Infrastructure Victoria

Opportunities to decarbonise Victorian Government infrastructure

/ DESIGN FOR A BETTER FUTURE

SUBMITTED BY WSP // MAY 2023

Question today
Imagine tomorrow
Create for the future

Opportunities to decarbonise Victorian Government infrastructure

ABOUT WSP

As one of the world's leading professional services firms, WSP exists to future-proof our cities and environment. We provide strategic advisory, engineering, and design services to clients in the transportation, infrastructure, environment, building, energy, water, and mining sectors.

DELIVERING NET ZERO

WSP is committed to achieve net zero emissions across its value chain by 2040, supported by science-based Greenhouse Gas emissions reduction targets.

We're leading the journey in decarbonisation by being the first engineering consultancy sector in Australia to commit to halving the carbon footprint of our designs and advice by 2030.

Prepared for —

Infrastructure Victoria

Prepared by —

Nick Gallaugher
Paras Bhutiani
James Logie

Reviewed by —

Ray Winn

Approved by —

Ray Winn

Date —

12 May 2023

Company —

WSP Australia Pty Ltd
ABN 80 078 004 798

Registered Address —

Level 27, 680 George Street
Sydney NSW 2000
+61 2 9272 5100

Local Address —

Level 11, 567 Collins Street
Melbourne, 3000
Australia

WSP Contact —

Ray Winn, Technical Executive - Economics and Business Cases
Ray.Winn@wsp.com

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.

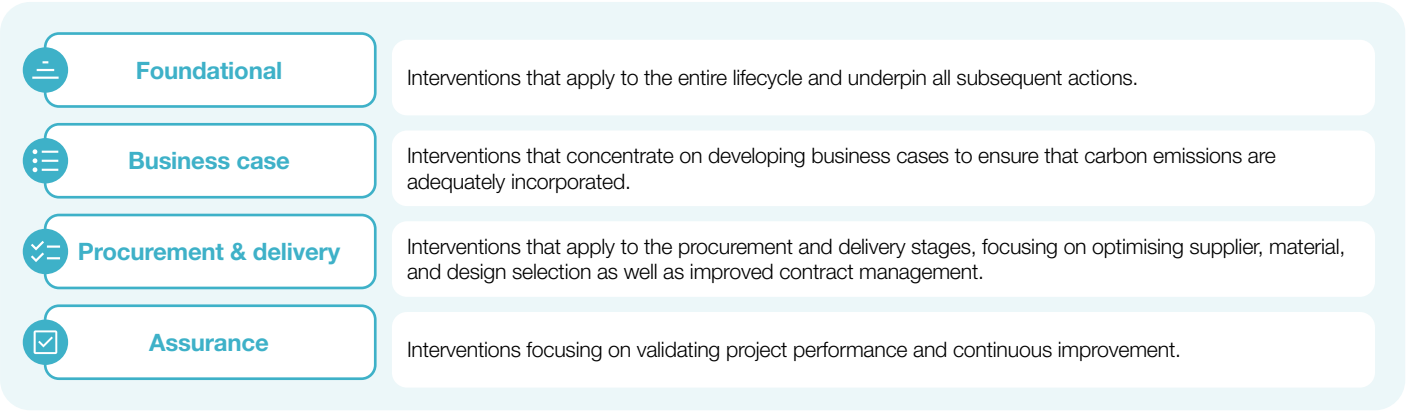


Figure 3: *Intervention categories*

Implementation stages guide the logical sequencing of actions over time.

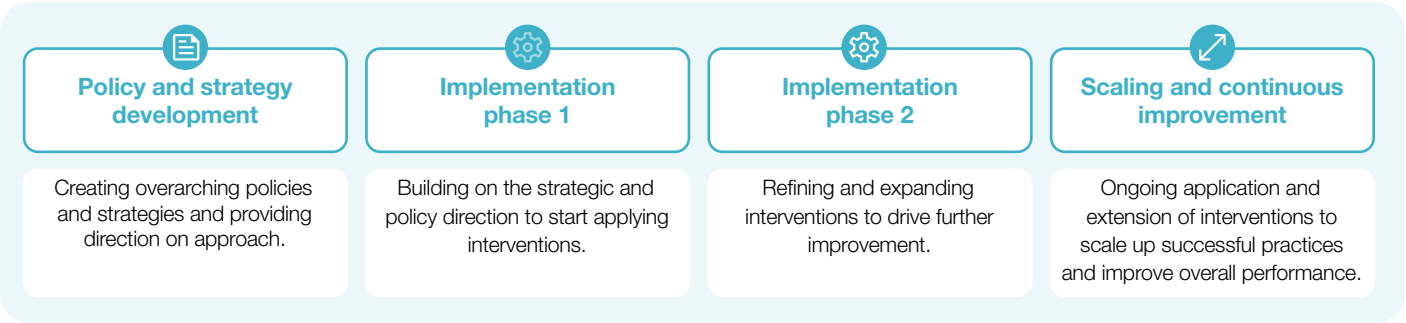


Figure 4: *Implementation stages*

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

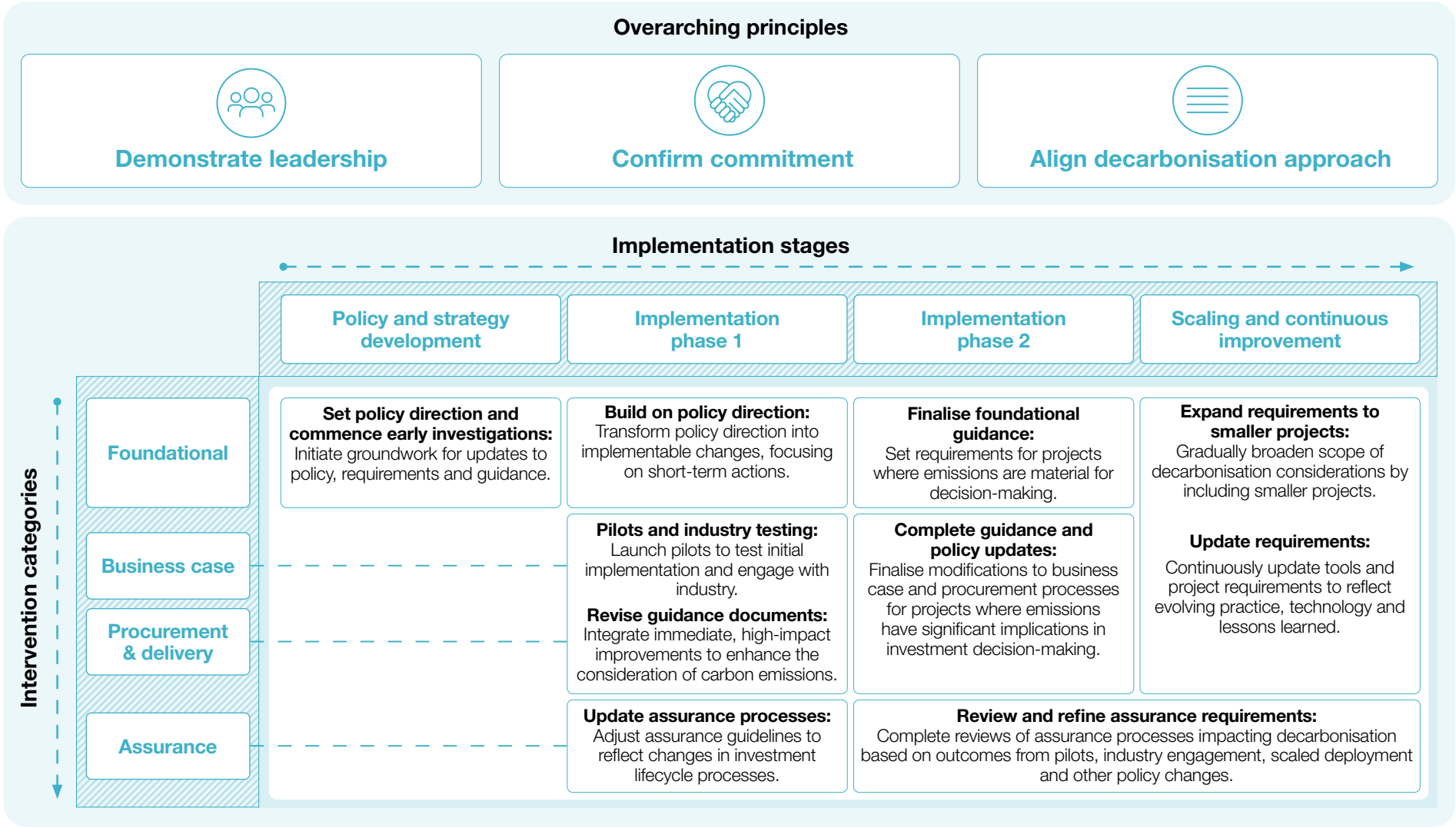
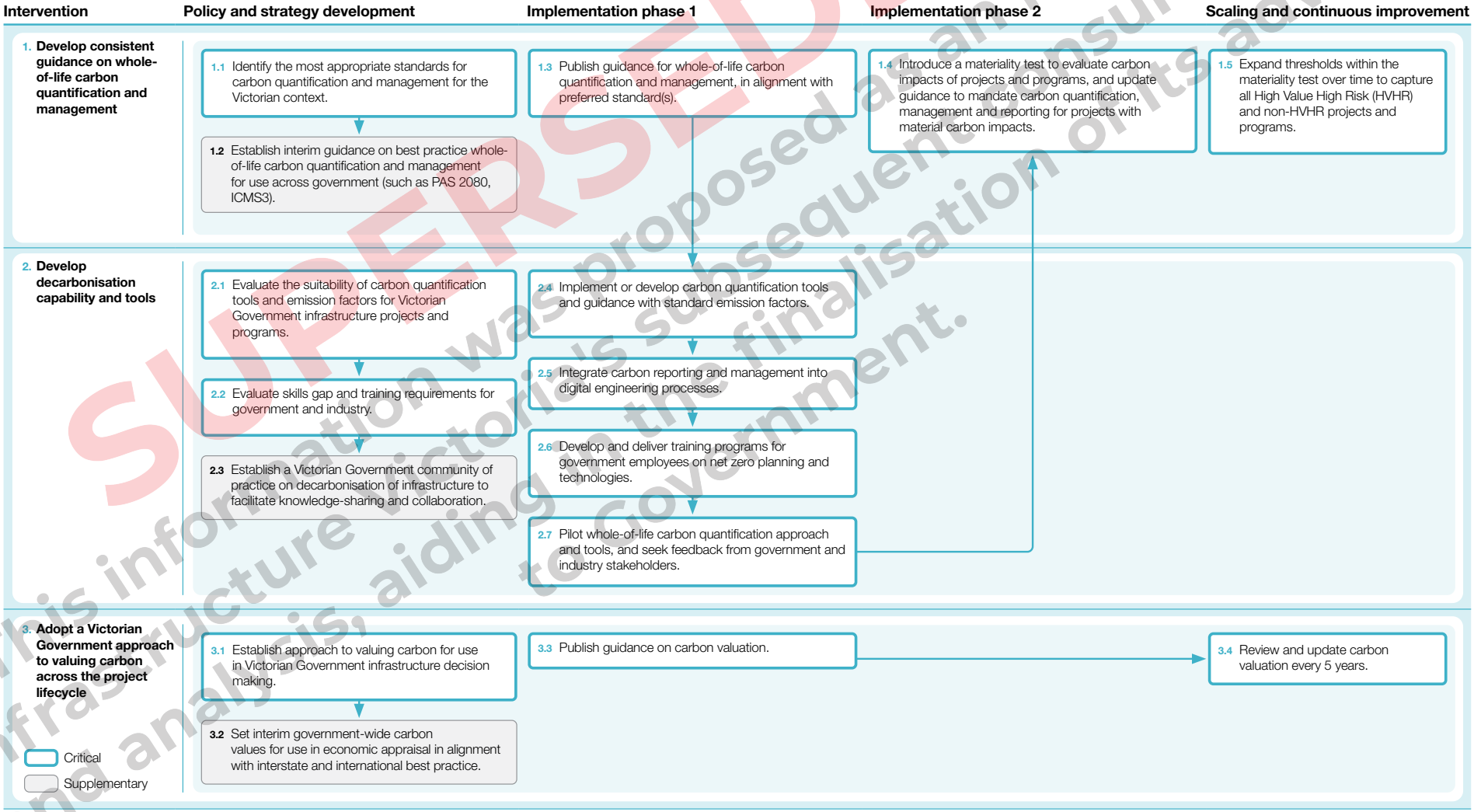


Figure 5: *Implementation framework*

PROPOSED IMPLEMENTATION PLAN

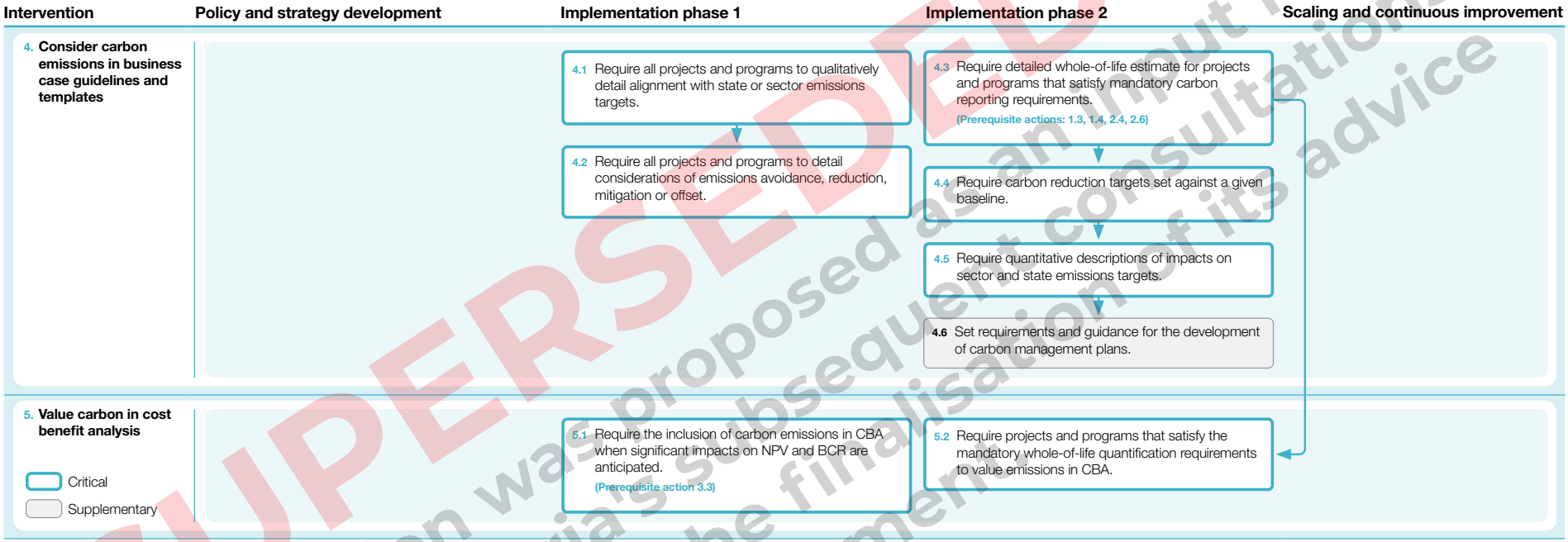
The implementation plan provides a detailed sequence of actions for the 10 proposed interventions across four implementation stages. The figures below highlight critical actions, which are crucial for Victoria to achieve its decarbonisation objectives, and supplementary actions that, although not on 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.

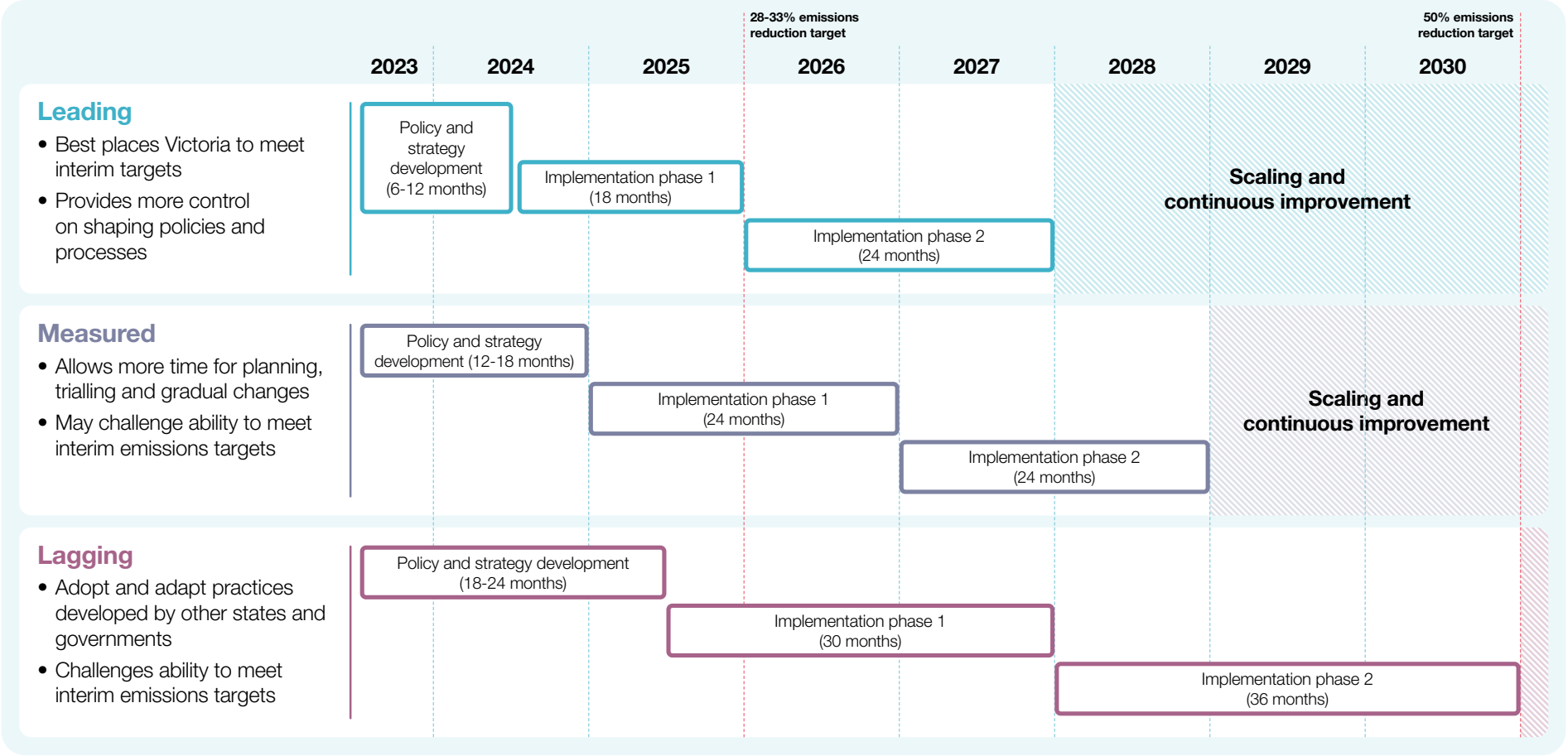


Figure 6: *Implementation timing*

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.

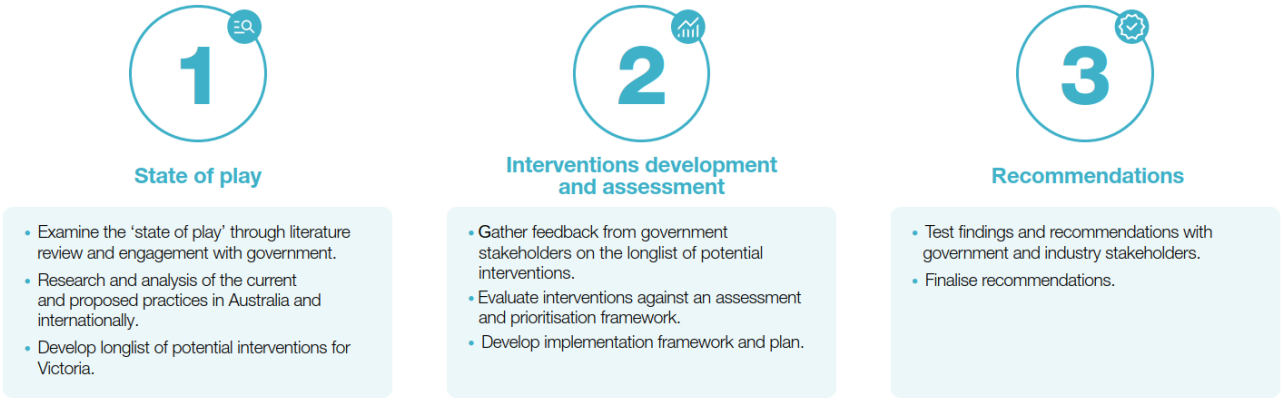


Figure 1.1: Project approach

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.

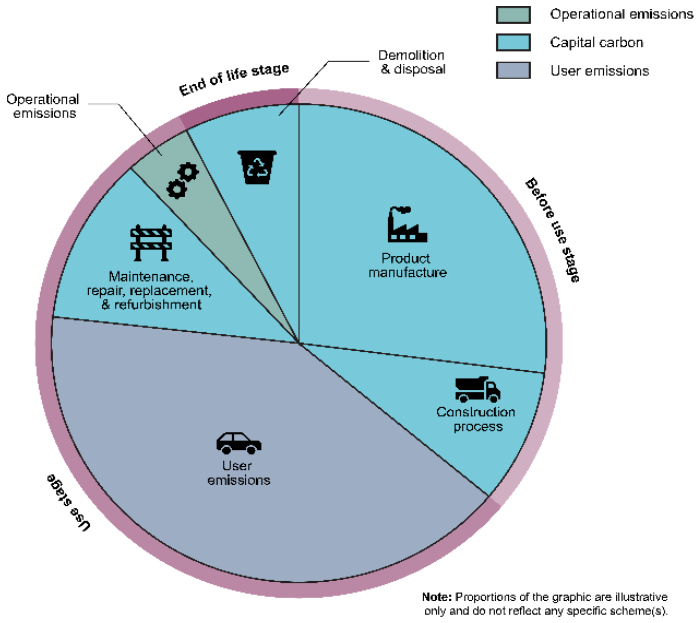


Figure 1.3: Sources of carbon emissions over the infrastructure lifecycle (PAS 2080)

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).

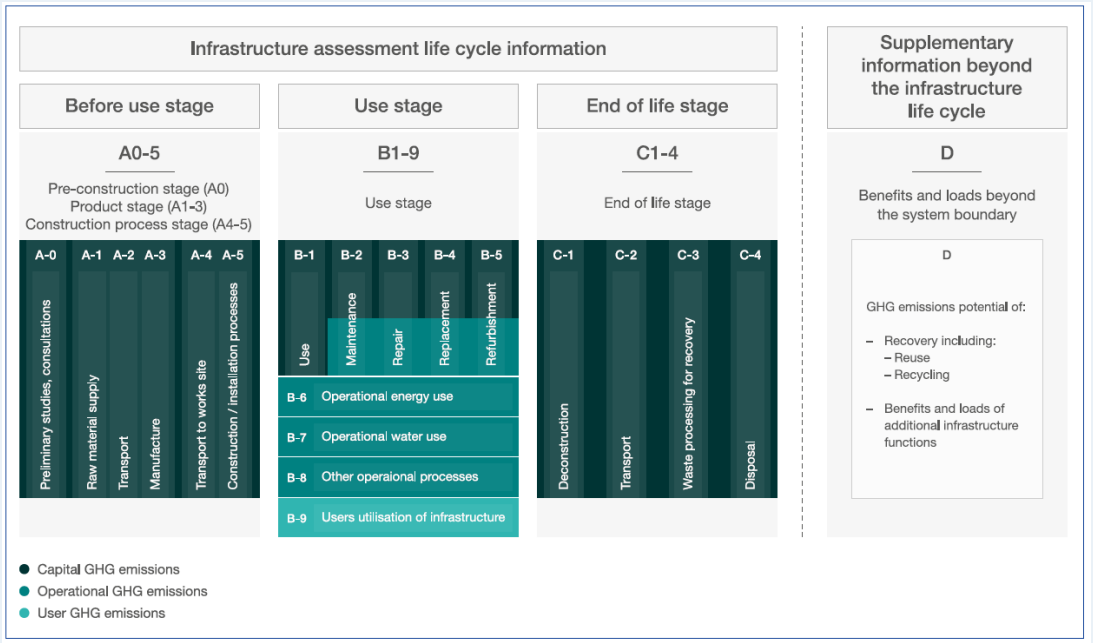


Figure 1.4: PAS 2080 framework for classifying GHG emissions in the infrastructure lifecycle

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.

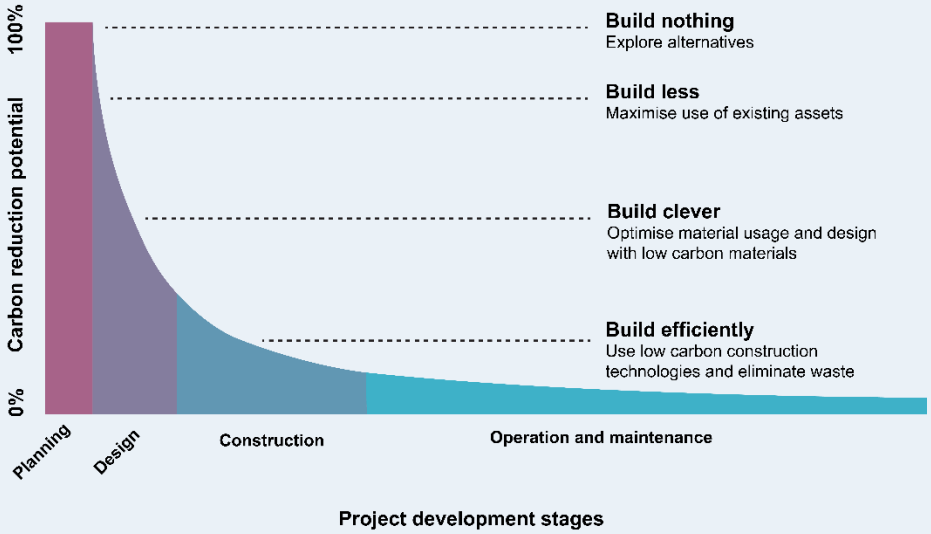


Figure 1.5: Carbon reduction potential across project development stages [11].

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:

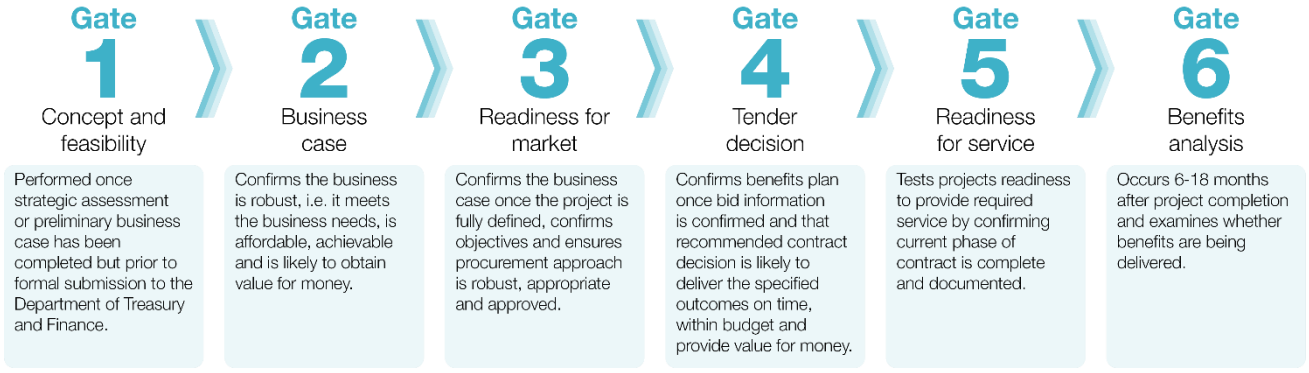


Figure 1.6: Victoria State Government Department of Treasury and Finance Gateway Reviews

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:

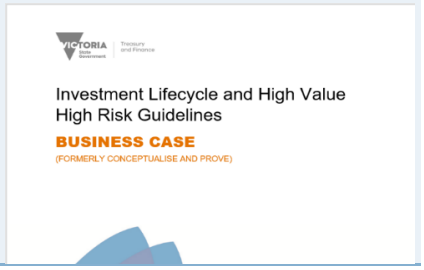
- have an inconsistent approach to estimating, measuring, and reporting carbon emissions
- focus on meeting legislated sustainability measures (e.g., building energy standards and requirements) rather than considering the value of additional emission reduction measures
- select preferred options without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

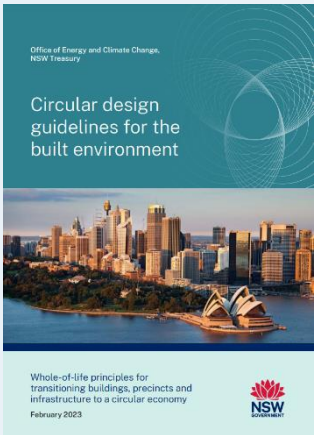
The Office of Energy & Climate Change has several decarbonisation related policies and initiatives underway. The recently released NSW Net Zero Emissions Dashboard presents past and projected future GHG emissions for NSW. It provides useful insights into the pace of decarbonisation expected in each sector – 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.

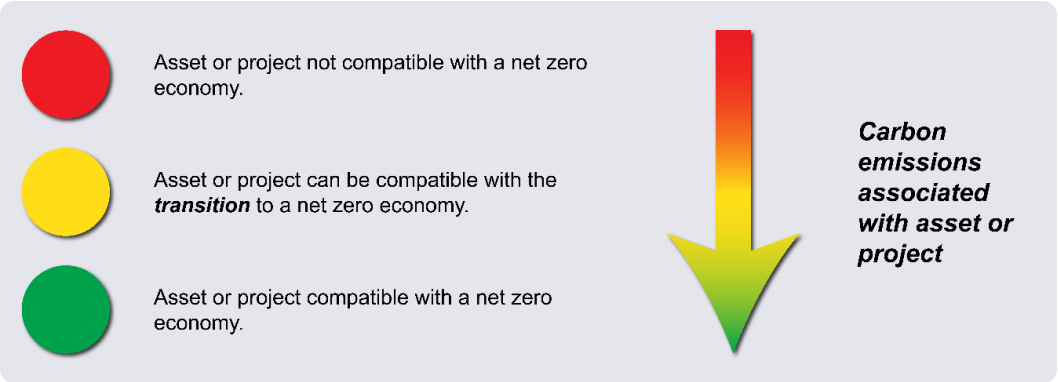


Figure 2.2: Example climate mitigation taxonomy principles (adapted from Climate Bonds Taxonomy)

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.

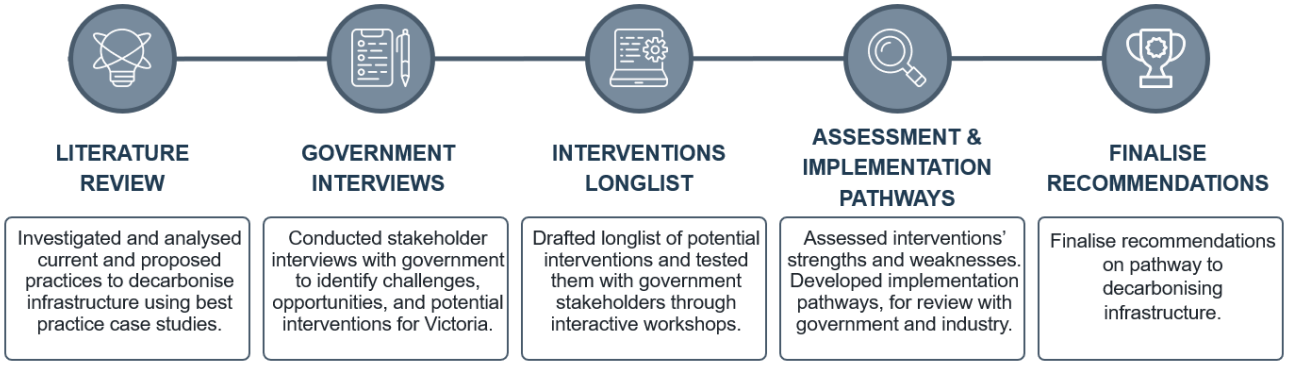


Figure 3.1: Interventions development process

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.

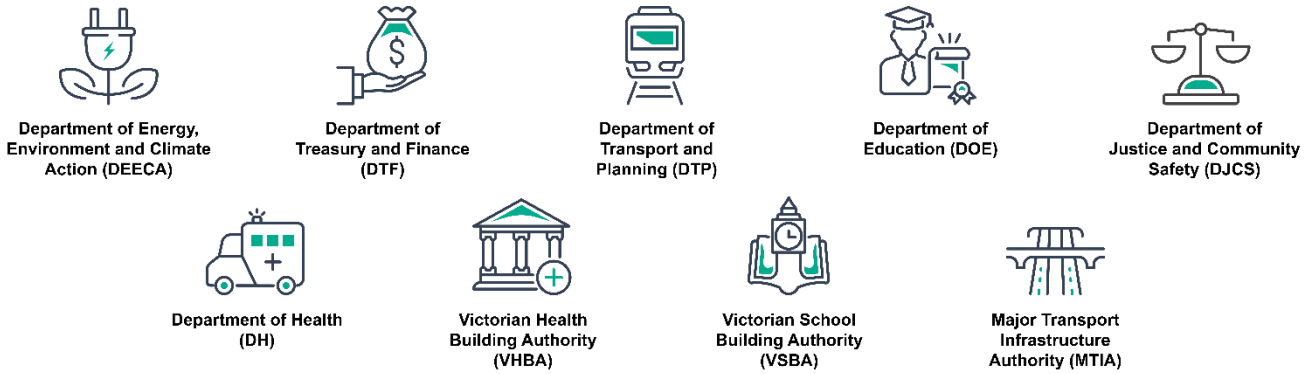


Figure 3.2: Victorian Government entities interviewed

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.

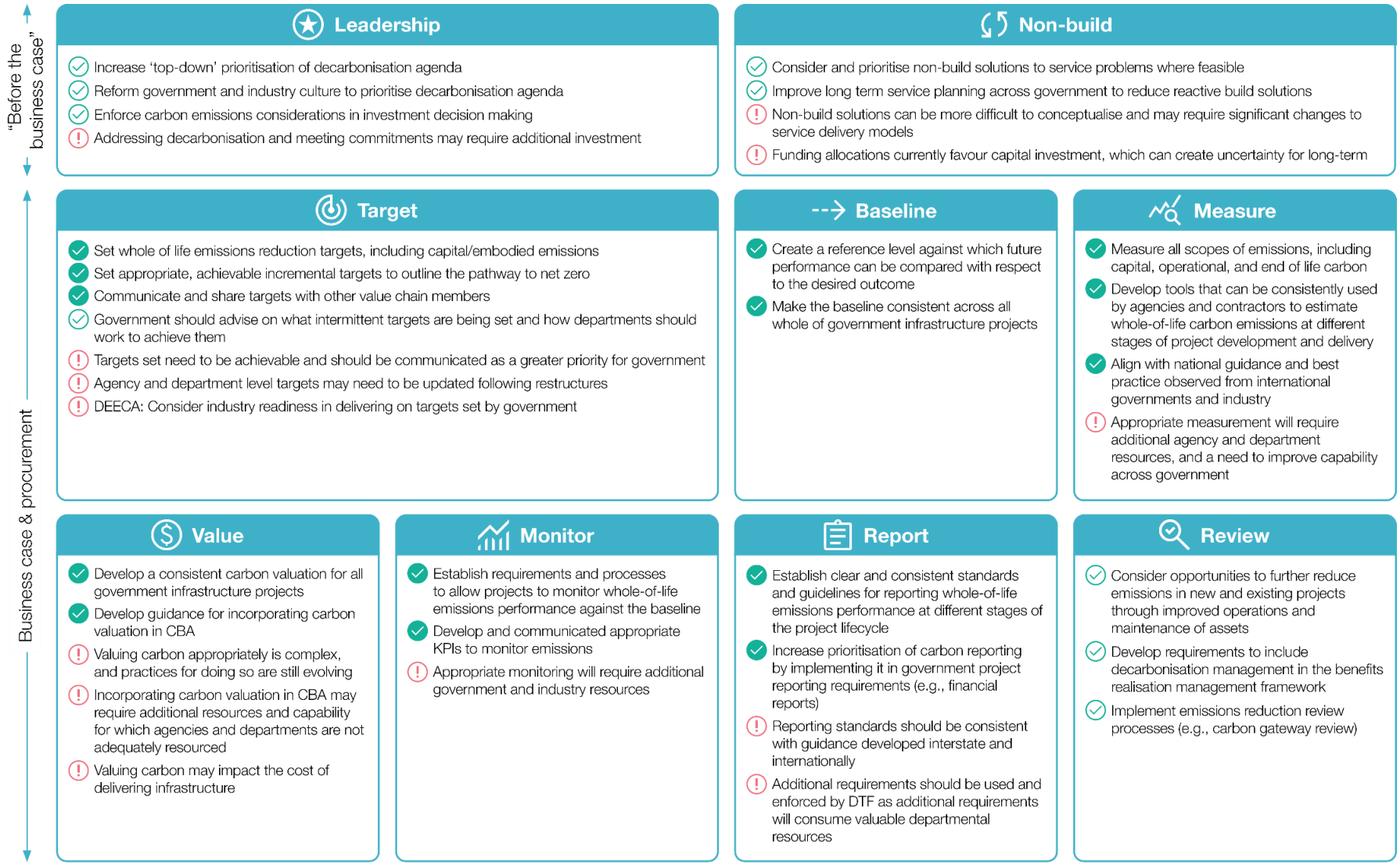


Figure 3.3 Summary of stakeholder feedback on decarbonisation requirements for Victoria

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.

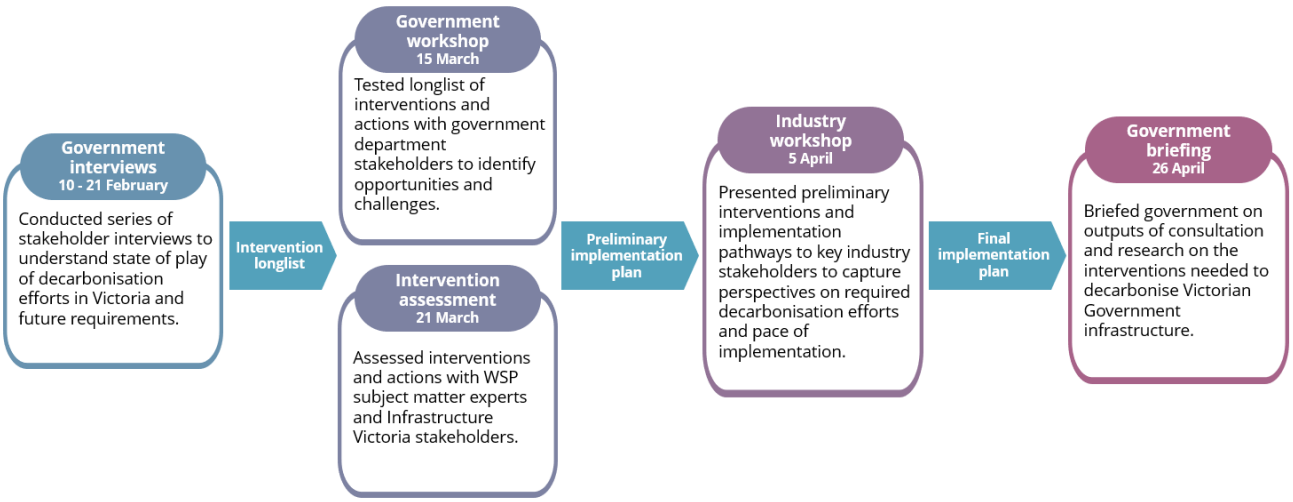


Figure 3.6: Stakeholder consultation and interventions assessment process

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.

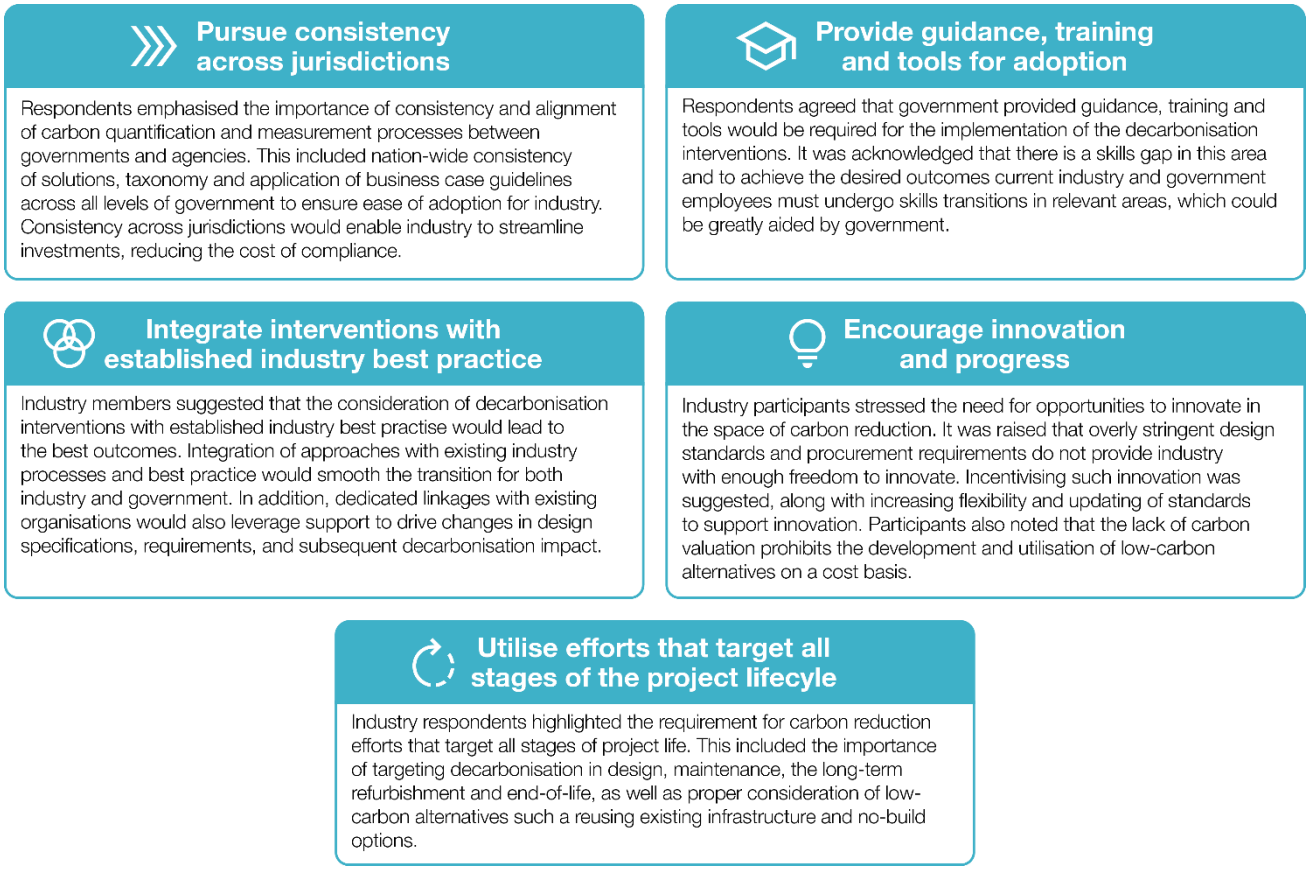


Figure 3.8: Key observations from industry workshop

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.

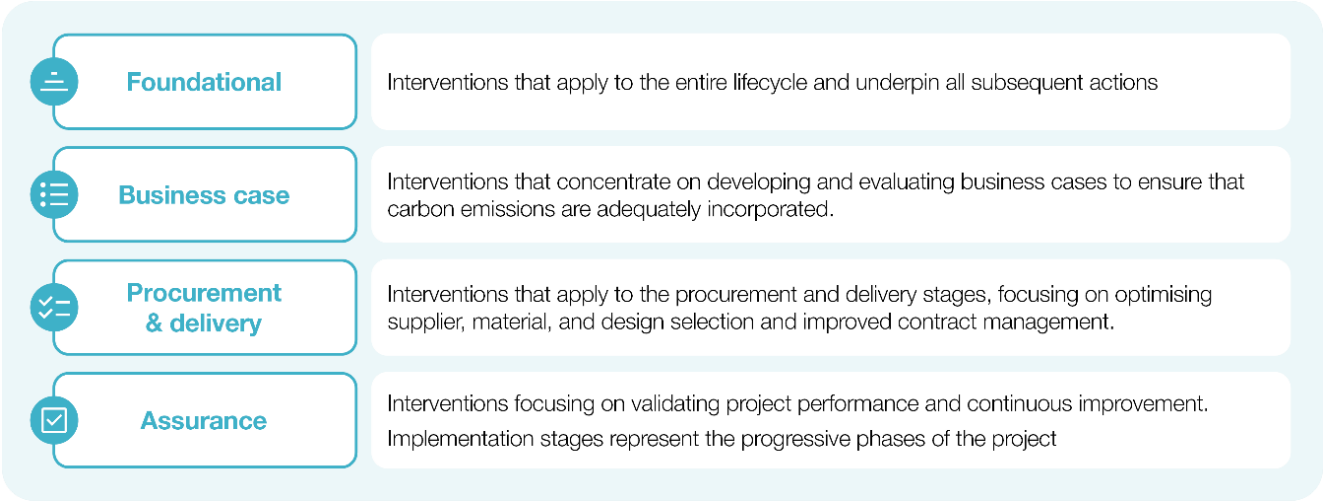


Figure 4.1: Intervention categories

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).

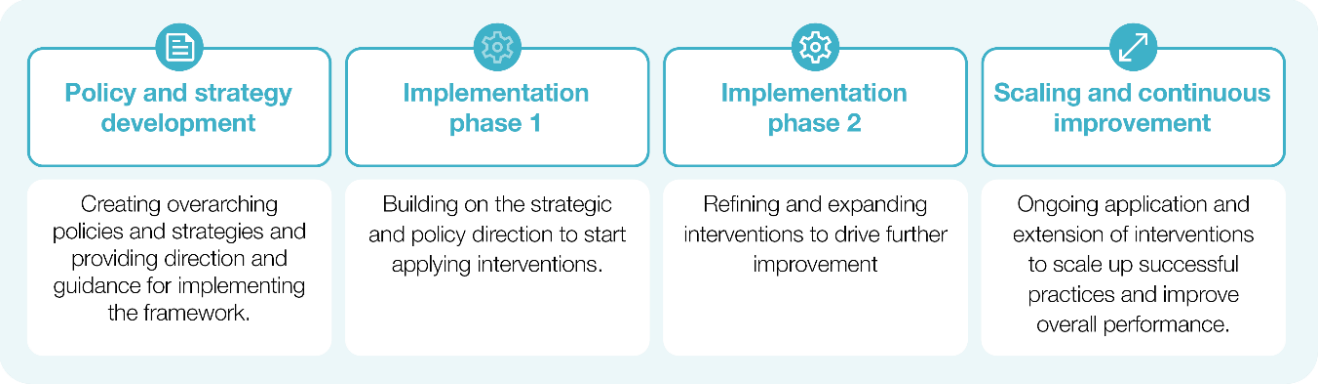


Figure 4.3: Implementation stages

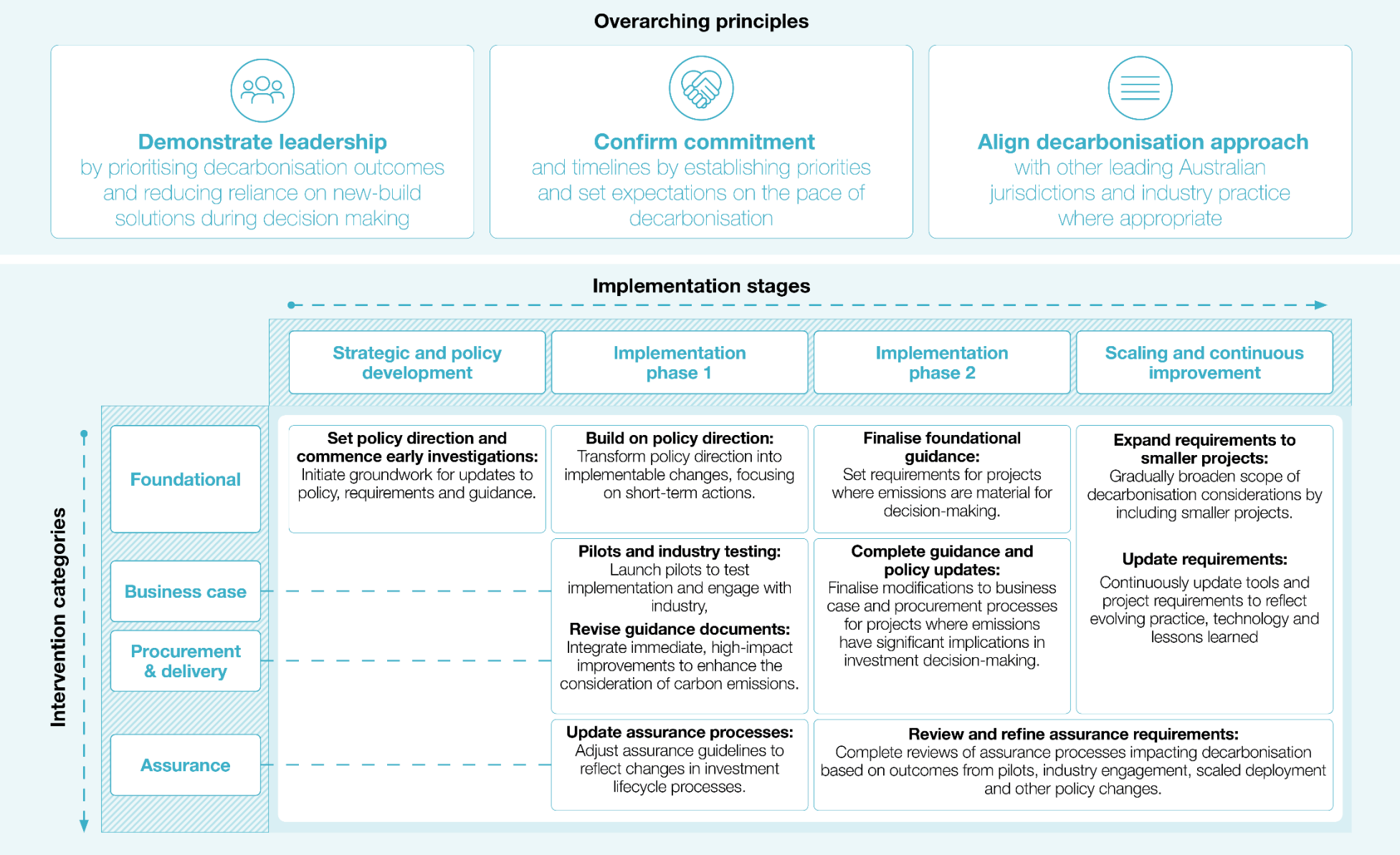


Figure 4.4: Implementation framework

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.

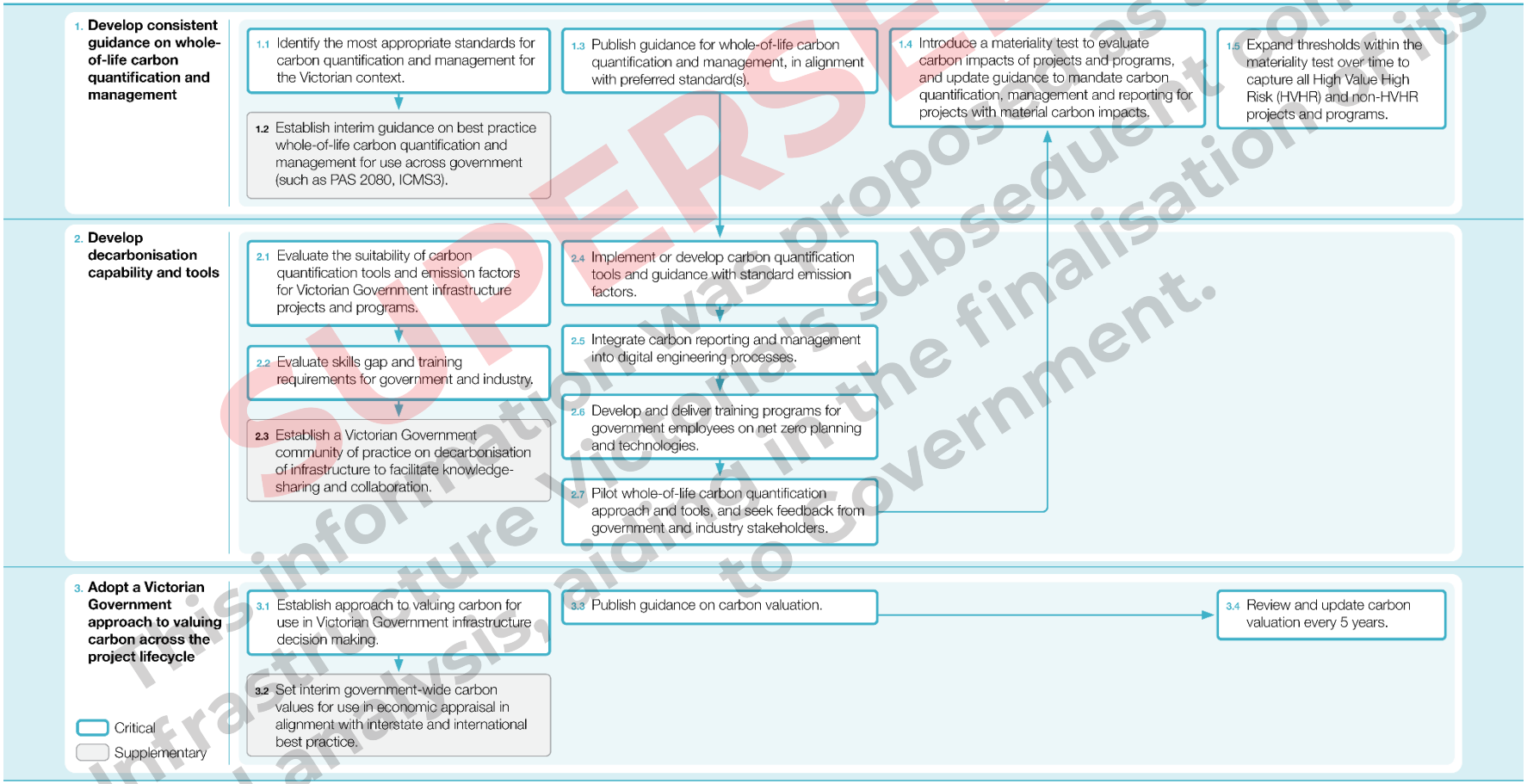
4.4 Implementation plan

This section provides an overview of the sequencing of actions across nine interventions and four implementation phases and across a series of figures highlight:

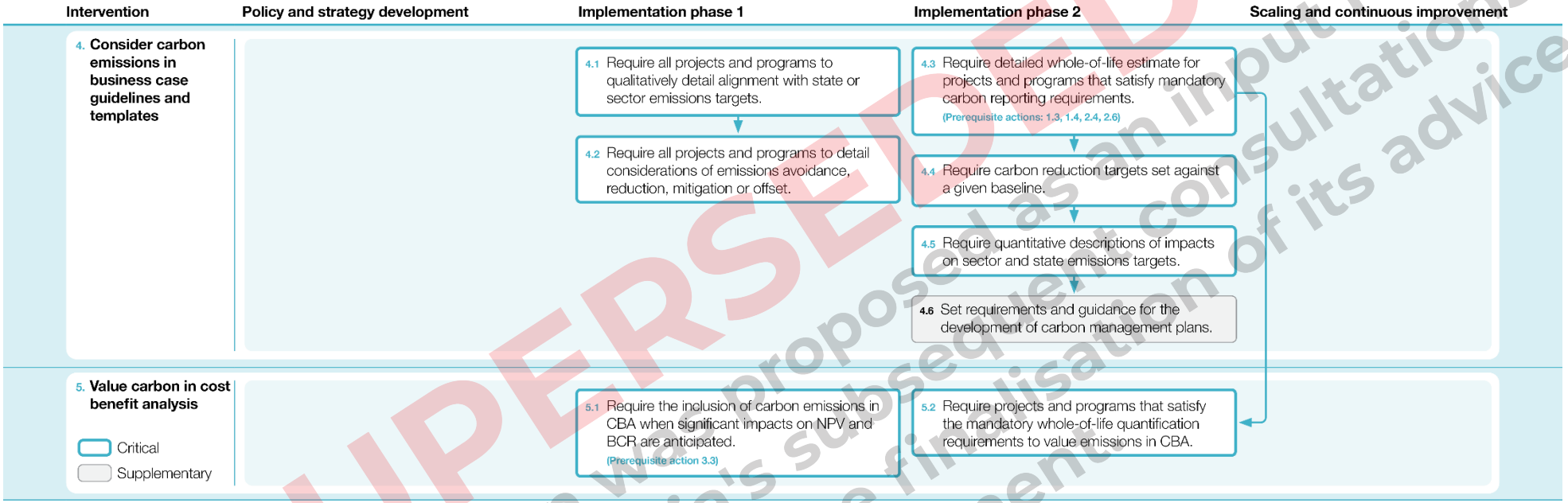
- **critical actions**: actions required to enable Victoria to achieve its decarbonisation objectives (marked with blue borders), and
- **supplementary actions**: actions that offer additional support and are likely to accelerate Victoria's decarbonisation progress (grey boxes).

For more information, refer to the detailed intervention and action descriptions at the end of this section.

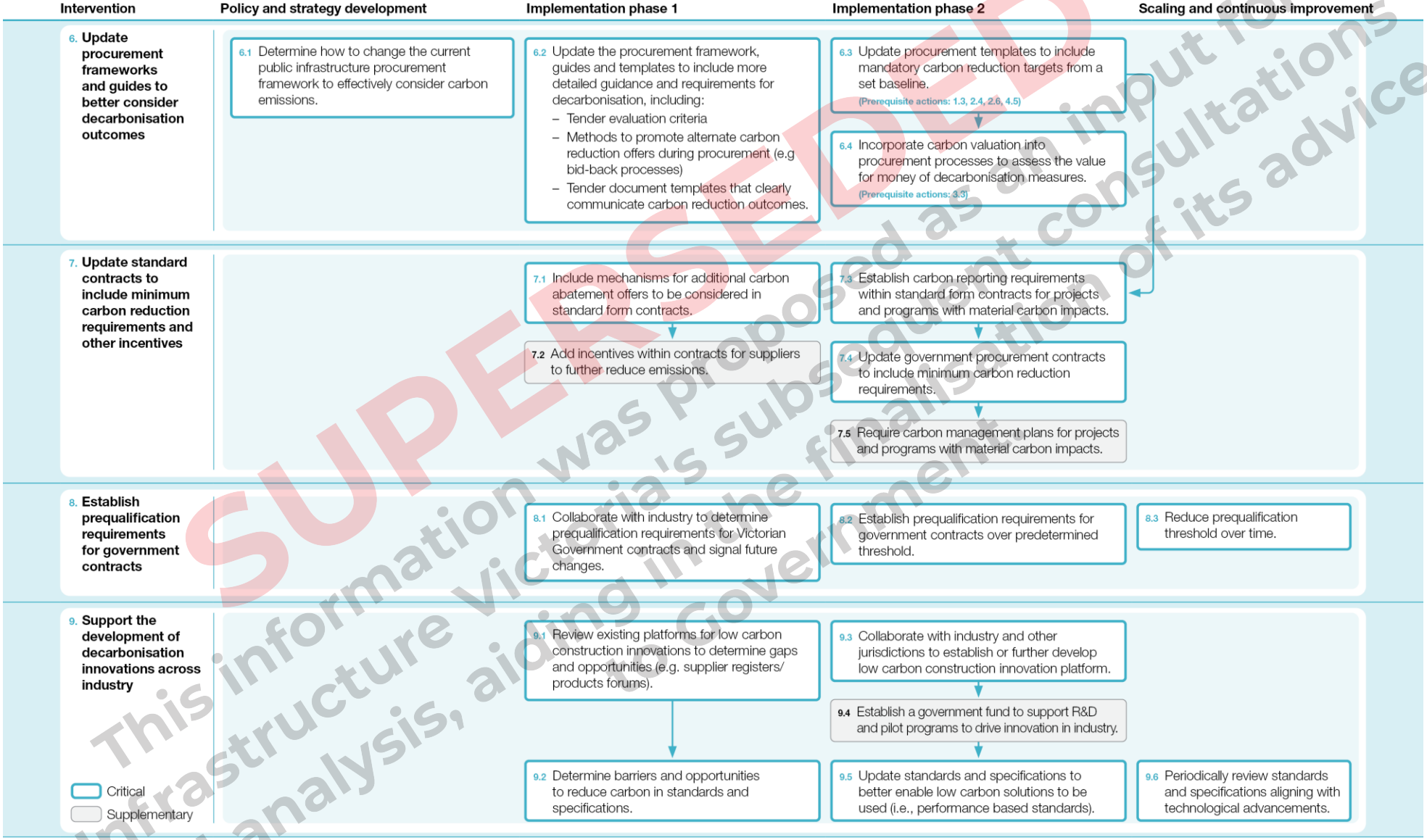
Foundational interventions



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.

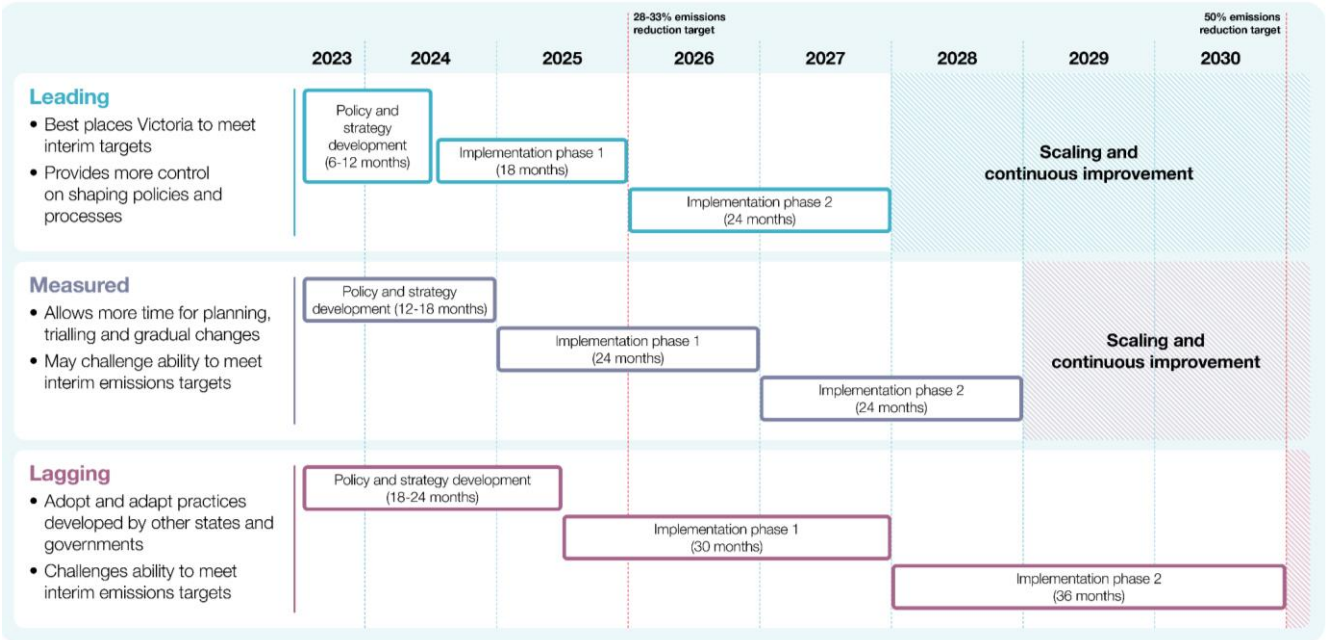


Figure 4.5 Implementation timeframes

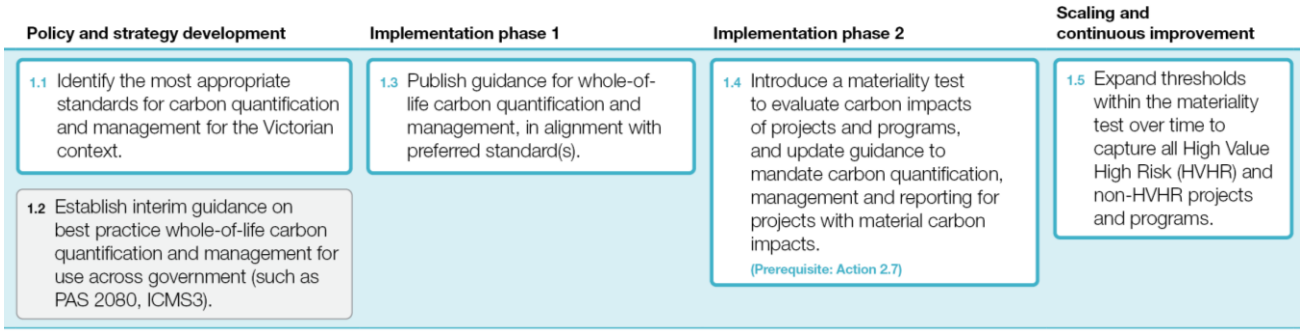
Foundational Interventions

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).

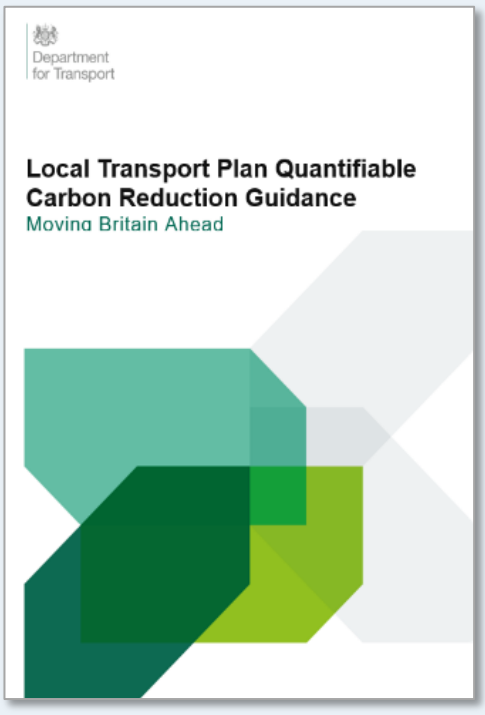
This should specify the approach to quantify, manage and report on carbon emissions at each stage of the project lifecycle, in accordance with the preferred approach identified in Action 1.1, and any lessons learned from deployment of interim guidance in Action 1.2.

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.

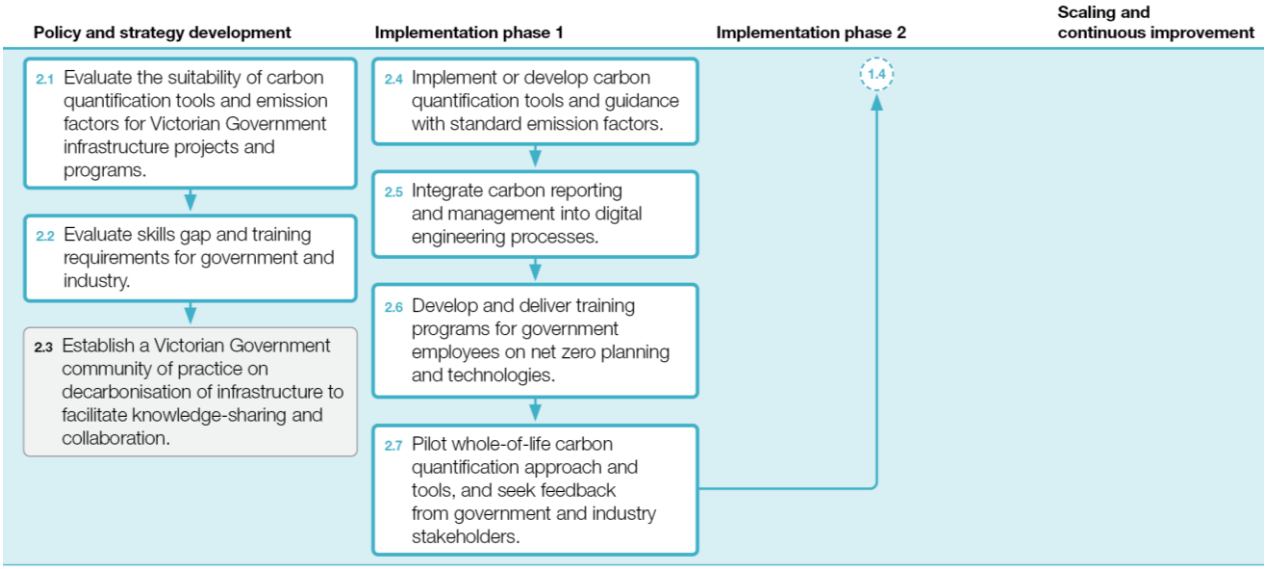
Developing decarbonisation capability and tools is essential for equipping the government agencies and industry partners with the knowledge, skills, and resources needed to effectively reduce the emissions associated with public infrastructure.

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.

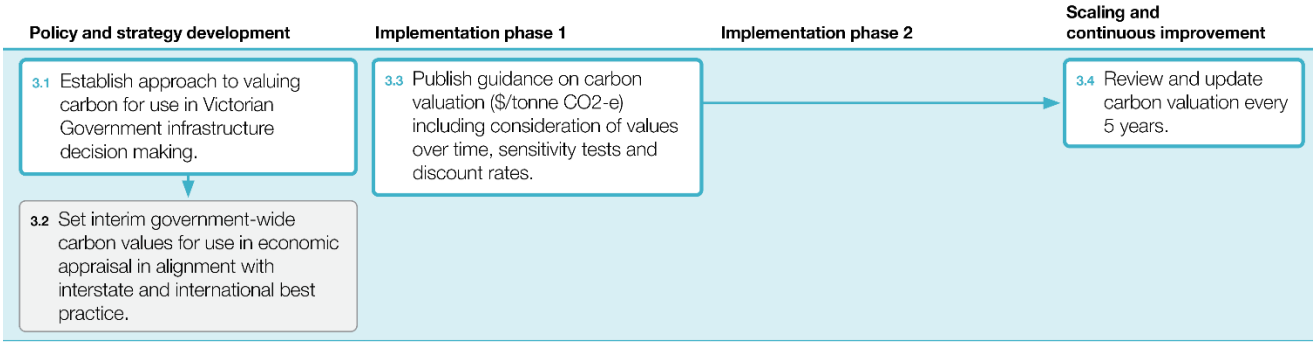
Carbon values, which represent the monetary value society places on one tonne of carbon dioxide equivalent ($/tCO2-e), differ from carbon prices, which are observed in carbon markets.

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.

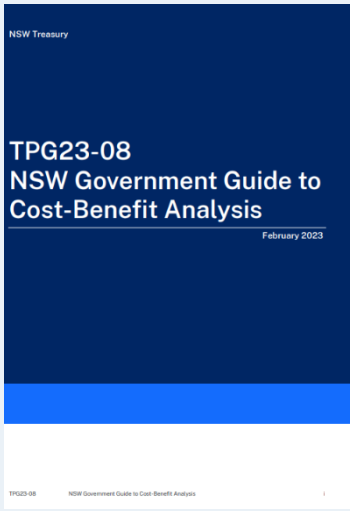
These interim values, aligned with interstate and international best practices, provide a starting point for incorporating monetary values in decision-making frameworks. These interim values may not fully capture the complex nature of carbon impacts and should be reviewed and updated as new information 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.

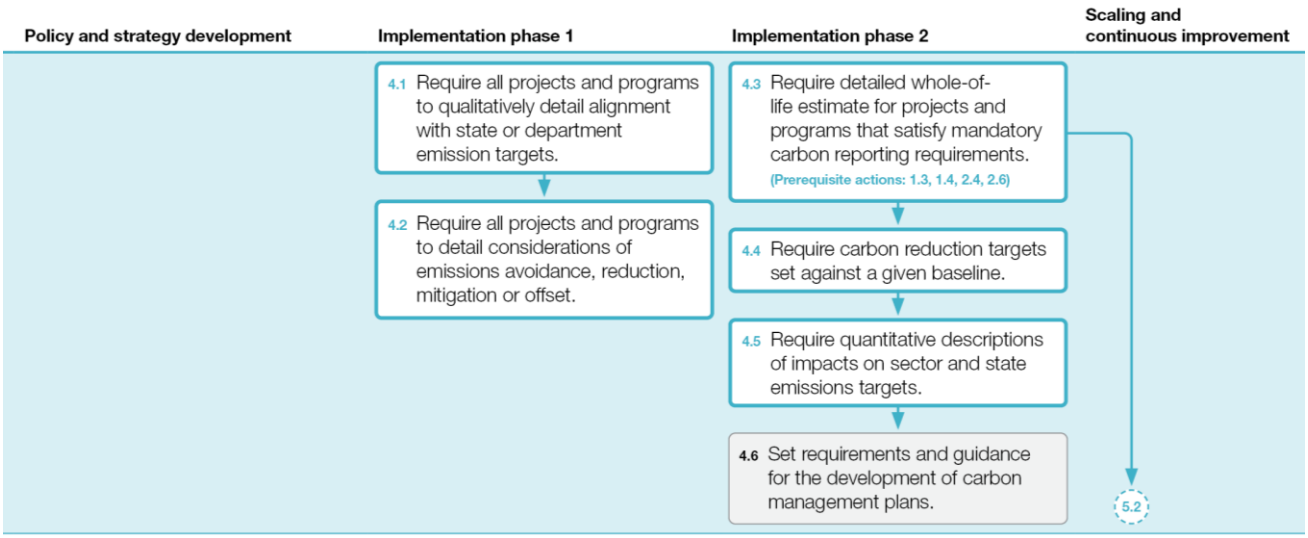
This example is highly relevant for intervention 3, as it showcases how a government can develop and implement a consistent set of guidance for valuing carbon emissions across the project lifecycle. By adopting a leading approach, Victoria can ensure the uniformity and comparability of carbon valuation 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.

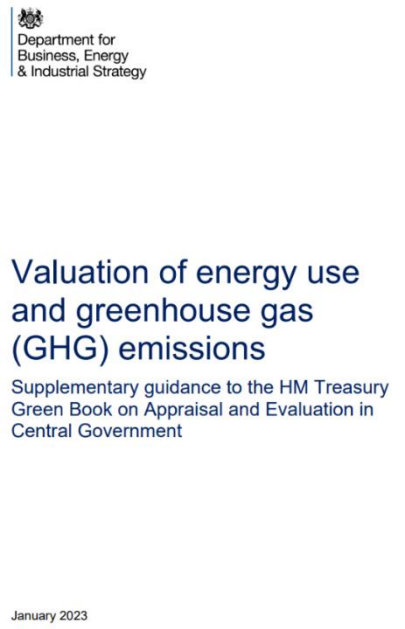
EXAMPLE 4.7: UK DEPARTMENT OF BUSINESS, ENERGY & INDUSTRIAL STRATEGY GUIDANCE ON QUANTIFICATION AND VALUATION OF GREENHOUSE GASES

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.

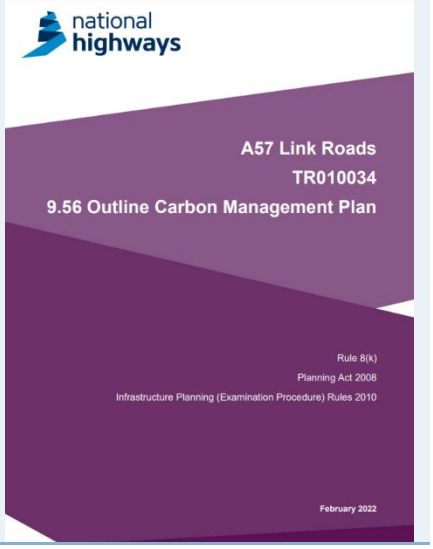
EXAMPLE 4.8: UK NATIONAL HIGHWAYS OUTLINE CARBON MANAGEMENT PLAN FOR A57 LINK ROADS

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.



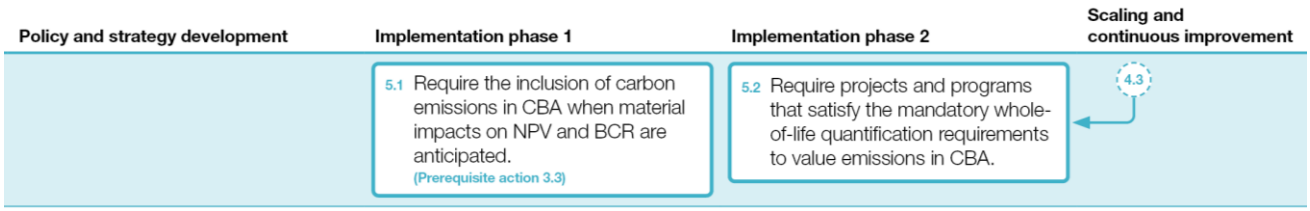
Intervention 5 – Value carbon in cost benefit analysis

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.

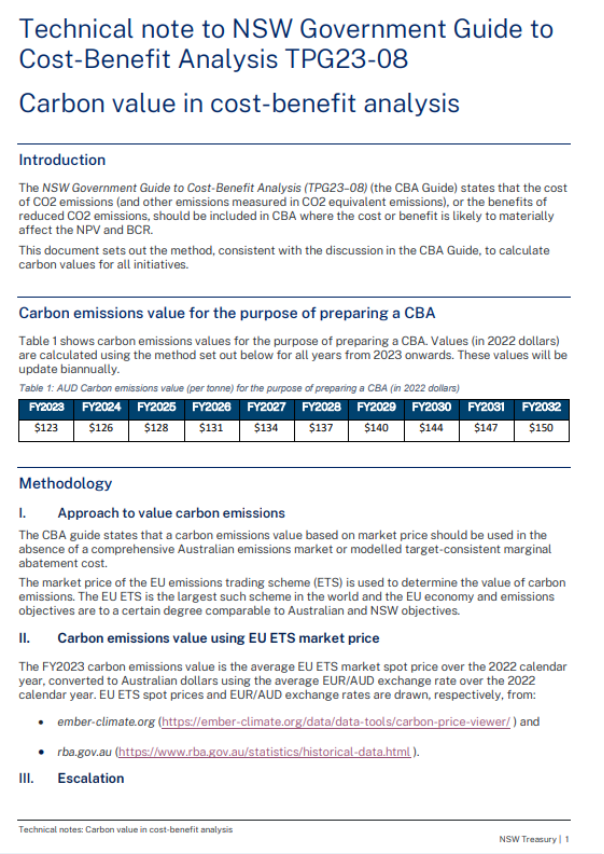
EXAMPLE 4.9: NSW TREASURY TECHNICAL NOTE ON VALUING CARBON IN COST BENEFIT ANALYSIS

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

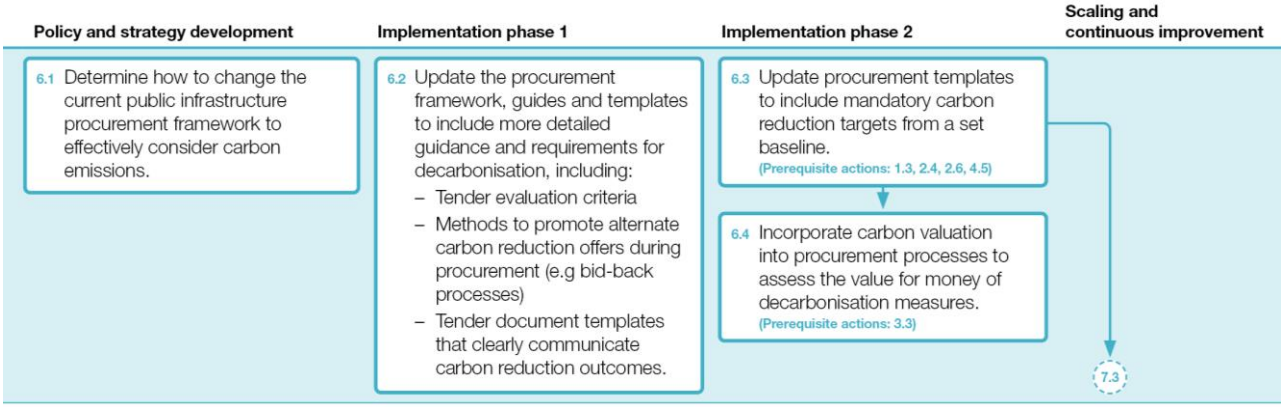
NSW Treasury | 1

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.

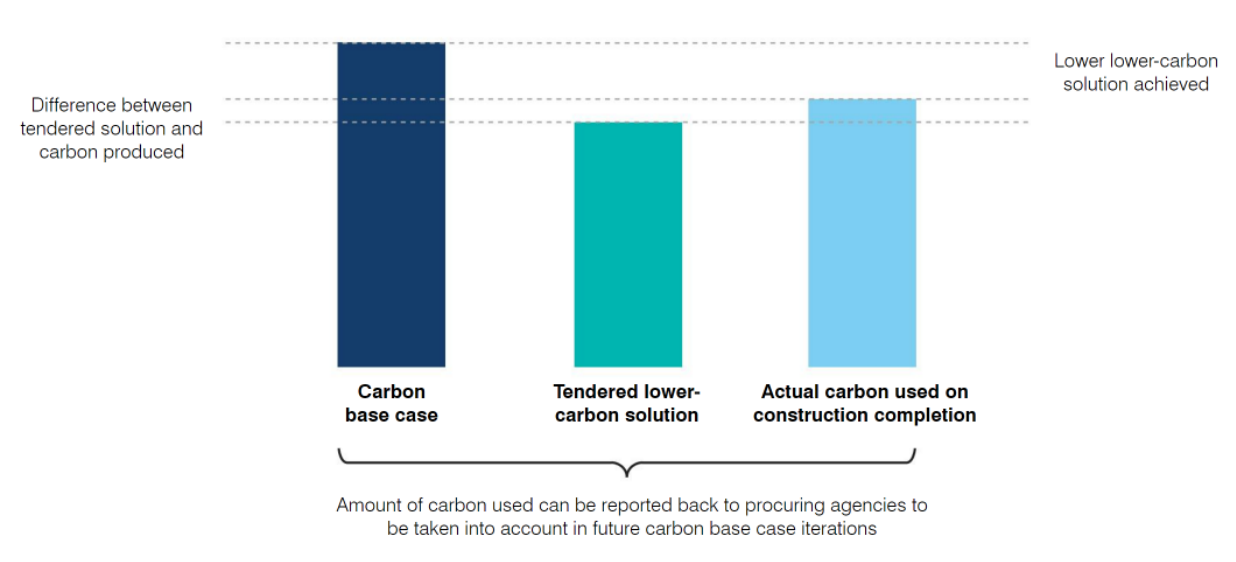


Figure 4.9: Illustrative scenario of a carbon base case being used in the procurement and construction of a project

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.

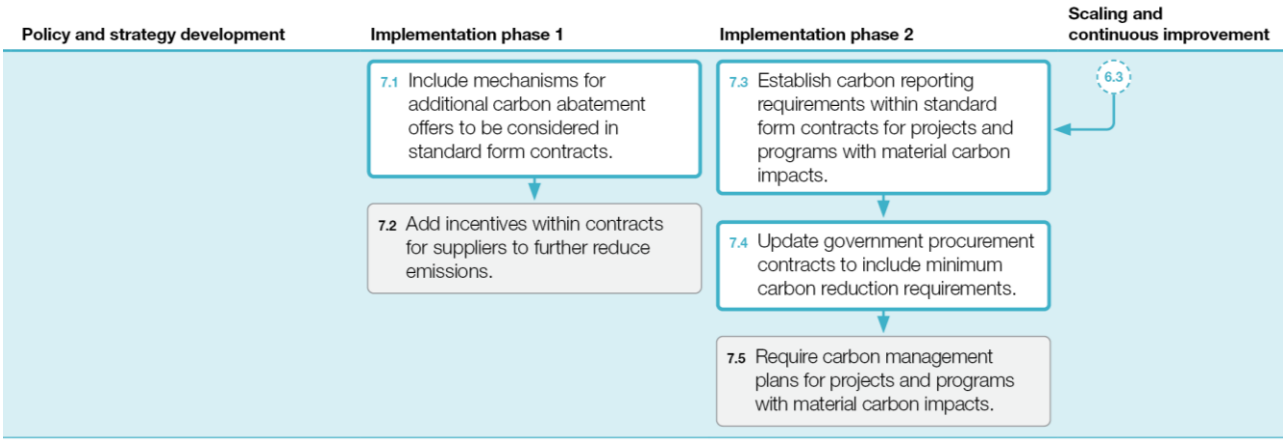
COMPANY	ENTRY PRICE	LEVEL ON THE COLADDER	FICTITIOUS DISCOUNT/ AWARD ADVATAGE	FICTIOUS PRICE	AWARD THE CONTRACT
A	€ 9,7 million	none	0%	€ 9,7 million	NO
B	€ 10 million	3	4%	€ 9,6 million	NO
C	€ 10,3 million	4	7%	€ 9,58 million	YES: € 10,3 million

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

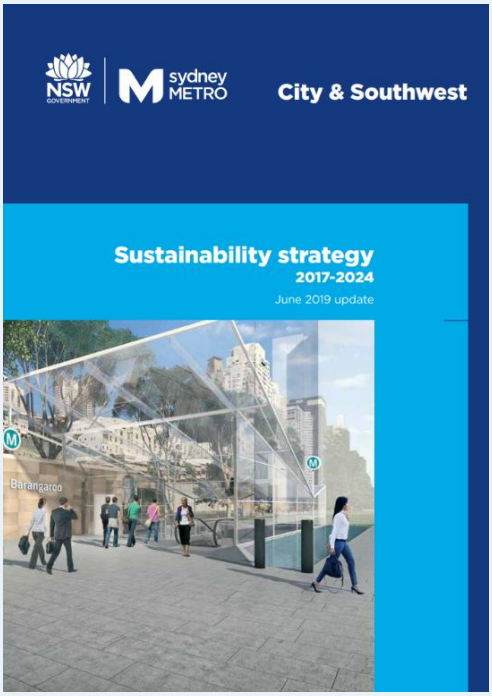
The Sydney Metro City & Southwest project incorporated a range of sustainability initiatives within its contracts, aiming to reduce GHG emissions and promote low carbon construction practices and technologies [54].

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

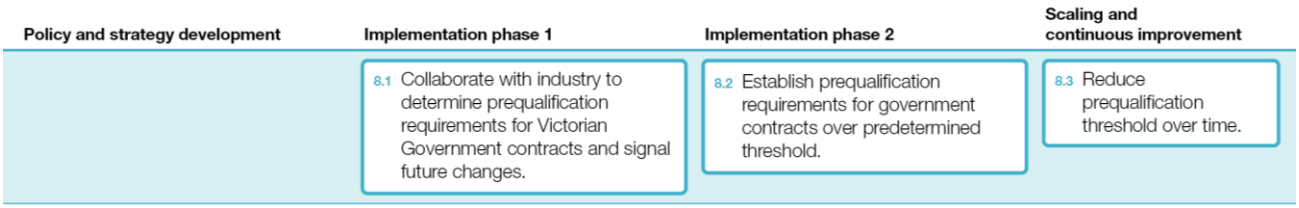
This optional action proposes requiring carbon management plans for projects with significant carbon impacts. These plans help to ensure that suppliers consider and plan for emissions reduction throughout the project lifecycle, from planning and design to construction and operation, ultimately leading 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

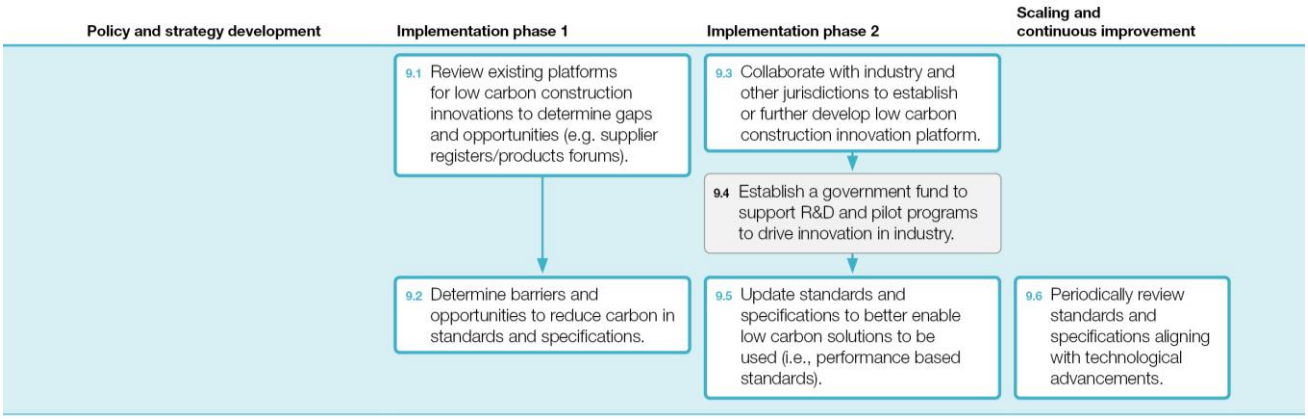
Reducing the prequalification threshold over time will present challenges for smaller suppliers that need to adapt to the evolving requirements, potentially reducing competition for government contracts.

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.

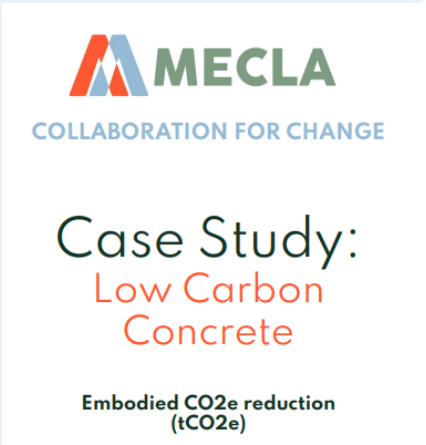
Establishing performance-based standards can drive the adoption of low carbon construction solutions, but they also require ongoing monitoring and evaluation to ensure that these new approaches meet safety, durability, and functional requirements.

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

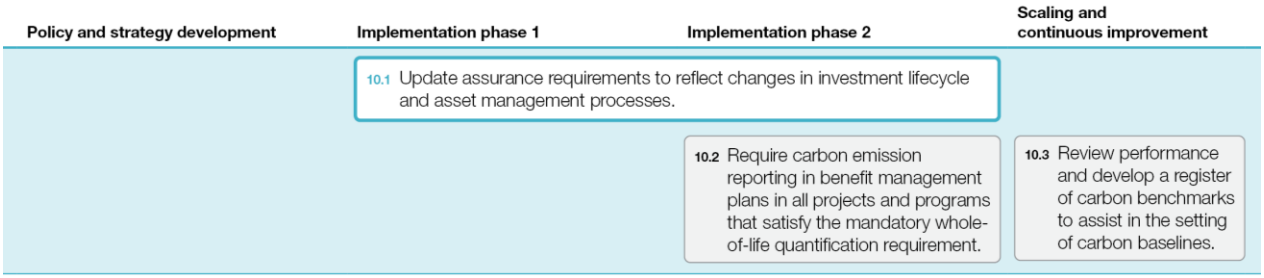
Regularly assess and update construction standards and specifications to keep pace with advances in low carbon materials and practices. This iterative process will help ensure that industry standards remain relevant and continue to support decarbonisation efforts in the construction sector.

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

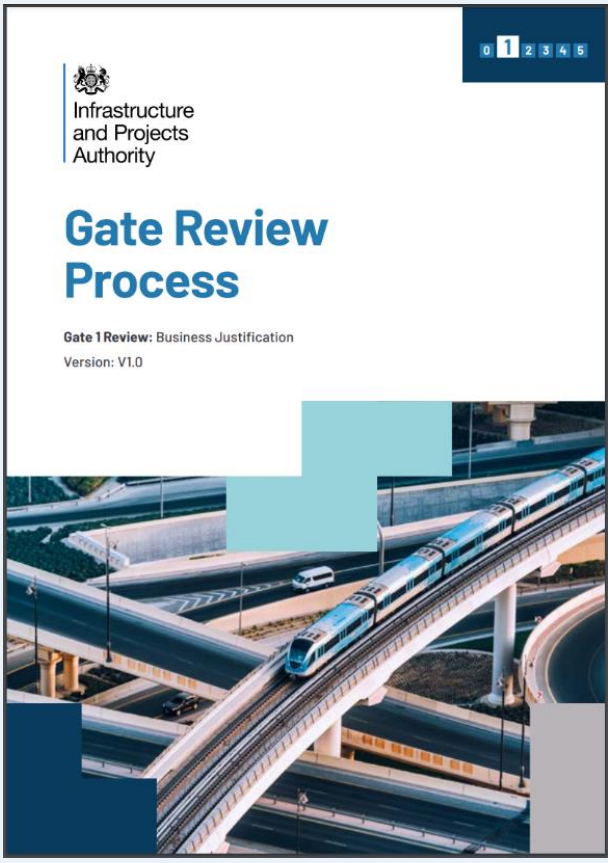
Starting in July 2021, the UK Infrastructure and Projects Authority (IPA) included net zero and climate change mitigation tests in their Gate Review process for major projects [55]. By integrating carbon management, the process ensures that departments properly quantify emissions and implement actions 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.



References

[1] Government, Victoria, “Climate Change Act 2017,” July 2022. [Online]. Available: https://content.legislation.vic.gov.au/sites/default/files/2022-06/17-5aa008%20authorised.pdf. [Accessed February 2023].

[2] E. a. C. A. Victorian Department of Energy, “A clean energy future,” [Online]. Available: https://www.energy.vic.gov.au/renewable-energy/a-clean-energy-future#:~:text=Victoria's%20Climate%20Change%20strategy%20is,clean%20and%20efficient%20energy%20future..

[3] ISOA, Climate Works Australia, ASBEC, “Reshaping infrastructure for a net zero emissions future - Issues paper,” 2020. [Online]. Available: https://apo.org.au/sites/default/files/resource-files/2020-03/apo-nid277486.pdf.

[4] UK Department for Business, Energy & Industrial Strategy, “Valuation of greenhouse gas emissions: for policy appraisal and evaluation,” 2 September 2021. [Online]. Available: https://www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation. [Accessed April 2023].

[5] U. C. C. Committee, “Advice on reducing the UK’s emissions,” [Online]. Available: https://www.theccc.org.uk/about/our-expertise/advice-on-reducing-the-uks-emissions/. [Accessed 2023].

[6] T. Guardian, “Net zero strategy shows UK will miss 2030 emissions cuts target,” 2023. [Online]. Available: https://www.theguardian.com/environment/2023/mar/30/net-zero-strategy-shows-uk-will-miss-2030-emissions-cuts-target.

[7] The Guardian, “UK road-building scheme breaches climate commitments, high court told,” 2021. [Online]. Available: https://www.theguardian.com/uk-news/2021/jun/29/uk-roadbuilding-scheme-breaches-climate-commitments-high-court-told.

[8] Victorian Government, Victorian Government Climate-related Risk Disclosure Statement 2022, 2023.

[9] Infrastructure Australia, “Decarbonising construction: Putting carbon in the business case,” 2022. [Online]. Available: https://issuu.com/infrapshipaus/docs/_web_major_report_-_putting_carbon_in_the_busines?fr=sYTE3ZjUzMTM4MDQ.

[10] C. Trust, “PAS 2080 - carbon management in infrastructure,” 2022. [Online]. Available: https://www.carbontrust.com/what-we-do/assurance-and-labelling/pas-2080-carbon-management-in-infrastructure#:~:text=What%20is%20PAS%202080%3F,intelligent%20design%2C%20construction%20and%20use..

[11] World Green Building Council, “Bringing Embodied Carbon Upfront: Coordinated action for the building and construction sector to tackle embodied carbon,” 2019. [Online]. Available: https://worldgbc.org/advancing-net-zero/embodied-carbon/. [Accessed 2023].

[12] D. o. T. a. F. Victorian Government, “Gateway Review Process,” [Online]. Available: https://www.dtf.vic.gov.au/infrastructure-investment/gateway-review-process. [Accessed 2023].

[13] D. o. T. a. F. Victorian Government, “High Value High Risk Framework,” [Online]. Available: https://www.dtf.vic.gov.au/infrastructure-investment/high-value-high-risk-framework. [Accessed 2023].

[14] Suburban Rail Loop Authority, “SRL East ESS Impact Assessment Summary - Greenhouse Gas,” Victorian Government, Melbourne, 2021.

[15] The State of Victoria Department of Environment, Land, Water and Planning, “Cutting Victoria's Emissions 2021-2025,” Victorian Government, Melbourne, 2021.

[16] Office of Projects Victoria, “Sustainable Investment Guidelines,” Victorian Govenrment, Melbourne, 2021.

[17] Department of Treasury and Finance, “Economic Evaluation - Technical Guide,” 1 July 2013. [Online]. Available: https://www.dtf.vic.gov.au/sites/default/files/2018-03/Economic%20Evaluation%20-%20Technical%20Guide.doc. [Accessed 28 February 2022].

[18] Australian Transport Council, “National Guidelines for Transport System Management in Australia Volume 3: Appraisal of Initiatives,” 2006. [Online]. Available: https://www.atap.gov.au/sites/default/files/National_Guidelines_Volume_3.pdf. [Accessed February 2023].

[19] Australia Transport Council, “National Guidelines for Transport System Management in Australia Volume 4: Urban Transport,” 2006. [Online]. Available: https://www.atap.gov.au/sites/default/files/National_Guidelines_Volume_4.pdf. [Accessed February 2023].

[20] Austroads, “Guide to Project Evaluation Part 4: Project Evaluation Data,” 6 August 2012. [Online]. Available: https://austroads.com.au/publications/economics-and-financing/agpe04-12/media/AGPE04-12.pdf. [Accessed 28 Februrary 2022].

[21] Austroads, “Updating Environmental Externalities Unit Values,” 16 December 2014. [Online]. Available: https://austroads.com.au/publications/environment/ap-t285-14/media/AP-T285-14_Updating_Environmental_Externalities_Unit_Values.pdf. [Accessed 28 February 2022].

[22] Australian Transport Assessment and Planning Guidelines, “PV5 – Environmental parameter values,” 2021. [Online]. Available: https://www.atap.gov.au/sites/default/files/documents/pv5-multi-modal-update.pdf. [Accessed 2023].

[23] TCFD, “TCFD Report: Implementing the Recommendations of the Task Force on Climate-related Financial Disclosures,” 2021.

[24] IFRS, “Exposure Draft: IFRS S2 Climate-related Disclosures,” 2022.

[25] Victoria, Department of Treasury and Finance, “EVALUATION CRITERIA (DIRECTION AND INSTRUCTION 3.7),” 2018. [Online]. Available: https://www.dtf.vic.gov.au/ministerial-directions-and-instructions-public-construction-procurement/evaluation-criteria-direction-and-instruction-37. [Accessed 2023].

[26] Department of Economic Development, “Victoria's social procurement framework,” 2018.

[27] Victoria's Big Build, “Level Crossing Removal Project Sustainability Policy,” [Online]. Available: https://bigbuild.vic.gov.au/projects/level-crossing-removal-project/benefits/sustainability/sustainability-policies. [Accessed February 2023].

[28] Victoria's Big Build, “Rail Projects Victoria Sustainability Policy,” [Online]. Available: https://bigbuild.vic.gov.au/about/mtia/rail-projects-victoria/initiatives/sustainability. [Accessed February 2023].

[29] Victoria's Big Build, “North East Link Sustainability Policy,” 2020. [Online]. Available: https://bigbuild.vic.gov.au/__data/assets/pdf_file/0014/524102/NELP-Sustainability-Policy-August-2020-signed-CEO.pdf. [Accessed February 2023].

[30] Victoria's Big Build, “Major Road Projects Victoria Sustainability Policy,” [Online]. Available: https://bigbuild.vic.gov.au/projects/major-road-projects-victoria/benefits/sustainability-policy. [Accessed February 2023].

[31] Big Build Victoria, “Suburban Rail Loop Sustainability Policy,” 2021. [Online]. Available: https://bigbuild.vic.gov.au/__data/assets/pdf_file/0009/599013/SRL-Sustainability-Policy.pdf. [Accessed February 2023].

[32] Victorian Health Building Authority, “Guidelines for sustainability in capital works,” Victorian Health Building Authority, 22 10 2021. [Online]. Available: https://www.vhba.vic.gov.au/guidelines-sustainability-capital-works. [Accessed 24 02 2023].

[33] Victorian School Building Authority, *Building Quality Standards Handbook*, State of Victoria (Department of Education and Training), 2022.

[34] Victoria Water Corporations, “Statement of Obligations (Emission Reduction),” 2022. [Online]. Available: https://www.water.vic.gov.au/__data/assets/pdf_file/0017/120671/FINAL-SIGNED-STATEMENT-OF-OBLIGATIONS-EMISSION-REDUCTION-2022-UPDATE.pdf. [Accessed February 2023].

[35] Development Victoria, “Sustainability Strategy,” [Online]. Available: https://www.development.vic.gov.au/our-approach/sustainability?page=our_sustainability_strategy. [Accessed February 2023].

[36] Department of Energy, Environment and Climate Action, Victoria, “Whole of Victorian Government emissions reduction pledge,” 2021. [Online]. Available: https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0034/522799/WoG-sector-pledge-full-colour.pdf. [Accessed February 2023].

[37] Victoria's Big Build, “Environmental Management Strategy: West gate tunnel project,” 31 January 2019. [Online]. Available: https://bigbuild.vic.gov.au/__data/assets/pdf_file/0007/502747/WGTP-Environmental-Management-Strategy-20180308.pdf. [Accessed February 2023].

[38] Western Distributor Authority, “West Gate Tunnel Project: Environmental Effects Statement - Chapter 8,” 2017.

[39] NABERS, “NABERS Embodied Emissions Public Consultation,” 02 11 2022. [Online]. Available: https://www.nabers.gov.au/publications/nabers-embodied-emissions-public-consultation. [Accessed 22 02 2023].

[40] Victoria's Big Build, “Sustainability objectives and targets,” Victoria Government, 06 10 2022. [Online]. Available: https://bigbuild.vic.gov.au/library/north-east-link-program/fact-sheets/environment/nelp-sustainability-objectives-and-targets. [Accessed 22 02 2023].

[41] Buying for Victoria, Victoria Goverment, “Detailed guidance for implementation of climate change policy objectives,” Victoria Goverment, 08 09 2022. [Online]. Available: https://www.buyingfor.vic.gov.au/detailed-guidance-implementation-climate-change-policy-objectives. [Accessed 21 02 2023].

[42] Victorian Goverment, “Office Accommodation Guidelines 2007,” Victorian Goverment, 2007. [Online]. Available: https://www.dtf.vic.gov.au/sites/default/files/2018-02/Office-Accommodation-Guidelines.pdf. [Accessed 22 02 2023].

[43] Department of Energy, Environment and Climate Action, “Cutting Victoria’s emissions 2021–2025,” Victorian Government, 05 2021. [Online]. Available: https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0034/522799/WoG-sector-pledge-full-colour.pdf. [Accessed 22 02 2023].

[44] BSI Group, PAS 2080:2023 Carbon management in buildings and infrastructure, 2023.

[45] RICS, Whole of Life Carbon Assessment for the Built Environment, 2017.

[46] Department of Climate Change, Energy, the Environment and Water, “National Greenhouse Gas Account Factors 2022,” Australian Government, Canberra, 2022.

[47] Transport Authorities Grenhouse Group, “Greenhouse Gas Assessment Workbook for Road Projects,” 2013.

[48] Infrastructure NSW, “Decarbonising Infrastructure Delivery,” 2022. [Online]. Available: https://www.infrastructure.nsw.gov.au/media/3686/infr9941-decarbonising-infrastructure-delivery.pdf. [Accessed February 2023].

[49] INSW, “Decarbonising Infrastructure Roadmap,” 2023.

[50] Department of Planning, Energy and Environment, NSW, “Net Zero Industry & Innovation Program,” March 2021. [Online]. Available: https://www.energysaver.nsw.gov.au/sites/default/files/2021-07/NetZero-Industry-Innovation-Program_FINAL_24-March-21_webaccessible.pdf. [Accessed February 2023].

[51] Office of Energy and Climate Change, NSW Treasury, “Circular design guidelines for the built environment,” February 2023. [Online]. Available: https://www.energy.nsw.gov.au/sites/default/files/2023-02/NZP_Circular_Design_Guide_2023_0.pdf. [Accessed February 2023].

[52] Transport for NSW, “Transport Sustainability Plan,” 2021.

[53] Transport for NSW, “Sustainable Procurement in Infrastructure: Industry Workshops Engagement Report,” 2022.

[54] Sydney Metro City & Southwest, “Sydney Metro City & Southwest Sustainability Strategy,” June 2019. [Online]. Available: https://www.sydneymetro.info/sites/default/files/2021-09/CSW-Sustainability-Strategy-June-2019_0.pdf. [Accessed April 2023].

[55] Infrastructure and Projects Authority, UK Government, “Infrastructure and Projects Authority: assurance review toolkit,” 14 July 2021. [Online]. Available: https://www.gov.uk/government/collections/infrastructure-and-projects-authority-assurance-review-toolkit. [Accessed February 2023].

[56] UK Department for Transport, “Transport Analysis Guideance Databook,” 2022.

[57] National Highways, “Carbon Emissions Calculation Tool,” 2022.

[58] EU, “Taxonomy: Final report of the Technical Expert Group on Sustainable Finance,” March 2020. [Online]. Available: https://finance.ec.europa.eu/system/files/2020-03/200309-sustainable-finance-teg-final-report-taxonomy_en.pdf. [Accessed February 2023].

[59] UK Green Finance Insitute, “GTAG: Advice on the development of a UK Green Taxonomy,” 2022.

[60] Australian Sustainable Finance Institute, “ASFI Taxonomy project webpage,” 2023.

[61] The Age, “Time for Australia to step up and be a climate leader: Kean,” November 2021. [Online]. Available: https://www.smh.com.au/national/nsw/time-for-australia-to-step-up-and-be-a-climate-leader-kean-20211111-p597xm.html.

[62] W. G. r. t. t. R. Review, “Welsh Government response,” 14 February 2023. [Online]. Available: https://www.gov.wales/sites/default/files/pdf-versions/2023/2/2/1676385038/welsh-government-response-roads-review.pdf. [Accessed April 2023].

[63] BCIS, “Built Environment Carbon Database,” [Online]. Available: https://www.becd.co.uk/. [Accessed April 2023].

[64] NSW Public Service Commission, “Procurement Professionals,” 2023. [Online]. Available: https://www.comprac.nsw.gov.au/communities-of-practice/procurement-professionals. [Accessed April 2023].

[65] NSW Treasury, “Centre for Evidence and Evaluation,” 14 February 2023. [Online]. Available: https://www.treasury.nsw.gov.au/projects-research/centre-evidence-and-evaluation. [Accessed April 2023].

[66] Transport for NSW, “Sustainability at Transport,” [Online]. Available: https://www.transport.nsw.gov.au/industry/doing-business-transport/sustainability-at-transport. [Accessed April 2023].

[67] NSW Treasury, “TPG23-08 NSW Government Guide to Cost-Benefit Analysis,” 27 February 2023. [Online]. Available: https://arp.nsw.gov.au/tpg23-08-nsw-government-guide-to-cost-benefit-analysis/. [Accessed April 2023].

[68] UK Department for Business, Energy & Industrial Strategy, “Valuation of energy use and greenhouse gas (GHG) emissions,” January 2023. [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1129242/valuation-of-energy-use-greenhouse-gas-emissions-for-appraisal.pdf. [Accessed April 2023].

[69] National Highways, “A57 Link Roads TR010034 9.56 Outline Carbon Management Plan,” February 2022. [Online]. Available: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR010034/TR010034-001103-TR010034_9.56_Outline_carbon_management_plan_D5%20230222.pdf. [Accessed April 2023].

[70] State Government of Victoria, “Social procurement document library,” 15 December 2021. [Online]. Available: https://www.buyingfor.vic.gov.au/social-procurement-document-library. [Accessed April 2923].

[71] Foundation for Climate Friendly Procurement and Business (SKAO), “What is the Ladder,” [Online]. Available: https://www.co2-prestatieladder.nl/en/what-is-the-ladder. [Accessed April 2023].

[72] UK Government, “Procurement Policy Note 06/21: Taking account of Carbon Reduction Plans in the procurement of major government contracts,” 17 April 2023. [Online]. Available: https://www.gov.uk/government/publications/procurement-policy-note-0621-taking-account-of-carbon-reduction-plans-in-the-procurement-of-major-government-contracts. [Accessed April 2023].

[73] State Government of Victoria, “ecologiQ - Victoria's Big Build,” [Online]. Available: https://bigbuild.vic.gov.au/about/ecologiq. [Accessed April 2023].

[74] MECLA, “Materials and Embodied Carbon Leaders’ Alliance,” 2022. [Online]. Available: https://mecla.org.au/. [Accessed April 2023].

[75] Department of Transport, UK Government, “Decarbonising Transport: A better, greener Britain,” 2021. [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1009448/decarbonising-transport-a-better-greener-britain.pdf. [Accessed February 2023].

[76] ISOA, Climate Works Australia, ASBEC, “Reshaping infrastrucxture for a net zero emissions future - Issues paper,” 2020. [Online]. Available: https://apo.org.au/sites/default/files/resource-files/2020-03/apo-nid277486.pdf.

[77] Infrastructure Partnerships Australia, “Decarbonising construction: Putting carbon in the business case,” 2022. [Online]. Available: https://issuu.com/infrapshipaus/docs/_web_major_report_-_putting_carbon_in_the_busines?fr=sYTE3ZjUzMTM4MDQ. [Accessed February 2023].

[78] ISOA, Climate Works Australia, ASBEC, “Re-shaping infrastructure for a net zero emissions future 2020,” [Online].

[79] ISOA, Climate Works Australia, ASBEC, [Online].

[80] Sydney Metro, “Sustainability Report,” 2018. [Online]. Available: https://www.sydneymetro.info/sites/default/files/2021-09/Sustainability_Report_Dec_2018.pdf. [Accessed February 2023].

[81] Victorian Health and Human Services Building Authority, “Department of Health and Human Services,” 2018. [Online]. Available: https://www.vhba.vic.gov.au/sites/default/files/2019-10/VHHSBA-Environmental-sustainability-strategy-2018-19-to-2022-23.pdf. [Accessed April 2023].

[82] The Department of Treasury and Finance - Victoria, “ Investment lifecycle and high value high risk guidelines - STAGE 1: BUSINESS CASE,” April 2023. [Online]. Available: https://www.dtf.vic.gov.au/investment-lifecycle-and-high-value-high-risk-guidelines/stage-1-business-case. [Accessed 2023].

[83] Australian Government Department of Climate Change, Energy, the Environment and Water, “Sustainable Procurement Guide A practical guide for Commonwealth entities,” 2021. [Online]. Available: https://www.dcceew.gov.au/sites/default/files/documents/sustainable-procurement-guide.pdf. [Accessed March 2023].

[84] S. Dray, “Climate change targets: the road to net zero?,” 24 May 2021. [Online]. Available: https://lordslibrary.parliament.uk/climate-change-targets-the-road-to-net-zero/. [Accessed April 2023].

[85] UK Infrastructure and Projects Authority, “Gate Review Process,” 2021. [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1002669/1174-APS-1-CCS0521656666-001_IPA_Gateway_Web1.pdf. [Accessed April 2023].

[86] West Gate Tunnel Project, “West Gate Tunnel Project Chapter 08 - Environmental Management Framework,” Victoria's Big Build, Melbourne, 2017.

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

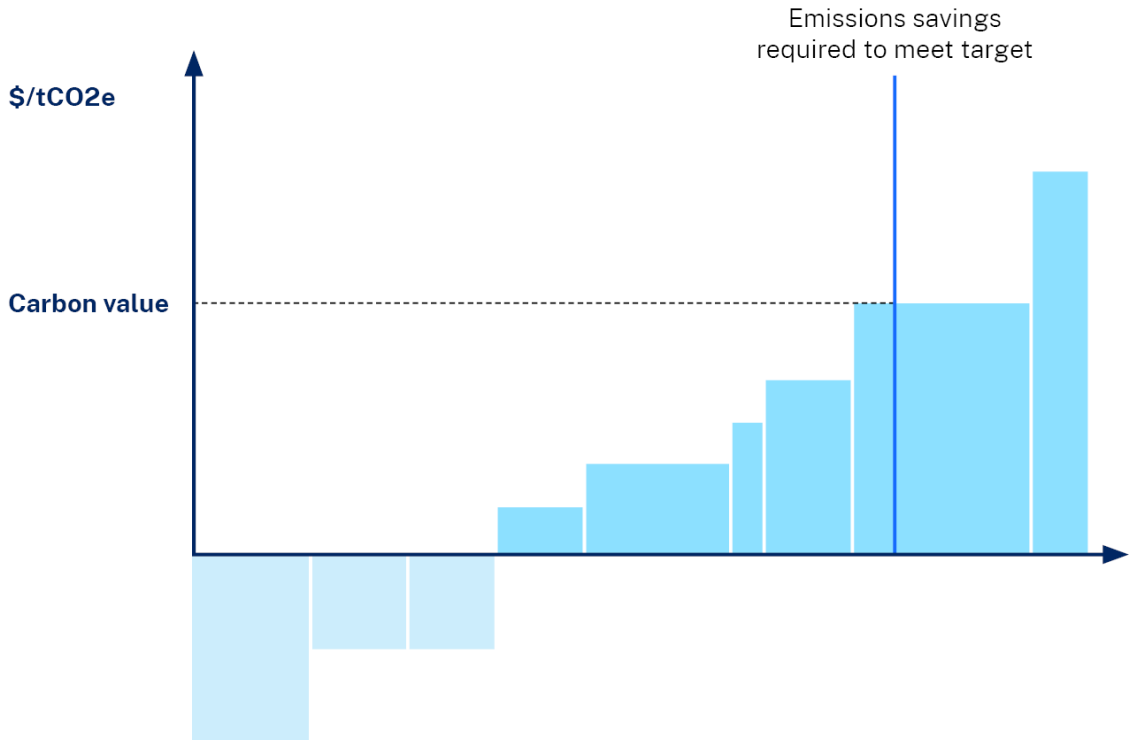
The target consistent approach is also commonly referred to as:

- 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

ABOUT WSP

As one of the world's leading professional services firms, WSP exists to future-proof our cities and environment. We provide strategic advisory, engineering, and design services to clients in the transportation, infrastructure, environment, building, energy, water, and mining sectors.

DELIVERING NET ZERO

WSP is committed to achieve net zero emissions across its value chain by 2040, supported by science-based Greenhouse Gas emissions reduction targets.

We're leading the journey in decarbonisation by being the first engineering consultancy sector in Australia to commit to halving the carbon footprint of our designs and advice by 2030.

WSP Australia

Level 11, 567 Collins Street
Melbourne, 3000
Australia

WSP.COM