon assessment across infrastructure and buildings
- transparency in databases and assumptions
- data quality and maintenance (periodic updates).

Table 2.8: Lifecycle emission assessment tools

Type	Tools commonly adopted in Victoria	Examples from other jurisdictions
GHG conversion / emission factors	• Department of Climate Change, Energy, the Environment and Water National Greenhouse Account Factors • Australian Transport Assessment and Planning Guidelines – PV5 Environmental Parameters • Australasian Environmental Product Declarations Programme (product specific) • EPiC Database – Melbourne University	• UK GHG Conversion Factors • UK Transport Analysis Guidance (TAG) Databook

Type	Tools commonly adopted in Victoria	Examples from other jurisdictions
Guidance	• Transport Authorities Greenhouse Group GHG Assessment Workbook for Road Projects (2013)	• UK Department for Transport Quantifiable Carbon Reduction Guidance
Building and infrastructure specific tools	• Transport Authorities Greenhouse Group Carbon Gauge (2013) • IS Materials Calculator • Green Building Council of Australia Upfront Carbon Calculator	• Transport for NSW Carbon Estimate and Reporting Tool • Waka Kotahi (NZTA) Project Emissions Estimation Tool • National Highways Carbon Tool (UK) • Klimatkalkyl "carbon calculation" (Sweden) • InfraLCA (Denmark)
Lifecycle assessment tools and databases	• eTool LCD* • OneClick LCA* • Tally* • Sima Pro Ecoinvent databases* • **Offer Building Information Modelling (BIM) integration*	• OpenLCA • NorEnviro (database) • ICE database • CO2data.fi (database)

There are a number of limitations to the tools listed above, for example:

- The *National Greenhouse Account Factors* are published annually by the Commonwealth Government Department of Climate Change, Energy, the Environment and Water [46], however they do not cover emission factors for construction materials and products or transport processes needed to assess embodied carbon on infrastructure projects.
- *The Transport Authorities Greenhouse Group GHG Assessment Workbook for Road Projects* [47] and *Carbon Gauge Tool* were produced in 2011 and have not been updated since 2013.

2.2 National leading examples

2.2.1 Infrastructure NSW

Infrastructure NSW (INSW) is a government agency responsible for providing expert advice on the planning, prioritisation, and delivery of infrastructure projects in New South Wales. INSW is demonstrating leadership in the decarbonisation of infrastructure and is regularly publishing research and advice to the NSW Government on this area.

In 2022, INSW published a discussion paper on decarbonising infrastructure delivery [48]. The paper provides guiding principles to decarbonise the delivery of public infrastructure across the planning, design, and construction phases, with a particular focus on considering embodied emissions.

The paper provides short-term (end of 2023), medium term (2024-2027) and long-term (by 2030) milestones and has since been turned into a Decarbonising Infrastructure Roadmap with a list of more specific actions to be completed by 2026 [49].

The key principles and actions for incorporating emissions reduction considerations into the upfront decision-making stages are summarised in Table 2.9.

Table 2.9: INSW Decarbonising Infrastructure Delivery discussion paper key actions

Principle/Action	Stage
Principle 1 – Use consistent methods for data to measure embodied carbon	
1.1 Adopt whole-of-government approach to measuring embodied emissions	All stages
Principle 2 – Reduce embodied carbon from options analysis and early design stages	
2.1 Use options analysis to consider non-build solutions or augmentation of existing assets	Planning and development
2.2 Establish business-as-usual carbon baseline and set a minimum target for emission reduction from early design	
2.3 Engage with industry early on low emissions designs and approaches	
2.4 Maximise use of recycled and low emissions building materials where possible and regularly review whether standards are constraints	
Principle 3 – Account for carbon in business cases	
3.1 Include carbon emissions and reduction plans in business cases	Business case
3.2 Value carbon in the business case, including embodied emissions	
3.3 Prepare carbon management plans to demonstrate how carbon reductions will be achieved	
3.4 Adopt consistent carbon reporting requirements via policy or regulatory instruments and work towards future carbon intensity targets	
Principle 4 – Establish minimum expectations for embodied emissions reduction in tenders	
4.1 Set minimum requirements for reducing emissions	Procurement
4.2 Update standard contracts to enforce emissions reductions	
Principle 5 – Evaluate tenderer performance on embodied emissions reduction	
5.1 Assess embodied emissions performance measures as part of tender criteria	Procurement
5.2 Assess embodied emissions performance measures as part of contractor performance reporting	
Principle 6 – Improve education and capability on embodied emission reduction across lifecycle	
6.1 Build knowledge and capability across the infrastructure delivery community	Ongoing
6.2 Identify and address staff capability gaps	

2.2.2 NSW Office of Energy & Climate Change

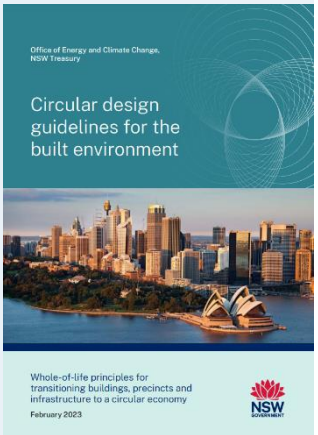
The Office of Energy & Climate Change has several decarbonisation related policies and initiatives underway. The recently released NSW Net Zero Emissions Dashboard presents past and projected future GHG emissions for NSW. It provides useful insights into the pace of decarbonisation expected in each sector – waste, industrial processes, transport, and stationary energy (excluding electricity generation) - are set to be the hardest and slowest to decarbonise. Resource consumption and carbon emissions are also reported with agency breakdown for whole of government through the Centralised Analysis System for Performance of Energy and Resources dashboard.

The NSW Government *Resource Efficiency Policy* sets out targets to reduce energy and install solar photovoltaic across all government sites. Specific minimum energy performance standards are provided for new building and office fit outs.

The Office of Energy & Climate Change has also established a Net Zero Industry & Innovation Program with over $305 million in grant funding to support heavy industry to rapidly decarbonise. Under the program, Clean Manufacturing Precinct Decarbonisation Roadmaps are being developed for the high emitting Hunter & Illawarra regions [50].

NSW CIRCULAR ECONOMY GUIDELINES FOR THE BUILT ENVIRONMENT

NSW Office of Energy & Climate Change released the *NSW Circular Design Guidelines for the Built Environment* in early 2023 [51], driven by policy to support the use of circular economy principles and strategies in construction. The guide complements and supports the NSW Government's commitment to reducing embodied carbon in construction under the *NSW Net Zero Plan Stage 1: 2020-2030*.



2.2.3 Transport for NSW (TfNSW)

TfNSW is a sustainability leader within the NSW Government and Australian transport agency peers:

- It was the first transport agency in Australia to commit to procuring 100% renewable energy for operations, after Sydney Metro Northwest was the first project to make the commitment in 2018.
- Like the MTIA delivery bodies, TfNSW embeds detailed carbon reduction requirements and targets in delivery contracts and contractors are being asked to align their procurement practices with *ISO 20400 Sustainable Procurement Guidance* (see Sydney Metro City & Southwest case study below).
- Unique amongst other transport agencies in Australia, TfNSW sets baseline sustainability requirements and sustainable design guidelines for smaller projects.
- The TfNSW *Sustainable Design Guidelines* include energy and carbon reduction targets for construction (embodied) and operational carbon, and an accompanying Carbon Estimate and Reporting Tool is used for projects to report on performance.

SUSTAINABLE PROCUREMENT IN INFRASTRUCTURE INITIATIVE

TfNSW launched a *Sustainable Procurement in Infrastructure* initiative following its *Transport Sustainability Plan in 2021* [52]. A series of five industry engagement workshops were held through 2022, where "almost 50% of participants wanted TfNSW to incorporate net zero principles into procurement, including updates to the road and rail engineering contracts manuals by 2023". The following actions summarise the industry engagement report [53]:

- use a consistent framework for carbon management like *PAS 2080 Carbon Management in Infrastructure*
- finalise and implement co-created multimodal sustainable procurement framework for common delivery methods, including early design briefs
- establish a clear path to measurement with an updated Carbon Estimate and Reporting Tool and an aligned solution in the Digital Engineering Framework for Building Information Modelling integrated tools
- develop a Transport Zero Carbon Materials Innovation Program with an associated roadmap with NSW Government and industry partners.

SYDNEY METRO CITY & SOUTHWEST – EMBEDDING CARBON TARGETS

The Sydney Metro City & Southwest project adopts several carbon reduction targets and uses sustainability ratings (e.g., Infrastructure Sustainability Rating and Green Star Railway Stations tools) to drive outcomes and provide assurance [54]. The carbon reduction requirements were set in the reference design for contractors' responses. A July 2019 review found that contractors met or are on track to meet 85% of the 43 performance targets.

To accelerate the development of principal contractors, Sydney Metro mandated that procurement should align with *ISO 20400 Sustainable Procurement Guidance*.

Embedding carbon reduction targets in delivery

Sydney Metro identified lower energy use and emissions reduction during construction and operations as a key opportunity of focus. Goals include:

- a 20% reduction in carbon emissions associated with construction (when compared with a business-as-usual reference case)
- maximising the capture and reuse of braking energy from trains
- designing buildings to achieve at least 15% improvement on Section J benchmark of the National Construction Code
- sourcing 5-20% of low voltage electricity demand at above ground stations from onsite renewable energy sources where feasible
- offsetting 25% of the electricity needs for the construction phase and procuring 100% renewable energy for the operational phase of the project
- reducing the environmental footprint of materials used on the project by at least 15% (when compared with a business-as-usual reference case)
- using concrete which has an average Portland cement replacement of more than 25%
- recycle or reuse 90% of construction and demolition waste.

2.2.4 Industry

While there is a lack of consistent government guidance on considering carbon in business cases and procurement processes, several leading industry bodies, think tanks and advocacy groups are actively engaging in research in infrastructure decarbonisation (Figure 2.1).

Austroads

Austroads has flagged two priority research projects for 2022-2023 which will help support the decarbonisation of transport infrastructure for transport agency members across Australia and NZ. Austroads research includes development of tools for measuring carbon and recycled content in infrastructure builds, as well as exploration of emissions reductions opportunities for Australian transport agencies.

Materials and Embodied Carbon Leaders' Alliance (MECLA)

MECLA is an Australian "do-tank" that brings together the ambition to reduce carbon that is embodied by the building and construction sector, with the goal or achieving net zero emissions. They facilitate collaboration between the member organisations through research and working groups that aim to the build collective capabilities of the sector in reducing embodied carbon.

Beyond Zero Emissions

Beyond Zero Emissions is an Australian think-tank recognised globally for its efforts in addressing climate change, headquartered in Australia. Beyond Zero Emissions regularly engages with government, other industry and academic bodies to develop insights on topics such as zero carbon materials, carbon capture, net zero economics, and infrastructure decarbonisation. The papers focus on public policy and economic implications, with a goal of transitioning advanced economies towards a zero emissions model.

ClimateWorks

ClimateWorks worked in partnership with Clean Energy Finance Corporation, an Australian Government owned Green Bank, to facilitate invetsment in the sector. In 2020, ClimateWorks published a paper on reshaping infrastructure for a net zero emission future. The paper explores challenges and opportunities of reshaping high emitting sectors and makes a case for emissions reductions to be considered a greater priority in upfront decision making.

Infrastructure Partnerships Australia

Released a discussion paper on Decarbonising Infrastructure for the Australian context. This paper considers a range of different policy mechanisms to transition the infrastructure sector to a zero-emission future rapidly, efficiently and affordably, laying out potential actions by the public sectors against some of the biggest emitting forms of infrastructure.

Figure 2.1: Australian industry bodies and think tanks

2.3 International leading examples

2.3.1 United Kingdom (UK)

The UK Government has demonstrated significant progress in decarbonising the infrastructure that it commissions through a combination of efforts including advocacy and leadership from decision makers, improved accountability mechanisms, updates to business case and procurement requirements, and improved accessibility to decarbonisation tools and capability.

The *Infrastructure and Projects Authority Gate Review Assurance Toolkit* is a set of guidelines developed by the UK Government to support public infrastructure projects in passing independent gateway assurance reviews and was updated to include tests for net zero and climate adaptation considerations [55]. The net zero test examines the lifecycle carbon footprint of the project, from construction to decommissioning, and ensures that emissions reduction is integrated into the project's design, delivery, and operation.

Measuring whole-of-life carbon

The Infrastructure and Projects Authority assurance tool kit recommends that a whole-of-life carbon methodology is used to assess carbon emissions, such as the *PAS 2080 Carbon Management in Infrastructure Standard*.

To support the consistent quantification of carbon emissions, the UK Government has a more comprehensive set of publicly available guides, datasets, and tools than there is in Australia – resources are also produced at the national level of government, while many resources in Australia differ between states and specific agencies. The UK GHG conversion factors, published annually, cover a significant range of scope 3 emission sources (e.g., various passenger and freight transport modes and building materials).

The Transport Analysis Guidance Databook [56] includes a detailed range of assumptions to incorporate carbon emissions and benefits/disbenefits and cost benefit analysis, including forecasts for electric vehicle market share and carbon emission intensity by mode and fuel source out to 2050. UK National Highways has also developed a Carbon Emissions Calculation Tool [57] along with supporting guidance and an e-learning training programme.

From late 2021, the UK Department for Transport (DfT) has further required major projects to quantify whole of life carbon emissions and produce a PAS 2080 aligned Carbon Management Plan during the strategic business case, which is to be followed and updated throughout project delivery. Quantifiable carbon reduction guidance is also being developed to support local authorities with their decarbonisation policies and projects.

In 2022, the UK DfT Permanent Secretary introduced a phased plan for assessing, reporting, and mitigating greenhouse gas emissions from infrastructure projects. This approach relies on project-level carbon measurement to manage emissions on a larger scale. New requirements include:

- Starting February 2022, whole-life carbon assessments for Tier 1 DfT projects or those with emissions exceeding 1 Mt CO2-e, covering all business case stages and monitoring during implementation.
- From June 2022, extending whole-life assessment requirements to Tier 2 DfT projects.
- From January 2023, expanding whole-life assessment to Tier 3 DfT projects.
- Achieving PAS 2080 accreditation for National Highways by the end of 2023

2.3.2 European Union (EU)

The EU Commission has a critical role in shaping EU policies and legislation related to the environment, including climate change. The Commission is responsible for the development and implementation of the EU's climate and energy policies, which aim to reduce GHG emissions and increase the use of renewable energy sources.

The Commission has developed and published guidance for considering carbon more effectively in business cases, including detailed guidance on valuing carbon in CBAs, as well as in procurement processes. These guidance documents are typically specific to sectors or types of projects.

The *EU Green Public Procurement Framework* assists public authorities of the member states to buy goods, services and works with a lower environmental impact. While not yet mandated by legislation, the framework includes guidance on sustainability and circular economic theory, and provides specific criteria to be considered when public servants engage in procurement practices, including:

- consulting the market for zero or low carbon materials
- implementing carbon reductions in contract requirements
- specifying embodied emissions criteria for materials used in construction
- verifying supplier compliance
- filtering suppliers based on environmental sustainability practices
- evaluating tenders to balance emissions reductions with cost and risk
- guidance on contract performance clauses

Emerging green and climate taxonomies

Various green and climate taxonomies are emerging to help define environmentally sustainable economic activities and assets. The primary aim is to help scale capital flows into activities and projects that support environmentally sustainable development, for example supporting the net zero transition. Figure 2.2 shows one of the many taxonomies are adopting a traffic light classification for climate mitigation management. Projects can be classified as either being compatible with a net zero carbon economy, compatible with the net zero transition, or not compatible.

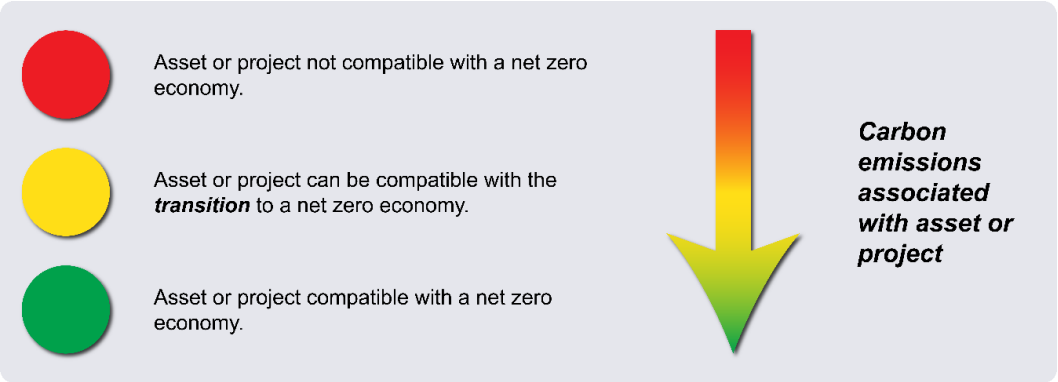


Figure 2.2: Example climate mitigation taxonomy principles (adapted from Climate Bonds Taxonomy)

The *EU Taxonomy Regulation and Low Carbon Benchmarks Regulation* established under the *European Commission's Action Plan on Sustainable Finance* are becoming rapidly adopted in Europe and North America [58].

Figure 2.3 shows some of the EU taxonomy climate mitigation thresholds and criteria that apply to infrastructure. Such taxonomies are primarily intended to apply to the private sector, however the UK Green Finance Institute notes the potential use cases of directing public funds and underpinning planning decisions at the local authority level [59].

Following the development of the EU Taxonomy and sustainability related taxonomies overseas (e.g., Canada, Singapore, Malaysia, and NZ), the Australian Sustainable Finance Institute is in the process of developing a sustainable finance taxonomy for Australia [60]. Such taxonomies could be adopted by the Victorian Government, for example through agency reporting to central government on alignment or eligibility, to better understand net zero transition related risks and opportunities associated with asset portfolios and investment pipelines.

Sector/activity	Example thresholds	Other qualitative criteria
Electricity generation	*100 g CO2-e / kWh power generated*	Threshold will reduce every 5 years
Transport – passenger	*50 g CO2-e / passenger km*	Zero direct emission land transport infrastructure are eligible e.g. electrified rail systems
Transport – low carbon infrastructure	*N/A*	Infrastructure associated with low carbon fleets, active mobility fleets and infrastructure, EV charging infrastructure upgrades are eligible
Materials – cement	*0.498 t CO2-e / t cement or alternative binder*	
Materials – steel	*1.328 t CO2-e / t steel product*	

Figure 2.3: EU Taxonomy climate mitigation thresholds and criteria that apply to infrastructure

2.4 Summary of state of play and gap analysis

Table 2.10 summarises Victoria's current state of play in decarbonising infrastructure across key themes, and identifies limitations compared to leading practices from national and international jurisdictions.

Table 2.10: State of play summary

Theme	Leading examples	Victorian state of play
Leadership 	The *United Kingdom Climate Change Act 2008* demonstrates strong leadership in climate action and decarbonisation, with a comprehensive legislative framework that holds the government accountable for meeting emissions reduction targets and forces the government to demonstrate how its current policies and investments will put them on track to meet those targets. Prioritisation of decarbonisation from senior levels of government has driven change at the department and agency level, leading to a coordinated and effective approach to emissions reductions.	In Victoria, there are emissions reduction targets and sector pledges established by legislation, which demonstrate the state's commitment to reducing the risks of climate change. In Victoria various departments and agencies are working on emissions reduction measures within their respective domains. While there is some level of coordination and collaboration, the overall implementation of measures is not fully consolidated, resulting in a more fragmented approach.
Non-build and low-carbon solutions 	The Welsh Government exemplifies strong commitment to non-build solutions in infrastructure planning. In 2023, the Welsh Government announced the scrapping of nine major road projects in favour of more carbon-friendly alternatives after a year-long review. This decision demonstrates a clear prioritisation of low-carbon transport options, including public transport, walking, and cycling. The Welsh Government has committed to only considering future road infrastructure investments that reduce carbon emissions and support shift towards sustainable transport.	Non-build and low-build solutions are considered in the planning process for infrastructure projects, but the extent to which they are prioritised varies across different agencies and projects. Although guidance for assessing non-build and low-carbon solutions exists, it's introduced too late in the evaluation process. Effective consideration requires exploring alternative service delivery solutions at the strategic level or concept and feasibility stage, broadening the range of options before the business case. Additionally, stronger leadership commitment is needed for consistent evaluation and implementation of these solutions.
Carbon quantification guidance 	The United Kingdom's PAS 2080 *Carbon Management in Infrastructure Standard* and Royal Institution of Chartered Surveyors *Whole-of-Life Carbon Assessment for the Built Environment* both provide a consistent and detailed methodology for assessing carbon emissions across the lifecycle of infrastructure projects. Both are based on the European Standard, EN 15978 Sustainability in Construction Works Standard, which is already adopted for Green Star Life Cycle Assessments in Victoria.	Victorian projects and agencies have adopted a range of guidance and standards relating to carbon quantification, but these do not always consider whole-of-life carbon and are inconsistently applied. Standards are also not mandated but voluntarily adopted, such as those referred to in sustainability rating tools like Green Star and the IS Rating tool. Different agencies use different methodologies or datasets, leading to varying levels of accuracy and comparability in emissions estimates.
Capability and tools 	Globally, the UK demonstrates best practice in capability and tools with a range of resources available for central government (GHG conversion factors), UK Department for Transport (Quantifiable Carbon Reduction Guidance) and National Highways (Carbon Emissions Reporting Tool, industry webinars, e-learning training programme). Within Australia, Transport for New South Wales has developed suite of tools, guidelines, and training programs to build capability in carbon management. These include the Sustainable Design Guidelines and supporting tools, the Carbon Estimate Reporting Tool, and the Climate Risk Assessment tool.	Victoria has made progress in building capabilities and tools for carbon management, but the availability and adoption of these resources are not yet consistent across all agencies and sectors. Government stakeholders identified the need for upskilling across all levels of government to ensure policy makers, project developers and procurement officers are more effective in driving decarbonisation outcomes. The state will benefit from development and standardisation of tools, training programs, and knowledge-sharing initiatives.

Theme	Leading examples	Victorian state of play
Carbon valuation 	The UK's Department for Business, Energy & Industrial Strategy published a policy paper [4] providing a consistent approach to valuing carbon emissions across all government departments and agencies in cost-benefit analysis. This guidance includes a specific list of time series values for projects, ensuring accuracy and consistency in carbon valuation. The guidance is based on a target consistent approach which aligns the value of carbon with the cost of abatement to achieve its legislated emissions targets. Periodically updated, it serves as a model for Australia and Victoria to adopt a uniform approach for effective climate change mitigation efforts.	In Victoria, there is no government-wide approach to valuing carbon emissions in infrastructure projects. The DTF Economic Evaluation Guidelines do not provide specific guidance on carbon valuation for business cases, and other available resources, such as the Australian Transport Assessment and Planning (ATAP) economic parameters, are outdated relative to the latest evidence and practice. As a result, the methodologies and assumptions used for carbon valuation may vary across different projects and agencies, leading to discrepancies in the perceived costs and benefits of emissions reduction measures.
Business case guidelines 	NSW Treasury updated the NSW Government Guide to Cost-Benefit Analysis (TPG23–08) to provide guidance on including carbon emissions in CBAs and business cases. The guidelines provide a clear framework for incorporating carbon emissions into CBAs and business cases, ensuring that the environmental impacts of projects are consistently considered.	Victoria's business case guidelines do not explicitly require comprehensive whole-of-life carbon quantification, valuation, and management considerations. While the Sustainable Investment Guidelines (SIGs) provide 'good practice' advice on considering decarbonisation in investment decisions, they do not set any requirements. As a result, the degree to which emissions reduction measures are integrated into project development and decision-making processes is not consistent across projects and agencies.
Procurement frameworks and templates 	The EU's Green Public Procurement framework provides detailed guidance and criteria for public authorities to consider when making procurement decisions, specifically addressing emissions reduction and management. It includes recommendations for consulting the market for zero or low-carbon materials, specifying embodied emissions criteria for materials used in construction, and evaluating tenders based on emissions reductions alongside cost and risk.	Victoria's social procurement framework and associated templates provide some consideration of environmental sustainability factors (e.g., energy efficiency, water conservation, waste management, GHG emissions, and the use of recycled materials). However, they do not consistently address or prioritise emissions reduction and low-carbon solutions.
Standard contracts 	Well-resourced delivery agencies for major transport projects, such as those managed by Transport for NSW and Sydney Metro Authority, have clear targets and requirements are embedded in contracts to drive reductions. Contractors are required to align procurement practices with sustainable procurement standards (such as ISO 20400) and include carbon considerations in tender evaluation. Contract mechanisms also exist to allow for and incentivise carbon reductions.	Some contracts for transport agencies and VHBA include clauses with carbon reduction targets, such as those for the Level Crossing Removal Project and Rail Project Victoria projects. These are generally voluntary and nominated by the delivery agencies, and often linked to sustainability ratings. However, specific requirements for reducing emissions are not universally incorporated or enforced to drive the required decarbonisation outcomes.

Interventions development and assessment

3 Interventions development and assessment

KEY POINTS

- 11 potential interventions were conceptualised for decarbonising Victorian Government infrastructure, based on state-of-play research and stakeholder interviews.
- Intervention development involved extensive research, stakeholder consultation, and iterative refinement processes.
- An assessment framework with 5 criteria was developed to evaluate interventions and actions for their effectiveness, ease of implementation, cost, repeatability, and alignment.
- Government and industry stakeholder workshops informed the refinement of interventions and actions, addressing essential aspects, interdependencies, and staged implementation.
- Industry workshop involved key players such as industry organisations, design and engineering groups, construction contractors, research bodies, and decarbonisation leaders.
- Industry input revealed the need to remove barriers, such as stringent specification requirements, to enable low-carbon solutions.
- Collaboration between government and industry was identified as a crucial factor for successful decarbonisation efforts.
- The development process resulted in 10 interventions and a comprehensive list of actions for the Victorian Government to achieve desired decarbonisation outcomes.

3.1 Intervention development process

The intervention development process is outlined in Figure 3.1. It shows the research and stakeholder consultation undertaken in developing the interventions presented in this report. The remainder of this section describes in further detail how stakeholder feedback and independent assessments shaped the interventions and implementation plan.

Refer to Appendix B for a comprehensive list of Victorian Government entities and industry members consulted with as part of the project's stakeholder engagement process.

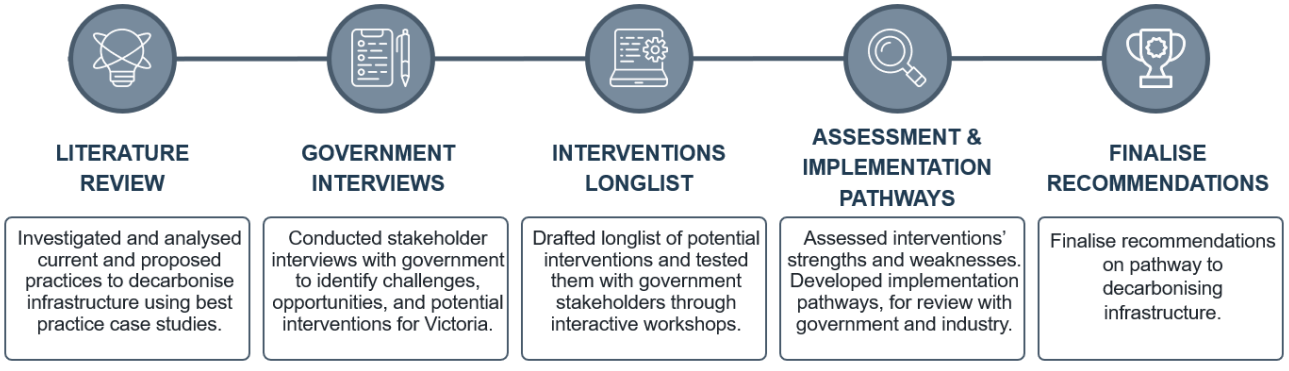


Figure 3.1: Interventions development process

3.2 Stakeholder interview findings

3.2.1 Approach

Infrastructure Victoria and WSP undertook a series of engagements with nine Victorian Government departments and authorities across six interviews to better understand decarbonisation efforts and to identify the opportunities for improvement and potential barriers to change. The departments interviewed (Figure 3.2) are responsible for more than 90% of capital investment identified in the Victorian state budget.

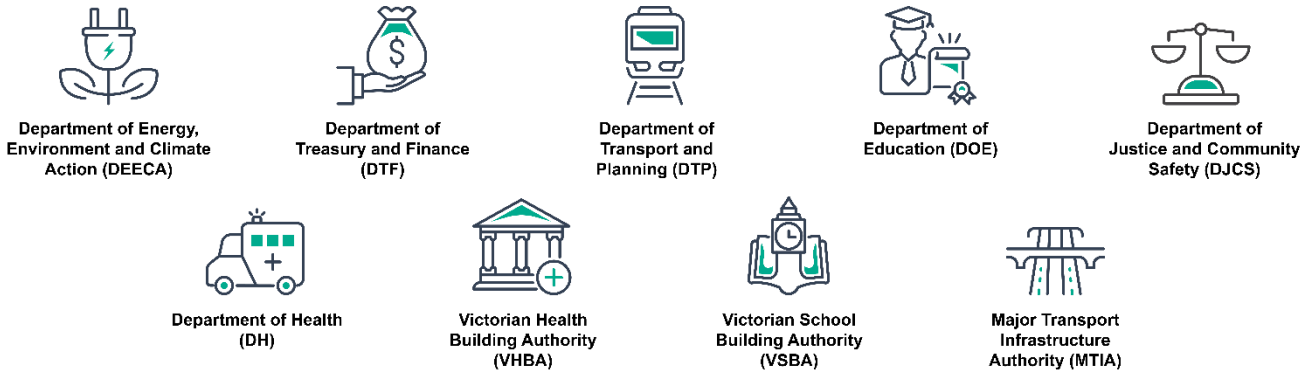


Figure 3.2: Victorian Government entities interviewed

The interviews aimed to determine how the government's decarbonisation agenda has impacted these agencies by understanding their perceptions and views on:

- current practices and the opportunities and challenges for improving decarbonisation efforts
- options for incorporating decarbonisation in business case and procurement processes
- success factors for policy interventions
- quick wins that the Victorian Government can achieve in the short term.

3.2.2 Key findings

Figure 3.3 summarises the engagement findings in terms of:

- change opportunities with widespread or frequent support ( )
- opportunities with clear but less widespread support ( )
- challenges ( ) - identified as potential barriers to change.

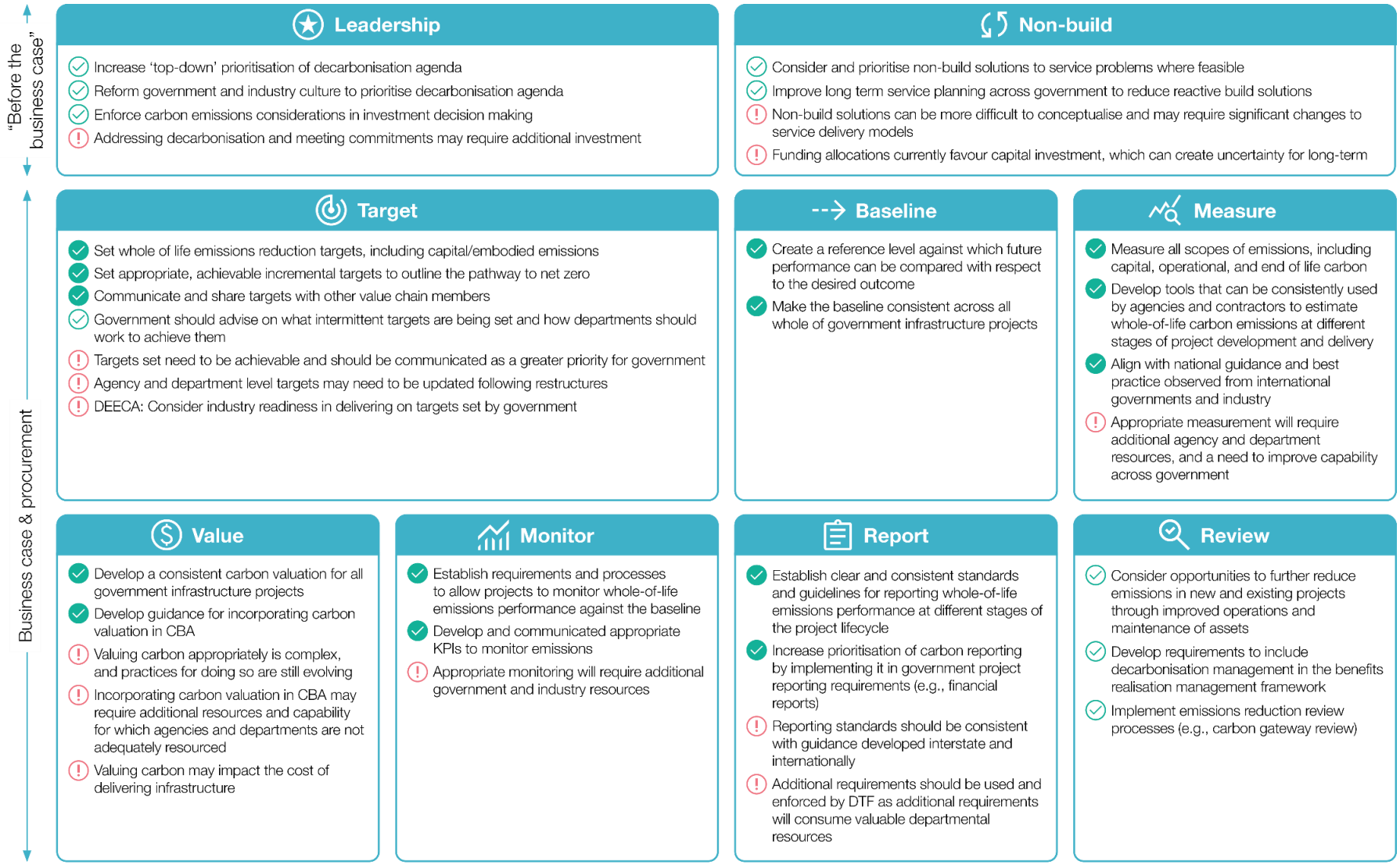


Figure 3.3 Summary of stakeholder feedback on decarbonisation requirements for Victoria

3.2.3 Criteria for success and quick wins

The Victorian Government stakeholders identified a range of factors for consideration when assessing potential options for decarbonisation in business cases and procurement, including consistency, leadership, effectiveness, cost of implementation and ease of implementation (Figure 3.4).

Consistency

Government and industry bodies across the world are investigating and developing practices for incorporating carbon in infrastructure decision making, including for business case and procurement processes. All stakeholders interviewed stated the importance of requirements and guidelines being adopted in Victoria that are consistent with those of other Australian states and territories, and where possible, consistent with international practice.

Leadership

Stakeholders frequently stated that prioritisation from government leaders and decision makers would be needed to make a sizeable impact on infrastructure decarbonisation efforts, and that in the absence of this, efforts to consider carbon in business cases and procurement would likely be diminished.

Effectiveness

Any new requirements imposed on departments and agencies for considering and managing carbon should be effective in significantly reducing carbon created through infrastructure. This means setting clear requirements for carbon to be considered in decision making, and not be overlooked in favour of cost savings.

Cost of implementation

Government agencies and departments have limited resources available to tackle the decarbonisation challenge in addition to their regular responsibilities. For new decarbonisation options to be successful, the cost to implement should be assessed relative to the options' effectiveness.

Ease of implementation

Stakeholders identified the technical ease of implementing options as a criterion for success because not all government agencies are equally equipped with the technical capability to decarbonise infrastructure. Time and effort will be required to upskill personnel.

Figure 3.4: Stakeholder identified criteria for decarbonisation success

Stakeholders also identified 'quick wins' – actions that the Victorian Government could take to have an immediate impact on the decarbonisation agenda, including:

- **improving internal capability** – upskilling officers within departments and agencies to better understand the challenge of decarbonisation and how it could be implemented as part of their regular activities
- **aligning with best practice** – reviewing and aligning with leading decarbonisation practices in other Australian states and territories such as NSW
- **developing carbon estimation guidance** - clear guidance being developed by DTF on how carbon can be measured, valued, and applied in the cost-benefit analysis in the business case, as well as procurement processes
- **making best use of existing carbon estimation tools** - informing departments and agencies of existing tools for estimating emissions associated with infrastructure.

3.2.4 Government roles and responsibilities

The decarbonisation challenge will require significant efforts from all government bodies as well as private industry. However, stakeholders interviewed identified the role of government to lead the agenda and communicate appropriate signals for industry to follow. Furthermore, stakeholders noted the role of central government departments such as DEECA and DTF in setting consistent requirements, guidance and policy for other departments and agencies to follow.

3.3 Longlist of options

The state of play research and stakeholder interviews from Part 1 of this study led to the development of 11 potential interventions to decarbonise Victorian Government infrastructure as shown in Figure 3.5.

A comprehensive list of actions was developed with each intervention for government consideration. The actions were tested by stakeholders during the consultation process to evaluate the strengths, weaknesses, and opportunities associated with each. Feedback on the different action variations ultimately informed the design of an implementation plan.

General / 'Pre business case' interventions

1. Develop capability and tools
2. Consider non-build or low carbon solutions
3. Develop processes for more effective carbon budget management
4. Develop consistent guidance on whole-of-life carbon quantification and measurement
5. Develop carbon emission gateway review process

Business case interventions

6. Update business case guidelines
7. Valuing carbon in cost benefit analysis

Procurement and delivery interventions

8. Update tender evaluation criteria
9. Update procurement contracts
10. Improve industry engagement and cooperation
11. Update design standards and specifications

Figure 3.5: Longlist of potential interventions

3.4 Consultation and assessment process

Figure 3.6 below summarises the consultation and assessment process taken to refine the longlist of interventions and actions, as well as inform the development of the implementation plan.

A series of stakeholder engagements with government and industry bodies led to the iterative refinement of the interventions presented in Figure 3.5.

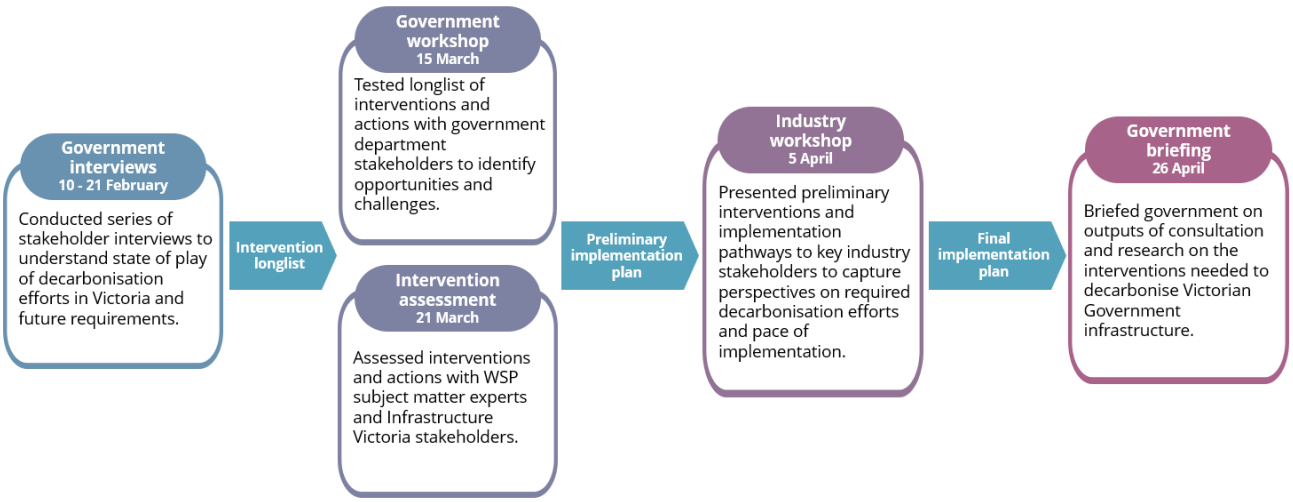


Figure 3.6: Stakeholder consultation and interventions assessment process

The remainder of this section provides a high-level overview of the considerations involved in the government and industry workshops, as well as the assessment framework applied in the WSP subject matter expert and Infrastructure Victoria review of the interventions and actions.

3.4.1 Assessment framework criteria

Following workshops with stakeholders, an assessment framework was developed incorporating five criteria, as shown in Table 3.1. Each of the interventions in the longlist and their underlying actions were assessed and

scored against these criteria. Rather than eliminating interventions from the longlist, the purpose of the scoring was to understand which interventions and actions could be implemented quickly and effectively, as well as which faced challenges and why. The assessment and scoring against criteria informed the development of an implementation plan which considered new actions, challenges and opportunities, interdependencies, and timelines.

Table 3.1: Assessment Framework Criteria

Criteria	Description
Effectiveness	How effective is this action in driving the decarbonisation of government infrastructure?
Ease of implementation	How technically complex and challenging will it be to implement this intervention?
Cost of implementation	How resource intensive will it be to implement this intervention for departments? (Monetary, physical, and human resources)
Repeatability	Can the action be used consistently across all Victorian Government entities and over time?
Alignment	Is the intervention consistent with practices supported by other states, federal government, international best practice, and industry bodies?

3.4.2 Key observations from government workshop

Figure 3.7 below outlines key observations that emerged from the analysis of the interventions and the longlist of actions informed by the workshop with government stakeholders and the application of the assessment framework.

Figure 3.7: Key observations from government stakeholder workshop

Following feedback from government stakeholders, the preliminary interventions and actions were refined to better address their essential aspects, interdependencies, and the need for a staged approach. For instance, during an industry workshop, the action of selecting flagship projects to demonstrate the use of carbon quantification tools was identified as crucial for government intervention rather than a supplementary action.

As a result, the original action under intervention 1, "Select flagship projects to demonstrate use of carbon quantification and management tools and processes" was revised into multiple sequential actions. The refined process now includes, in sequential order:

- **action 1.3**: publish guidance on whole-of-life carbon quantification and management
- **action 2.2:** implement or develop tools and guidance
- **action 2.5:** integrate carbon reporting and management into digital engineering processes
- **action 2.6**: develop training programs
- **action 4.1**: pilot whole-of-life carbon estimation approach.

Following the pilot, lessons learned will be incorporated into action 1.4, which involves updating the guidance based on the pilot's outcomes in a subsequent stage of implementation. This refined approach ensures that the interventions and actions are more effective, considering the essential aspects, interdependencies, and the need for a staged implementation.

3.4.3 Key observations from industry workshop

Similar to the government stakeholder workshops, key industry players will likely play a significant role in Victoria's decarbonisation journey were also consulted to ensure their perspectives were captured and addressed in the interventions proposed. These industry players included material suppliers, design and engineering groups, construction contractors, research bodies and other industry leading decarbonisation bodies.

Key observations from the industry workshop are summarised in Figure 3.8 below.

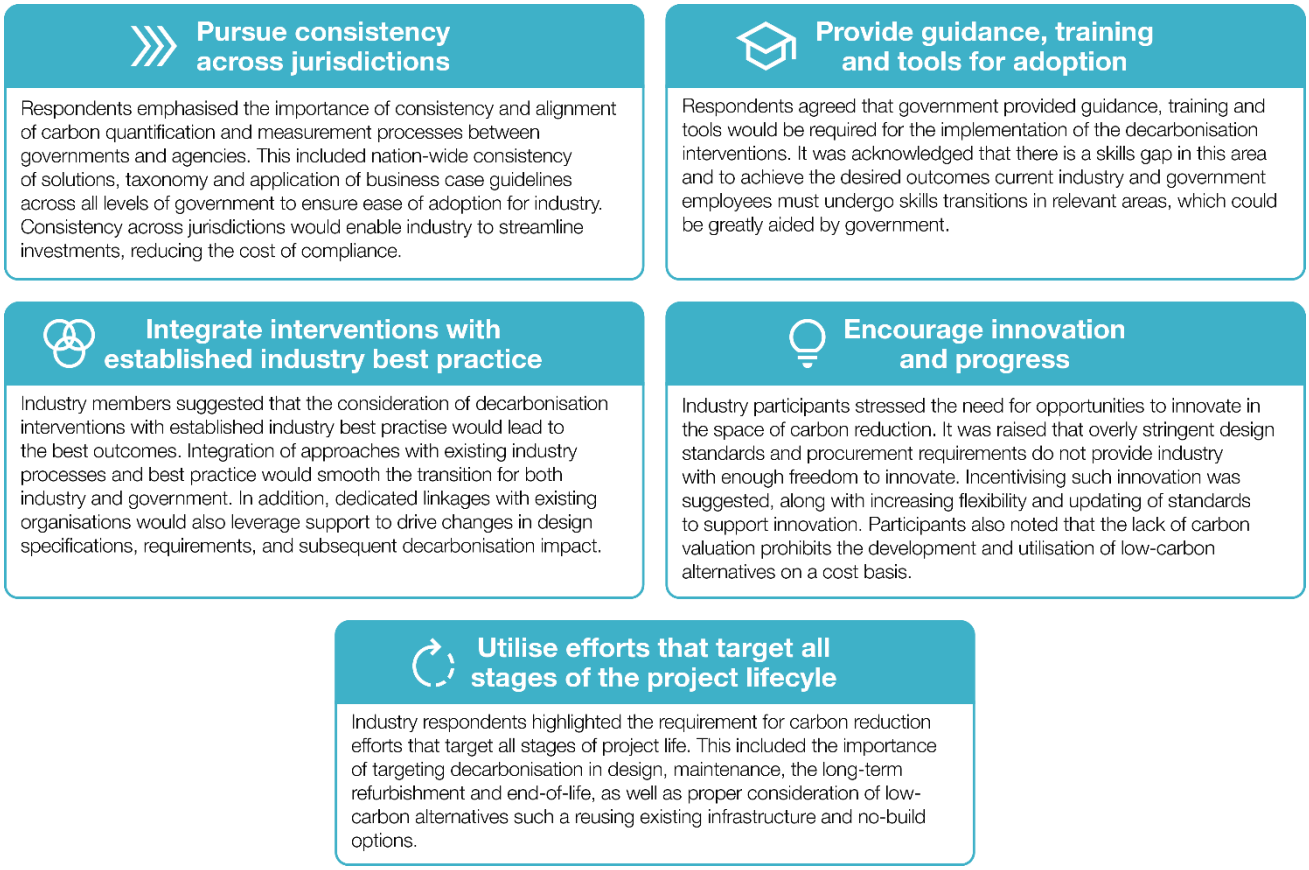


Figure 3.8: Key observations from industry workshop

In response to feedback from industry stakeholder workshops, the preliminary interventions, actions, and implementation plan underwent further refinement. Industry consultation revealed that substantial work had already been done on carbon quantification and management techniques and tools (as described in Section 2.2), leading to adjustments in the staging for implementing decarbonisation tools for the Victorian Government.

As a further example, intervention 9, which focused on improving industry engagement and cooperation, with actions such as:

- **action 9.1:** develop platform for low carbon construction solutions, and
- **action 9.2:** support the development of decarbonisation innovations across industry

were also modified. The feedback indicated that industry had already developed such platforms and would instead benefit from the removal of barriers, such as stringent specification requirements, and the enablement of low carbon solutions.

As a result, intervention 9 was revised to "support the development of decarbonisation innovations across industry" with new actions including:

- **action 9.1:** review existing platforms for low carbon construction innovations to determine gaps and opportunities, and
- **action 9.5:** update standards and specifications to better enable low carbon solutions.

The updated intervention also placed greater emphasis on government collaboration with industry.

Recommendations

4 Recommendations

STRUCTURE OF THIS CHAPTER

- Section 4.1 introduces the final list of proposed interventions.
- Section 4.2 describes the framework for implementing these proposed interventions.
- Section 4.3 explains the importance of government adopting the overarching principles.
- Section 4.4 summarises the sequencing of actions within the ten interventions and provides detailed descriptions of these actions including associated opportunities, challenges, and examples of best practice.
- Section 4.5 presents three implementation timings for the interventions, each with varying risks and opportunities.

4.1 Proposed interventions

The interventions proposed in this report are categorised as described in Figure 4.1 below, and are summarised in Figure 4.2 on the next page.

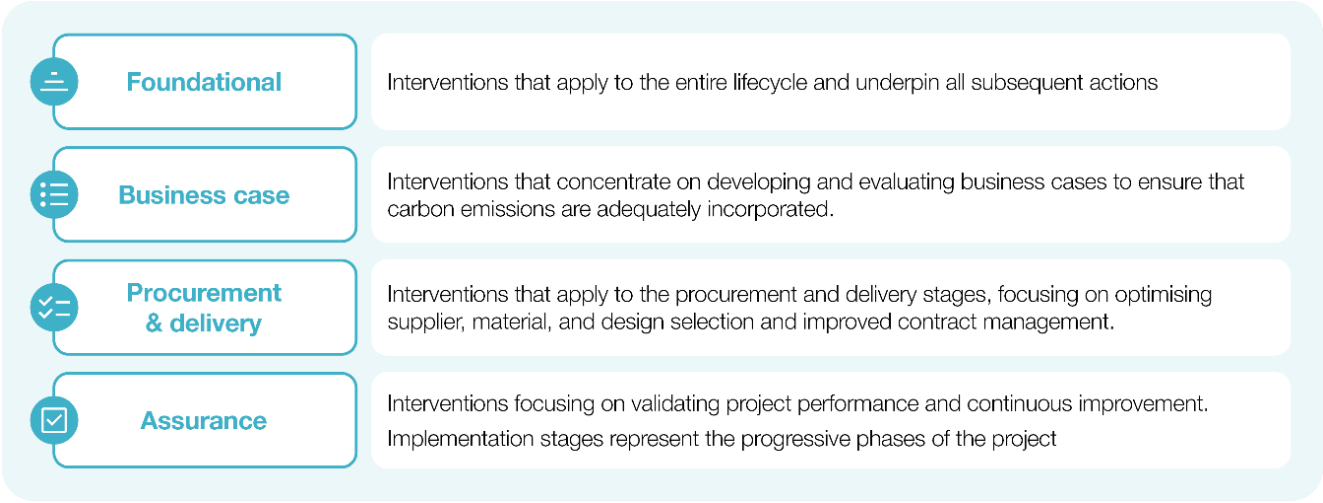


Figure 4.1: Intervention categories

Foundational interventions

Intervention 1
Develop consistent guidance on whole-of-life carbon quantification and management

Standardise procedures for quantifying and reporting carbon emissions, providing the information needed to monitor progress and improve the understanding of the emissions associated with public infrastructure.

Intervention 2
Develop decarbonisation capability and tools

Equip government agencies and industry with the knowledge, skills, and tools needed to effectively reduce the emissions in public infrastructure.

Intervention 3
Adopt a Victorian Government approach to valuing carbon across the project lifecycle

Establish a consistent, evidence-based carbon valuation approach and provide guidance for its application throughout the project lifecycle.

Business case interventions

Intervention 4
Consider carbon emissions in business case guidelines and templates

Require business cases to estimate whole-of-life carbon emissions, detail alignment with Victoria's decarbonisation objectives and targets, and describe carbon avoidance, reduction, mitigation, and offset strategies.

Intervention 5
Value carbon in cost benefit analysis

Ensure that the full impacts of carbon emissions are adequately considered alongside other economic costs and benefits by requiring projects and programs to value emissions in their CBAs.

Procurement and delivery interventions

Intervention 6
Update procurement frameworks and guides to better consider decarbonisation outcomes

Provide more specific direction on decarbonisation requirements (e.g setting minimum carbon reductions from a baseline) and establish a more robust approach to consider decarbonisation in procurement through tender evaluation criteria and bid-back processes.

Intervention 7
Update standard contracts to include minimum carbon reduction requirements and other incentives

Promote sustainable infrastructure development by integrating carbon reduction requirements into contracts, setting clearer expectations for suppliers, and ensuring that they align their practices with government objectives.

Intervention 8
Establish prequalification requirements for government contracts

Ensure that contractors possess the necessary experience, knowledge, and commitment to decarbonisation, promoting a competitive market that consistently works towards lowering carbon emissions in government infrastructure projects.

Intervention 9
Support the development of decarbonisation innovations across industry

Expand the use of low-carbon materials and practices in government commissioned infrastructure through the update of standards and specifications (performance-based standards) and learning from the successful implementation of low carbon solutions.

Assurance intervention

Intervention 10
Update assurance processes to include carbon emissions

Improve accountability and transparency in investment decision-making by incorporating carbon emissions considerations into assurance processes and by monitoring emissions across the project lifecycle.

Figure 4.2: Summary of proposed interventions

4.2 Implementation framework

Figure 4.4 (next page) provides a framework for the implementation of the interventions proposed in this report. The framework conceptualises how the proposed interventions can be categorised and implemented in stages over time, as well as the overarching principles that should be followed to promote the effective decarbonisation of Victorian Government infrastructure.

The framework has the following three dimensions:

- **overarching principles** which serve as guiding themes and are applicable to all proposed interventions across all implementation stages.
- **intervention categories** that include four clearly defined types (as shown in Figure 4.1): foundational, business case, procurement and delivery, and assurance.
- **implementation stages** that guide the logical sequencing of actions over time (described in Figure 4.3).

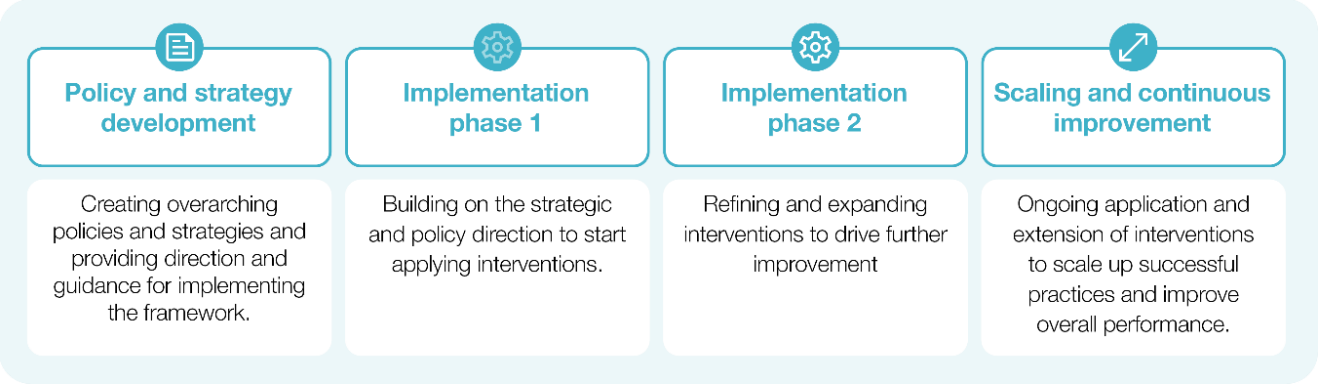


Figure 4.3: Implementation stages

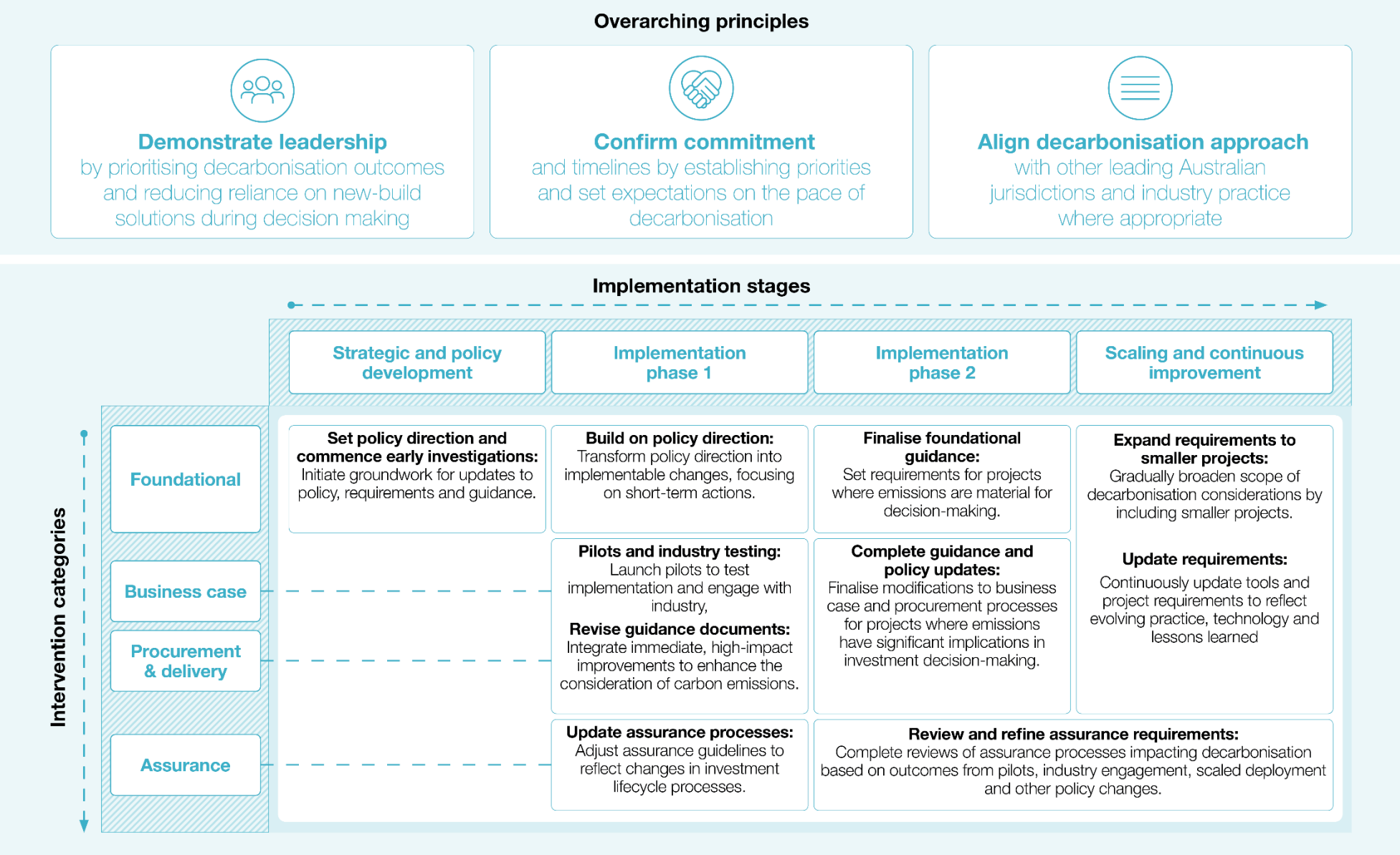


Figure 4.4: Implementation framework

4.3 Overarching principles

These principles were developed following stakeholder engagement during government interviews and workshops. They serve as key themes that shape and guide effective policy and process interventions across every implementation stage.

4.3.1 Demonstrate leadership in climate action

Strong leadership throughout government is important for the timely achievement of the state's net zero goals for Victoria. This type of leadership empowers and enables the public and private sectors to go beyond tick box approaches to decarbonisation by applying effective processes and tools and appropriately prioritising decarbonisation when informing government decisions. It also has the potential to position Victoria as a leader in this area within Australia and to be a catalyst for driving innovation in partnership with the private sector.

Government leadership in decarbonisation can be demonstrated by:

- increasing the prioritisation of decarbonisation outcomes during investment decision making
- reducing reliance on new-build solutions and prioritising non-build or low-build solutions where they are viable alternatives.

Prioritise decarbonisation during investment decision making

By incorporating decarbonisation goals alongside cost, time, and quality considerations, the government can drive sustainable practices and encourage innovative solutions when developing and procuring infrastructure.

Leadership through prioritisation may be in the form of Ministerial sponsorship for projects, programs or other initiatives which aim to decarbonise infrastructure. In NSW, the former Treasurer and Minister for Energy and Environment held a combined portfolio and was a vocal advocate for stronger leadership in climate action [61]. The strategic alignment of ministerial portfolio functions and ministerial sponsorship placed greater emphasis on decarbonisation in investment decisions, setting a clear path for departments, and industry to follow.

Reduce new-build solutions where non-build or low-build solutions are viable

Non-build infrastructure solutions avoid the emissions associated with constructing and operating new infrastructure to meet service needs. Victorian guidelines already require the consideration of non-build options (for example through demand management) when developing business cases. However, government agencies confirmed that it was often too late to fully consider alternatives to building infrastructure at this stage.

The work to fully consider non-build options needs to encompass portfolio-wide planning, before business case development, to develop service delivery options that can enable viable, non-build alternatives. Clear signalling from government about the need to intensify the search for reduced build solutions and its willingness to fund these options would enable agencies to respond.

The example below shows how the Welsh Government shifted the dial in considering no-build options in responding to transport problems when responding to financial constraints and the need to rapidly reduce carbon emissions.

EXAMPLE 5.1: WELSH GOVERNMENT RESPONSE TO THE ROADS REVIEW

In February 2023, the Welsh Government changed its approach to road building [62]:

- Roads will only be built if they support modal shift and reduce carbon emissions, improve safety, help adapt to climate change or connect people to jobs and activity centres to support modal shift.
- This has led to a significant reduction and re-prioritisation of its investment in new road schemes to more sustainable modes such as cycling, walking and public transport.

4.3.2 Confirm commitment and timelines by establishing priorities and set expectations on the pace of decarbonisation

Clarity about decarbonisation commitments and clearly messaged expectations about the required pace of decarbonisation will shape and enable appropriate responses from the private and public sectors. Stakeholders consulted through industry workshops raised the view that early engagement with the supply chain is critical to ensure availability and capability to drive innovation and investment.

The benefits of providing clear commitments and expectations now are:

- helping to mitigate the significant risk of falling short of the Victorian Government's 2050 net zero target by activating the public and private sectors to focus on how to achieve this target now
- seizing the opportunity to be, along with NSW, a leading state in this area
- influencing the involvement of the private sector in meeting this challenge by creating a supportive environment promoting collaboration between government, industry, and academia. This type of collaboration will accelerate the new technologies and approaches to reduce emissions and drive down long-term infrastructure costs and leading to a stronger more resilient economy.

4.3.3 Align decarbonisation approach with other leading Australian jurisdictions and industry practice where appropriate

Doing this is likely to unlock the following benefits for Victoria:

- **Reducing costs**: Utilising existing tools, research, and administrative resources minimises the need for additional investment in developing new solutions, thus reducing overall expenditure for the government.
- **Reducing the burden on industry**: Harmonising requirements across jurisdictions reduces the burden on industry, allowing businesses to focus on implementing effective decarbonisation strategies.
- **Accelerating adoption**: Aligning with successful jurisdictions enables Victoria to rapidly adopt proven approaches and move more quickly towards decarbonisation targets.
- **Building greater capability**: Consistency and precedent across jurisdictions contribute to building capability and expertise within the industry, leading to a more resilient and prepared workforce.

By collaborating and coordinating efforts with leading jurisdictions, Victoria can foster a culture of shared knowledge and experience. This ensures that the transition to a low-carbon future is more effective, and that Victoria remains at the forefront of sustainable practices and innovations in the Australian context.

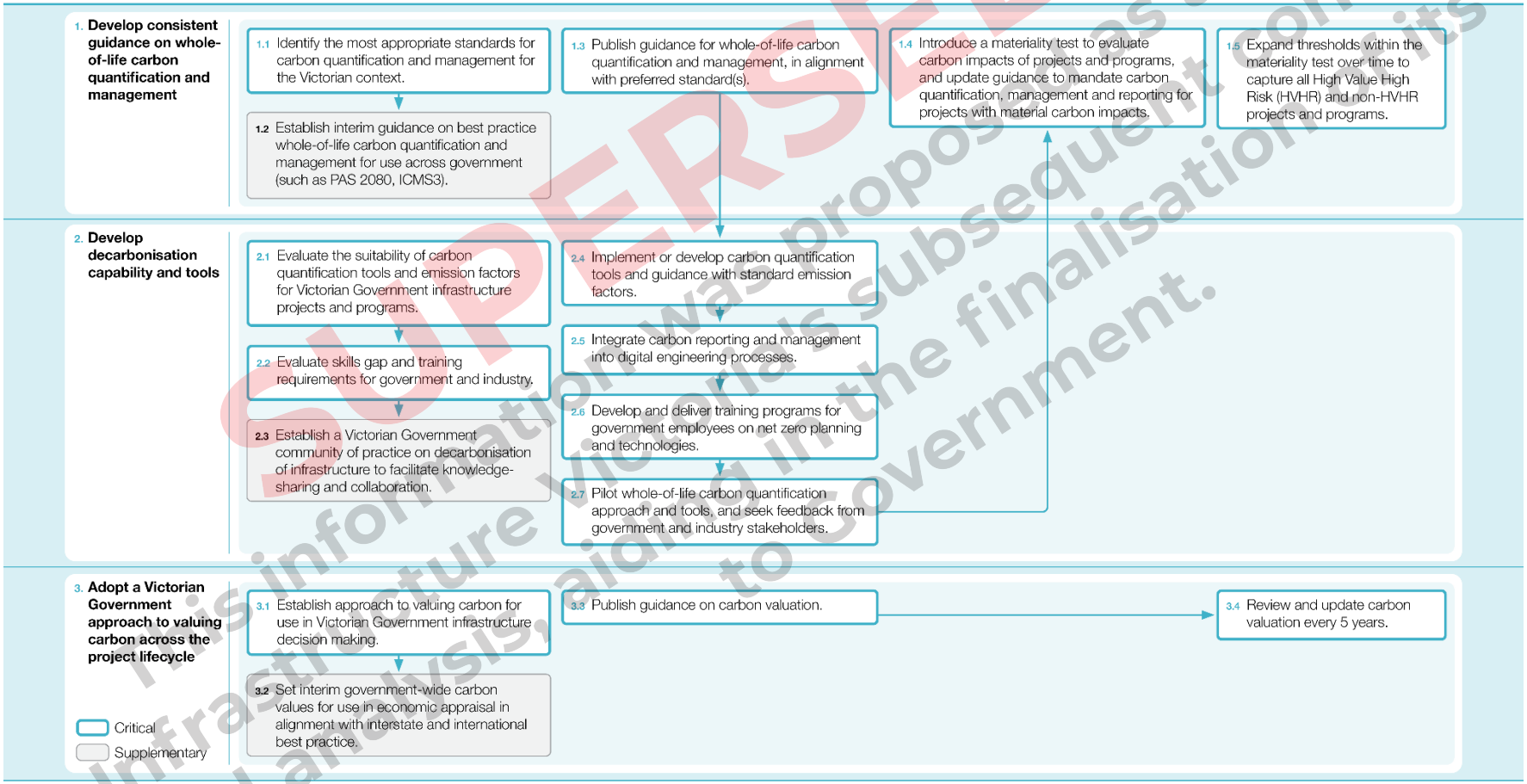
4.4 Implementation plan

This section provides an overview of the sequencing of actions across nine interventions and four implementation phases and across a series of figures highlight:

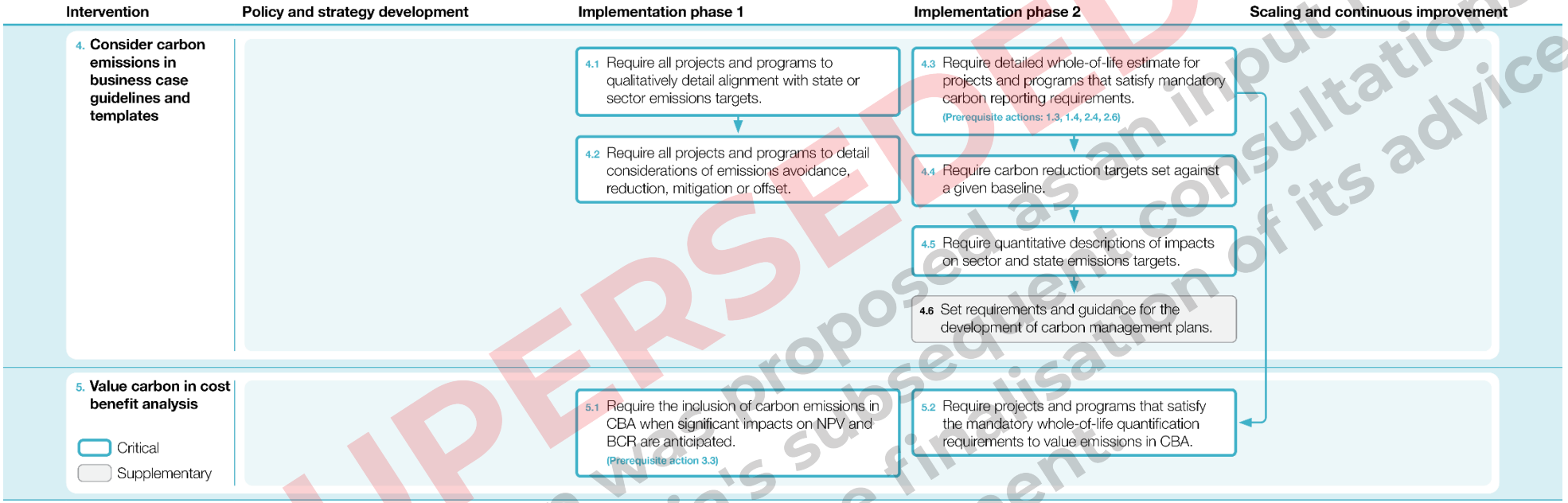
- **critical actions**: actions required to enable Victoria to achieve its decarbonisation objectives (marked with blue borders), and
- **supplementary actions**: actions that offer additional support and are likely to accelerate Victoria's decarbonisation progress (grey boxes).

For more information, refer to the detailed intervention and action descriptions at the end of this section.

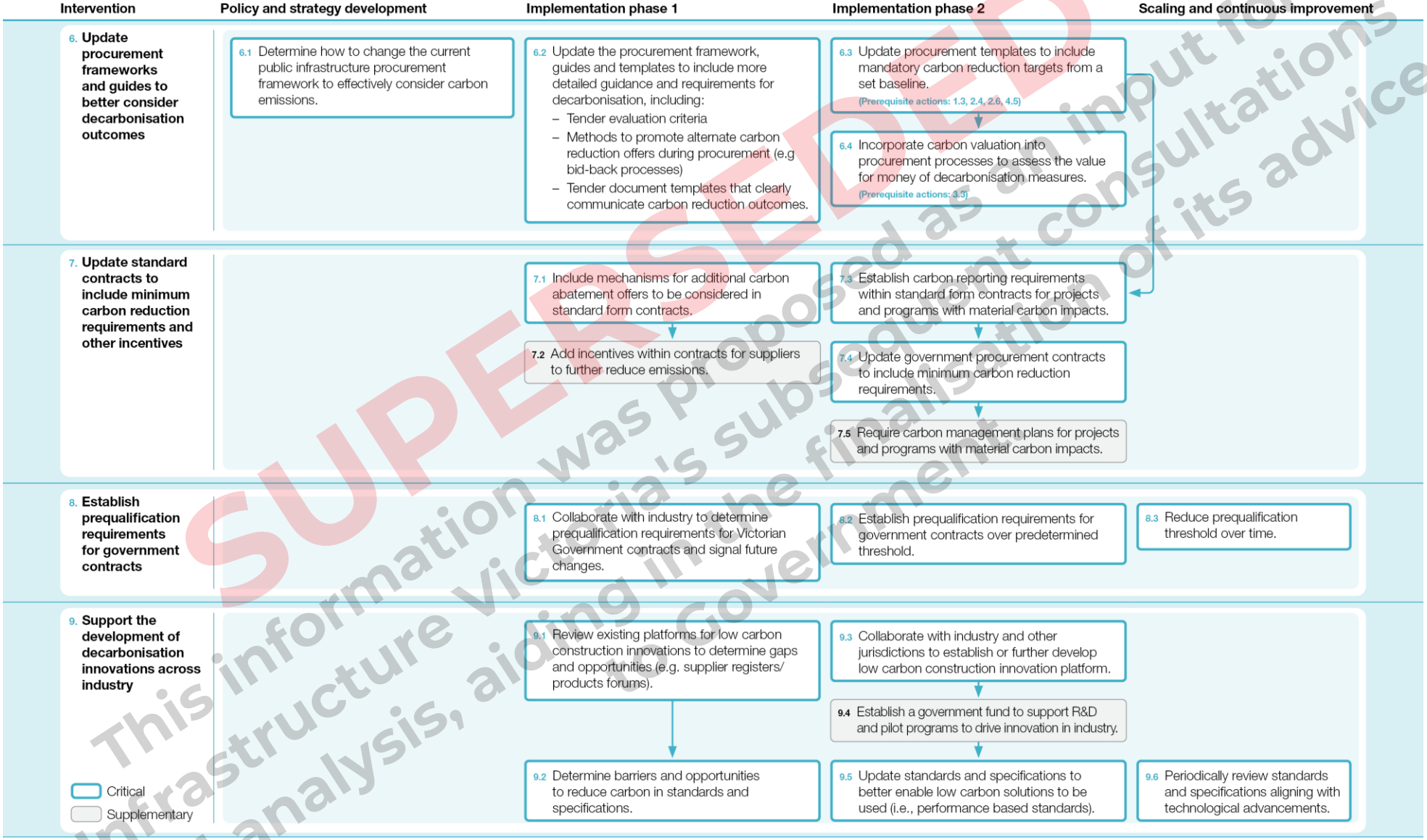
Foundational interventions



Business case interventions



Procurement interventions



Assurance interventions

Intervention	Policy and strategy development	Implementation phase 1	Implementation phase 2	Scaling and continuous improvement
10. **Update assurance processes to include consideration of carbon emissions**		10.1 Update assurance requirements to reflect changes in investment lifecycle and asset management processes.	10.2 Require carbon emission reporting in benefit management plans in all projects and programs that satisfy the mandatory whole-of-life quantification requirement.	10.3 Review performance and develop a register of carbon benchmarks to assist in the setting of carbon baselines.

Critical

Supplementary

4.5 Implementation timing

Government's decisions about the timing of the interventions it accepts will be shaped by:

- an assessment of the time and resources needed to implement interventions
- the level of priority given to implementing these interventions
- the impact of alternative timings on achieving government's interim and final decarbonisation goals.

In this context, the report provides three alternative implementation timelines including the fastest 'Leading' option, a more moderately timed 'Measured' option, and a slower 'Lagging' option.

The purpose of these illustrations is to inform government decision-making by illustrating the benefits and risks of the alternative timelines. The three implementation scenarios, Leading, Measured, and Lagging, represent distinct approaches to the implementation timeline:

- **Leading**: entails an implementation plan from 2023 to 2027, allowing Victoria to rapidly align with other, progressive jurisdictions.
- **Measured**: involves a more conservative approach, spanning 2023 to 2028, permitting additional time for planning, trialling, and a more gradual implementation.
- **Lagging**: covering 2023 to 2030, entails a delayed response, as Victoria adopts the development of practices in other jurisdictions.

Figure 4.5 highlights the influence of different implementation speeds on Victoria's ability to meet its legislated emissions reduction targets for 2025 and 2030. A proactive approach enables greater control over practices and policies implemented in Victoria, allows for more time to scale, and improve, and best places Victoria on track to meet its interim emissions targets. Conversely, a lagging approach challenges the attainment of interim targets and means Victoria is more likely to follow other jurisdictions rather than shaping decarbonisation practices.

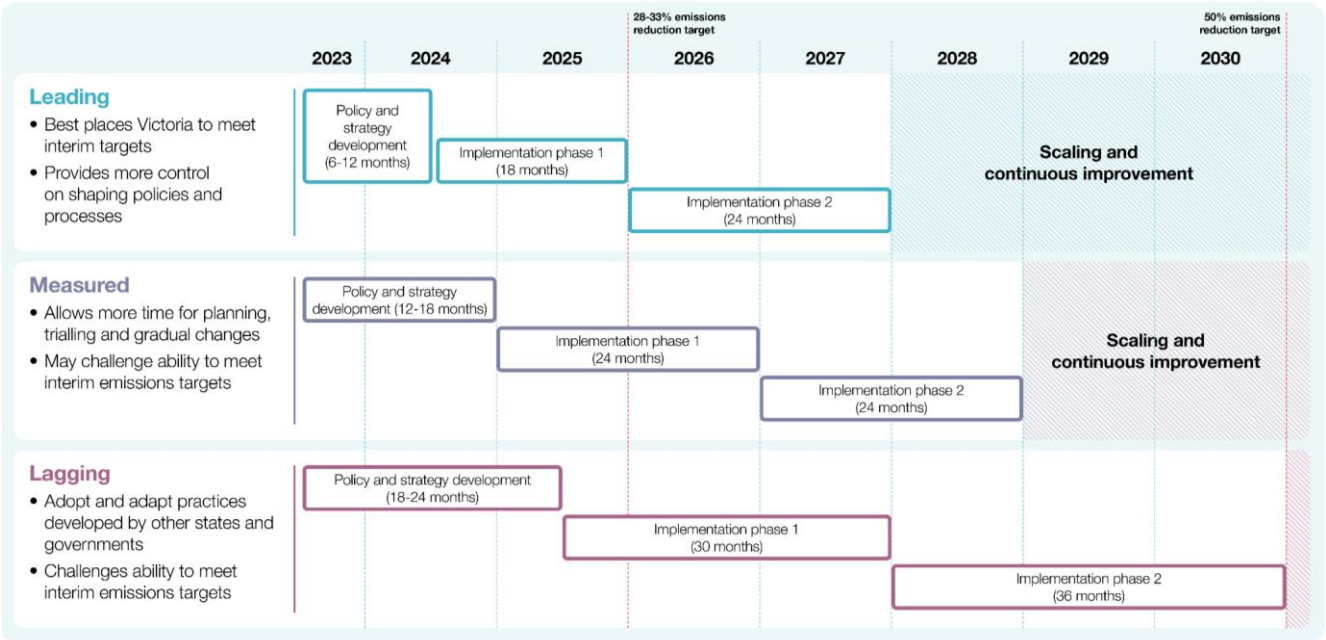


Figure 4.5 Implementation timeframes

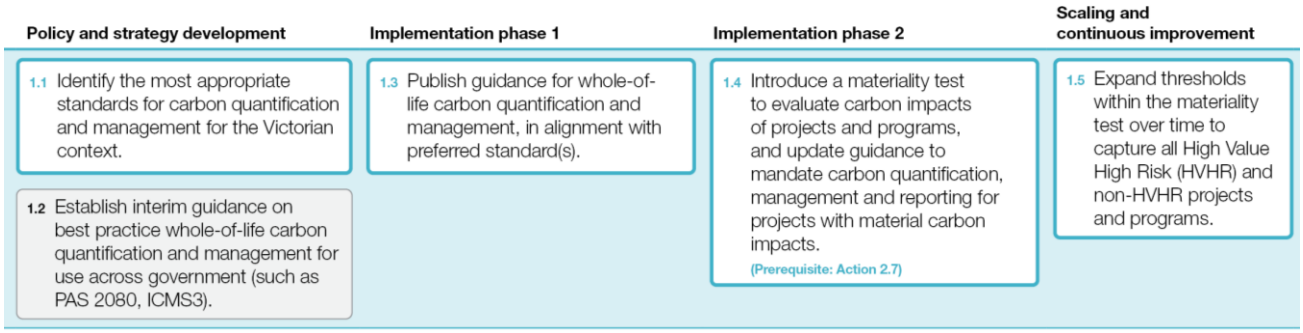
Foundational Interventions

Intervention 1 – Develop consistent guidance on whole-of-life carbon quantification and management

Currently, the Victorian Government lacks a consistent framework and processes for quantifying and managing carbon emissions associated with infrastructure across the project lifecycle. Different agencies and sectors employ various methods and data sources to estimate emissions. Additionally, the data on carbon emissions from infrastructure assets is often limited in detail, regularity, and reliability, particularly as some industry reporting standards exclude scope 3 emissions.

The actions within this intervention have been designed to address these issues and together will provide the comprehensive guidance needed to unify approaches across government. This will standardise procedures for quantifying and reporting carbon emissions, provide the information needed to monitor progress and improve the understanding of the emissions associated with public infrastructure. Developing consistent cross-sector guidance will reduce reporting costs for government and industry.

Implementation plan



Action 1.1 – Identify the most appropriate standards for carbon quantification and management for the Victorian context

This action involves comparing existing standards to find the most suitable option for carbon quantification and management in Victoria. Factors such as accuracy, ease of use, compatibility with existing systems, and adaptability to Victoria's unique needs should be considered during the selection process.

During the review, the Victorian Government should also:

- review and examine approaches used across sectors to inform the selection of a consistent unified approach across government
- weigh the advantages and drawbacks of the level of detail required in different approaches (refer to section 2.1.4 and Appendix C for a preliminary comparison) and set a level of commitment that best suits Victoria's context and objectives.

Opportunities and challenges

The state of play research identified that the NSW Government, Commonwealth Government, and industry bodies (such as MECLA) are currently reviewing carbon quantification and management standards. There is an opportunity for the Victorian Government to work with these parties to expedite the evaluation process, but additional efforts will be required to ensure that the standards are tailored to suit the Victorian context.

Collaborating with other jurisdictions may present challenges when it comes to reaching a consensus on a unified approach. However, this provides opportunities for governments to pool resources, thereby reducing costs for both governments and industry while maintaining a consistent strategy across states.

Supplementary Action 1.2 – Establish interim guidance on best practice whole-of-life carbon quantification and management for use across government (such as PAS 2080, ICMS3)

While Action 1.1 is taking place, an opportunity for a quick win would be to adopt an existing standard as interim guidance. This supplementary action would address current gaps in the existing guidance which departments and agencies have requested. Establishing interim guidance will offer clarity, instil confidence, and give a well-defined direction, enabling immediate support for ongoing projects while promoting the early adoption of carbon quantification methods.

Adopting existing standards, such as PAS 2080 or ICMS3, in the interim will enable projects and programs currently in the infrastructure pipeline to include carbon quantification and management considerations while more detailed guidance is under development. This is particularly important for projects with significant carbon impacts, or for projects requiring a detailed greenhouse gas assessment in an Environmental Effects Statement.

Action 1.3 – Publish guidance for whole-of-life carbon quantification and management, in alignment with preferred standard(s).

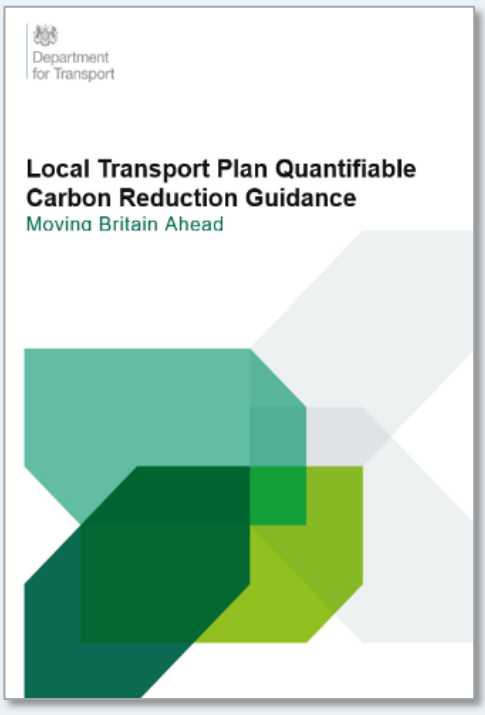
This should specify the approach to quantify, manage and report on carbon emissions at each stage of the project lifecycle, in accordance with the preferred approach identified in Action 1.1, and any lessons learned from deployment of interim guidance in Action 1.2.

This guidance is necessary to ensure consistent and comprehensive carbon management across the Victorian Government. By providing a clear framework for quantifying and reporting emissions, project teams can track progress and identify opportunities to reduce emissions and contribute to Victoria's decarbonisation goals.

EXAMPLE 4.1: UK DEPARTMENT OF TRANSPORT QUANTIFIABLE CARBON REDUCTION GUIDANCE

PAS 2080 (described in Section 1.3.3) provides guidance on tools and techniques that can be used to quantify carbon, evaluate design and construction options, and manage project risks.

The UK Department of Transport's Quantifiable Carbon Reduction Guidance, based on PAS 2080, is being developed to further support the goals of the standard. This guidance will apply from the early conceptual and planning phase, even before the business case is developed. By considering whole-of-life carbon from the earliest stages of a project, the department aims to embed carbon reduction into the heart of infrastructure planning and development.



Action 1.4 – Introduce a materiality test to evaluate carbon impacts of projects and programs, and update guidance to mandate carbon quantification, management and reporting for projects with material carbon impacts

Feedback from stakeholders indicated that requirements for all projects to quantify and report on carbon emissions will be ineffective and resource intensive. Instead, government should focus on high impact projects and programs.

A materiality test is a mechanism to evaluate the whole-of-life carbon impacts of a project relative to measures such as project's estimated costs on an order-of-magnitude basis. The materiality test should apply to all High Value High Risk (HVHR) projects and non-HVHR projects with significant carbon impacts, and should evaluate net-zero transition risks and opportunities.

By setting thresholds for material carbon impacts, government departments and agencies can focus resources on projects or programs with the highest potential for decarbonisation. This should be informed by government and industry feedback from piloting the whole-of-life carbon quantification approach and tools (Action 2.7), avoiding unnecessary burden on projects with low carbon impacts.

Action 1.5 – Expand thresholds within the materiality test over time to capture all High Value High Risk (HVHR) and non-HVHR projects and programs

This action aims to progressively extend carbon quantification and reporting requirements to all projects by lowering thresholds in the materiality test (outlined in Action 1.4). When determining how and when to broaden the scope, it is important to consider the scale of the carbon impacts captured and the expertise of the staff responsible for implementing guidance, in order to avoid imposing unnecessary administrative burdens on smaller projects. Despite any potential challenges, all projects will ultimately need to estimate and manage emissions to ensure the achievement of the net zero target.

Intervention 2 – Develop decarbonisation capability and tools

Government and industry stakeholders raised the issue of varying levels of understanding about the decarbonisation challenge, the available tools and how to improve day-to-day decision-making. This is a significant barrier to effective change in this area.

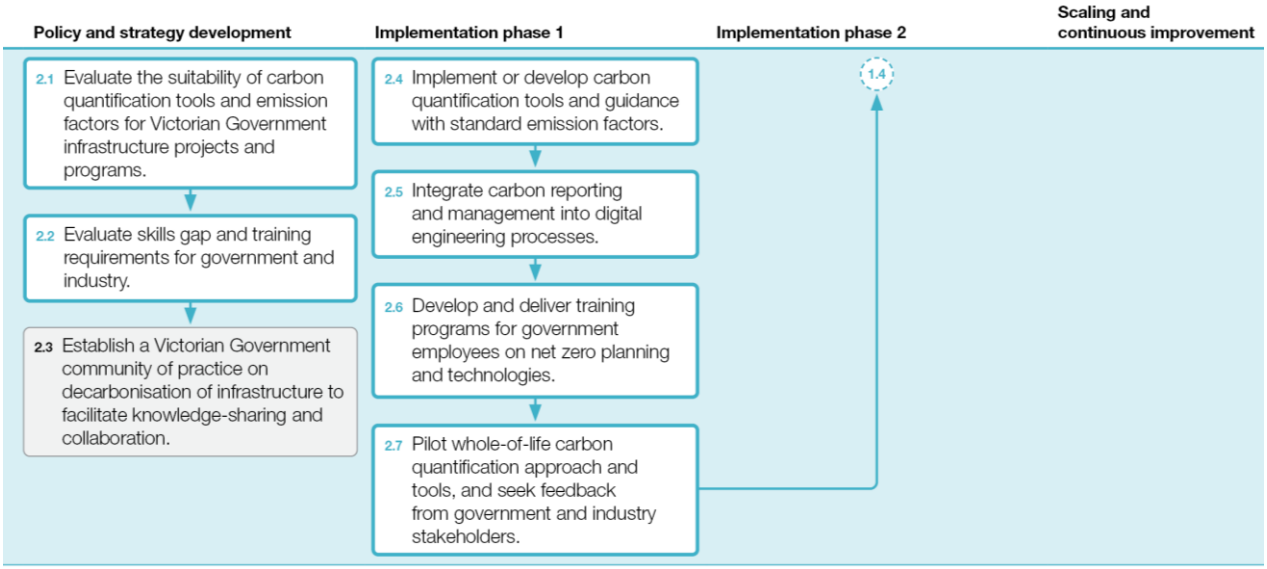
Developing decarbonisation capability and tools is essential for equipping the government agencies and industry partners with the knowledge, skills, and resources needed to effectively reduce the emissions associated with public infrastructure.

Training programs should cover net zero concepts and principles, how to better manage emissions when planning infrastructure and technical training on the updated guidance, tools, and technologies for realising decarbonisation. Appropriate training programs need to be selected or developed and targeted at relevant staff.

The tools are likely to include:

- a comprehensive open-source database of emission factors
- lifecycle assessment software
- carbon footprint calculators
- emissions monitoring and reporting tools.

Implementation plan



Action 2.1 – Evaluate the suitability of carbon quantification tools and emission factors for Victorian Government infrastructure projects

Carbon quantification tools with standard emission factors are needed to consistently estimate emissions for public infrastructure projects and programs.

Evaluating these tools and emission factors should consider the operational and data requirements and be based on a detailed investigation of best practice tools and emission factors used by Australian and international jurisdictions. The evaluation should consider for potential tools and emission factors:

- their accuracy, transparency, ease of use, adaptability, and compatibility of tools and emission factors
- their versatility and how widely they can be used across the full range of government sectors and projects
- the ongoing support required to maintain and effectively use them

- their accessibility and cost because these influence how widely tools and emission factors are adopted.
- alignment with industry needs and the tools and factors adopted in other Australian jurisdictions as a way of building consistency. The stakeholders consulted recognised the importance of consistency.

The evaluation will inform further development or implementation of tools and standard emission factors undertaken in action 2.4.

EXAMPLE 4.2: UK BUILT ENVIRONMENT CARBON DATABASE

A relevant example of a tool that aligns with many of the evaluation criteria detailed above is the UK's Built Environment Carbon Database. This database, launched in November 2021, is a collaborative initiative among various industry organisations including the Institute of Civil Engineers, BRE Group, Carbon Trust, Royal Institute of British Architects, Royal Institute of Chartered Surveyors, and the UK Green Building Council [63].

The database collects and provides access to product data via a dedicated portal, providing transparency, ease of use, and making it a versatile tool applicable across a variety of sectors and projects. The tool is kept up to date with new data and ongoing support for users. The Built Environment Carbon Database could provide useful insights when evaluating potential tools and emission factors for Victorian Government infrastructure projects.

Action 2.2 – Evaluate skills gap and training requirements for government and industry

This evaluation should identify areas where training and development are needed to use the tools identified in previous stages and adequately inform decision-makers about the carbon impacts of infrastructure.

The process should involve reviewing current skills and knowledge within government departments and agencies, conducting surveys or interviews with stakeholders, and consulting with industry experts to determine specific, decarbonisation training needs. The assessment should cover policy development, project planning, emissions estimation, and new technologies.

Opportunities and challenges

Collaboration with industry partners and other jurisdictions will provide valuable insights and guidance in identifying relevant skills gaps and training requirements, as it is likely that the processes undertaken, and lessons learned in other jurisdictions will apply to Victoria.

Supplementary Action 2.3 – Establish a Victorian Government community of practice on decarbonisation of infrastructure to facilitate knowledge-sharing and collaboration

Establishing a community of practice will create a collaborative network of representatives across government with an interest in decarbonisation. This community would serve as a platform for knowledge sharing, innovation, and coordination among its members, promoting the exchange of best practices, lessons learned, and emerging strategies for decarbonising public infrastructure.

The community of practice would involve periodic meetings, workshops, and online forums for participants to discuss and share their experiences, insights, and resources related to decarbonisation. It will facilitate collaboration on joint initiatives, create synergies and reduce duplication across government. It will allow those government stakeholders at the forefront of decarbonisation efforts to present leading examples.

This initiative was identified as an opportunity to supplement other actions in developing capability and identifying appropriate tools for Victoria and to align with other local jurisdictions such as NSW.

The example below describe the benefits of Communities of Practice in NSW.

EXAMPLE 4.3: NSW COMMUNITIES OF PRACTICE AND CENTRE FOR EVIDENCE AND EVALUATION

The NSW Public Sector has several Communities of Practice (COP) which are available for government staff to join share knowledge and lessons learned from trials on a variety of topics such as procurement, change management and analytics. The Community for Procurement Professionals is an example of a COP that could be used to share knowledge and processes on considering decarbonisation during procurement stages across government departments and agencies [64].

The Centre for Evidence and Evaluation was established in 2018 to provide economic analysis and advice and promote evidence-based decision making across the NSW Government [65]. The Centre's role is to support the NSW public sector to build evidence to advise government how best to deliver on its objectives including emissions reductions.

Action 2.4 – Implement or develop carbon quantification tools and guidance with standard emission factors

Building upon Action 2.1, which involves evaluating suitable carbon quantification tools, this action implements these tools and updated guidance for use in Victorian Government infrastructure projects throughout the entire project lifecycle. If Action 2.1 does not yield appropriate tools, there is an option to develop custom tools.

The selected tools should be integrated into existing processes and systems across government. Existing policy and procurement guidelines should be updated to incorporate these additions.

Establishing consistent tools and guidance across government projects is crucial as it ensures that emissions data is accurate, comparable, and transparent, which facilitates better decision-making and effective tracking of progress towards decarbonisation goals.

Opportunities and challenges

Challenges in implementing carbon quantification tools and guidance include adapting them to various agencies' unique requirements, overcoming potential resistance to change, and integrating them within existing systems and processes. There are opportunities to streamline decarbonisation practices by using the same tools across all agencies leading to more effective and cost-efficient emissions reductions.

EXAMPLE 4.4: TRANSPORT FOR NSW CARBON ESTIMATE AND REPORTING TOOL (CERT)

The Carbon Estimate and Reporting Tool (CERT) has been developed by Transport for New South Wales (TfNSW) to facilitate the measurement and reporting of greenhouse gas (GHG) emissions in compliance with TfNSW's Sustainable Design Guidelines [66]. Designed to provide consistency in GHG reporting and streamline the reporting process, the CERT is intended for use in all new projects with a value of at least $15 million and replaces the previous TfNSW Greenhouse Gas Inventory for Construction Projects. The tool is designed to capture relevant and material scope 1, 2 and 3 GHG Emissions as identified through an emissions materiality assessment. TfNSW are now looking to align CERT with their digital engineering framework to enable automated reporting of emissions, saving associated time and costs (see Action 2.5).

CERT's objective to ensure uniformity in carbon quantification and reporting by establishing a standardised tool tailored for projects of certain sizes. By using a similar tool, Victoria can ensure accurate, consistent and cost-effective measurement of the carbon impacts across a wider range of public infrastructure projects.

Figure 4.6: CERT completion process during stages of project development and delivery

Action 2.5 – Integrate carbon reporting and management into digital engineering processes

This involves incorporating emissions data and consistent measurement methods into digital platforms such as Building Information Modelling, emissions monitoring dashboards and digital tools used in procurement, operations, benefits management and assurance processes.

Embedding carbon reporting and management into digital engineering processes will ultimately reduce cost and improve the consistency of carbon emission reporting.

Opportunities and challenges

Challenges may include the need to adapt existing digital processes and systems to accommodate new carbon management requirements, ensuring compatibility with departmental systems and addressing potential resistance to change.

Government stakeholders identified that there is an opportunity to use digital engineering processes beyond carbon reporting and monitoring, by deploying it in upfront design stages to identify carbon 'hot-spots' (aspects of the design where emissions may be concentrated).

Action 2.6 – Develop and deliver training programs for government employees on net zero planning and technologies

Throughout this project, government stakeholders have consistently identified the need to improve internal capability and characterised it as a critical success factor for Victoria to meet its decarbonisation goals.

These training programs will provide government employees with the knowledge and skills to understand and effectively implement decarbonisation strategies. The scope of these programs will be informed by previous actions incorporating up-to-date tools, guidance, and digital engineering processes.

This action is essential in building capacity and a consistent approach to decarbonisation across government. The programs will cover topics such as net zero planning, emissions estimation and reporting and the use of digital tools for carbon management.

Opportunities and challenges

Tailoring training programs to address varying levels of knowledge within government agencies will be challenging. Additionally, allocating time and resources to develop and deliver these training programs is also challenging when staff need to balance the need for upskilling with the ongoing demands of infrastructure projects.

Action 2.7 – Pilot whole-of-life carbon quantification approach and tools, and seek feedback from government and industry stakeholders

Piloting a whole-of-life carbon estimation approach (established in Action 1.3) on major projects provides a valuable opportunity to test and refine carbon quantification and management and the associated tools.

By focusing on large-scale projects with significant carbon impacts, this pilot initiative will generate insights and learnings to improve guidance and ensure that these methodologies are accurate and effective. The pilot phase should involve continuous feedback from government and industry stakeholders throughout this process.

The pilot would integrate the selected approach and tools across the project lifecycle of a sample of selected public infrastructure projects. Projects will be selected to test the approaches and tools efficiently across all development stages for a sample that is representative of Victorian infrastructure projects.

Intervention 3 – Adopt a Victorian Government approach to valuing carbon across the project lifecycle

This intervention focuses on incorporating carbon valuation into investment decision making in a consistent and evidence-based approach. Valuing GHG emissions will ensure that climate change impacts are fully accounted for alongside other costs and benefits when appraising projects and programs.

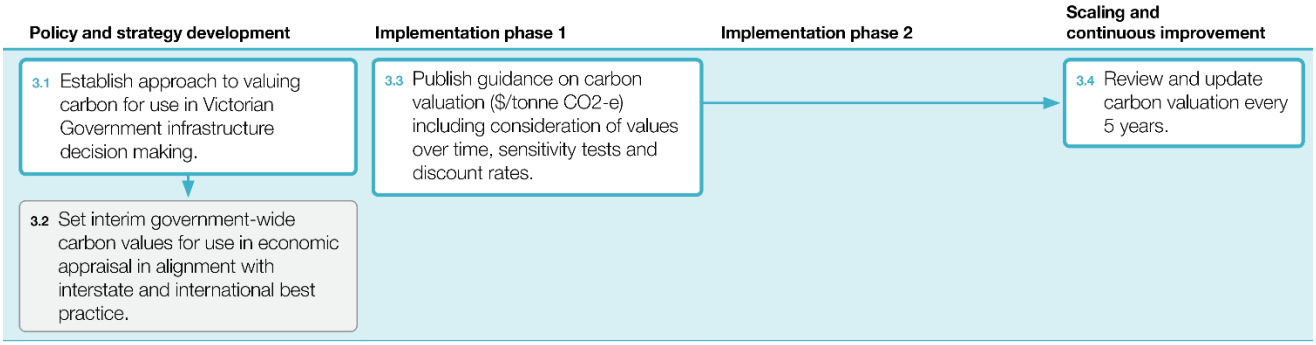
Carbon values, which represent the monetary value society places on one tonne of carbon dioxide equivalent ($/tCO2-e), differ from carbon prices, which are observed in carbon markets.

This intervention will determine the method used to value carbon emissions and provide clear guidance on how carbon valuation should be applied across the project lifecycle to inform business case and procurement decisions.

Price vs value

A distinction in terminology should be made between carbon prices and carbon values. A carbon price is determined in a carbon market or through a carbon tax, whereas carbon value refers to the cost of carbon to society and the economy. For the purpose of government investment decision making, this paper specifically focuses on monetised carbon values, as opposed to carbon prices, for use in economic CBA.

Implementation plan



Action 3.1 – Establish approach to valuing carbon for use in Victorian Government infrastructure decision making

The initial step of this intervention involves identifying a method for valuing carbon tailored to the Victorian Government's infrastructure decision-making process. This approach chosen should be based on the best available evidence. Figure 4.7 shows the main valuation options including the damage cost, target consistent and market price approaches.

Figure 4.7 Carbon valuation approaches

The target consistent approach is emerging as the preferred choice in several international jurisdictions like the UK, European Union and New Zealand. However, each approach has its relative merits and drawbacks and each needs to be assessed for their application in the Victorian context.

This assessment should consider how well each approach aligns with Victorian Government policies, how reliable each is likely to be, and the ease with which values can be determined and applied, and how well each aligns with national and international valuation methods. The chosen approach should also be adaptable to adequately reflect valuation changes resulting from policy changes and progress against emissions targets.

Supplementary Action 3.2 – Set interim government-wide carbon values for use in economic appraisal in alignment with interstate and international best practice

Government stakeholders identified the need for interim guidance for immediate use to ensure projects and programs adequately reflect the economic impacts of carbon emissions on society. Setting interim guidance will allow projects to value the monetary impacts of GHG emissions in the economic appraisal of options.

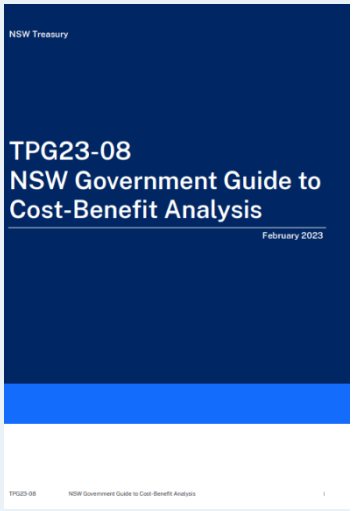
These interim values, aligned with interstate and international best practices, provide a starting point for incorporating monetary values in decision-making frameworks. These interim values may not fully capture the complex nature of carbon impacts and should be reviewed and updated as new information becomes available.

Opportunities and challenges

Aligning interim guidance with approaches used by comparable jurisdictions, such as NSW, provides an opportunity to streamline the process for setting interim values.

EXAMPLE 4.5: NSW GUIDE TO COST BENEFIT ANALYSIS AND CARBON VALUATION GUIDANCE

NSW Treasury updated the NSW Government Guide to Cost Benefit Analysis (TPG23–08) to include more guidance on the inclusion of carbon emissions in CBAs [67]. The guide states that the cost of CO2 emissions (and other emissions measured in CO2 equivalent emissions), or the benefits of reduced CO2 emissions, should be included in the CBA where the cost or benefit is likely to materially affect the Net Present Value (NPV) and Benefit Cost Ratio (BCR).



The guidance discusses the relative merits of different approaches and sets a hierarchy of preferred approaches to valuing carbon for use in government appraisals. Key takeaways include:

- while the damage cost approach would most closely reflect the cost of the negative impacts caused by climate change (e.g. crop loss, droughts, and disease spread), there are several drawbacks which inhibit its application in the CBA. This approach is not preferred.
- A comprehensive Australian emissions market would value carbon emissions consistently with Australian targets, abatement opportunities, and opportunity costs. However no such market is currently in operation.
- In the absence of a reliable Australian market, a cost modelled in line with the target consistent approach is preferred. The NSW Government is working to develop such a cost model for future iterations of the guidance.

In the absence of the above, existing market prices from the market that most comprehensively prices emissions (e.g., the European Union carbon permit market) can be used as a proxy valuation.

Action 3.3 – Publish guidance on carbon valuation

Once the appropriate approach for valuing carbon has been determined (Action 3.1), it should be employed to generate a series of carbon valuations for, at least, the next 30 years, aligning with common appraisal periods for infrastructure projects.

These values should align with the chosen approach, reflecting the latest understanding of potential climate change impacts, abatement costs, or market predictions (spot and futures pricing), depending on whether the

damage cost, target-consistent, or market price approach is employed. The guidance should also provide information on the appropriate discount rate and sensitivity tests.

Upon developing carbon valuations (or an alternate specific approach for projects to determine their own values), guidance should be published for consistent application across government projects. The guidance should be specific, easy to follow, and simple to apply. It should also clearly outline which projects are required to use it, as discussed in intervention 5.

Action 3.4 – Review and update carbon valuation every 5 years

Regularly updating carbon valuations will ensure that they remain relevant and accurate, reflecting the most up-to-date information on climate change impacts, abatement costs, technological advancements, and market conditions. As such, it is recommended that the Victorian Government update carbon valuations established in Action 3.3 every 5 years to maintain their accuracy and effectiveness in guiding infrastructure decision-making.

In updating the carbon valuations, the Victorian Government should consider the latest scientific research, policy developments, and international best practices. The review process should involve consultation with relevant stakeholders, including industry experts, academic institutions, and other government agencies, to gather diverse perspectives and incorporate emerging trends or innovations.

EXAMPLE 4.6: UK CARBON VALUATION GUIDANCE

The UK's Department for Business, Energy & Industrial Strategy published a policy paper titled "Valuation of greenhouse gas emissions: for policy appraisal and evaluation" on September 2, 2021 [4]. This document provides guidance on the valuation of greenhouse gas (GHG) emissions, specifically for policy appraisal and evaluation purposes. Developed through a robust process that incorporated expert advice, scientific evidence, and stakeholder input, this guidance aims to promote a consistent approach to valuing carbon emissions across the entire government.

One of the key features of this guidance is its consistency, providing a unified set of principles and methodologies for all government departments and agencies. This ensures that carbon emissions are valued in a standardised manner, facilitating comparison and coordination across different sectors and policy areas. It provides a specific list of time series values for projects to use, allowing for accurate and consistent carbon valuation across all projects and policies. The guidance is easily accessible online, enabling policymakers and other stakeholders to readily access the information.

To maintain its relevance and accuracy, the guidance is updated periodically, typically every five years, reflecting the latest developments in climate science, economics, and policy. This ensures that the values used for carbon emissions remain in line with the current understanding of climate change impacts and mitigation strategies.

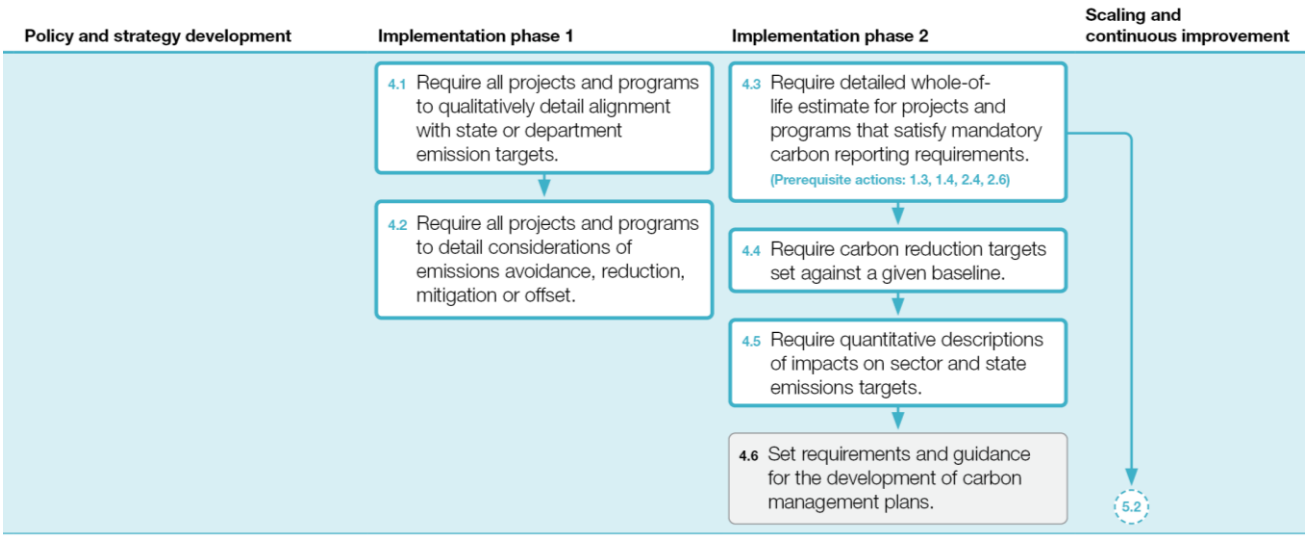
This example is highly relevant for intervention 3, as it showcases how a government can develop and implement a consistent set of guidance for valuing carbon emissions across the project lifecycle. By adopting a leading approach, Victoria can ensure the uniformity and comparability of carbon valuation across different projects and sectors, ultimately supporting effective climate change mitigation efforts.

Business Case Interventions

Intervention 4 – Consider carbon emissions in business case guidelines and templates

Existing guidelines and templates do not adequately address carbon emissions. This intervention will incorporate whole-of-life carbon estimation and assessment to align with Victoria's decarbonisation targets. The updated guidelines will enable project teams to better incorporate carbon considerations in developing options, designs and in using materials. They will require the comprehensive assessment of emissions impacts and avoidance, reduction, mitigation and offset strategies.

Implementation plan



Action 4.1 – Require all projects and programs to qualitatively detail alignment with state or sector emission targets

This qualitative requirement will improve the understanding of each project's impact on decarbonisation without requiring resource-intensive, quantitative estimations.

Incorporating this requirement is a straightforward modification, as it involves the addition of a section and criteria for qualitative assessment. This change encourages projects to consider carbon and articulate the strategies, initiatives, and design choices that support alignment with emissions targets. This action lays a foundation for incorporating more detailed, quantitative estimations in later stages of the process.

Action 4.2 – Require all projects and programs to detail considerations of emissions avoidance, reduction, mitigation or offset.

In order to comprehensively address carbon emissions in the development and execution of projects, Action 4.3 requires all projects to describe how they have considered avoiding, reducing, mitigating or offsetting emissions.

By including aspects of emissions management in the planning and evaluation stages, project teams will be encouraged to explore a range of strategies and measures that can minimise projects' carbon footprint. Incorporating these considerations into project documentation is expected to promote a more holistic view of emissions management and drive innovation in the pursuit of low-carbon infrastructure solutions.

Action 4.3 – Require detailed whole-of-life estimate for projects and programs that satisfy mandatory carbon reporting requirements

This action updates business case guidance to mandate detailed, whole-of-life carbon emissions estimates for projects that meet the materiality test outlined in actions 1.3 and 1.4. By leveraging the tools and training developed in actions 2.4 and 2.6, projects with high emissions impacts can consistently quantify their whole-of-life emissions according to the standard set by government.

This updated guidance will improve consistency across projects, allow for easier comparison of emissions impacts, and minimising costs through the use of adopted estimation tools.

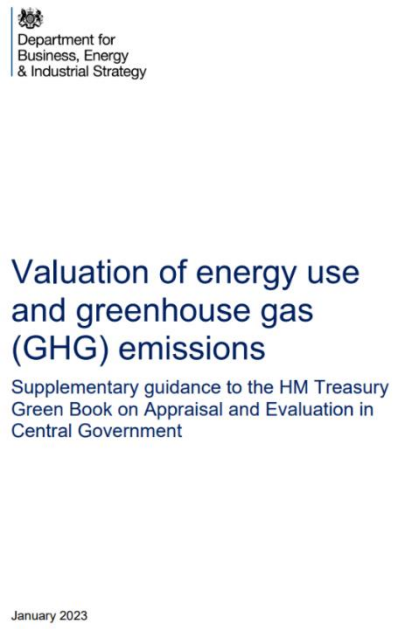
EXAMPLE 4.7: UK DEPARTMENT OF BUSINESS, ENERGY & INDUSTRIAL STRATEGY GUIDANCE ON QUANTIFICATION AND VALUATION OF GREENHOUSE GASES

The "Valuation of energy use and greenhouse gas (GHG) emissions" is supplementary guidance to His Majesty's Treasury's Green Book, offering specific guidance on quantifying and valuing GHG emissions for proposals with direct or indirect impacts on energy use and supply [68]. Developed by the UK Government, it is intended for use in options appraisal, building business cases, conducting impact assessments, and evaluating policies.

The guidance supports the modelling of GHG impacts when they are pertinent to decision-making, ensuring consistency in the valuation and quantification of emissions across sectors and government departments. It highlights the importance of considering the entire lifecycle of a project including planning, land use change, construction, and the introduction of new energy-using products.

The guidance provides an Excel-based calculation toolkit for converting energy consumption changes into GHG emissions and valuing them. It also provides data tables containing, for the period 2010 to 2100, up-to-date assumptions for carbon values, energy prices, long-run variable energy supply costs, emission factors, and air quality activity costs.

A supplementary document outlines the methodologies employed. By adhering to this guidance, project teams can consistently and efficiently quantify and report emissions over a project's lifespan.



Action 4.4 – Require carbon reduction targets set against a given baseline

Requiring projects to set minimum carbon reduction targets, based on the business-as-usual baseline, ensures that carbon reduction is prioritised from the earliest conceptual stage. This proactive approach helps identify opportunities for emissions reduction and creates a sense of responsibility and commitment to decarbonise.

For this, projects should first be required to establish a business-as-usual carbon baseline, which represents the carbon emissions typically expected from this type of investment. This baseline provides a starting point for determining how to reduce these emissions through design, optioneering and the use of materials in accordance with the hierarchy of approaches described under Action 4.3. This will encourage project teams to explore innovative solutions, technologies, and strategies that reduce carbon emissions.

In practice, project teams should be guided by established methodologies and tools to determine the business-as-usual baseline and set appropriate carbon reduction targets. Regular monitoring and reporting on progress towards these targets will ensure that decarbonisation efforts are on track and enabling adjustments if needed to enhance overall performance.

Opportunities and challenges

Several agencies identified that they currently lack insight on the baseline carbon footprint of their assets. Ensuring the accuracy and reliability of baselines requires enhanced capabilty and access to up-to-date data, which may be resource-intensive for project teams and agencies.

Action 4.5 – Require quantitative descriptions of impacts on meeting sector and state emissions targets

Strengthening the alignment between individual projects and broader state and sector emissions targets will be achieved by updating business case guidelines to require projects to quantify their carbon emissions impacts on these targets. This action builds upon previous efforts to develop quantification guidance, tools, and qualitative descriptions. Project teams should apply established quantification methods to assess and demonstrate their contributions to Victoria's climate change goals.

Supplementary Action 4.6 – Set guidance and requirements for the development of carbon management plans

Requiring projects to develop carbon management plans is an optional action. These provide a structured approach to carbon management and mitigation. A carbon management plan describes a project's carbon reduction goals, its strategies for avoiding, reducing, mitigatiing and offsetting emissions and adopted monitoring and reporting mechanisms. They can also include timelines, milestones, and responsibilities for implementing various carbon reduction measures.

By implementing this optional action, projects would have a clear and coherent roadmap for managing carbon throughout the project's lifecycle. Moreover, carbon management plans would provide valuable insights and lessons learned to be shared across government and reinforcing best practices and accelerating innovations.

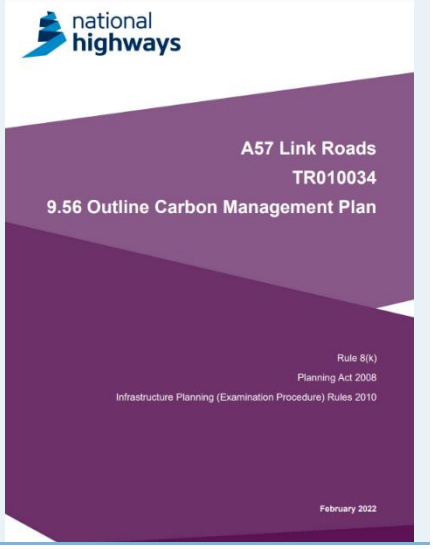
EXAMPLE 4.8: UK NATIONAL HIGHWAYS OUTLINE CARBON MANAGEMENT PLAN FOR A57 LINK ROADS

The UK National Highways developed a comprehensive Carbon Management Plan (CMP) for the A57 Link Roads Scheme [69], aligned with the PAS 2080:2016 Carbon Management in Infrastructure standard.

The CMP covers design, construction planning, procurement, and value chain engagement, and is intended for use by all parties involved in the project, including the Principal Designer and Contractor, subcontractors, sub-consultants, material suppliers, and National Highways management.

Key technical requirements of the PAS 2080 standard implemented in the CMP include the use of a carbon management process, following the carbon reduction hierarchy, quantifying, assessing, and reporting on the Scheme's carbon emissions, and engaging with other value chain members in a collaborative way.

In relevance to Optional Action 4.7, the A57 Link Roads Scheme CMP showcases the advantages of setting guidance and requiring projects to develop carbon management plans, providing a structured approach to carbon mitigation throughout the project's lifecycle.



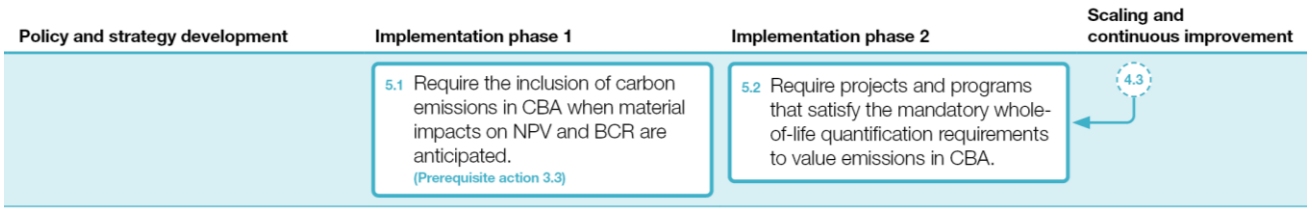
Intervention 5 – Value carbon in cost benefit analysis

Valuing carbon in the cost benefit analysis (CBA) integrates the quantification and valuation of carbon emissions into the decision-making process for projects with material impacts on emissions. By building on the previous interventions, this approach ensures that the full impacts of carbon are adequately considered alongside other impacts monetised within the CBA.

Initially, major projects already in the infrastructure development pipeline can apply interim guidance on quantification and valuation to account for carbon emissions in their CBAs. Subsequently, as detailed guidance becomes available, projects that satisfy the mandatory whole-of-life quantification requirements should also be required to value emissions in their CBAs, further embedding environmental considerations into project evaluation processes.

Further information on methods for valuing carbon and comparisons of international valuations of carbon in transport are provided in Appendix A.

Implementation plan



Action 5.1 – Require the inclusion of carbon emissions in CBA when significant impacts on NPV and BCR are anticipated

In the interim period, while comprehensive guidance and requirements are being developed, it is important that major projects do not overlook the importance of carbon emissions. By incorporating the valuation of carbon emissions into their CBAs, these projects can deliver a more accurate and holistic understanding of a project's carbon impacts. The significance of carbon impacts on NPV and BCR should be determined on a case-by-case basis by the project team, and then reviewed during standard assurance processes for accuracy.

If developed, major projects will be able to utilise interim carbon quantification guidance (action 1.2) and valuation guidance (action 3.2). This approach bridges the gap between current practices and the forthcoming detailed guidance, maintaining a consistent emphasis on carbon emissions throughout the transition.

Action 5.2 – Require projects and programs that satisfy the mandatory whole-of-life quantification requirements to value emissions in CBA

Mandating projects that satisfy the whole-of-life quantification requirements (as per Action 4.3) to value emissions in their CBAs will be critical to align investment decisions with Victoria's environmental objectives. By incorporating the environmental costs of carbon emissions into the CBA, decision-makers can better compare projects and identify those that contribute to the state's emission reduction targets.

This requirement builds on previous actions, leveraging the guidance and tools developed to quantify and value emissions. By incorporating carbon valuation in CBAs, project teams can systematically integrate emission reduction considerations into the project design and decision-making process.

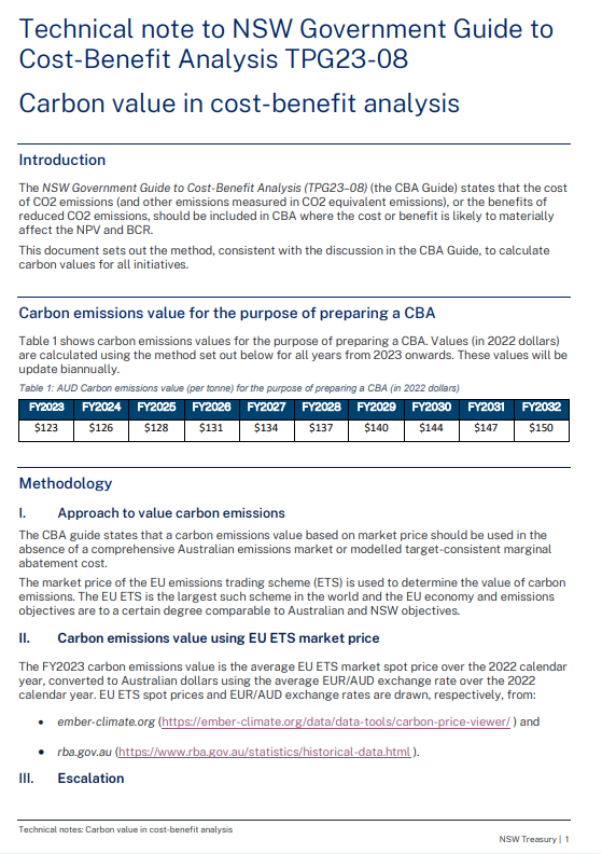
EXAMPLE 4.9: NSW TREASURY TECHNICAL NOTE ON VALUING CARBON IN COST BENEFIT ANALYSIS

As described in example 4.5 above, the NSW Government Guide to Cost Benefit Analysis states that the cost of CO2 emissions or the benefits of reduced CO2 emissions should be included in CBA where the cost or benefit is likely to materially affect the NPV and BCR. While the NSW Government develops detailed guidance on consistent carbon values for economic appraisal, the NSW Treasury released a technical note providing interim guidance for projects to value carbon in CBAs.

The technical note presents carbon emissions values for use in CBA preparation, calculated using the average European Union Emissions Trading System market spot price for the 2022 calendar year, converted to Australian dollars using the average exchange rate for the same year. These values are expected to be updated biannually until more comprehensive guidance is finalised. The carbon emissions value is increased by 2.25% per annum for each year after FY2023 to account for anticipated real increases in the cost of emissions, aligning with the increase in real prices suggested by the Emissions Trading System futures market.

Moreover, the technical note advises project teams to test the sensitivity of CBA results to carbon costs to demonstrate the impact of a project's emissions on its NPV and BCR.

This example showcases how an interim measure can be employed by the Victorian Government to require projects to value emissions in their CBAs while more detailed guidance is under development.



Technical note to NSW Government Guide to Cost-Benefit Analysis TPG23-08

Carbon value in cost-benefit analysis

Introduction

The *NSW Government Guide to Cost-Benefit Analysis (TPG23–08)* (the CBA Guide) states that the cost of CO2 emissions (and other emissions measured in CO2 equivalent emissions), or the benefits of reduced CO2 emissions, should be included in CBA where the cost or benefit is likely to materially affect the NPV and BCR.

This document sets out the method, consistent with the discussion in the CBA Guide, to calculate carbon values for all initiatives.

Carbon emissions value for the purpose of preparing a CBA

Table 1 shows carbon emissions values for the purpose of preparing a CBA. Values (in 2022 dollars) are calculated using the method set out below for all years from 2023 onwards. These values will be update biannually.

Table 1: AUD Carbon emissions value (per tonne) for the purpose of preparing a CBA (in 2022 dollars)

FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032
$123	$126	$128	$131	$134	$137	$140	$144	$147	$150

Methodology

I. Approach to value carbon emissions

The CBA guide states that a carbon emissions value based on market price should be used in the absence of a comprehensive Australian emissions market or modelled target-consistent marginal abatement cost.

The market price of the EU emissions trading scheme (ETS) is used to determine the value of carbon emissions. The EU ETS is the largest such scheme in the world and the EU economy and emissions objectives are to a certain degree comparable to Australian and NSW objectives.

II. Carbon emissions value using EU ETS market price

The FY2023 carbon emissions value is the average EU ETS market spot price over the 2022 calendar year, converted to Australian dollars using the average EUR/AUD exchange rate over the 2022 calendar year. EU ETS spot prices and EUR/AUD exchange rates are drawn, respectively, from:

- *ember-climate.org* (https://ember-climate.org/data/data-tools/carbon-price-viewer/) and
- *rba.gov.au* (https://www.rba.gov.au/statistics/historical-data.html).

III. Escalation

Technical notes: Carbon value in cost-benefit analysis

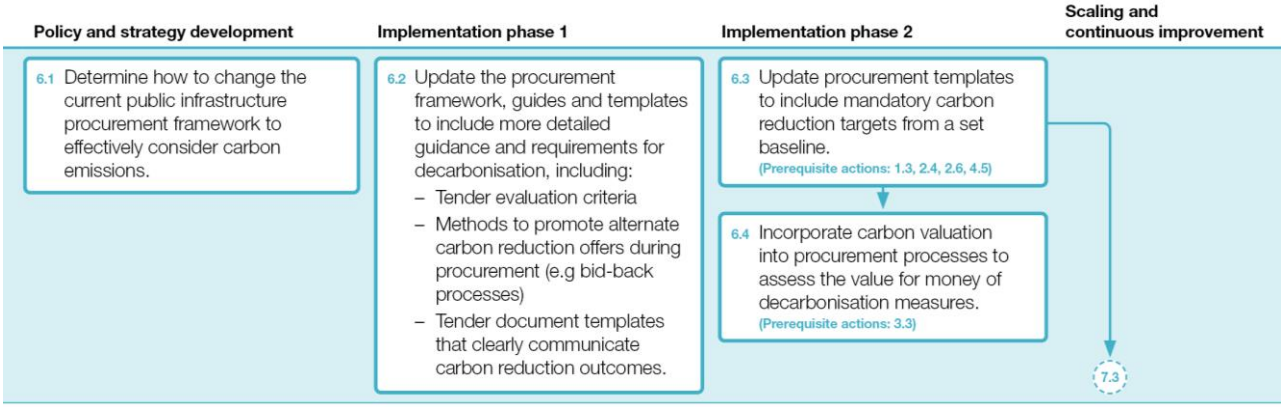
NSW Treasury | 1

Procurement and Delivery Interventions

Intervention 6 – Update procurement frameworks and guides to better consider decarbonisation outcomes

The Victorian Government should better incentivise decarbonisation into procurement processes, aligning them with wider net zero goals. Currently, procurement guidance lacks specificity regarding clear targets and decarbonisation requirements and is combined with other sustainability and social procurement guidance, creating confusion, and diluting the focus on reducing carbon emissions during the process. By updating procurement frameworks and guides to better consider decarbonisation outcomes, the government can provide clearer direction and establish a more robust approach and help scale up the manufacture and use of sustainable, low carbon materials across the supply chain.

Implementation plan



Action 6.1 – Determine how to change the current public infrastructure procurement framework to effectively consider carbon emissions

The initial step in effectively considering carbon emissions in public infrastructure procurement is for the Victorian Government to review key guidelines and documents such as the Social Procurement Framework and the Investment Lifecycle and High Value High Risk Guidelines. Understanding how decarbonisation fits within existing frameworks and guidelines will allow the government to determine the best approach for integrating decarbonisation outcomes and future changes into procurement processes.

A crucial decision will involve determining whether decarbonisation should continue to be incorporated within the Social Procurement Framework, or if the sustainable procurement guidance or decarbonisation-specific guidance should be presented separately. This foundational work will facilitate a cohesive approach towards decarbonisation across all aspects of procurement, enabling the government to update relevant documents to provide clear and specific decarbonisation requirements.

Action 6.2 – Update the procurement framework, guides, and templates to include more detailed guidance and requirements for decarbonisation

Government should strengthen the commitment to reducing carbon emissions in procurement by:

- **Integrating minimum decarbonisation requirements into procurement**. Tender requirements should specify minimum reduction targets for embodied and operational carbon emissions, setting clear expectations for bidders to design and implement low-carbon solutions.
- **Communicating carbon reduction expectations in tender document templates**, giving suppliers a clear understanding of the government's decarbonisation objectives and helping them align their proposals.

- **Considering carbon emissions in tender evaluation criteria.** This can be incorporated as part of non-price criteria, pass/fail requirements, or price criteria and will require industry to provide embodied carbon estimates and reduction committments in their submissions.
- **Promoting alternative carbon reduction offers in procurement** through bid-back processes (also referred to as second-round bidding) enabling tenderers to suggest additional carbon reduction initiatives. This method supports bidders in refining their initial proposals by concentrating on fine-tuning designs and materials to lower carbon emissions. These alternatives will often involve cost impact, risk, co-benefits and impact on other evaluation criteria, therefore requiring a clear process to assess.
- **Offering guidance on using various procurement models** to support decarbonisation. For example, implementing design and construct and public private partnership procurement models can lead to more effective consideration of carbon emissions during the procurement process, as they promote collaboration and innovation between parties to develop low carbon solutions.

Opportunities and challenges

Updates to the procurement framework set clear expectations of government to industry and creates an incentive for industry to respond and expand its skills.

EXAMPLE 4.10: VICTORIA'S SOCIAL PROCUREMENT FRAMEWORK

The Victorian Government's sustainable procurement objectives encompass the implementation of climate change policy objectives, including setting project-specific requirements to minimise GHGs [70]. Currently, the existing framework mandates that projects over $20 million with a design component incorporate GHG emissions requirements.

While the foundation exists for integrating decarbonisation within performance standards, contract requirements, and targets, more clarity and detail are needed throughout the supporting documentation to effectively convey the implications and expectations.

Victoria's Social Procurement Framework Individual procurement activity requirements				
	Below threshold Regional under $1 million Metro or State-wide under $3 million	**Lower band** Regional $1 to $20 million Metro or State-wide $3 to $20 million	**Middle band** $20 to $50 million	**Upper band** Over $50 million
Planning requirement for government buyers	Incorporate SPF objectives and outcomes into regular procurement planning		Complete a Social Procurement Plan during procurement planning	
Described approach	**Encouraged** Seek opportunities where available to directly or indirectly procure from social enterprises, ADEs or Aboriginal businesses	**Proportionate** Use evaluation criteria (5 to 10 per cent weighting) to favour businesses whose practices support social and sustainable procurement objectives	**Targeted** Include performance standards and contract requirements that pursue social and sustainable procurement objectives	**Strategic** Include targets and contract requirements that pursue social and sustainable procurement objectives
Recommended actions for government buyers				
Environmental sustainability		Ask suppliers to demonstrate environmentally sustainable business practices in weighted framework criteria	Include requirements as relevant on recycled content, waste management and energy consumption.	
Climate change			Where procurement includes a design component, include requirements on greenhouse gas emissions and climate change resilience	

Figure 4.8: Individual procurement activity requirements for government buyers

Action 6.3 – Update procurement templates to include mandatory carbon reduction targets from a set baseline

To help Victorian Government agencies reduce carbon emissions, procurement templates must include mandatory carbon reduction targets from a baseline. This approach would help to ensure that all future projects have a clear carbon reduction target to aim for, making it easier to track progress and take action to reduce carbon emissions.

Initially, a carbon baseline can be established using simple metrics like estimated concrete, aggregate, and steel volumes during the business case. As carbon assessment in major infrastructure projects advances throughout the project lifecycle, this base case can be periodically refined.

When implementing mandatory carbon reduction targets, tenderers will need to be provided with the necessary information, including the carbon baseline and proposed reductions. This enables competitive bids that meet the carbon reduction targets. Supplying this information during procurement ensures all suppliers are aware of the targets and can factor them into their proposals, the outcome will be a reduction in emissions as shown in Figure 4.9.

Due to data availability and potential for scope changes through the project development and delivery process, it is important to note that the baseline needs updating between project phases. To demonstrate carbon reductions are achieved, assessments should ensure a comparable baseline and proposed scenarios at both project and initiative level.

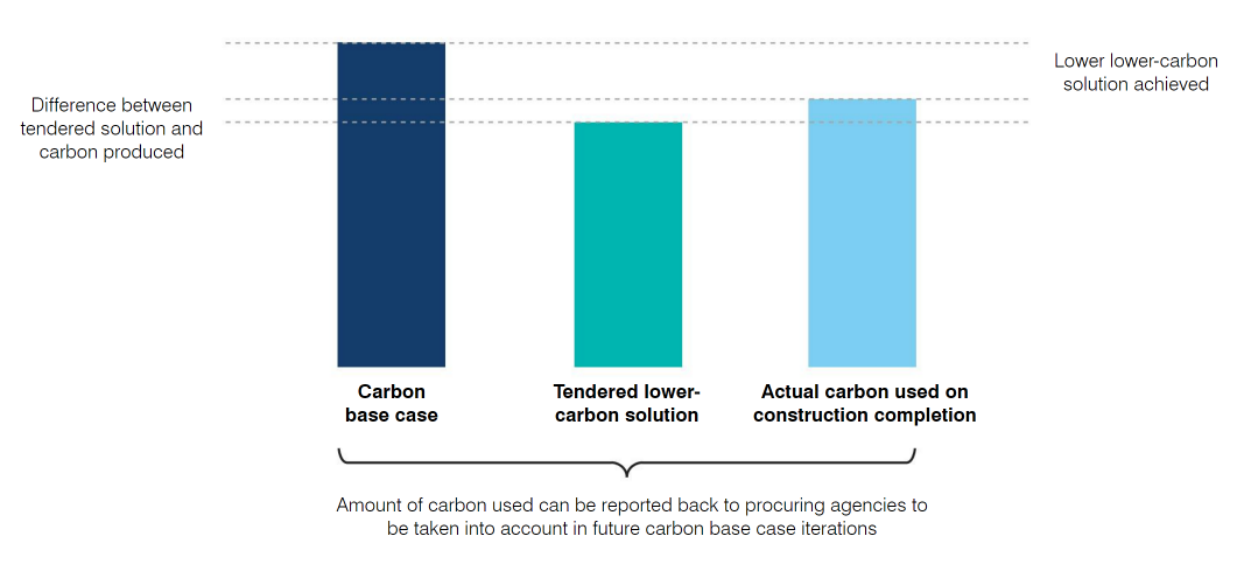


Figure 4.9: Illustrative scenario of a carbon base case being used in the procurement and construction of a project

Source: Decarbonising Construction: *Putting Carbon In The Business Case*, Infrastructure Partnership Australia

Opportunities and challenges

Currently, many agencies lack insight into their projects' embodied carbon and their assets' baseline carbon footprint. This information gap often results in projects without clear reduction targets, causing missed opportunities for lowering emissions.

Introducing mandatory carbon reduction targets introduces further complexities as a project progresses through detailed design.

Action 6.4 –Incorporate carbon valuation into procurement processes to assess the value for money of decarbonisation measures

Valuing carbon emissions within the procurement phase will assist decision makers to determine if carbon reduction initiatives provide a positive economic return. The economic cost of embodied carbon can be used in conjunction to the financial cost of the project to assess which submission provides the greatest value for money. This action follows on from Intervention 3 where government must first establish an approach and publish guidance on how to value carbon emissions across the project lifecycle.

Opportunities and challenges

Applying a carbon value to decarbonisation measures allows agencies to provide clear evidence of the proposed measures value for money.

EXAMPLE 4.11: CO2 PERFORMANCE LADDERS IN THE NETHERLANDS

Rijkswaterstaat, the Dutch Ministry of Infrastructure and Water Management, has incorporated a CO2 Performance Ladder into their procurement processes to promote carbon reduction [71]. The ladder consists of five levels, with each level representing a different degree of commitment to reducing CO2 emissions. During the tendering process, suppliers submit their proposals along with their current CO2 Performance Ladder level. Higher ladder levels provide a virtual discount on bid prices, making proposals more competitive and effectively placing a value on carbon reduction. Figure 6 provides an example of how this approach applies in practice.

The Netherlands' innovative approach to procurement has driven organisations to actively reduce their carbon emissions by implementing more sustainable project designs, materials, and execution methods. As suppliers progress through the levels of the CO2 Performance Ladder, they demonstrate increasing commitment to sustainability and carbon reduction.

This concept can be expanded to include the monetary value assigned to carbon emissions, as suggested in Intervention 3, and incorporate the cost of embodied carbon emissions as a component of the tender evaluation process.

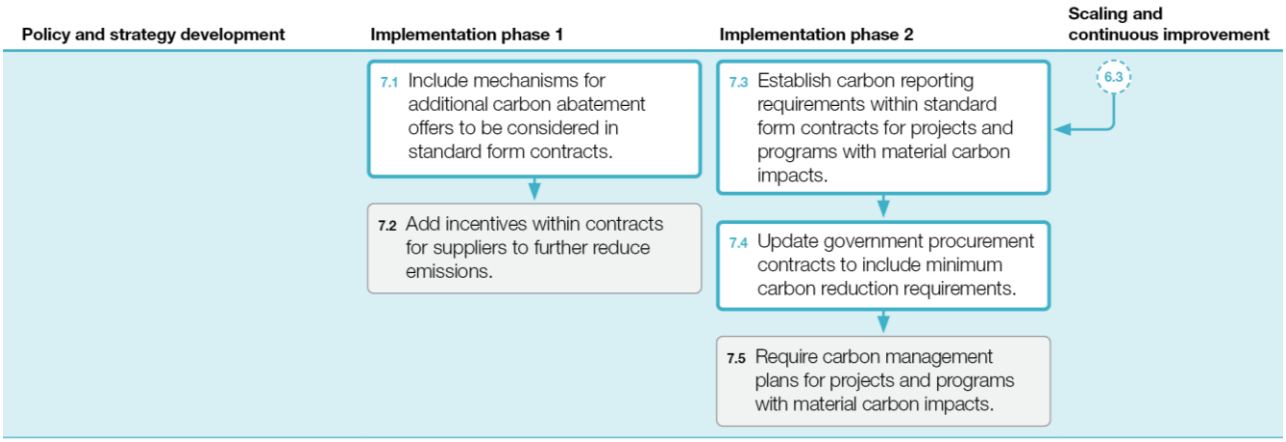
COMPANY	ENTRY PRICE	LEVEL ON THE COLADDER	FICTITIOUS DISCOUNT/ AWARD ADVATAGE	FICTIOUS PRICE	AWARD THE CONTRACT
A	€ 9,7 million	none	0%	€ 9,7 million	NO
B	€ 10 million	3	4%	€ 9,6 million	NO
C	€ 10,3 million	4	7%	€ 9,58 million	YES: € 10,3 million

Figure 4.10: Performance ladder example with bid price reduction and contract award

Intervention 7 – Update standard contracts to include minimum carbon reduction requirements and other incentives

Updating standard contracts to include minimum carbon reduction requirements and other incentives will promote sustainable infrastructure development. By integrating these requirements into contracts, the government can set clear expectations for suppliers, ensuring that they align their practices with decarbonisation objectives and requirements. Enforcing these commitments through legally binding contracts provides a strong foundation for responsible and innovative approaches within the industry, encouraging suppliers to seek out and implement low carbon methods, materials, and practices.

Implementation plan



Action 7.1 – Include mechanisms for additional carbon abatement offers to be considered in standard form contracts

This action involves incorporating mechanisms in standard contracts that allow for the consideration of additional carbon abatement offers from suppliers, encouraging them to propose innovative solutions for emissions reduction throughout project delivery (e.g. the use of low-carbon materials, energy-efficient equipment, and renewable energy).

This action will improve collaboration between suppliers and the government, creating an environment where inventive and effective carbon reduction strategies can be incorporated into project delivery as opportunities arise.

Supplementary Action 7.2 – Add incentives within contracts for suppliers to further reduce emissions

This action proposes incorporating financial incentives into contracts for suppliers who exceed GHG emissions reduction targets. This approach encourages suppliers to pursue ambitious emissions reductions and adopt innovative sustainability practices into their projects. By rewarding suppliers who accelerate emissions reductions, the government can stimulate innovation and inspire the industry to achieve faster and deeper carbon reductions.

Incentives can include monetary rewards, funding of innovation or research and development initiatives, contract extensions, or preferential treatment in future procurement processes, all of which encourage suppliers to continuously enhance their whole-of-life sustainability performance.

Action 7.3 – Establish carbon reporting requirements within standard form contracts for projects and programs with material carbon impacts

Regular reporting on contractor embodied emissions is rarely embedded into contracts but is required both to monitor performance and inform future target setting. Incorporating carbon reporting requirements into standard contracts for projects with substantial climate impacts enables the government to effectively track and monitor progress towards emission reduction goals. This approach streamlines reporting procedures, ensuring consistency and compliance across different projects.

Regular reporting on contractor embodied emissions is crucial for evaluating performance and informing future target setting. These requirements hold contractors accountable for their emissions reductions and provide valuable data for the government to assess policy effectiveness and identify areas for improvement.

Opportunities and challenges

Carbon reduction commitments are not routinely enforced and monitored, and there is opportunity to do so through contract terms.

EXAMPLE 4.12: Sydney Metro City & Southwest

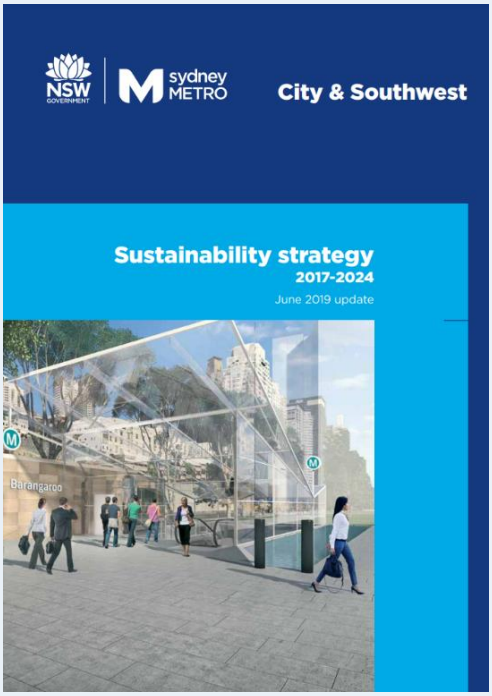
The Sydney Metro City & Southwest project incorporated a range of sustainability initiatives within its contracts, aiming to reduce GHG emissions and promote low carbon construction practices and technologies [54].

Incentives within contracts:

To encourage contractors to meet or exceed the 15% GHG reduction target compared to a business-as-usual approach, Sydney Metro implemented incentives within its contracts through tender criteria and Key Performance Criteria for sustainability and innovation

Carbon reporting requirements within contracts:

In addition to the incentives, Sydney Metro required contractors to report on their emissions reduction progress, promoting transparency and accountability. This approach allowed for the monitoring of contractors' performance against the targets and helped ensure the adoption of low-carbon practices throughout the project.



Minimum specifications within contracts:

Sydney Metro also established minimum specifications within its contracts to guide contractors towards sustainable practices. These specifications set clear expectations regarding the use of energy-efficient equipment, low-carbon materials, and innovative construction methodologies.

Tender alternatives and bid-backs:

The tendering process invited contractors to bid back on targets and initiatives in the contract related to carbon emissions. This mechanism allowed contractors to clearly demonstrate how their offers can provide additional value in contributing further to Sydney Metro's sustainability targets and objectives. The contracts also allowed for contractors to propose value add alternatives during the tendering process, whereby the benefits of the alternatives proposed were to be clearly communicated alongside any impact on other criteria e.g., program, cost, risk, environmental and social outcomes.

Action 7.4 – Update government procurement contracts to include minimum carbon reduction requirements

By revising procurement contracts to include minimum carbon reduction requirements, the government reinforces its commitment to sustainability and ensures that suppliers are held accountable for meeting these targets. This action establishes a baseline performance level that all suppliers must meet, driving progress towards decarbonisation objectives and creating a level playing field for competition. Suppliers demonstrating a strong commitment to sustainability will be better positioned to secure future contracts, promoting continuous improvement and innovation within the industry.

Supplementary Action 7.5 – Require carbon management plans for projects and programs with material carbon impacts

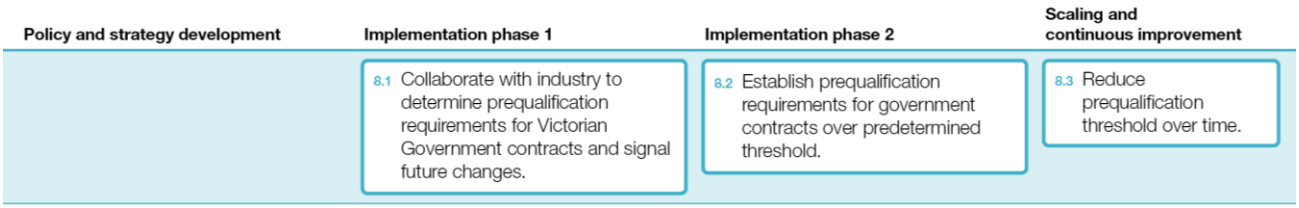
This optional action proposes requiring carbon management plans for projects with significant carbon impacts. These plans help to ensure that suppliers consider and plan for emissions reduction throughout the project lifecycle, from planning and design to construction and operation, ultimately leading to more comprehensive and well-considered approaches to emissions reduction.

Carbon management plans help to embed emissions reduction considerations into project planning and provide a roadmap for suppliers to achieve their emissions reduction targets.

Intervention 8 – Establish prequalification requirements for government contracts

Introducing prequalification requirements focused on decarbonisation for Victorian Government contracts helps guarantee that suppliers align with Victoria's emissions reduction goals. This intervention aims to establish requirements ensuring that contractors possess the necessary experience, knowledge, and commitment to decarbonisation. Consequently, this promotes a competitive market that consistently works towards lowering carbon emissions in government infrastructure projects.

Implementation plan



Action 8.1 – Collaborate with industry to determine prequalification requirements for Victorian Government contracts and signal future changes

This action involves engaging with industry stakeholders to identify appropriate prequalification requirements related to decarbonisation for government contracts. A key outcome should be to determine what level of prequlification requirements should apply with respect to project size.

Signalling future changes to industry will give suppliers time to adapt and prepare for the new criteria, facilitating a smooth transition and minimising potential disruptions.

Action 8.2 – Establish prequalification requirements for Victorian Government contracts over a predetermined threshold

As part of the procurement process, setting prequalification requirements that align industry with government commitment will decarbonise embodied emissions and emissions throughout the supply chain. For government contracts that exceed a predetermined threshold, specific prequalification requirements may include:

- Demonstrating a commitment to reducing carbon emissions in line with Victoria's emissions targets.
- Possessing relevant experience in implementing low-carbon technologies and practices.
- Employing a dedicated sustainability or carbon reduction team or expert within the organisation.
- Submitting a Carbon Reduction Plan outlining the supplier's approach to decarbonisation and their emissions reduction targets.

EXAMPLE 4.13: VICTORIAN GOVERNMENT CONSTRUCTION PREQUALIFICATION REQUIREMENTS

The Victorian Government already has prequalification requirements in place for suppliers involved in construction works. These requirements focus on Occupational Health and Safety, Industrial Relations, and adherence to the Victorian Government Supplier Code of Conduct. The existing prequalification requirements in the Victorian Government construction context highlight the potential for expanding these criteria to include decarbonisation and sustainability measures.

EXAMPLE 4.14: UK GOVERNMENT, PROCUREMENT POLICY NOTE 06/21 (PPN 06/21)

The UK Government's Procurement Policy Note 06/21 (PPN 06/21) provides guidance on taking account of Carbon Reduction Plans in the procurement of major government contracts [72]. PPN 06/21 is applicable to all central government departments, their executive agencies, and non-departmental public bodies for procurements with an estimated contract value exceeding £5 million.

Under PPN 06/21, suppliers are required to submit an organisation-based Carbon Reduction Plan with their tender, outlining their commitment to achieving Net Zero by 2050 and providing details on their current greenhouse gas emissions, as well as their short- and long-term reduction targets. The Carbon Reduction Plan also requires suppliers to present a description of the environmental management measures they have in place and any initiatives they participate in to reduce emissions. By implementing PPN 06/21, the UK Government ensures that suppliers demonstrate a commitment to decarbonisation in line with the country's Net Zero target. This case study illustrates the potential benefits of introducing prequalification requirements focused on decarbonisation in the Victorian context.

Action 8.3 – Reduce prequalification threshold over time

This action proposes a gradual reduction of the prequalification threshold over time, ensuring that even smaller contracts are subject to decarbonisation requirements. As industry capabilities and awareness of decarbonisation improve, lowering the threshold can encourage a more widespread adoption of low-carbon practices and technologies across various project sizes.

Opportunities and challenges

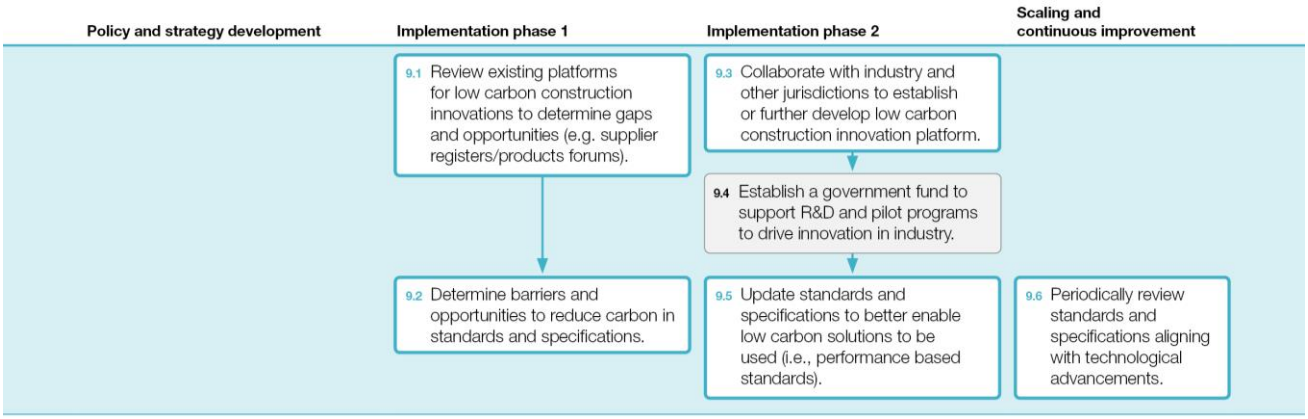
Reducing the prequalification threshold over time will present challenges for smaller suppliers that need to adapt to the evolving requirements, potentially reducing competition for government contracts.

Intervention 9 – Support the development of decarbonisation innovations across industry

Government infrastructure investment has a significant influence on the demand for sustainable materials and construction techniques. Encouraging decarbonisation innovations across the industry is crucial for promoting the development and adoption of low emission building materials and practices.

By driving demand through infrastructure projects, the Victorian Government can motivate industry stakeholders to invest in producing and improving sustainable materials. Expanding demand for sustainable materials usage will lead to economies of scale, driving down the cost of low-carbon materials and enhancing contractor experience in using alternative materials and construction techniques.

Implementation plan



Action 9.1 – Review existing platforms for low carbon construction innovations to determine gaps and opportunities (e.g., supplier/product registers and forums)

Action 9.1 emphasises the evaluation of existing platforms and initiatives related to low carbon construction materials and practices, aiming to identify areas for improvement and collaboration opportunities. Engaging with industry stakeholders and delivery agencies will improve alignment on critical requirements, such as the availability of open-source information, reliability and validation of specifications, and transparency of assessments.

Action 9.2 – Determine barriers and opportunities to reduce carbon in standards and specifications

A thorough assessment of construction standards is necessary to ensure they align with global best practices and encourage the use of sustainable, low-emission methods and materials. These reforms should promote innovation and the piloting of new techniques and materials.

The challenges associated with introducing these materials and methods stem from the emerging market and the lack of an extensive performance history that engineers and designers can rely on. Further research and capability-building will help demonstrate how building standards and technical specifications, designed to achieve safety, durability, functionality, and other requirements, can still be met using low-emission building materials. This effort should be supported by initiatives that send clear signals to the market, incentivising the supply of low-emission building materials.

One of the primary obstacles to adopting new approaches is achieving consensus among the various stakeholders involved in a project's lifecycle, such as designers, engineers, contractors, and asset owners.

Addressing their diverse incentives, risk tolerances, and knowledge levels can be facilitated through more accessible materials and standards data and early, structured engagement with the market. For instance:

- Designers need assurance that their materials and design advice will not result in future losses or claims.
- Organisational standards should be flexible and have research capabilities to validate approaches that deviate from established practices.
- Procuring agencies must trust the tenderer's ability to source materials and implement innovative approaches, particularly when compared to traditional methods.
- Builders and asset managers need confidence that the new approach will prove durable over time.
- A review of construction standards will ensure they reflect global best practice and promote the use of more sustainable, lower-emission methods and materials. These reforms should allow for innovation and piloting new techniques and materials

Opportunities and challenges

- Trials of low emissions building materials have not become business as usual specifications.
- Availability of low emissions building materials and capability to validate supplier credentials is still developing.
- Low emission building materials behave differently and training and upskilling necessary to implement solutions.

Action 9.3 – Collaborate with industry and other jurisdictions to establish or further develop low carbon construction innovation platform

This action involves engagement with industry stakeholders and collaboration with other jurisdictions to establish or further develop a platform that showcases low carbon construction innovations, including a catalogue of low emissions building materials, their characteristics, and use cases. This platform will support the adoption of sustainable materials and practices by providing accessible information on available solutions.

Opportunities and challenges

There is an opportunity to collaborate with industry and other jurisdictions such as TfNSW who is set to develop a Zero Carbon Materials Innovation Program in 2024 which aims to accelerate R&D, updates to standards and specifications, and broaden uptake in procurement.

A collaborative platform can help break down barriers to adopting low carbon construction solutions by providing a centralised source of information and facilitating knowledge sharing across jurisdictions and industry sectors.

EXAMPLE 4.15: ECOLOGIQ

EcologiQ is a Victorian Government initiative designed to enhance the environmental sustainability of infrastructure projects through the promotion of recycled materials [73]. By focusing on materials with a reduced carbon footprint, EcologiQ aims to encourage the construction industry to adopt more sustainable and innovative practices, mitigating the overall environmental impact of construction projects.

The Victorian Government can leverage EcologiQ's existing focus on recycled materials and strengthen the focus on low emission building materials and processes. By providing detailed information on specifications, case studies, and trials, EcologiQ can serve as a valuable resource for industry stakeholders seeking to implement sustainable practices and materials.

Expanding the scope of EcologiQ to include low emission materials and processes would drive innovation within the construction industry, supporting the Victorian Government's emissions reduction goals. This broader focus would further contribute to the development and adoption of sustainable practices, leading to more environmentally friendly and cost-effective infrastructure projects.

Supplementary Action 9.4 – Establish a government fund to support R&D and pilot programs to drive innovation in industry

Create a dedicated government fund to financially support research, development, and pilot programs focused on low carbon construction materials and techniques. This initiative will help overcome cost barriers and encourage innovation in the construction sector.

Action 9.5 – Update standards and specifications to better enable low carbon solutions to be used (i.e., performance based standards)

It is governments' role to set the standards for industry to follow, and then make room for the private sector to create lower-carbon solutions. Reforming standards in line with global best practice and with regard to embedded emission issues will deliver substantial benefits. A key area of reform will be to improve visibility of the sector's embedded emissions through supply chains in where, and how, the construction industry sources materials. Projects that sit within the more mature sustainable investment target levels should aim to pursue innovation and support capacity building/commercialisation of sustainable materials, processes and products.

Opportunities and challenges

The results of trials and the transition of certain specifications to performance-based standards can be documented and help build government and industry knowledge.

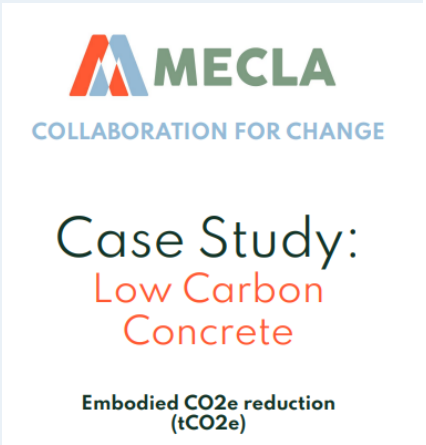
Establishing performance-based standards can drive the adoption of low carbon construction solutions, but they also require ongoing monitoring and evaluation to ensure that these new approaches meet safety, durability, and functional requirements.

EXAMPLE 4.16: MATERIALS AND EMBODIED CARBON LEADERS' ALLIANCE (MECLA)

The Materials and Embodied Carbon Leaders' Alliance (MECLA) is a not-for-profit organisation funded by the NSW Government dedicated to promoting the adoption of low-emission building materials and practices in the construction industry [74]. MECLA provides information of sustainable materials and their specifications, facilitating the sourcing of eco-friendly options for construction projects.

In addition to this, MECLA provides a range of case studies demonstrating the successful implementation of low-emission construction practices across different sectors and project types. These serve as valuable resources and inspiration for industry stakeholders looking to adopt sustainable practices in their projects.

The Victorian Government can leverage the expertise and resources provided by MECLA to support their decarbonisation efforts in the construction industry. By collaborating with MECLA, the government can access valuable information on low-emission materials and practices, learn from successful case studies



Action 9.6 – Periodically review standards and specifications aligning with technological advancements

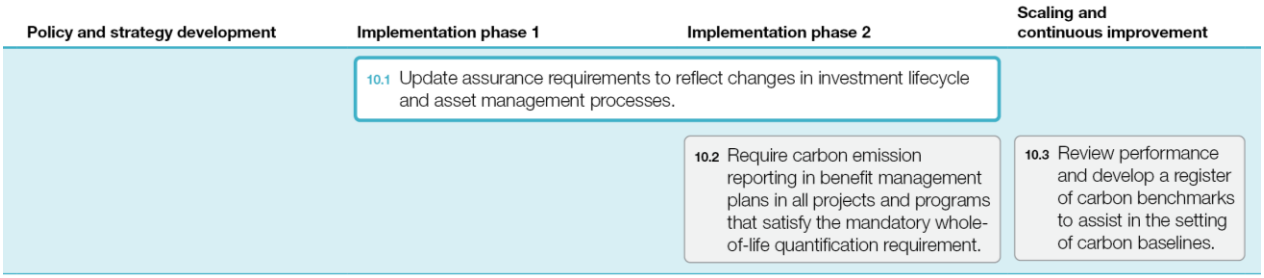
Regularly assess and update construction standards and specifications to keep pace with advances in low carbon materials and practices. This iterative process will help ensure that industry standards remain relevant and continue to support decarbonisation efforts in the construction sector.

Assurance Interventions

Intervention 10 – Update assurance processes to include carbon emissions

Integrating carbon emission considerations into assurance processes will strengthen accountability and transparency in infrastructure investment decision making. Specific actions that should be taken include updating assurance processes and guidelines to incorporate the changes described in the other interventions and requiring carbon emissions to be reported in Benefit Management Plans. Improving assurance processes will ensure that the impact of carbon emissions are carefully monitored and managed and any carbon emission reduction benefits are evaluated post-completion.

Implementation plan



Action 10.1 – Update assurance processes and guidelines to reflect changes in investment lifecycle processes and asset management processes

This action involves updating assurance processes relating to the *Victorian Government's Investment Lifecycle and High-Value, High-Risk guidelines* and asset management processes to accommodate new foundational guidance or modifications to existing business case and procurement frameworks, guidance, and templates.

Updating the Gateway Review and Project Assurance Review guidance and templates is necessary to clearly outline the importance of reviewing carbon consideration throughout the project lifecycle stages. Departments should also integrate these changes into their internal assurance and asset management processes. Carbon emission requirements should be clearly delineated from other sustainability requirements.

EXAMPLE 5.18: VICTORIA'S LOCAL JOBS FIRST COMMISSIONER

The Victorian Local Jobs First Commissioner was established to strengthen the local economy and promote job growth within the state by advocating for local businesses and workers in government procurement processes. The Commissioner works to ensure that local businesses have a fair opportunity to compete for government projects and contracts, ultimately supporting economic growth and employment in Victoria.

LOCAL JOBS FIRST COMMISSIONER

The assurance processes for decarbonising infrastructure could draw parallels with the role of the Local Jobs First Commissioner. Drawing inspiration from the Local Jobs First Commissioner's role, a similar dedicated role or body could be deployed to oversee the implementation of decarbonisation measures in infrastructure projects. This role would oversee project development and delivery to ensure that government departments and agencies remain accountable in their efforts to decarbonise infrastructure. By ensuring that decarbonisation measures are integrated into investment lifecycle processes and asset management processes, the Victorian Government can more effectively facilitate the transition to low-carbon infrastructure and ensure it remains on track to meet its emissions reductions targets.

Supplementary Action 10.2 – Require carbon emission reporting in benefit management plans for all projects and programs that satisfy the mandatory whole-of-life quantification requirement

Quantified and monetised sustainability benefits should be tracked and managed according to the Benefits Management Plan. This plan should ideally be linked to reporting requirements placed on contractors and infrastructure operators. Carbon abatement measures identified in the business case should also be linked to government policies and priorities, with their articulation in the Benefits Management Plan ensuring they are not unintentionally traded off due to time, resource, or cost pressures.

Action 10.3 – Review project performance and develop a register of carbon benchmarks to assist in the setting of carbon baselines

Following the successful completion and delivery of projects, post completion evaluation reports and contractor performance reporting can be used to inform and improve embodied emissions estimates for future projects, as well as identify opportunities for more ambitious reductions. This will help agencies develop consistent carbon footprint models by asset type that utilise historical data to inform early decision making and setting of the carbon base case.

EXAMPLE 5.19: MEASURING CARBON IN THE UK INFRASTRUCTURE AND PROJECT AUTHORITY GATEWAY REVIEW PROCESS

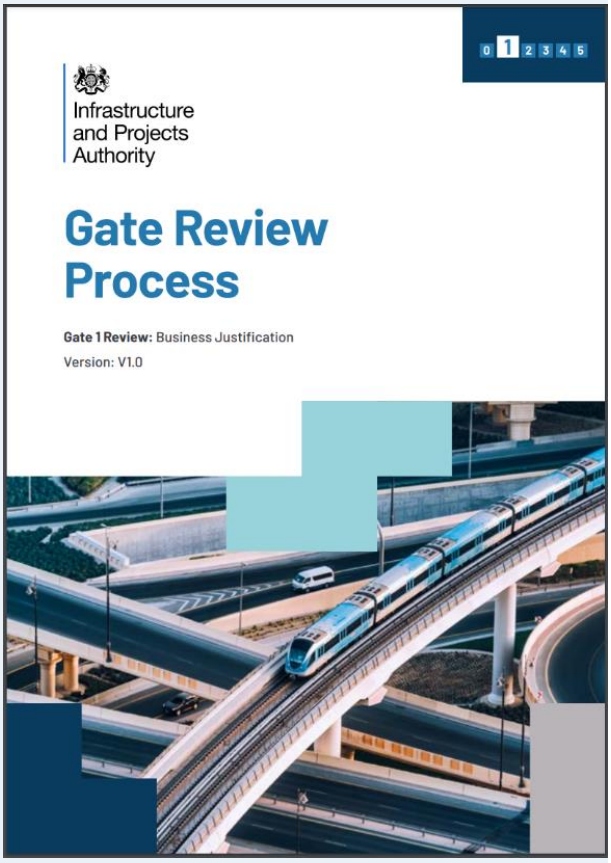
Starting in July 2021, the UK Infrastructure and Projects Authority (IPA) included net zero and climate change mitigation tests in their Gate Review process for major projects [55]. By integrating carbon management, the process ensures that departments properly quantify emissions and implement actions to reduce them throughout the project lifecycle.

As part of the UK Gate Review process, a whole-of-life carbon assessment must be conducted during the business case development, following the PAS 2080 standards. These standards provide a consistent method for quantifying and managing infrastructure carbon emissions, allowing the government to systematically address carbon from project inception to completion.

Besides measuring carbon in business cases, the Gateway Review process includes other tests to verify that project teams consider emissions mitigation activities, net zero targets, and UK carbon budgets across all gates, including procurement. These tests encourage the exploration of low emission designs, the use of low carbon materials and energy, and the potential benefits of off-site construction methods.

Integrating carbon management into the IPA's Gateway Review process demonstrates the UK Government's commitment to decarbonising infrastructure and achieving net zero targets.

By embedding carbon considerations into project assurance, the government ensures a more comprehensive and sustainable approach to infrastructure development, setting a strong example for other jurisdictions.



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Appendix A - Carbon Valuation

A1 Valuing carbon in economic appraisals

Carbon valuation is a complex and evolving area of research, and there are competing ideas and approaches to valuing carbon for economic appraisals globally. This section provides an overview of the three key approaches to valuing carbon, how carbon has been valued traditionally in Australia, as well as international examples.

Approaches to valuing carbon

Assigning a monetary value to carbon emissions that most appropriately reflects the welfare impacts for the community is a challenging and complex task, particularly for the long-term. The figure below shows the three typical methods for evaluating GHGs in monetary terms ($/t CO2-e):

Damage costs

Damage costs are an evaluation of the total costs of climate change under the assumption that no efforts are taken to reduce the pace of climate change. They are estimated as the net present value of climate change impacts over the next 100 years (or longer) of one additional tonne of carbon emitted today.

The damage cost approach is also commonly referred to as the:

- social cost of carbon method
- impact pathway approach
- climate change impact cost method
- marginal damages approach

Damage costs are calculated using detailed modelling to assess the physical impacts of climate change such as melting ice caps, rising sea levels, and the increased intensity and frequency of extreme weather events. These physical impacts are then combined with estimates of their economic impacts to determine damage cost estimates.

From an economic point of view, the damage cost approach measures directly the damages related to the external effects of climate change, and hence provides a first-best estimation of the monetary value of these impacts. Therefore, if reliable and accurate, damage costs have the advantage that they would provide the best estimate of the total impact to society of climate change.

However, there are several major sources of uncertainty and weaknesses in estimating damage costs of climate change, including:

- uncertainty in modelling the physical impacts of climate change
- the absence of certain cost categories from estimates
- damage costs do not account for risk aversion
- the assessment of a baseline scenario.

If damage costs could be estimated accurately and precisely, they would appropriately capture the economic, social, and environmental impacts of climate change. However, while damage costs would provide a 'socially optimal' GHG valuation, the high degree of uncertainty and variability makes it impractical for use in investment decision making. Further, given the uncertainty, the use of damage cost valuations may not align with society's preference for risk aversion.

Target consistent approach

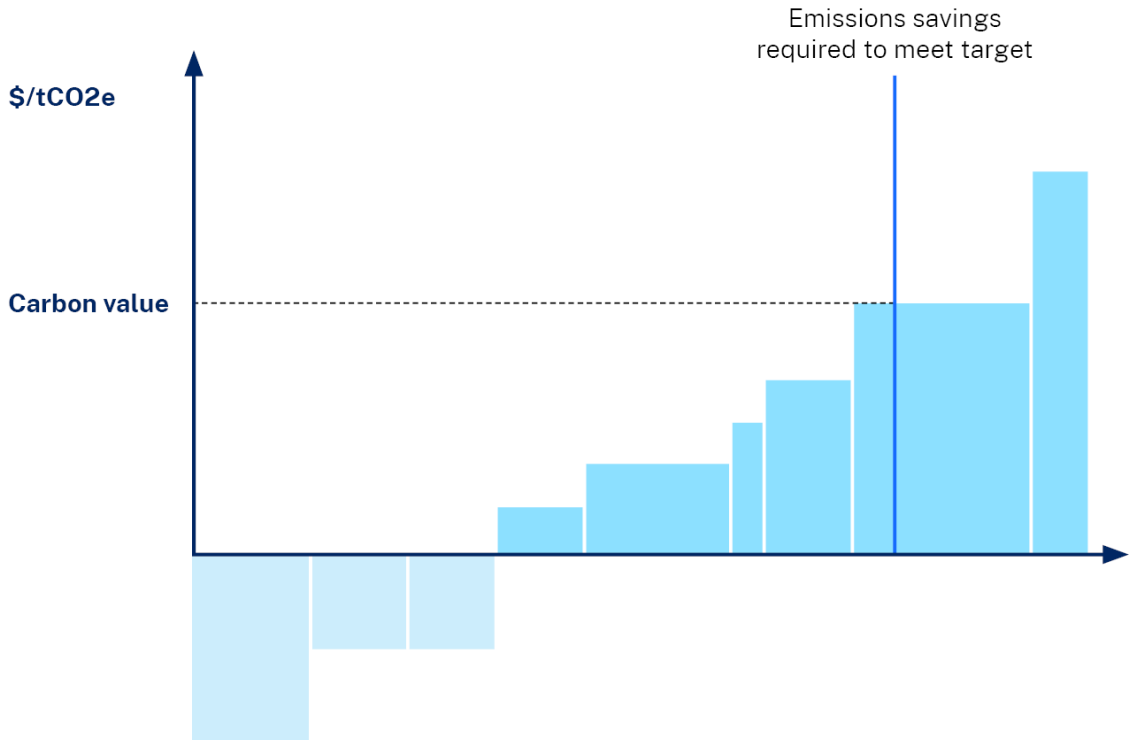
The target consistent approach is also commonly referred to as:

- avoidance cost method
- marginal abatement cost method
- target-based approach

The target consistent approach uses a relevant policy target, such as 'net zero by 2050', and determines the scale and cost of GHG abatement required to achieve that target over a given timeframe.

The method is based on a cost-effectiveness analysis, which determines the least-cost option to achieve a required level of GHG emission reduction. The approach is depicted on a Marginal Abatement Cost curve, which shows the cost of a series of discrete abatement measures (such as 'reforestation', 'implement fuel economy standards'). The value of carbon is set at the level that is consistent with the level of marginal abatement costs required to reach the targets adopted. The curve shows an incremental increase in abatement costs as the abatement target is increased.

The figure below illustrates how a "target-consistent" carbon value would be set. From existing understanding of emissions projections and abatement options, the emission savings required to meet set environmental targets can be determined. Reading across from the abatement curve produces the corresponding carbon value level.



Further, from a welfare economics perspective, the avoidance cost approach is not a first-best solution as it does not directly measure and value all impacts of climate change. Valuations from the target consistent approach dependent on:

- The adopted policy target.
- The marginal abatement costs used.
- The baseline scenario.

Market Price

A market price approach bases the GHG valuation on the observed and expected traded price of carbon in each carbon market. Carbon valuations based on market prices have the advantage that they can represent actual prices of carbon or abatement at a given time. The two most relevant carbon markets are:

- The Australian Emission Reduction Fund (ERF)
- The European Union Emissions Trading System (EU ETS).

Carbon markets are exposed to market imperfections which can lead to carbon prices that differ from the optimum economic value. Carbon prices in emissions trading markets are determined by market maturity, market structure, political influences, informative disclosure, supply side factors and demand side factors. Market imperfections lead to several disadvantages, including:

- Market structure
- Volatility
- Short- and long-term supply.

For these reasons, carbon prices based on emissions trading markets are not typically considered appropriate for valuing carbon in government economic CBAs.

Price vs value

A distinction in terminology should be made between carbon prices and carbon values. A carbon price is determined in a carbon market or through a carbon tax, whereas carbon value refers to the cost of carbon to society and the economy. For the purpose of government investment decision making, this paper specifically focuses on monetised carbon values, as opposed to carbon prices, for use in economic CBA.

Discount Rates

The choice of discount rate can strongly impact the value of future costs and benefits, meaning that a small change in the rate may have large impacts on net present value (NPV) and the benefit-cost ratio (BCR) of projects and potentially change the outcome of the CBA.

There are two prevailing theoretical bases to social discounting:

- **Time preference** – recognises that society values current consumption over future consumption.
- **Social opportunity cost of capital** (SOCC) – recognises that any given public investment may occur at the expense of alternative public or private investment, as capital is limited.

Project BCRs are highly sensitive to discount rates, particularly for projects with benefits accrued over a long-term. The initiatives that have very long-term impacts may involve intergenerational equity considerations, which is often debated and tend be the main rationale for declining discount rates.

Discounting

Discounting accounts for people's preference to consume goods and services today, rather than in the future. When someone is benefited in the future, we discount it to value it in today's terms. This allows for decisions to be made today about initiatives that have costs today and benefits in the future.

For sustainability related projects, benefits are often realised over the long term. This means that the present value of long-term benefits may be heavily impacted by the rate of discounting, and this can have a significant impact on the outcome of a CBA.

The choice of discount rates is of unique importance as GHG emissions have intergenerational impacts and society's time preference can change in acknowledgement of the impact to future generations. The table below shows the wide disparity of discount rates that are used to value carbon emissions in projects internationally. These jurisdictions apply a Social Rate of Time Preference (SRTP) approach which favours investments that benefit future generations, typically ranging from 2-3%. This approach is becoming increasingly common; however, the exact discount rate remains debated.

Region	VIC and NSW	UK	Canada	US (Federal)	New York	Washington
Real discount rate	• 5% p.a (NSW), 7% p.a (VIC) • For all cost and benefits streams	• 3.5% p.a. for years < 31 • 3% p.a. for years 31-75 • 2.5% p.a. for years 76-125	• 3% p.a. for SRTP • 8% p.a. for SOCC	• 3% p.a. for SRTP • 7% p.a. for SOCC	• 2% p.a.	• 3.5 % p.a.

Valuing carbon for transport projects

The table below includes a summary comparison of carbon valuation methods and values adopted overseas with those adopted by Australian Transport Assessment and Planning (ATAP), as well as a comparison with the abatement costs included in the recent Federal Government Long-Term Emissions Reduction Plan.

Jurisdiction	Body	Valuation method	Cost ($/t CO2-e) – indexed to FY2021/22	Indexation	GHG policy commitments
EU	European Commission	Target Consistent Approach	$150 (short term) $403 (long term)	EU	55% reduction by 2030 on 1990 levels and net zero by 2050
UK	UK Government	Target Consistent Approach	$447 (2022) $681 (2050)	1.5% per annum	68% reduction by 2030 on 1990 levels and net zero by 2050
NZ	New Zealand Transport Agency (NZTA)	Target Consistent Approach	$88 (2022) $164 (2050)	2.25% per annum	50% reduction by 2030 on 2005 levels and net zero by 2050
USA	US Federal Government	Damage cost	$70	N/A	50-52% reduction by 2030 on 2005 levels and net zero by 2050
	New York State Government	Damage cost	$175	N/A	
Australia	Australian Government	Could be applied for Target Consistent Approach	$170 (no international offsets) $400 (no offsetting)	N/A	26-28% reduction by 2030 on 2005 levels and net zero 2050 (NSW is committed to 50% reduction by 2030)
	ATAP	Damage and Target Consistent Approach	$65	0%	

Appendix B - Stakeholder engagement list

A2 Stakeholder engagement list

The table below provides a summary of Victorian Government entities and industry members consulted throughout the development of this report.

Victorian Government

- Department of Education (DOE)
- Department of Energy, Environment and Climate Action (DEECA)
- Department of Health (DOH)
- Department of Justice and Community Safety (DJCS)
- Department of Premier and Cabinet (DPC)
- Department of Transport and Planning (DTP)
- Department of Treasury and Finance (DTF)
- Development Victoria (DV)
- EcologiQ
- Major Transport Infrastructure Authority (MTIA)
- Office of Projects Victoria (OPV)
- Victorian Health Building Authority (VHBA)
- Victorian School Building Authority (VSBA)

Industry

- Acciona
- Australasian Procurement and Construction Council (APCC)
- Arcadis
- Arup
- Aurecon
- Australian Constructors Association
- Australian Flexible Pavement Association
- Australian Steel Institute
- Business Council of Australia
- Civil Contractors Federation Victoria
- Cement Concrete & Aggregates Australia
- Climateworks Centre
- Consult Australia
- CPB Contractors
- Lendlease
- Deloitte
- Engineers Australia (EA)
- Green Building Council of Australia (GBCA)
- Infrastructure Partnerships Australia (IPA)
- Infrastructure Sustainability Council (ISC)
- Jacobs
- John Holland
- KPMG
- Laing O'Rourke
- Materials and Embodied Carbon Leaders' Alliance (MECLA)
- Mott MacDonald
- Royal Institution of Chartered Surveyors (RICS)
- Slattery
- Transurban
- Victorian Chamber of Commerce and Industry

Appendix C - Comparison of carbon standards and tools

A3 Detailed comparison of carbon standards and tools

This appendix provides detailed comparison tables for carbon standards and tools adopted by some agencies in Victoria, emerging, or adopted in other jurisdictions. Refer to tables on the following pages and section 2.1.4 in the main report for discussion.

Comparison of carbon standards and guidance adopted for infrastructure in Victoria and emerging

Standard	Date (latest revision)	Reporting perspective	Primary use	Relevant sectors	Relied upon or linked standards and guidelines	Mandatory scope of assessment	Limitations for infrastructure sector
Adopted in Victoria							
GHG Protocol Corporate Standard	2004	Organisation	Organisational GHG accounting	Any	ISO 14040 and 14044 Range of supplementary standards and guidance	Direct Scope 1 and indirect Scope 2 emissions	Organisational reporting boundaries Indirect Scope 3 emissions optional
GHG Protocol Corporate Value Chain (Scope 3) Standard	2011	Organisation	Organisational GHG accounting of scope 3 emissions	Any	ISO 14040 and 14044 Supplementary to GHG Protocol Corporate Standard	Nine categories of scope 3 emissions defined under company influence	Organisational reporting boundaries Private road users not captured for road asset owners/operators
ISO 14064-1 GHG Assessment Part 1 (Organisations)	2018	Organisation	Organisational GHG accounting	Any	ISO 14040 and 14044	Direct Scope 1 and indirect Scope 2 emissions	Organisational reporting boundaries
ISO 14064-2 GHG Assessment Standard Part 2 (Projects)	2018	Project	Project GHG accounting	Construction	ISO 14040 and 14044	Direct Scope 1 and indirect Scope 2 emissions	Indirect Scope 3 emissions optional
Climate Active Carbon Neutral Standard for Organisations	2022	Organisation	Carbon neutral certifications	Any	ISO 14040 and 14044 GHG Protocol Corporate Standard	Direct Scope 1 and indirect Scope 2 emissions	Relevance test allows flexibility to exclude indirect Scope 3 emissions
Climate Active Carbon Neutral Standard for Buildings	2022	Project	Carbon neutral certifications	Buildings	ISO 14040 and 14044 GHG Protocol Corporate Standard	Direct Scope 1 and indirect Scope 2 emissions	Relevance test allows flexibility to exclude indirect Scope 3 emissions
Science Based Targets Initiative Corporate Net Zero Standard	2023	Organisation	Organisational net zero target setting	Any	GHG Protocol Corporate Standard GHG Protocol Corporate Value Chain (Scope 3) Standard	Direct Scope 1 and indirect Scope 2 emissions Majority of scope 3 emissions	Organisational reporting boundaries Still misses some enabled or 'user' emission sources due to organisational perspective

Standard	Date (latest revision)	Reporting perspective	Primary use	Relevant sectors	Relied upon or linked standards and guidelines	Mandatory scope of assessment	Limitations for infrastructure sector
EN 15978 - Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method	2011	Project	Lifecycle assessment of buildings (within Green Star)	Buildings	EN 15643 EN 15804 ISO 14044	Whole of life building emissions	Comprehensive and more complex calculation method
EN 15804 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products	2019	Product	Lifecycle assessment and Environmental Product Declarations for construction products	Manufacturing (construction products)	EN 15643 EN 15978 ISO 14044	Whole of life carbon emissions	Comprehensive and more complex calculation method
Emerging standards and guidance							
RICS Whole of Life Carbon Assessment for the Built Environment	2017	Project	Whole of life carbon assessment	Buildings focused	EN 15978 EN 15804 PAS 2080 ISO 14040 and 14044	Whole of life carbon emissions	Comprehensive and more complex calculation method
RICS International Cost Management Standard (ICMS): Global Consistency in Presenting Construction Life Cycle Costs and Carbon Emissions	2022	Construction projects and assets	High-level structure and format for classifying and reporting carbon and lifecycle costs	Buildings focused	Recommends use of "appropriate and emerging" whole of life carbon standards (EN 15978, EN 15804, PAS2080) for carbon calculations	Not mandatory, but whole of life carbon recommended	Classification system more building focused and classification doesn't cover all infrastructure elements
EN 17472 Sustainability of construction works. Sustainability assessment of civil engineering works - Calculation methods	2022	Civil engineering works	Lifecycle assessment of civil infrastructure projects	Infrastructure	EN 15643 EN 15804 EN 15978	Whole of life carbon emissions	Comprehensive and more complex calculation method

Standard	Date (latest revision)	Reporting perspective	Primary use	Relevant sectors	Relied upon or linked standards and guidelines	Mandatory scope of assessment	Limitations for infrastructure sector
PAS 2080 – Carbon Management in Infrastructure	2023	Asset (primarily) or organisation	Whole of life carbon measurement and management Adopted in IS v2.1 rating tool	Infrastructure and buildings	EN 15978 and EN 17472	Whole of life carbon emissions, including asset users (enabled emissions)	Comprehensive and more complex calculation method

Carbon tools and resources adopted in Victoria and other jurisdictions or emerging

Tools	Owner	Date (latest version)	Format	Sector coverage	Advantages and opportunities	Limitations and scope (emission source) exclusions
Adopted in Victoria						
National Greenhouse Account Factors	Department of Climate Change, Environment, Energy and Water	2022	Report providing factors and calculation guidance	Energy, transport, waste, industrial processes, land use change and forestry	Free access Easy to use Could be expanded to include factors for scope 3 emission sources	Does not include emission factors covering construction scope 3 emission sources Limited guidance & factors for transport modes Does not include forecasted change in carbon intensity for electricity (included in UK TAG data book)
Australian Transport Assessment and Planning (ATAP) Guidelines - PV5 Environmental Parameters	Infrastructure and Transport Ministers	2021	Report with emission factors	Transport	Free access Could be updated to consider scenarios for forecasted growth in share of EV	Limited focus on transport Does not include any forecasted change in carbon intensity of electricity change in vehicle emissions (both included in UK TAG data book)
Environmental Performance in Construction (EPiC) database	University of Melbourne	2019	Webpage, PDF and excel providing emission factors	Building materials	Free access Easy to use Covers building material related scope 3 emissions	Limited emission factor library
EPD Australasia Environmental Product Declaration (EPD) Library	EPD Australasia	Frequently updated	Webpage database with Environmental Product Declarations	Construction products	Free access High quality data with strict verification requirements in line with EN 15804 Data could be extracted into an easier to use database	Complex reporting across several indicators with breakdown by lifecycle modules (challenging to interpret for average user)
Carbon Gauge	Transport Authority	2011	Excel tool	Road	Free access Easy to use	Outdated Limited emission factor library

Tools	Owner	Date (latest version)	Format	Sector coverage	Advantages and opportunities	Limitations and scope (emission source) exclusions
	Greenhouse Group					Limited flexibility Limited reporting functionality
IS Materials Calculator	Infrastructure Sustainability Council (ISC)	2021	Excel tool	Transport & Water	Easy to use	Less calculation flexibility Limited emission factor library beyond civil materials Limited reporting Only available to ISC Infrastructure Sustainability Accredited Professionals (ISAP)
eTool	Cerclos	Frequently updated	Web-based app	Mostly buildings	Allows more detailed assessment with balance of usability	Paid subscription and training needed
One Click LCA	OneClick (FI)	Frequently updated	Web-based app	Mostly buildings	Allows more detailed assessment with balance of usability	Paid subscription and training needed
GaBi	Sphera (US)	Updated annually	Desktop-based app	All	Modelling flexibility and comprehensive database	Paid subscription and significant training needed
SimaPro	Pre-Sustainability (NL)	Updated annually	Desktop-based app	All	Modelling flexibility and comprehensive database	Paid subscription and significant training needed
Green Star Upfront Carbon Calculator	Green Building Council of Australia	2022	Web-based app	Buildings	Easy to use Supports assessment of key scope 3 emissions for buildings	Excludes operation and embodied use and end of life stage emissions Only available to projects registered for rating Limited emission factor library
Adopted in other jurisdictions or emerging						
Carbon Estimate and Reporting Tool (CERT)	Transport for NSW	2017	Excel	Transport	Free access Easy to use Austroads planning to adapt to develop tool for all Australia and NZ transport agencies	Excludes road user emissions Limited emission factor library Limited flexibility Limited reporting functionality

Tools	Owner	Date (latest version)	Format	Sector coverage	Advantages and opportunities	Limitations and scope (emission source) exclusions
Project Emissions Estimation Tool (PEET)	Waka Kotahi (NZ)	2022	Excel	Transport	Free access Easy to use Whole of life scope (includes road user emissions)	Limited emission factor library Limited flexibility Limited reporting functionality
UK GHG Conversion Factors	UK Government	2022	Excel with supporting guidance	All sectors (organisational perspective)	Provides more emission factors for transport and construction materials than National Greenhouse Account factors	Data for construction materials is limited
UK Transport Analysis Guidance (TAG) data book	UK Government	2022	Excel with supporting guidance	Transport	Provides detailed assumptions to support the forecast enabled or 'user' carbon emissions in transport appraisals. This includes forecast share of EVs, EV electricity consumption, change in carbon intensity for electricity, and change in vehicle emissions with tightening standards	Transport focused
Carbon emission calculation tool	National Highways (UK)	2020	Excel with supporting guidance	Road	Free access Easy to use	Excludes road user emissions Limited emission factor library Limited flexibility Limited reporting functionality

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