GOVERNMENT OF WESTERN AUSTRALIA

Infrastructure Western Australia

Infrastructure WA

Major Infrastructure Proposal Assessment Subject Guide

Decarbonisation of infrastructure

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Amendment and Review, Distribution, and Authorisation Record

Amendment and Review Record

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This document is prepared for publication.

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Related documentation

Description / Details
Major Infrastructure Proposal Assessment Guidelines

Acknowledgement of Country

Infrastructure WA acknowledges the Traditional Custodians throughout Western Australia and their continuing connection to the land, waters and community. We pay our respects to all members of the Aboriginal communities and their cultures, and to Elders both past and present.

This is intended to be a “living” document that is continuously reviewed and improved to reflect emerging best practices, new insights, and evolving needs. We invite ongoing feedback and collaboration to ensure its relevance and effectiveness. To provide feedback and suggestions for refinement please contact IWA’s proposals team on proposals@infrastructure.wa.gov.au.

This publication can be made available in alternative formats and languages on request, please contact us.

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1. Purpose of guidance

The purpose of this subject guide (Decarbonisation Guide) is to support state agencies and government trading enterprises (GTEs), collectively called 'proponents', in the development of best-practice capital investment proposals to be considered by Infrastructure WA (IWA) as part of its Major Infrastructure Proposal Assessment (MIPA) function.

The Strategic Asset Management Framework (SAMF) Policy identifies that incorporating sustainability into asset investment decision making processes ensures government expenditure contributes towards positive social, economic, environmental and governance outcomes. Within the SAMF Business Case Guidelines, climate change and greenhouse gas emissions impacts are highlighted environmental impacts that may be relevant to option assessment.

This Decarbonisation Guide is intended to support proponents by aligning well-accepted approaches to carbon emission mitigation through the decarbonisation of infrastructure to the expectations of capital investment proposals set out in the SAMF Business Case Guidelines and the MIPA Guidelines.

Objectives of this Decarbonisation Guide include:

- enabling proponents to identify the strategic relevance of decarbonisation of infrastructure to their proposal
- promoting a consistent approach to carbon assessment for major infrastructure projects across WA Government agencies
- supporting access to, and alignment with, where appropriate, best-practice guidance from other jurisdictions
- demonstrating alignment with national approaches to evaluation of carbon impacts in decision-making.

Proponents should note this document is expected to be updated to reflect evolving policy and knowledge.

2. Scope of guidance

For the purposes of this guide, decarbonisation of infrastructure is defined as reducing or eliminating carbon emissions throughout the delivery and the full life cycle of major infrastructure. It focuses on considering carbon impacts during early stages of infrastructure planning, which includes business case development and procurement planning.

During proposal development, proponents should consider how to apply the principles outlined in this guide across the entirety of the asset life cycle, from strategic planning, delivery, operation and use through to end-of-life. This will help identify trade-offs for decision-makers and cost-effective opportunities to minimise emissions.

3. Applicability

This Decarbonisation Guide principally applies to proposed major infrastructure projects that will be assessed through the MIPA process. It is applicable to both linear (for example, roads and utilities) and vertical (buildings) infrastructure. It can be used to support developing capital investment proposals to meet the expectations of SAMF and MIPA.

Some categories of projects have mandatory carbon impact assessment requirements, including:

- projects that will be submitted to Infrastructure Australia for assessment and prioritisation
- transport projects valued at more than $100 million

Other categories of projects are encouraged to consider carbon impacts where they are material.

Agencies are encouraged to engage with IWA early in the development of the proposal to clarify requirements for their project.

4. Background

The United Nations Environment Program (2021) identified that, globally, infrastructure is responsible for 79% of greenhouse gas emissions and accounts for 88% of forecast climate adaptation costs. At the local level, greenhouse gas mitigation needs to be considered in the context of national and state commitments to reaching net zero by 2050. Recognising the potential impact of infrastructure on greenhouse gas emissions, IWA's State Infrastructure Strategy recommended emissions be quantified and considered in infrastructure options and decision-making (Recommendation 14).

Aligning to international and national targets for net zero by 2050, the Government of Western Australia (WA) introduced the Western Australia Climate Policy in 2020. This policy outlines the priority themes and practical actions the WA Government is taking to enhance climate resilience and support the state's transition to low carbon. The Climate Change Bill 2023 was introduced to the WA Parliament in November 2023. If enacted, it would require the WA Government to report on the state's progress towards interim targets for scope 1 and scope 2 emissions, and net zero emissions by 2050.

Early planning and analysis of carbon impacts over the life cycle of an infrastructure project can ensure that potential negative environmental effects are avoided or managed, and that decarbonisation ambitions are not compromised. It is also an opportunity to prioritise solutions that avoid excessive consumption of materials. By carefully considering project scoping, sustainability in design, efficient and innovative technologies, and by choosing the right materials, carbon emissions can be minimised without negatively impacting the functionality and longevity of infrastructure.

5. Summary of Proposal Guidance

A summary of how proponents can consider and apply this Decarbonisation Guide to develop SAMF compliant business cases is set out in Table 1. Table 1 also indicates opportunities for proponents to build capability towards better practice. This list is not exhaustive, and proponents should consider application of good and better practice on a case-by-case basis.

Note, proposals likely to be assessed by Infrastructure Australia (IA), should refer to the IA Assessment Framework for requirements across submission stages.

Further detail on carbon reduction guidance and integration into business cases can be found in Section 6 and Section 7, respectively.

Table 1: Summary and examples of potential application of Decarbonisation Guide to projects

SAMF Business Case Guidelines	Considerations for SAMF alignment	Good practice	Better practice*
Project Purpose	Where relevant, outline if lack of intervention will impact on the WA Government's and the proponent's own emissions reduction targets. *e.g. include consideration of WA Government's Climate Policy.*	Consider the problem definition in terms of carbon emissions that can be influenced by the proposal. Where the need for intervention is identified for carbon emissions, include an indication of the urgency of acting and the implications of delaying a response.	Where relevant, assess existing Scope 1, 2 and 3 emissions as part of the base case definition. *e.g. identify if current carbon emissions needs to be addressed and incorporate as a base case to allow consideration of benefits of options to reduce emissions.*
Investment Proposal	Qualitatively discuss the benefits or drawbacks related to greenhouse gas emissions of the proposal. Align any relevant direct benefits with state and/or national greenhouse gas emission reduction targets.	Where relevant, link the problem, benefits and strategic response with decarbonisation initiatives. Identify and consider engaging with stakeholders and regulators regarding how the project may impact or be impacted by broader trends in decarbonisation of infrastructure. *e.g. consider a broad range of strategic responses, such as avoiding carbon intensive infrastructure, as part of an Investment Logic Map.*	Where applicable, establish targets or project objectives related to greenhouse gas emission reduction/ decarbonisation as part of problem definition, benefits identification and strategic responses.
Strategic Options Analysis	Demonstrate due consideration of non-asset/low carbon solutions, such as digital, operational or other reforms, in the response to the identified problem. *e.g. include demand management as an option for consideration in the strategic options analysis.*	Utilise an environmental and/or carbon related criteria to differentiate project options. Demonstrate use of the carbon mitigation hierarchy for option development. *e.g. utilise an environmental criterion with a carbon emissions component to initially test the strategic merit of options.*	Incorporate a quantitative assessment of whole-of-life carbon (Scope 1 and 2, and ideally Scope 3) to develop and evaluate project options. Demonstrate consideration of circular economy principles of the asset at end-of-life. *e.g. utilise a quantified carbon emissions criterion as part of an MCA or Rapid CBA.*

SAMF Business Case Guidelines	Considerations for SAMF alignment	Good practice	Better practice*
Shortlisted Options Evaluation	Identify and fulfil any mandatory (or voluntary) carbon assessment frameworks (refer Section 6.1). *e.g. Application of ITMM for transport projects over $100 million (see S6.1).* Consider carbon emissions impacts of each shortlisted option. Consider including decarbonisation opportunities to deliver environmental benefits (or mitigate risks) that may not be critical to the proposal but that support WA Government or agency objectives (e.g. Net Zero transition).	Include quantification of Scope 1 and 2 emissions in the environmental impact and economic analysis. Include decarbonisation opportunities to deliver wider environmental benefits (than those critical for the proposal) as part of the shortlisting evaluation. Where possible, include carbon related capital and operational costs with associated exclusions and contingency assumptions.	Include quantification of Scopes 1, 2 and 3 emissions in the economic analysis. Monetise decarbonisation opportunities that deliver environmental benefits as part of the economic analysis. *e.g. include the monetised impacts of carbon within the Cost Benefit Analysis with supporting evidence.*
Implementation Analysis	Where relevant, identify and evaluate risks related to delivering on carbon management objectives and/or commitments. Consider including carbon management, emission reduction or sustainability objectives into the benefits management plan.	Identify key carbon management outcomes and requirements to address during development and procurement planning.	Develop a draft carbon management plan that supports identification and prioritisation of carbon reduction initiatives, incorporating whole-of-life carbon reduction into procurement plans and identifies how carbon will be incorporated into future phases.

*'Best' practice for decarbonisation is continuously evolving and expanding. The summary aims to improve business case considerations to support proponents build capability towards best practice.

6. Decarbonisation Guidance

IWA acknowledges that guidance on decarbonisation is constantly evolving. To support proponents, a brief outline of currently accepted assessment frameworks and national guidance is provided in Section 6.1. However, agencies should be aware that there are policy work programs at the state and national level that may become relevant to proposals that are currently at early stages of development.

IWA acknowledges that many agencies currently have limited capacity to assess and manage carbon emissions. To support business case proponents with limited technical experience in carbon assessment, an overview of the carbon mitigation hierarchy and examples of practical carbon reduction are provided in Section 6.2, with further technical information in Appendix A.

Agencies should consider their current level of capability and how this could be improved over time when they are developing their approach to carbon impact assessment as part of developing their proposal.

Greenhouse Gas Protocol

The Greenhouse Gas Protocol was developed to help organisations quantifying their carbon emissions. This approach is consistent with the Australian Government to categorise emissions for NGER Scheme reporting requirements into Scope 1, 2 and 3 (Figure 1):

- Scope 1 emissions are direct carbon emissions from owned or controlled sources
- Scope 2 emissions are indirect emissions related to energy use
- Scope 3 emissions includes all other indirect sources.

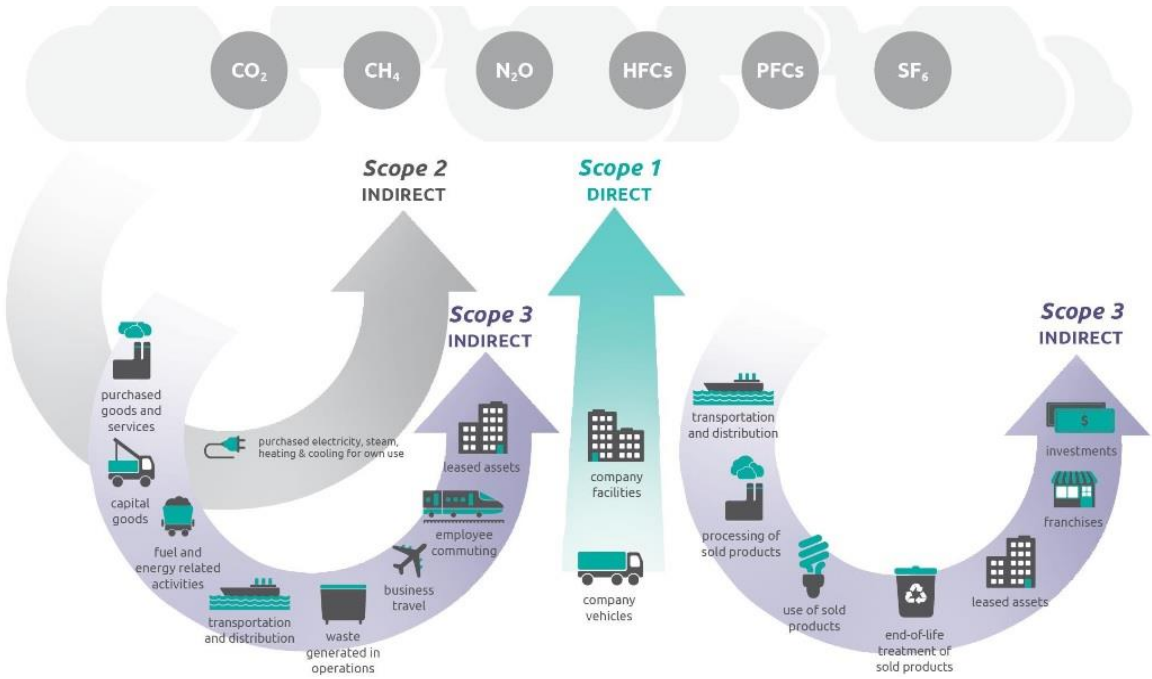

Figure 1: Scope 1, 2 and 3 emissions across the value chain

The Greenhouse Gas Protocol framework is an excellent way to understand the carbon emissions that an organisation can most easily influence through its operations. However, it is not as well suited to projects, where a large proportion of the carbon emissions occur during the one-time construction of the infrastructure.

6.1 Existing Carbon Assessment Frameworks

This section provides a brief background on existing nationally agreed carbon impact assessment and greenhouse gas emission reporting frameworks for organisational and infrastructure projects.

National Greenhouse and Energy Reporting Scheme

The National Greenhouse and Energy Reporting (NGER) Scheme is the single national framework for reporting information about greenhouse gas emissions, energy production and energy consumption at the organisational level. The Australian Department of Climate Change, Energy, Environment and Water has oversight of the NGER Scheme, which establishes a consistent national methodology for calculation of scope 1 and scope 2 emissions. Scope 3 emissions are not reportable under the NGER Scheme.

Infrastructure and Transport Ministers' Meeting (ITMM)

The Infrastructure and Transport Ministers' Meeting (ITMM) provides a forum for intergovernmental collaboration, decision-making and progressing priorities of national importance. In 2023-24, ITMM established an Infrastructure Decarbonisation Working Group (IDWG) to progress a work program of policy initiatives to support decarbonisation of transport infrastructure that addresses scope 1, scope 2 and scope 3 (embodied) emissions.

The ITMM approach to decarbonisation has targeted interventions at capital projects.

As of 7th June 2024, ITMM has:

- Published shared principles for national transport decarbonisation
- Approved a nationally consistent set of carbon values (NCV) for use in transport infrastructure decision making. Further information on the carbon values can be found at Infrastructure Australia's Valuing emissions for economic analysis page
- Provided in-principle support through the Policy on the application of National Carbon Values for the use of a nationally consistent set of carbon values in the assessment of state level business cases for transport infrastructure projects over $100 million, with an aspirational commencement date of 1 January 2025.
- Agreed a nationally consistent approach for measuring embodied carbon for use in transport infrastructure projects, called the *Embodied Carbon Measurement for Infrastructure: Technical Guidance*.

ITMM's agreement on the use of the NCV and guidance on embodied carbon is currently limited to transport infrastructure projects valued at over $100M. However, the values and methods outlined in the technical guidance are applicable to other types of infrastructure and have been adopted for broader use by Infrastructure Australia.

To support a nationally consistent approach to carbon impact assessment for infrastructure projects, agencies should consider whether using the NCV and guidance would be appropriate for their proposal.

Building Ministers Meeting (BMM)

In June 2024, the BMM agreed to include a voluntary pathway in the National Construction Code (NCC) 2025 to measure and report on embodied carbon utilising the National Australian Built Environment Rating System (NABERS) method. This method is aimed at measuring the operational performance of buildings.

Ministers also asked the Australian Building Codes Board to investigate how to incorporate and fund inclusion of a future minimum standard for embodied carbon in NCC 2028 to further support Australia's transition to net zero.

6.2 Practical Carbon Reduction

The level of certainty for a project's emissions starts low but improves as it moves through the various stages of its life cycle. This pattern mirrors the estimation of costs and benefits, where the lowest certainty exists during the initial stages of project development. Nonetheless, it is during the early development stages that agencies have the greatest potential to reduce whole-of-life carbon emissions. The sooner the interaction between proposed infrastructure and carbon emissions are considered, the greater the opportunity to make impactful decisions.

The Avoid-Switch-Improve carbon mitigation hierarchy is internationally accepted as a keystone principle for decarbonisation of infrastructure (Figure 2). Practical examples of each approach within an infrastructure project, considering energy, built environment and transport markets, are provided in Table 2. Further information is provided in Appendix A.

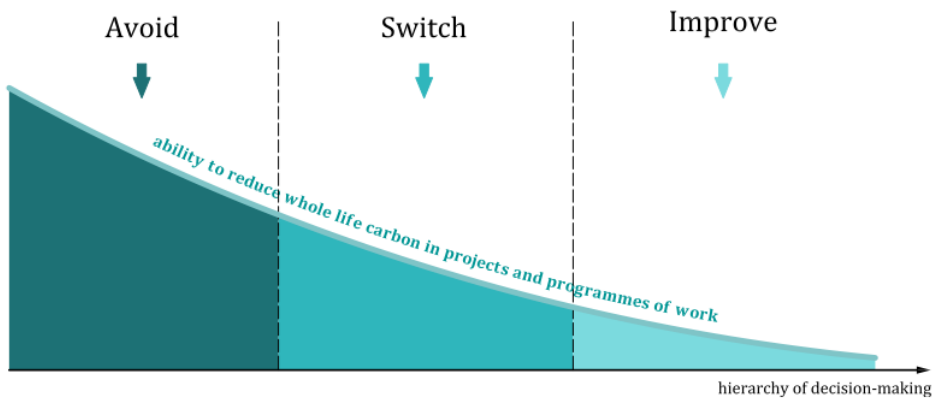

Figure 2: Carbon reduction decision-making hierarchy

Source: PAS 2080:2023 – Carbon management in buildings and infrastructure standard

Avoid: The priority is to avoid carbon emissions wherever possible. This involves evaluating the need for an asset and considering alternative solutions (for example, non-infrastructure interventions, such as demand management) or design approaches that minimise the carbon footprint from the outset.

Switch: Where carbon emissions cannot be avoided, the project should consider how it can switch fossil fuel usage in its construction and operation to renewable energy. Whenever feasible, low-carbon alternatives should also be considered during the design phase, to enable a switch to lower embodied carbon materials, processes and technologies throughout the infrastructure's life cycle.

Improve: This step focuses on continuously improving the carbon performance of the infrastructure, through identifying and adopting techniques that improve the design life and use of resources, such as incorporating energy-efficient equipment into project specifications.

Table 2: Examples of carbon reduction actions for infrastructure projects

Avoid Demand management, smart design, build less, repurpose	**Switch** Change to zero/low carbon options, use recycled materials	**Improve** Reduce life cycle impacts, specify and design for efficiency
Transport		
• Eliminate the need for new infrastructure through demand management measures, such as increasing frequency of public transport services, intelligent transport systems, transport pricing (e.g. public transport fares, road tolls, parking fees) • Build less by reducing the project's footprint and/or optimising the design to use fewer materials	• Promote active transport to reduce car use • Specify alternative materials (e.g. recycled or reused materials, lower carbon materials, fly ash) • Use electric/hybrid construction equipment, vehicles and site offices and/or biofuel blends • Switch from diesel/petrol to electric transport (e.g. expand electrified rail network, enable battery-electric locomotives/buses, • Include EV charging infrastructure in the project scope	• Use space within the road or rail reserve for renewable energy generation • Implement modular or precast design elements • Incorporate energy-efficiency measures (e.g. regenerative breaking for rail cars, intelligent transport systems, LED street lamps) • Reduce transport of materials (e.g. reuse spoil or demolition waste onsite, source materials locally)
Built environment		
• Eliminate the need for new construction through building retrofits to improve use of space • Include reuse of building facades in built environment projects • Prioritise compact development, mixed land use and walkable neighbourhoods • Include passive heating/cooling in the design (e.g. appropriate orientation, tree shading, natural ventilation)	• Eliminate gas and ensure electrification of heating, hot water and cooking • Specify alternative materials (e.g. recycled or reused materials, timber, lower-carbon materials) • Switch from diesel-powered cranes/construction equipment/ generators to equipment powered by renewable electricity • Include EV charging infrastructure in scope • Procure renewable power through Power Purchase Agreements that are time matched to consumption	• Incorporate energy-efficient technologies (e.g. high-performance insulation, efficient HVAC systems, LED lighting) • Encourage methods that reduce construction time • Reduce transport of materials (e.g. reuse spoil or demolition waste onsite, source materials locally)

Avoid Demand management, smart design, build less, repurpose	**Switch** Change to zero/low carbon options, use recycled materials	**Improve** Reduce life cycle impacts, specify and design for efficiency
Energy and water		
• decentralised energy/water systems rather than new distribution systems (e.g. rooftop solar, community batteries, water recycling) • Reduce the need for new supply/distribution infrastructure through energy/water demand management (e.g. energy/water efficient technologies, load shifting for major energy users, commercial/residential batteries, community education)	• Consider anaerobic rather than aerobic processes to enable capture and re-use of biogas for heating and electricity generation • Specify alternative materials (e.g. recycled or reused materials, timber, lower-carbon materials) • Use renewable-powered equipment (e.g. pumps) • Procure renewable power through Power Purchase Agreements that are time matched to consumption	• Incorporate efficient technologies (e.g. energy efficient equipment, LED lighting, electricity transmission at a higher voltage) • Select, size and control pumps, blowers and compressors for maximum efficiency

7. Business case integration

All agencies are expected to determine whether carbon emissions are a relevant consideration for the proposed infrastructure project.

If decarbonisation is a relevant consideration, the level of detail provided by proponents is expected to be proportionate to the value and risks of the project and to align with the structure set out in the Strategic Asset Management Framework (SAMF) Business Case Guidelines (Figure 3).

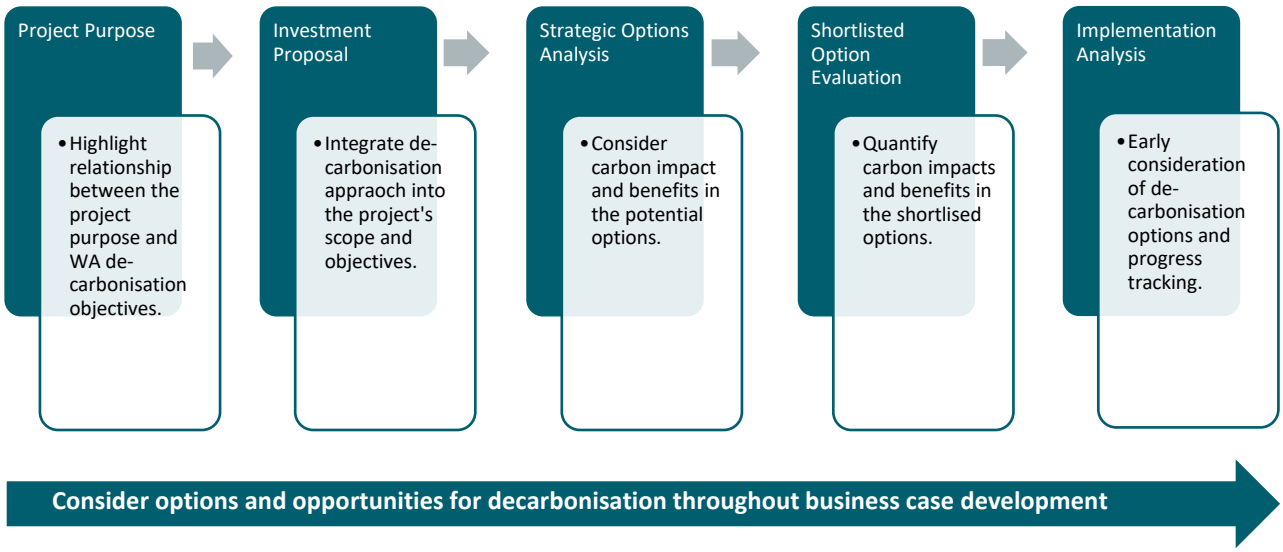

Figure 3: Decarbonisation integration with the SAMF Business Case Guidelines

The following sections detail the opportunities for integration of decarbonisation within each of the business case sections shown in Figure 3. As far as possible, these align with and address the subsections of each business case section in the SAMF Business Case Guidelines (Figure 4).

Figure 4: Overview of requirements in the SAMF Business Case Guidelines

7.1 Project purpose

This section provides an opportunity for the proponent, as part of defining the strategic project context, to highlight how the project supports decarbonisation outcomes sought by the WA Government. This could include:

- outlining how the project contributes to meeting WA Government policy commitments, including but not limited to the Sectoral Emissions Reduction Strategy, WA Climate Policy, WA Climate change risk management guide (interim) and Climate Adaptation Strategy
- identifying links to the agency's corporate and/or asset management objectives as set out in its Strategic Asset Plan.

Problem definition

Determine if decarbonisation is a relevant element of the problem or service need that the project is addressing. This could be established through links between forecast demand, current and forecast performance or asset condition and future greenhouse gas emissions. It is recommended that a consistent boundary and approach to emissions accounting is established. It may also be useful apply to the Carbon Mitigation Hierarchy (Section 6.2) to conceptually describe if elements of the problem (e.g. a need to upgrade, retrofit, expand or build new infrastructure) could have significant carbon impacts.

Rationale for intervention

Communicate the clear rationale for proceeding with any new infrastructure options. Clearly defining the need for intervention through building infrastructure is an important consideration for good practice in business case preparation. Defining the base case of the proposal could consider how intervention might use the carbon mitigation hierarchy, particularly at the 'avoid' level (Figure 2).

Timing considerations

Timing considerations establish the urgency of an investment proposal. If decarbonisation outcomes are a significant element of the proposal, it would be appropriate to establish the required timeframe for delivery in the context of state and/or national decarbonisation ambitions. This could include the relative sequencing of decarbonisation of the economy as described in the WA Government's Sectoral emissions reduction strategy, which highlights the relative trajectory of different sectors. For example, buildings are expected to decarbonise ahead of industry, and the decarbonisation of the electricity grid will enable the decarbonisation of other sectors.

7.2 Investment proposal

This section of the business case requires proponents to define the investment logic of the planned investment, linking the problem statement and proposal objectives to the relevant benefits.

Proposal objectives

It may be relevant to establish a specific decarbonisation objective or target as part of the overall proposal objectives (refer to Appendix A). When setting targets, agencies should consider their alignment with emission reduction goals at government, agency or project level, and identify any trade-offs between carbon reduction and additional cost.

Benefits to be delivered

Outline the direct advantages that can be secured through the proposal. This should refer to corporate outcomes, asset management objectives and government policy. Benefits may include quantifiable economic benefits related to carbon reduction initiatives (for example, avoiding more expensive offsets in the future). However, for some projects, it may be sufficient to discuss qualitative benefits such as environmental benefits or support for the WA Government's decarbonisation initiatives.

To demonstrate that decarbonisation goals have been considered, the agency could:

- demonstrate that non-build options have been considered through appropriate stakeholder involvement in problem definition and the strategic response

- identify key interdependencies between carbon and other aspects of the project/external context.

7.3 Strategic options analysis

This section of a business case typically involves an option identification process for a potential longlist of options, followed by a qualitative or quantitative assessment to reduce these to a shortlist.

Generate long list of options

Consider the carbon-related environmental and economic benefits and impacts of a range of options. Identify both non-asset solutions (for example, digital or operational interventions) and asset solutions by considering the carbon reduction decision-making hierarchy.

Long list evaluation

When evaluating the longlist, the agency could consider carbon in both environmental and economic terms. This could be achieved by including a decarbonisation criterion within a structured multi-criteria assessment options screening tool.

Depending on the project context, it may also be helpful to analyse the longlist with reference to the strategic carbon reduction objectives set by industry bodies, other governments or similar major projects. This would identify how various options align with broader trends in decarbonisation action in the infrastructure sector and help reduce the risk of misalignment of investment.

7.4 Shortlisted options evaluation

This section includes a series of detailed analyses to effectively assess the shortlisted options and recommend a preferred option. This is an opportunity for the agency to quantify the carbon-related environmental, social and economic benefits/impacts of the shortlisted options.

Carbon emissions are increasingly recognised as an environmental, economic and financial issue for major infrastructure projects. For high-value, high-risk proposals, the SAMF Business Case Guidelines note that any analysis should extend beyond a description of the proposal's key impacts to an assessment of the specific impacts of each shortlisted option. If carbon emissions are a material consideration, these impacts could be analysed as follows:

- Estimate the whole-of-life carbon emissions for each shortlisted option in accordance with the agency's level of capability and maturity, and the level of option detail.
- Quantify the carbon benefits and impacts to be delivered by the proposed solution, both in terms of the environment and the economy.
- Estimate the economic value of the carbon emissions/reduction associated with each shortlisted option as part of a cost benefit analysis
- Identify whether carbon emissions associated with options could be substantially reduced by additional investment.
- Identify whether the risks associated with carbon management through the project life cycle are materially different for the shortlisted options. These risks could include failure to obtain social license, increased costs over the life of the project due to future abatement or constraining the opportunity to make a later switch to a lower-carbon alternative.

When outlining the recommended option, it may be appropriate to identify any significant broader impacts that the project could have. In the context of decarbonisation, this could include catalysing innovation in industry or supporting the development of a workforce with the skills to enable achieving the Australian Government's legislated target of net zero greenhouse gas emissions by 2050.

7.5 Implementation analysis

This section requires the proponent to consider how it will effectively implement and deliver the preferred option. This is an early opportunity for the agency to consider how the decisions regarding project implementation may positively or negatively influence the carbon outcomes of the project.

Demonstrating an understanding of how decarbonisation of infrastructure can be effectively implemented for the project could be done in several ways:

- For the preferred option, identify the main sources of whole-of-life carbon and use this to set targets and/or inform carbon reduction objectives for market engagement.
- Outline whether the procurement strategy will promote early engagement and innovative decarbonisation approaches.
- Consider carbon risks in the broader project risk assessment, particularly those related to the costs of achieving specified targets or goals. Describe how these risks will be managed within the project's governance arrangements.
- Consider and describe how delivery timelines might impact on the ability to leverage low-carbon materials and/or construction methods.

A broader benefits management approach could also consider the use of sustainability rating tools (for example, Green Star, Infrastructure Sustainability Council) to track and validate outcomes. If the intention to undertake sustainability ratings is stated, how rating goals align with project objectives and Government policy should be identified. Understanding of how the targets set by rating tools may impact whole of life costs should be demonstrated.

Developing a Carbon Management Plan as part of implementation analysis can provide rigour during pre-delivery analysis to manage cost and reputational risks during implementation of major infrastructure. A CMP is a document that can be established early in project development and iterated with additional detail as the delivery progresses. The CMP should:

- Outline key stakeholders and roles and responsibilities across the project life cycle.
- Identify how the project will identify and implement carbon management opportunities across the project life cycle to meet or exceed the project's carbon objectives, including a clear understanding of the financial cost of optimising carbon mitigation within the project
- Identify how scope changes will be managed.
- Set up requirements for monitoring and reporting, tracking of data, and accountable roles at each process stage.

8. Definitions

Term	Definition
Agency	All agencies and government trading enterprises.
Carbon emissions	The release of carbon dioxide (CO_2) and other greenhouse gases into the atmosphere, primarily from burning fossil fuels, deforestation and industrial processes.
Circular economy	An economic system that aims to minimise waste and increase the reuse, recycling and repurposing of materials and products, ensuring the most efficient use of resources and reducing environmental impacts.
Cost benefit analysis (CBA)	A decision-making tool that compares the costs and benefits of a project, policy, or investment, assessing the economic viability and potential returns against the costs, including environmental and social factors.
Electric vehicle	A vehicle that runs on electricity stored in rechargeable batteries, eliminating or reducing the need for conventional fossil fuels and emitting fewer or zero greenhouse gases.
Embodied carbon	Carbon emissions associated with the production, transportation and disposal of materials used in construction or manufacturing, including emissions from raw material extraction, manufacturing processes and transportation.
Emission factor	The amount of carbon emissions produced per unit of activity or output, often used to calculate or estimate the carbon footprint or emissions associated with a specific process, fuel or sector.
Environmental product declaration	Verified documents providing information on a product's environmental impact throughout its life cycle, including carbon emissions, energy usage, water consumption and waste generation.
Greenhouse gases	Gases that trap heat in the Earth's atmosphere, contributing to climate change and global warming.
Heating, ventilation and air conditioning	Systems used for controlling indoor temperature, humidity and air quality in buildings for comfort and/or industrial purposes.
Investment Logic Map (ILM)	A process to articulate the investment story in relation to the problem, the benefits, the strategic response and the solution definition.
Operational carbon	Carbon emissions released during the day-to-day operations of a building or facility, such as energy consumption for heating, cooling, lighting and powering equipment.
Upfront carbon	Carbon emissions associated with the fabrication, construction or manufacturing of a product, infrastructure or building before it becomes operational.
Value chain	The complete set of activities and processes involved in the production, distribution and consumption of goods or services, including suppliers, manufacturers, logistics, retailers and end users.
Whole-of-life carbon	The total carbon emissions, both embodied and operational, associated with the entire life cycle of a product, infrastructure or building, including raw material extraction, manufacturing, transportation, use and disposal or recycling.

9. Further information

BSI Standards Limited, PAS 2080:2023 – Carbon management in buildings and infrastructure standard, 2023

Department of Climate Change, Energy, the Environment and Water, Climate change, DCCEEW website, Australian Government, 2023

Department of Climate Change, Energy, the Environment and Water, Australia's national greenhouse accounts, DCCEEW website, Australian Government, 2023

Department of Climate Change, Energy, the Environment and Water, National greenhouse accounts factors: 2023, DCCEEW website, Australian Government, 2023

Department of Finance, TG040 Environmentally sustainable design guideline for non-residential government buildings, WA Government, 2023

Department of Water and Environmental Regulation, DWER regulatory documents, DWER website, WA Government, 2024

Engineers Australia, CSE carbon measurement fundamentals for engineers, 2024

European Standards, BS EN 15978:2011 – Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method, 2011

European Standards, BS EN 17472:2022 – Sustainability of construction works. Sustainability assessment of civil engineering works. Calculation methods, 2022

Greenhouse Gas Protocol website

Infrastructure and Transport Ministers, Embodied carbon measurement for infrastructure: technical guidance, Australian Government, 2024

Infrastructure Australia, Assessment framework, Australian Government, 2021

Infrastructure Australia, Guide to assessing greenhouse gas emissions, Australian Government, 2024

Infrastructure Australia, Policy on application of national carbon values, Australian Government, 2024

Infrastructure NSW, Decarbonising infrastructure delivery policy and measurement guidance, NSW Government, 2024

Institute of Civil Engineers, Guidance document for PAS 2080, 2023

Royal Institute of Chartered Surveyors, Whole life carbon assessment for the built environment, 2023

WA Government, Climate Adaptation Strategy, 2023

WA Government, Climate Change Bill, 2023

WA Government, Sectoral Emissions Reduction Strategy for Western Australia, 2023

WA Government, WA Climate Policy, 2020

Appendix A: Supporting Guidance

While the initial focus of emissions reduction policy has been direct and indirect emissions, recent international developments, such as the European Union's Carbon Border Adjustment Mechanism (CBAM) and the Climate Risk Disclosure International Financial Reporting Standard 2 (IFRS 2) also focus on value-chain emissions

Value-chain emissions are embodied in the products and processes used to construct and operate infrastructure. All major infrastructure projects are intended to have extended lifespans, and this can 'lock-in' upfront, operational and user carbon impacts. Long project development phases also increase the risk of penalties for carbon impacts becoming more significant between the early planning stages and implementation.

Carbon Impact Assessment

The following section provides supporting guidance on carbon impact assessment to assist business case proponents with limited technical experience in carbon assessment.

Understand greenhouse gases

There are many greenhouse gases, but the most common are:

- carbon dioxide (CO_2)
- methane (CH_4)
- nitrous oxide (N_2O)
- hydrofluorocarbons (HFCs)
- perfluorocarbons (PFCs)
- sulphur hexafluoride (SF_6).

Each of these gases has a different impact on the environment and contributes to climate change to different extents. It is traditional in carbon accounting to convert emissions from all greenhouse gases to a carbon dioxide equivalent (CO_{2eq}) so the total impact of all emissions can be considered. This is generally what is meant by 'carbon emission'.

Analyse carbon emissions across the infrastructure life cycle

Analysing carbon emissions across the life cycle of an asset offers a holistic view of an infrastructure project's carbon footprint. By estimating carbon emissions at all stages, from construction to end-of-life, agencies can target their carbon-reduction strategies during project development and identify the most cost-effective initiatives for decarbonisation of their proposal.

- Upstream carbon emissions can be reduced by minimising materials, sourcing sustainable materials and using sustainable transport practices.
- Carbon emissions during construction and operations can be reduced by adopting energy efficiency measures and minimising emissions from machinery and equipment.
- Downstream carbon emissions can be reduced by taking a circular economy approach, promoting material recycling, waste minimisation and efficient disassembly and disposal strategies.
- Emissions associated with activities enabled by an infrastructure asset, such as road use or building use, also known as user carbon, can be reduced by encouraging better whole-of-life carbon outcomes.

Several frameworks are available to guide agencies to analyse and address the carbon emissions of infrastructure projects. Agencies should select the framework that is most suited to the proposed project or initiative, subject to the requirements or recommendations of other assessing bodies (for example, Infrastructure Australia), sector-standard methodologies (for example, Australian Transport Assessment and Planning) or industry body guidance on methods (for example, Engineers Australia).

Whole-life carbon assessment for the built environment

The Whole life carbon assessment for the built environment standard produced by the Royal Institute of Chartered Surveyors addresses direct and indirect emissions. Originally developed for use in the United Kingdom, it has been widely adopted, including in Australia. For example, the approach is used, with some modifications, as the basis for the national *Embodied Carbon Measurement for Infrastructure: Technical Guidance* .

It provides a number of categorisations that are specifically aligned to the construction and operation of infrastructure (Figure 5):

- upfront carbon (A1 to A5)
- use-stage carbon (B1 to B8)
- end-of-life carbon (C1 to C4)
- circular economy (D).

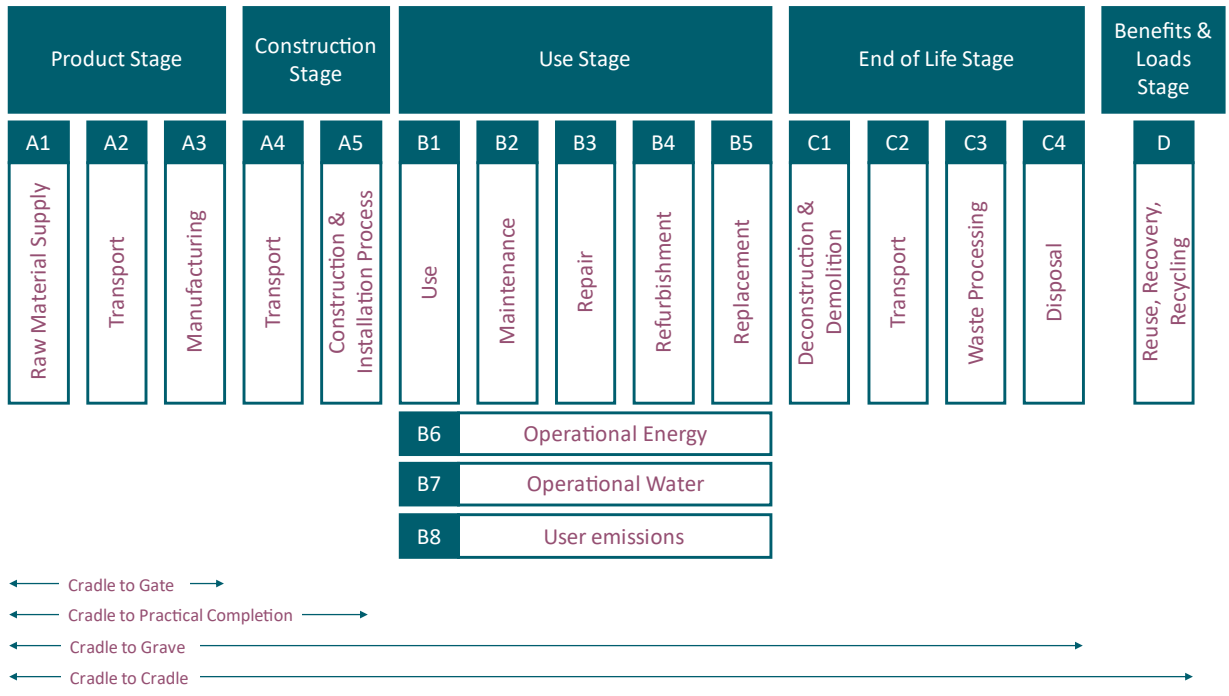

Figure 5: Infrastructure life cycle stages

Source: BS EN 15978:2011 – Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method.

Estimate carbon emissions

The following section outlines the process for estimating the carbon emissions associated with a project. It provides a brief description of key steps in a robust analysis but does not provide technical details of analysis or methodologies.

Define the project boundary

If undertaking an analysis of carbon emissions, agencies should define the project boundary by identifying the infrastructure's life cycle and the sources of emissions that will be included. The definition should:

- be comprehensive, including both direct and indirect sources of carbon emissions
- justify any decisions to exclude specific activities and/or emission sources
- be feasible from a data collection viewpoint

- reflect the project's size and risks.

Clearly defining the project boundary can help better manage the full range of risks and opportunities that exists along the value chain and enable better decision-making.

Assess sources of carbon emissions

Determining the materiality of carbon emission sources is an important step in carbon accounting. It involves identifying and prioritising the most significant emissions and excluding insignificant sources from the analysis. This will allow the agency to efficiently target its efforts to account for and reduce carbon emissions.

It is typical to set a threshold for individual emission sources and put an upper limit on excluded sources as a proportion of the project's total emissions. For example, a threshold could exclude individual sources that account for less than 1% of a project's emissions, where the total of the excluded emissions is less than 5% of the project's total emissions. It is recommended that agencies consider adopting materiality thresholds and applying them consistently to projects.

Assessing the materiality of an emission source can be an iterative process. Carbon emissions are determined for sources that are likely to be material, and additional sources are tested using the materiality thresholds. Carbon footprints of previous infrastructure projects can be a useful basis for identifying sources that are likely to be significant.

Estimate carbon emissions

Once the main sources are identified, there are a variety of tools and sources of emissions data that support carbon emission calculations. The level of detail in estimating carbon emissions should be proportionate to data availability, project size and time available to inform decisions.

To estimate the carbon associated with the preferred solution and any shortlisted options, 2 types of data are required (Figure 6):

- activity measures
- emission factors.

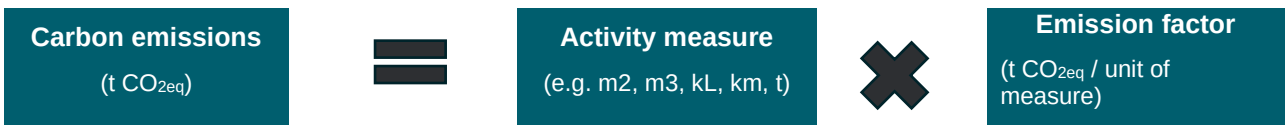

Figure 5: Data required to estimate carbon emissions

During the initial stages of an asset investment proposal, when there is a lack of detailed project data, agencies can estimate carbon emissions by using general carbon intensity benchmarks, initial material quantities, high-level project details and/or qualitative assessment. However, as the project progresses and more detailed information becomes accessible, the calculation method for carbon emissions is expected to become more precise (Figure 7).

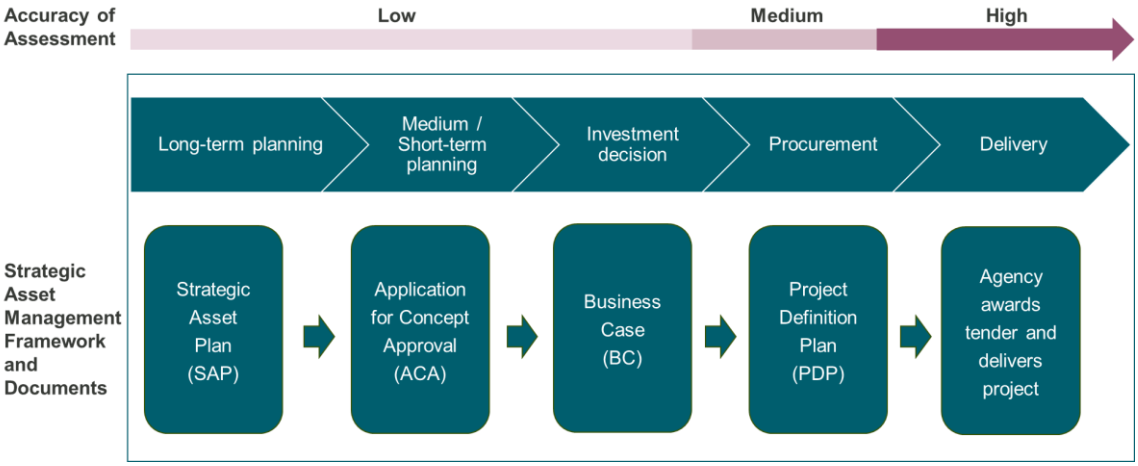

Figure 7: Accuracy of carbon emission assessments across SAMF stages

While recognising that data availability can be very limited at early project stages, this is the time when there is the greatest potential to influence carbon emissions. Emission reduction strategies at the early business case stage can include:

- option selection
- scope definition
- investment decisions.

Measurement at this stage encourages low-carbon behaviours and decisions. The use of a suitable input data hierarchy can overcome data availability barriers (Figure 8).

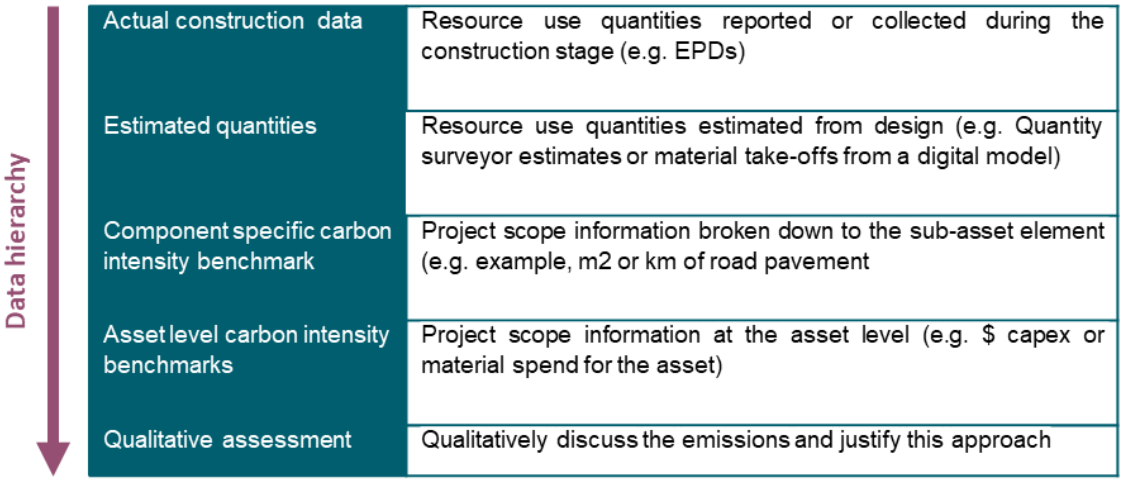

Figure 8: Data hierarchy for carbon emission assessment

In the development of a business case, when detailed quantities are either not available or are limited to major civil and structural components, it is acceptable to use carbon intensity benchmark data, even though they may be less precise. The accuracy of the data and the extent of the analysis should be proportionate to the size, risk, available information and complexity of the investment proposal.

More information

Proponents are advised to refer to the following standards and consider which is most appropriate for their project:

- PAS 2080:2023 Carbon management in buildings and infrastructure
- Whole life carbon assessment for the built environment
- EN 15978:2011 – Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method
- BS EN 17472:2022 – Sustainability of construction works. Sustainability assessment of civil engineering works. Calculation methods
- ISO 14064-2:2019 – Greenhouse gases — Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements

Details on data sources, methodologies and calculation tools can be found in the Australian Government's Embodied Carbon Measurement for Infrastructure: Technical Guidance and Engineers Australia's Carbon measurement fundamentals for engineers.

Identify carbon reduction opportunities

Identifying carbon reduction opportunities should follow the Avoid-Switch-Improve carbon reduction decision-making hierarchy (Figure 9) and consider:

- non-build responses, which could include demand management or better use of technology
- upgrading or repurposing of existing infrastructure
- low-carbon design and construction techniques.

Carbon reduction decision-making hierarchy

The level of certainty regarding a project's emissions improves as it moves through the various stages of its life cycle. This pattern mirrors the estimation of costs and benefits, where the lowest certainty exists during the initial stages of project development. Nonetheless, it is during the early development stages that agencies have the greatest potential to reduce whole-of-life carbon emissions. The sooner the interaction between the proposed infrastructure and carbon emissions are considered, the greater the opportunity to make impactful decisions.

The Avoid-Switch-Improve carbon reduction decision-making hierarchy is internationally accepted as a keystone principle for decarbonisation of infrastructure (Figure 1).

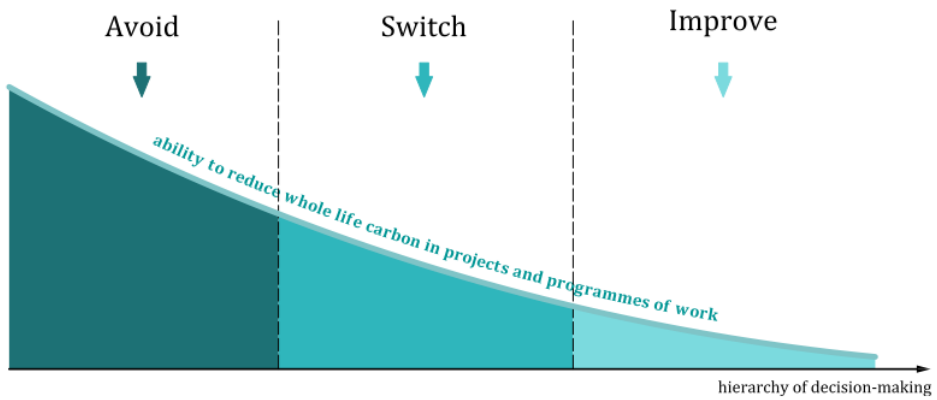

Figure 9: Carbon reduction decision-making hierarchy

Source: PAS 2080:2023 – Carbon management in buildings and infrastructure standard

Avoid

The ‘Avoid’ level of the carbon hierarchy can have the most significant impact on greenhouse gas emissions and is likely to be a lower capital cost than new infrastructure. Therefore, all business cases must demonstrate that the project need cannot be met through non-build alternatives and include a clear rationale for any new infrastructure option. This is consistent with the SAMF requirement to demonstrate need for investment when compared to the base case.

Switch

If the need for new infrastructure is demonstrated, targeting the main sources of emissions will have the greatest impact on the overall project. Generally, if a proposal is energy intensive, moving to renewable energy sources will reduce direct emissions significantly. However, the main sources of emissions can differ by project and sector.

Improve

Material selection and efficient design can also have significant emissions impacts. For example, embodied carbon reductions could be achieved by using materials with lower levels of emissions associated with the upstream extraction and/or processing or downstream disposal. A whole-of-life approach can also influence carbon emissions, as investing in high-quality, long-lasting components could reduce the need for frequent replacements, which reduces the overall emissions associated with infrastructure maintenance and replacement.

Carbon offsets

The carbon mitigation hierarchy focuses on avoiding and reducing carbon emissions throughout the infrastructure life cycle as the highest priority. However, there are likely to be residual emissions associated with infrastructure development.

As a last resort, carbon offsets can provide a net reduction in emissions through reducing emissions and/or removing carbon from the atmosphere.

More information

For projects with a capital value of under $100 million, the Department of Finance Technical Guideline TG040 Environmentally sustainable design guideline for non-residential government buildings provides advice on reducing the impacts of certain classes of non-residential buildings.

Main Roads WA have developed local guidance on the use of recycled materials in road design in their guide Recycled and sustainable materials at Main Roads. The Department of Transport has established the Transport Portfolio Sustainable Infrastructure Policy and are currently developing resources to support evaluation of opportunities for more sustainable use of materials.

Other information, including case studies on carbon reduction opportunities, is available from organisations such as the Green Building Council of Australia, Infrastructure Sustainability Council, Supply Chain Sustainability School, Australian Sustainable Built Environment Council and the Materials Embodied Carbon Leaders’ Alliance.

Assess the carbon value

When assessing the costs and benefits of a project, agencies could include the economic impact of carbon emissions in their analysis.

A National Carbon Value has been developed for use in the assessment of all proposals considered by Infrastructure Australia. At the June 2024 Infrastructure and Transport Ministers' Meeting, Ministers provided in principle support for the use of a nationally consistent set of carbon values in the assessment of state level business cases for transport infrastructure projects over $100 million, with an aspirational commencement date of 1 January 2025.

More information

Guidance on how to apply the National Carbon Value in economic analysis is available in Infrastructure Australia's Guide to assessing greenhouse gas emissions.

Implement appropriate governance

Effective leadership and the establishment of clear accountability and responsibilities within the project team is required to drive the implementation of sustainable practices. Appropriate governance to support managing whole-of-life carbon includes ensuring consistency in:

- assessment
- use of data
- procurement
- target setting
- continuous improvement
- monitoring
- reporting.

Clear accountabilities and responsibilities should be assigned within project structures.

Although full project governance details may not be set out in a business case, accountability for any commitments made for carbon management could be given effect by identifying the risk of additional cost to deliver on commitments within the project risk register so they can be carried through into implementation.

More information

An overview of governance and leadership principles for effective carbon management for infrastructure, including the specific role of government and designers, is provided in PAS 2080:2023.

The role of engineers in decarbonisation is outlined in Appendix A-4 of Engineers Australia's CSE carbon measurement fundamentals for engineers.

Set objectives, targets and baselines

Setting carbon reduction objectives or targets is fundamental to demonstrating a commitment to reducing carbon emissions. It is important to establish these objectives or targets against well-defined baselines or benchmarks, enabling performance evaluation and allowing the value chain to focus its efforts on achieving them. When establishing targets, consider the trade-offs between a greater carbon reduction, the cost of carbon reduction measures and the economic impact of carbon emissions.

As a minimum, agencies must consider whether the impacts of the proposal align with and support the national and state target of net zero emissions by 2050. This includes considering the impact of the project post-construction on the WA Government Emissions Interim Target to reduce operational Scope 1 and 2 emissions to 80% below 2020 levels by FY2030 across all agencies and trading enterprises.

This Decarbonisation Guide encourages agencies to set targets for projects. Agencies with less capability could align with climate targets at a system level, to reduce the risk that isolated targets at the asset level could inadvertently lead to increased carbon emissions elsewhere in the system. They could also review objectives or actual performance for similar projects in the public and private sector, including interjurisdictional examples, to understand the appropriate targets for their project.

Agencies with more capability could define a baseline or benchmark and establish a whole-of-life carbon reduction target. They should also consider how value-chain perspectives could be

incorporated and identify and evaluate any carbon and/or financial trade-offs across the life cycle of the asset.

If agencies choose to set targets, they should plan to reassess their baselines and targets as design and procurement proceed and more detailed information becomes available. Agencies should also revise their calculation methodology following procurement and project completion. This will ensure that accurate data is used and that the project's performance is not inadvertently affected by data limitations in its early stages.

Formalising targets within the project's governance will support tracking outcomes to provide better understanding of the benefits and costs of proposed initiatives as the project moves from investment decision into delivery.

Monitor and report

Consistent monitoring and transparent reporting of carbon emissions during a project's life cycle is important to inform decision-making in managing whole-of-life carbon and also provides information for future continuous improvement. Gathering reliable data from various agencies will also facilitate the comparison of asset categories within the WA Government. This is crucial for establishing more-accurate benchmarks and assumptions regarding carbon intensity in the infrastructure sector.

While recognising that data availability is very low at the business case stage, agencies should consider setting up requirements for upcoming stages:

- Data and systems should be tracked in a way that can easily be monitored in the following stages and through governance review mechanisms.
- Roles and responsibilities should be identified at each work stage for monitoring and reporting.
- Accurate records should be kept on low-carbon options and the extent to which they can improve performance over the baseline.

Agencies with maturing capabilities may choose to report internally on projects that are making progress towards carbon reduction targets through the planning, procurement and delivery stages.

If agencies choose to report, the level of detail in reporting should be increased as the available data and carbon calculations become more detailed at each project stage. This will ensure that the data provided is clear, transparent and genuinely valuable.

Whenever feasible, the project's carbon emission should be reported using uniform declared units (for example, emissions for social infrastructure may be reported per patient or student, or per square metres of gross floor area). It is also important to include breakdowns of carbon emissions based on the asset's life cycle stage, asset type and, where possible, the key contributing elements to such emissions.

More information

While national reporting frameworks and data management systems are still being developed, the Australian Government's Embodied Carbon Measurement for Infrastructure: Technical Guidance sets out minimum expectations for consistent measurement data to support development of a national database. Appendix 10 provides reporting templates and Appendix 11 provides details of declared units that are aligned to Infrastructure Australia's mastertype and typecasts for assets.

Plan procurement

Guidance on how to incorporate decarbonisation into major government infrastructure projects is an evolving area of policy. This recognises that agencies can unlock numerous advantages by thinking about decarbonisation early in the business case development process, particularly to enable integrating low-carbon solutions and circular economy principles into the procurement phase. Such a proactive approach not only minimises the need for retrofitting or costly carbon

reduction measures, but it also creates opportunities for innovation, cost savings and enhanced project resilience.

The focus on procurement is not just about developing contractual agreements. It is also a mechanism to incentivise sustainable behaviours across the economy. Agencies can leverage the procurement process early on to encourage suppliers and contractors to prioritise low-carbon solutions and practices. For example, this could be achieved through:

- clear sustainability requirements within tender documents
- weighting of evaluation criteria that emphasise carbon reduction
- contract clauses that promote ongoing measurement and reporting of emissions.

More information

Agencies are advised to consider the guidance provided by ISO 20400:2017 – Sustainable procurement – Guidance.

Continuous improvement

This Decarbonisation Guide recognises that the capability to manage carbon will evolve over time. As agencies gain experience and capacity, it is expected that they will progressively implement more of the elements of good practice outlined in this guide and the quality of options analysis will improve. The aim is for agencies to identify and develop cost-effective decarbonisation practices for an increasing number of projects.

To this end, agencies could develop a decarbonisation process/procedure that outlines how they will approach decarbonisation across a project's life cycle, including in the investment decision stage, to enable a consistent approach across projects.

Agencies may also identify potential supporting systems and processes that would enable their projects to deliver greater levels of decarbonisation, ultimately contributing to substantial carbon reductions across government infrastructure. Examples include:

- prohibiting the use of fossil fuels for certain applications
- requiring the inclusion of renewable energy and water recycling infrastructure
- regular reviews and updates to design standards and product approval processes.

GOVERNMENT OF WESTERN AUSTRALIA

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