Infrastructure NSW

October 2022

Decarbonising Infrastructure Delivery

NSW Government Discussion Paper

Acknowledgement of Country

Infrastructure NSW acknowledges the Traditional Custodians of the lands where we walk, work and live, and pays respect to their Elders past and present.

We acknowledge and respect their continuing connection to land, seas and waterways of NSW, and the continuation of their cultural, spiritual and educational practices.

We acknowledge the importance of Aboriginal and Torres Strait Islander people's unique history of land and water management, and of art, culture and society that began over 65,000 years ago.

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Message from Minister Stokes

The NSW Government's investment in infrastructure is at record levels. The State's infrastructure pipeline has grown to $112.7 billion, forming a significant part of the broader construction sector across NSW, and presents both challenges and opportunities for Government and its industry partners moving forward.

But while the benefits from our nation-leading infrastructure program are well known, we cannot hide from the fact that building infrastructure is a big driver of our carbon emissions.

The NSW Government has adopted a goal of Net Zero emissions across the whole NSW economy by 2050 – and a 50% cut in emissions below 2005 levels by 2030.

We cannot achieve that target without changing the way we procure, build and operate infrastructure in NSW.

Decarbonising the infrastructure sector requires a reduction in emissions right across asset stages – emissions embedded during construction, generated by ongoing asset operations, and left behind through waste.

The Government's infrastructure program is building a brighter future – it allows greater connectivity to jobs and homes, improved health and education outcomes, and fosters cultural and artistic expression.

But we can also use our infrastructure program to drive cultural change across the wider construction sector by pioneering more sustainable practices.

Embodied carbon is the next frontier in our task to decarbonise the infrastructure sector, and I'm pleased to support Infrastructure NSW to plan the way forward for the construction sector in NSW.

This discussion paper sets out the next phase in our decarbonisation journey by incorporating consideration of embodied carbon into our business as usual decision making processes. We know we can't face this issue without the support of industry, and we look forward to working with you to propel the state forward.

The Hon. Rob Stokes MP
Minister for Infrastructure, Cities and Active Transport

Introduction and purpose

The purpose of this document is to provide guiding principles to decarbonise the delivery of public infrastructure across the planning, design and construction phases (i.e. reducing 'embodied emissions').[1]

The principles address the current absence of a clear mandate and lack of incentives for agencies and delivery partners, which has been a key barrier to reducing embodied emissions in infrastructure construction to date. Harmonisation of the approach to embodied emissions across sectors and jurisdictions would help provide industry with clarity and reduce costs. This will be sought through progressive implementation.

Embodied emissions of construction materials are estimated to be approximately 5% to 10% of Australia's total emissions and this share is expected to rise in coming years.[2] [3] Acting on embodied emissions will require a collaborative approach with all members of the industry supply chain and is necessary to ensure that infrastructure built today is positioned for a net zero future. Setting progressive and incremental targets for public infrastructure delivery agencies will also drive action in harder to abate extractive and industrial sectors.

Box 1: What are embodied emissions?[4]

Embodied emissions, for the purpose of these principles, are those that result from the production of materials used in the construction of infrastructure, their transport to site and from the construction process itself. Embodied emissions may also be referred to as embodied carbon or 'upfront' carbon.

Infrastructure decision-makers have control over these emissions through choices made in the planning, siting, designing and procurement stages of a project — for example, sourcing less emissions-intensive steel for the construction of a bridge.

Control over these emissions may be limited by the cost and availability of technology and the constraints of their supply chain. However, the magnitude of infrastructure expenditure is large enough that procurement preferences, for example for recycled materials or low-carbon construction practices, can transform the activities of supply chains.

1 This approach is consistent with recommendations from industry. In particular, Infrastructure Partnerships Australia (Decarbonising Construction: Putting carbon in the business case, 2022, p.40) and the Business Council of Australia (Infrastructure in a world moving to net zero, 2022, Recommendation 2) have been recommending consideration of embodied emissions from the early planning and business case stages.

2 Clean Energy Finance Corporation, Australian buildings and infrastructure: Opportunities for cutting embodied carbon, 2021, p. 8

3 Infrastructure Partnerships Australia, Decarbonising Construction: Putting carbon in the business case, 2022, p. 4

4 Climateworks, Reshaping Infrastructure for a Net Zero Emissions Future, 2020, p. 15.

The table below summarises the proposed key actions for Government and industry as documented in these Principles.

Principles				
	Action	**Project Stage**[5]	**Responsible Entity**	**Rationale**
1	**Principle 1 — Use consistent methods and data to measure embodied carbon**			
1.1	**Adopt a whole of NSW Government approach to measuring embodied emissions in infrastructure**	All stages	Infrastructure NSW with infrastructure delivery agencies	There is currently no NSW Government framework or process that outlines expectations for managing carbon across the infrastructure lifecycle. Agencies are adopting inconsistent approaches (scope and data sources) to measuring their emissions — or are not doing so at all — hampering efforts to reduce them.
2	**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**	Initiation through to Planning & Development	Infrastructure delivery agencies	The opportunity to influence a project's emissions is greatest in the early design stages. Opportunities to reduce embodied carbon, such as policy change, technology or augmentation of existing assets, are not routinely a factor in options analysis.
2.2	**Establish a BAU carbon baseline and set a minimum target for emission reduction from the earliest design phase**	Initiation through to Planning & Development	Infrastructure delivery agencies	Most agencies are not measuring the embodied carbon in their projects and have little insight into the 'BAU baseline' (i.e. status quo) carbon footprint of their assets. As a consequence, the majority of projects do not have a requirement to achieve a reduction from a BAU baseline.
2.3	**Engage with industry as early as possible on low emission designs and approaches**	Planning & Development	Infrastructure delivery agencies	Early and structured engagement with the market is currently insufficient to ensure that sustainable designs are feasible given the current market for materials and capability.

5 Project stages reference the Infrastructure NSW Infrastructure Investor Assurance Framework project lifecycle and include:
- Initiation: Needs Confirmation — Gate 0 'Go/No Go' Review.
- Planning & Development: Needs Analysis and Investment Decision — Gate 1 Strategic Options Review and Gate 2 Business Case Review.
- Procurement: Procure — Gate 3 Readiness for Market Review and Gate 4 Tender Evaluation Review.

Principles			
Action	**Project Stage**[5]	**Responsible Entity**	**Rationale**
2.4 Maximise use of recycled and low emissions building materials where possible and regularly review whether standards are constraints	All stages	Infrastructure delivery agencies with Office of Energy and Climate Change (OECC) and Infrastructure NSW	Trials of recycled and low emissions building materials are not becoming business as usual specifications. Availability of low emissions building materials and capability to validate supplier credentials is still developing.
3 Account for carbon in business cases			
3.1 Include carbon emissions and reduction plans in business cases	Planning & Development	NSW Treasury with infrastructure delivery agencies	Investment decisions are currently being made without an understanding of how whole of life carbon is being mitigated, with potentially higher cost retrofits required in the future to achieve net zero.
3.2 Value carbon emissions — including embodied emissions	Planning & Development	NSW Treasury with infrastructure delivery agencies	Currently there is no specific requirement to include embodied emissions in cost benefit analysis (CBA) which reduces the opportunity to evaluate and select lower emissions designs.
3.3 Prepare carbon management plans to demonstrate how carbon reductions will be achieved	Planning & Development	Infrastructure NSW with infrastructure delivery agencies	There is no common template or approach to demonstrate credibility of carbon reduction planning in the same way that cost and timing (deliverability) are considered.
3.4 Adopt consistent carbon reporting requirements via policy or regulatory instruments and work towards future carbon intensity targets	Planning & Development	Environment Protection Authority and Department of Planning and Environment with Infrastructure NSW	*State Environmental Planning Policy (Sustainable Buildings)* is commencing the requirement to measure embodied emissions in residential and some non-residential development. However, there is currently no regulatory requirement to measure and/or mitigate embodied emissions for the majority of infrastructure projects. Options will be considered to address this through the planning assessment framework or other environmental policies or regulations.

Principles			
Action	**Project Stage**[5]	**Responsible Entity**	**Rationale**
4 Establish minimum expectations for embodied emissions reduction in tenders			
4.1 Set minimum requirements for reducing embodied emissions	Procurement	Infrastructure delivery agencies	Most tender requirements do not specify minimum embodied emissions reductions — reducing opportunities for industry to build this capacity. Effective options analysis and early engagement on design approaches should ensure that business cases preferred options are already optimised for embodied carbon. Tenders present an opportunity for bidders to seek to beat the optimised embodied carbon. This will require provision of reliable data and certainty that sustainability improvements will be given weight in tender evaluations (see below).
4.2 Update standard contracts to enforce carbon reductions	Procurement	Infrastructure delivery agencies	Carbon reduction commitments are not routinely enforced and monitored and there is opportunity to do so through contract terms.
5 Evaluate tenderer performance on embodied emissions reduction			
5.1 Assess embodied emissions performance measures as part of tender criteria	Procurement	Infrastructure delivery agencies	Embodied emissions reduction is not currently a criterion in tender evaluations undermining action on this issue, particularly where there are cost implications.
5.2 Assess embodied emissions reduction performance measures as part of Contractor Performance Reporting	Ongoing	Infrastructure delivery agencies	Regular reporting on contractor embodied emissions is rarely embedded in contracts and is required both to monitor performance and inform future target setting.
6 Improve education and capability on embodied emission reduction across the asset lifecycle			
6.1 Build knowledge and capability across the infrastructure delivery community	Ongoing	Infrastructure delivery agencies with Infrastructure NSW	There are few opportunities for infrastructure practitioners across the lifecycle to share knowledge and best practices on decarbonising infrastructure delivery.
6.2 Identify and address staff capability gaps	Ongoing	Infrastructure delivery agencies	Government delivery agencies and the construction industry have varying levels of skill and knowledge in relation to measuring, managing and reducing embodied carbon.

Expectations

These principles apply to all new NSW Government infrastructure projects. They aim to set a consistent approach and direction for NSW Government and will inform the development of guidelines on embodied emissions. Noting there are varying levels of capability and capacity across agencies, the guidelines will assist agencies to determine the actions required at each step of the project development lifecycle. The guidelines will also refer agencies to other relevant NSW Government policies at each project stage and should be adopted in a way that is proportional to each project.

Some agencies have commenced significant sustainability and emissions reduction programs and Government has a range of related policies and initiatives (see Appendix 1). Further, some agencies and projects are achieving reductions in embodied carbon through initiatives such as the Green Building Council of Australia — Green Star and Infrastructure Sustainability Council certification schemes. However, the majority of infrastructure projects are not assessed using these tools or the tools are not applied in the early design stages. This document outlines a set of expectations that are consistent with those efforts and should not be interpreted as a limitation on them.

This document does not supersede the expectation that agencies set their own organisational decarbonisation targets and agencies retain responsibility for planning, procurement, and delivery specifications in accordance with their Cluster responsibilities and experience.

Policy and Regulatory Framework

NSW Government policy and regulatory responses targeted at emissions reduction are currently focused on operational emissions. However there is momentum from both government and industry to ensure embodied emissions are addressed. In particular, the recent *State Environmental Planning Policy (Sustainable Buildings)* will require that embodied emissions are measured for residential and certain non-residential development and embodied carbon calculators are developed by BASIX and NABERS. Appendix 1 outlines the policy and initiatives underway that will target embodied emissions reduction.

Infrastructure NSW is also working with the Office of Energy and Climate Change (OECC), the NSW Environment Protection Authority and the Department of Planning and Environment to determine the appropriate policy and regulatory framework for emissions reduction for the whole infrastructure sector. This will initially focus on measurement and reporting on embodied emissions before the development of targets.

Principles For Decarbonising Infrastructure Delivery

1 Use consistent methods and data

When does the principle apply?	
Project Stage	All Stages
IIAF Review Gate	All Stages

The majority of NSW Government agencies do not have a framework to measure and manage carbon throughout the project lifecycle. Many are able to consider operational emissions of their assets but measuring embodied emissions of projects can be challenging without a deep understanding of the infrastructure supply chain.

Some agencies are developing tools to estimate embodied carbon (e.g. Transport for NSW's Carbon Estimation Reporting Tool and updates to BASIX and NABERS) or are accustomed to industry tools (e.g. those from the Infrastructure Sustainability Council or Green Building Council of Australia). However, many agencies embarking on this journey remain reliant on ad-hoc consultant expertise if they seek to measure embodied emissions.

Consistently measuring emissions is a critical step to making progress on their reduction. Lessons from overseas suggest that guidance and standards on the process of measuring embodied carbon should be introduced first — allowing accuracy and capability to improve over time.

Actions

1.1 Adopt a whole of NSW Government approach to measuring and managing infrastructure emissions

Infrastructure NSW will develop a policy for NSW Government infrastructure agencies, outlining the preferred approach to measuring and managing infrastructure project emissions, drawing on guidance from the UK's Construction Playbook and Publicly Available Standard (PAS) 2080 (carbon management in infrastructure).

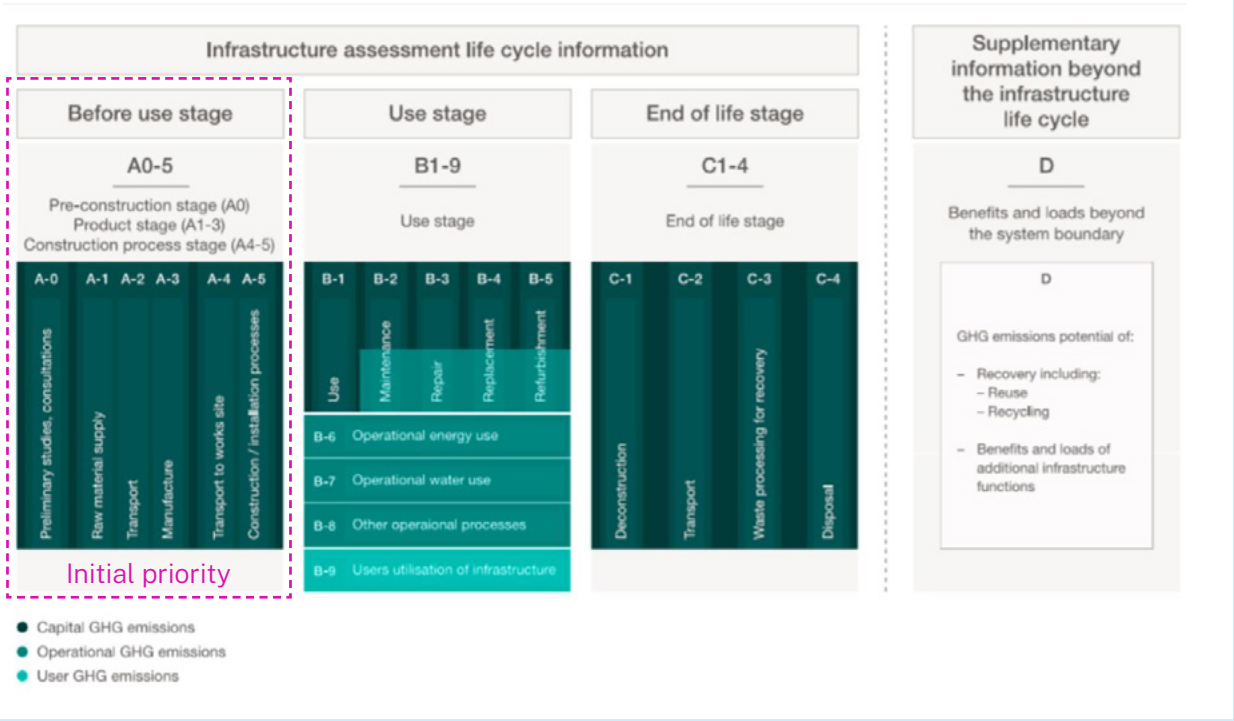
Infrastructure NSW and the OECC will work with infrastructure agencies to agree a common whole of government approach to the use of embodied carbon calculators (i.e. consistent scope, data sources, etc). The approach will be flexible to emerging digital innovations such as combining cost and carbon calculations in digital engineering or building information models (BIM). It is expected that aspects of the calculation approach and outputs will be common across all infrastructure to promote capability building and reduce reporting costs for government and industry. Opportunities for alignment with NABERS, which is rolling out a new embodied emissions tool for buildings, will be explored as these will help to build national consistency. Sectoral differences, as they arise between buildings and other civil infrastructure, could also be accommodated.

Box 2: PAS2080 Standard for Measuring Carbon in Infrastructure

For agencies to start to document and estimate the embodied carbon of infrastructure they should estimate pre-construction, production (e.g. materials, transport and manufacture) and construction stage emissions. This is consistent with PAS2080 (Carbon Management in Infrastructure), a publicly available standard developed in consultation with industry in the UK.

The standard provides a process and expectations for project teams to set carbon baselines and targets, quantify (with industry engagement), report, monitor and improve as the project evolves. While the initial focus of this document is an infrastructure project's 'before use' stage, the standard also outlines project team considerations in the 'use' and 'end of life' stages.

Figure 1: Extract from PAS2080:2016 showing project life cycles for carbon accounting



2 Reduce embodied carbon from options analysis and early design stages

When does the principle apply?	
Project Stage	Initiation — Planning & Development
IIAF Review Gate	Gate 0 Go/No Go Gate 1 Strategic Options Gate 2 Business Case

Options analysis and early design stages represent the greatest opportunity to influence embodied carbon. However, most agencies do not currently have a defined process or requirement to optimise design or source alternative materials that would reduce embodied emissions. The overwhelming majority of stakeholders — including designers, engineers, agency project teams and industry bodies — have raised the need to embed processes to reduce embodied carbon earlier in the design stage.

As noted in Principle 1, most agencies are not measuring the embodied carbon in their projects and have little insight into the status quo or Business as Usual (BAU) carbon footprint of their assets. Once project teams have access to a status quo or BAU baseline carbon footprint they can more effectively use options analysis and design optimisation to apply a hierarchy of approaches:

a) avoid embodied carbon, particularly by pursuing non-build solutions or adapting an existing asset,

b) reducing the quantity of materials used (particularly those with high embodied carbon),

c) increase use of recycled materials,[6] or

d) specify low emission building materials (LEBM) or low emissions construction practices.

In the near term, avoidance and optimisation of quantities are the most readily available methods and complement efforts to achieve public value in an environment of cost escalation. Over the longer term, low emissions building materials will be required to achieve net zero.

The lack of readily available LEBM that can be substituted for existing materials, such as green concrete or steel, is a challenge for agencies and industry. This reflects both the nascent market for these materials and the absence of a long track record of performance information that can be relied upon by engineers and designers. Further investigation and capability-building is required to demonstrate how building standards and technical specifications that are set to achieve safety, durability, functional and other requirements can continue to be met using LEBM. This work will need to be complemented by initiatives that set clear signals to the market encouraging the supply of LEBM.

Getting the variety of stakeholders across the project lifecycle (designers, engineers, contractor, asset owner, etc.) to agree to new approaches remains a barrier. Their differing incentives, risk tolerances and knowledge levels could be further addressed through more accessible materials and standards data and early and structured engagement with the market (see Box 3 outlining key barriers that need to be overcome).

6 As per the NSW Waste and Sustainable Materials Strategy, agencies should preference recycled materials in procurement. The principles set out in the forthcoming NSW Government Circular Design Guidelines, notably considering the project's end of life stage, should also be considered.

Box 3: Risk is a barrier to the use of recycled or low emission building materials

In addition to having awareness of innovative approaches, multiple stakeholder groups must face their unique risk considerations when designing and validating the use of sustainable materials or innovative construction processes.[7]

- **Design:** Designers must be confident that their materials and design advice poses no risk of future losses or claims.
- **Specify:** Organisational standards must have flexibility and research capability to validate approaches when they vary from established practices.
- **Procure:** Procuring agencies must have confidence in the tenderer's ability to obtain materials and deliver an innovative approach, particularly when compared against more traditional approaches.
- **Deliver and Operate:** Builders and asset managers must have confidence that the new approach will be durable over time.

Actions

2.1 Use options analysis to consider options for non-build solutions or augmentation of existing assets

When considering the strategic need for the project, project teams should use options analysis and design optimisation to apply a hierarchy of approaches:

a) Avoid embodied carbon, such as by pursuing non-build solutions or adapting an existing asset.

b) Reduce the quantity of materials used (particularly those with high embodied carbon).

c) Increase the use of recycled materials.

d) Specify low emissions building materials (LEBM) or low emissions construction practices.[8]

2.2 Establish a BAU carbon baseline and set a minimum target for emission reduction from the earliest design phase

Agencies or industry partners designing a project must establish a BAU carbon baseline for projects at the earliest possible design stage. The BAU baseline should be measured using an approach consistent with Principle 1. Project teams must set a carbon reduction target relative to the BAU carbon baseline during the design phase. At the conclusion of the design phase, the embodied carbon of the preferred option, i.e. the 'optimised baseline', is to inform tender requirements (see Figure 2 below).

Depending on the contractual model, the level of design undertaken may be limited or extensive. The baseline (BAU), and any proposed reductions (optimised), should be provided:

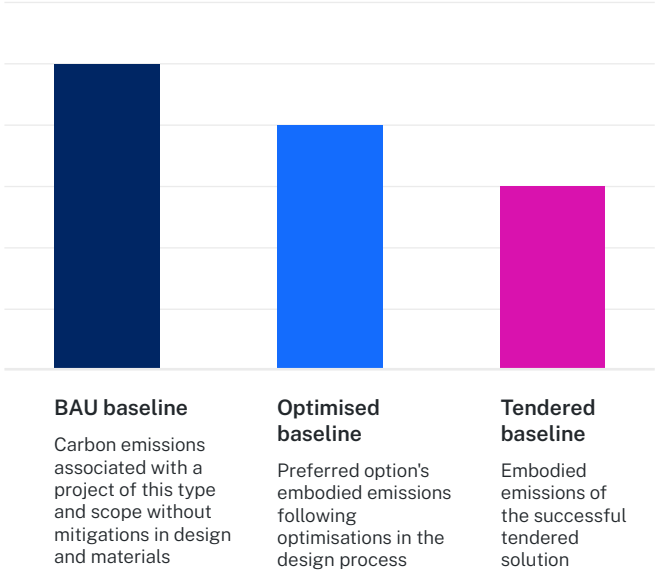
a) during the business case development stage (see Principle 3): to support effective investment decision-making, project teams will need a BAU carbon baseline, at a minimum. However, consistent with the level of detail provided by cost estimators, design teams should also provide the best available estimates of embodied emissions of the options (including proposing reductions)

b) to tenderers during the procurement stage (see Principle 4 and 5): it is important that any assumptions about a carbon baseline and proposed reductions are provided to tenderers, noting that further reductions may be expected/assessed as part of the tender evaluation (Figure 2).

7 Adapted from OECC (NSW Treasury), The Low Emissions Building Materials Program briefing, 2021, p. 21.

8 The hierarchy is intended to reduce the overall project's embodied emissions and therefore should not prefer options that use low emissions materials unless they lead to a project with lower overall emissions.

Figure 2: Carbon baseline across project phases (illustrative example)[9]



2.3 Engage with industry as early as possible on low emission designs and approaches

During early market interactions, agencies must engage industry on low emissions design and alternative approaches before releasing tenders.

In accordance with the Premier's Memorandum on Procurement for Large, Complex Infrastructure Projects[10] agencies should engage prior to finalising options (Strategic Business Case) through market soundings or establish Early Contractor Involvement models to ensure adequate time to investigate alternative designs that reduce embodied carbon.

2.4 Maximise use of recycled and low emissions building materials where possible and regularly review whether standards are constraints

Once options to avoid or reduce materials are exhausted, agencies must maximise use of recycled and low emissions building materials or justify why not (from a specifications, cost or emissions perspective).

Infrastructure NSW and the OECC will develop tools and guidance to support specifications reform in partnership with infrastructure delivery agencies. For example, a catalogue of piloted recycled and low emissions building materials, outlining their specifications and use cases, will be developed to support uptake.

Agencies must also publish their standard setting process (and process for reviewing technical standards) for industry visibility and awareness.

Agencies are already piloting a number of innovative materials on infrastructure projects and research continues (by various agencies and the EPA) to identify circular economy opportunities for priority waste materials, such as using coal ash and crushed glass (Box 4). Building infrastructure is also increasingly exploring the use of engineered timber materials that can also sequester carbon.[11]

9 Adapted from Infrastructure Partnerships Australia, Decarbonising Construction: Putting Carbon in the Business Case, 2022.
10 NSW Government, M2021-10 Procurement for Large, Complex Infrastructure Projects, 2021.
11 Clean Energy Finance Corporation, Australian buildings and infrastructure: Opportunities for cutting embodied carbon, 2021, p. 26.

Box 4: NSW Government pilots are demonstrating benefits of recycled materials

Transport for NSW has successfully deployed recycled materials in major projects.

Albion Park Rail bypass

The Albion Park Rail Bypass was opened in October 2021. The $630 million project which completed the 'missing link' for a high standard of road between Sydney and Bomaderry adopted a circular economy approach to keep materials in use for longer. The project represents best practice in circular infrastructure, successfully reusing approximately:

- 500,000 tonnes of coal wash, a low-grade mining waste.
- 300,000 tonnes of tunnel spoil.
- 130,000 tonnes of recycled Select Material Zone (SMZ) material.
- 180,000 tonnes of Heavily Bound Base (HBB).
- 6,000 tonnes of Recycled Crushed Glass (RCG) used in asphalt.

To replace sand used in asphalt, the Albion Park Rail bypass used recycled crushed glass that is the equivalent of 30 million glass bottles. The base asphalt layer used on the Albion Park Rail bypass is made up of 25 per cent recycled material, including 10 per cent recycled crushed glass and 15 per cent reclaimed asphalt pavement.

Recycled crushed glass has also been used for the Sydney Metro Trains Facility expansion, avoiding the need to import virgin bedding sand, and avoiding the impacts of extraction and transport of natural resources, and generating cost savings for the project.[12]

Transport for NSW is now incorporating its learnings into discrete technical specifications and continuing to research other emerging areas of recycled materials.

Box 5: NSW Government pilots are demonstrating benefits of recycled materials

Wells Crossing to Glenugie

For pavements on the 'Wells Crossing to Glenugie' Pacific Highway project, ACCIONA has worked with the EPA and Transport for NSW to document the results of its trial along almost 10 kilometres of the corridor. The project replaced significant quantities of sand in its concrete mix with 2000 tonnes of recycled crushed glass.

sand replacement in lean mix

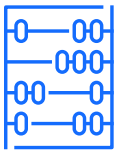
Box 6: Modern Methods of Construction offer opportunities for decarbonisation

School Infrastructure NSW has also continuously improved its Modern Methods of Construction approach which enables modular construction of classrooms, vertical risers, lift cores and amenity modules in factories offsite, then installed as a complete module at the school site. Further efforts to standardise building components (e.g. kit of parts) has driven safety, cost and time benefits and can also be used to trial use of engineered mass timber such as at Fern Bay Public School.[13] Modern Methods of Construction can be used to reduce embodied carbon by reducing carbon emitted during transport of materials, minimising waste and more efficient construction processes.

Ongoing collaboration with the OECC and the EPA will ensure that the results of trials and the transition of certain specifications to performance-based standards can be documented and help build government and industry knowledge.

12 Transport for NSW, Sustainability Plan, 2021, p. 66.
13 Schools Infrastructure NSW, Modern methods of construction, 2022.

3 Account for embodied emissions in business cases



When does the principle apply?	
Project Stage	Planning & Development
IIAF Review Gate	Gate 1 Strategic Options Gate 2 Business Case

Embodied carbon is not currently considered in investment appraisal. Business case guidelines do not require agencies to articulate and/or mitigate the carbon emissions associated with their projects and Cost Benefit Analysis Guidelines do not require carbon to be valued. As part of its independent review of infrastructure business cases, the Infrastructure Investor Assurance Framework (IIAF) has a limited and general sustainability focus area (with attention primarily on planning and environmental approvals rather than carbon management).

Industry stakeholders are aware of this critical phase and are consistently calling for the cost-benefit analysis and business case processes to better consider carbon and mitigation efforts.[14] The NSW Government has signalled it is open to changing this and is reviewing and updating its Guidance on Cost-Benefit Analysis, which is to be released in early 2023, before moving on to its Business Case Guidelines.

Jurisdictions in the EU and the UK with legislated and or highly regulated carbon emissions objectives are increasingly embedding embodied emissions in investment decision-making and planning processes. The approach taken in these jurisdictions initially focusses on measuring embodied emissions before using this information to set targets.[15] For example, whole of life carbon assessment is required in France, the Netherlands and Denmark where it has informed targets for embodied carbon in regulations. Finland, Sweden, Germany and Switzerland have introduced the requirement for whole of life carbon assessment with plans to introduce carbon targets in the near term.[16]

Similarly, the UK House of Commons Environmental Audit Committee recommended that a mandatory requirement to undertake Life Cycle Assessment for buildings would allow the government to then set carbon targets for construction.[17] Building on this, members of the UK construction industry have proposed an amendment to the UK building regulations that gives guidance on how to measure carbon and sets limits for embodied carbon.[18]

14 Infrastructure Partnerships Australia, Decarbonising Construction: Putting carbon in the business case, 2022. Business Council of Australia, Infrastructure in a world moving to net zero, 2022.

15 UK Parliament, Building to net zero: costing carbon in construction, House of Commons Environmental Audit Committee, 2022, p. 17.

16 Buildings Performance Institute Europe, Whole-Life Carbon: Challenges and Solutions for Highly Efficient and Climate-Neutral Buildings, 2021.

17 UK House of Commons Environmental Audit Committee 2022, Building to net zero: costing carbon in construction, House of Commons Environmental Audit Committee, 2022.

18 Arnold, W., den Dekker, T., Giesekam, J., Godefroy, J. and Sturgis, S., Part Z: Whole life carbon, UK Construction Industry proposal to amend The Building Regulations 2010, 2022.

Box 7: Measuring carbon in the UK Infrastructure and Project Authority Gateway Review Process[19]

Since July 2021, the Infrastructure and Projects Authority's Gate Review process for major projects includes tests for net zero and climate change mitigation. The tests are equivalent to Gateway Review focus areas facilitated through Infrastructure NSW's Assurance review process. They are designed to ensure agencies have estimated emissions and are taking steps to reduce them across the project lifecycle.

The UK Gate Review process requires that a whole life carbon assessment is undertaken as part of the development of the business case. It is recommended that the whole life carbon assessment is undertaken in accordance with PAS 2080.

The requirement to measure carbon in business cases is complemented by other tests that seek to verify that project teams contemplate emissions mitigation activities, Net Zero targets and the UK carbon budgets (across all gates including procurement) as well as considering:

- the cost-effectiveness of low emission designs (as compared to difficult retrofits at a later phase)
- low-carbon materials and energy
- the range of potential future low-carbon behaviours
- off-site construction methods.

Actions

Disclaimer: Updates to Treasury's Guidelines on Cost-Benefit Analysis and Business Cases have not yet been publicly released. The below actions should be adopted as proportional and relevant to individual projects.

3.1 Include carbon emissions and reduction plans in business cases

Agency business cases must estimate whole of life emissions, including embodied emissions, associated with project options. The degree of detail provided is to be proportional to the size and detailed development of the project. The scope of embodied emissions included should be in line with PAS 2080.

Agencies must also, as part of their business case implementation planning, outline their proposed emissions reductions plans.

Avoiding or reducing the scope of construction required for new physical infrastructure is the preferred approach to reducing embodied emissions. This is consistent with good practice options evaluation where agencies must include 'if-not-why-not' options to use/augment an existing asset where feasible as an alternative to new physical infrastructure.

3.2 Value carbon emissions — including embodied emissions

Agencies must include the value of carbon estimated as part of their proposed project options in accordance with NSW Treasury guidance on carbon values.

Including these lifecycle carbon costs will ensure decision-makers have a greater understanding of the strengths and weaknesses of certain options and the potentially higher cost retrofits required in the future to achieve net zero.

19 Infrastructure and Projects Authority (UK), Assurance Review Toolkit, 2021.

3.3 Prepare carbon management plans to demonstrate how carbon reductions will be achieved

For large projects, or those meeting State Significant Development thresholds, agencies must prepare carbon management plans (as per PAS 2080) at the final business case stage to demonstrate how they intend to achieve the target carbon footprint for the project. The threshold for what constitutes a large project is to be developed in consultation with agencies and industry. Carbon management plans may form part of environmental and sustainability management plans.

For projects subject to the Infrastructure Investor Assurance Framework (IIAF), reviews may request the carbon management plan to demonstrate a project team has measured and independently verified its carbon estimates as well as query whether options to avoid, recycle or innovate in the use of materials have been appropriately considered.

Gate 1 Strategic Options and Gate 3 Readiness for Market will also query whether project teams have adequately considered opportunities for reductions (and consulted with industry).

3.4 Adopt consistent carbon reporting requirements via policy or regulatory instruments and work towards future carbon intensity targets

Infrastructure NSW will work with the Environment Protection Authority and Department of Planning and Environment to develop consistent embodied carbon reporting requirements for infrastructure projects as part of the planning assessment and/or environmental protection regulatory framework. These measures will be consistent with the embodied carbon reporting requirements for residential and non-residential development in *State Environmental Planning Policy (Sustainable Buildings)* and will focus on reporting embodied carbon to enable reduction targets to be set in the future.

4 Establish minimum requirements for reducing embodied emissions in tenders

When does the principle apply?	
Project Stage	Procurement
IIAF Review Gate	Gate 3 Readiness for Market

Tender requirements for infrastructure projects do not consistently specify embodied emissions reductions. Specifying emissions reduction requirements would set a clear direction to industry about the expectations of government and support adaptation and growth in the supply chain.

Agencies should develop minimum requirements, relating to embodied emissions, that can be flexibly applied depending on the project and procurement method. Tender requirements must be proportional and relevant to what is being procured and should have the ability to be turned on or off depending on the situation. Transport for NSW has developed a set of targets, referred to as Baseline Sustainability Requirements, that can help to inform broader application across NSW Government (see Box 8).

Actions

4.1 Set minimum requirements for reducing embodied emissions

In the procurement stage, agencies should set minimum requirements in tenders. Agencies' requirements may specify a minimum reduction in embodied emissions, a minimum use of certain sustainable materials or other options provided there is sufficient consistency to reduce compliance costs for industry. Tenderers are then required to demonstrate how they will meet or exceed the target, ideally through their own carbon management plans. If reductions in embodied emissions are required, tenderers should be given information on the embodied carbon assessed for the preferred option that is the optimised baseline in Figure 2. However, depending on the procurement model, industry may work collaboratively with government to reduce a BAU baseline.

Box 8: Transport for NSW Baseline Sustainability Requirements [20]

Transport for NSW (TfNSW) has developed and co-created with industry a Sustainable Procurement in Infrastructure (SPII) initiative to support decarbonisation and the development of a circular economy.

The SPII introduce 'baseline sustainability requirements' to be included in tenders. These requirements set objective and quantitative targets for various sustainability areas, including embodied emissions. Tenderers must demonstrate how they will meet or exceed the baseline sustainability requirements.

The baseline sustainability requirements for embodied emissions are currently set to require reductions of 10% from the project baseline — relative to the embodied emissions of a BAU approach. This builds upon existing TfNSW Sustainable Design Guidelines which require all projects with a capital expenditure of $15 million or more to reduce embodied emissions by a minimum 5% from the project baseline footprint.

4.2 Update standard contracts to enforce carbon reductions

Agencies should make carbon reduction commitments in tenders legally enforceable through contracts. To drive industry action, reduction requirements and associated carbon management plans should become key performance indicators and may have financial incentives attached.

20 Transport for NSW, Sustainable Procurement in Initiative Discussion Paper, 2022.

5 Evaluate tenderer performance on embodied emissions reduction

When does the principle apply?	
Project Stage	Procurement
IIAF Review Gate	Gate 4 Tender Evaluation

Embodied emissions reduction is not currently a criterion in tender evaluations. Ongoing reporting of emissions by contractors is also inconsistently requested. Including embodied emissions reduction performance in tender evaluation reinforces the expectations of government to industry and creates an incentive for industry to respond and expand its skills.

Experience in other jurisdictions suggests there are several ways to adjust tender evaluations to solicit improvements from the embodied carbon baseline established in the design stages. Transport for NSW has also been successful in requesting maximum target cost/reverse-engineered tender processes where bidders are permitted to innovate on scope, design requirements and standards to maximise outcomes within a defined budget envelope.

NSW Government procurement policy is undergoing a significant review for opportunities to support key sustainability outcomes. There are opportunities to learn from other jurisdictions like the Netherlands who have been integrating emissions performance into the price evaluation since 2015.

Box 9: Netherlands Case Study: Methods to integrate emissions performance into price criteria in procurement evaluation[21]

Rijkswaterstaat (the Department of Public Works of the Ministry of Infrastructure and the Environment) developed two methods for procuring agencies to choose to assess emissions performance while maintaining a most economically advantageous tender outcome.

CO2 performance ladder: The ambition level of the tenderer against a specified 5 rung 'performance ladder' leads to corresponding percentage reduction in their assessed price. The first step (or "rung" on the ladder) is to measure the organisation's project emissions — yielding a 1 percent reduction in price — as compared to a level 5 ambition which yields a 5 percent reduction in price.

Environmental Cost Indicator (ECI) value: The ECI is a consistent calculation of lifecycle carbon emissions for infrastructure. It uses an independent (national) dataset containing certified embodied carbon information for each material. The ECI value is transformed into a monetary value and used by the contracting authority to combine with the tendered prices. The lowest combined price is the preferred tenderer.

The Dutch approach should not suggest that additional carbon reduction achievements always impact on price competitiveness. As noted below, positive outcomes associated with cost and carbon can be achieved together (Box 10 below).

21 OECD, Public Procurement Toolbox, Green public procurement in the Netherlands, 2016.

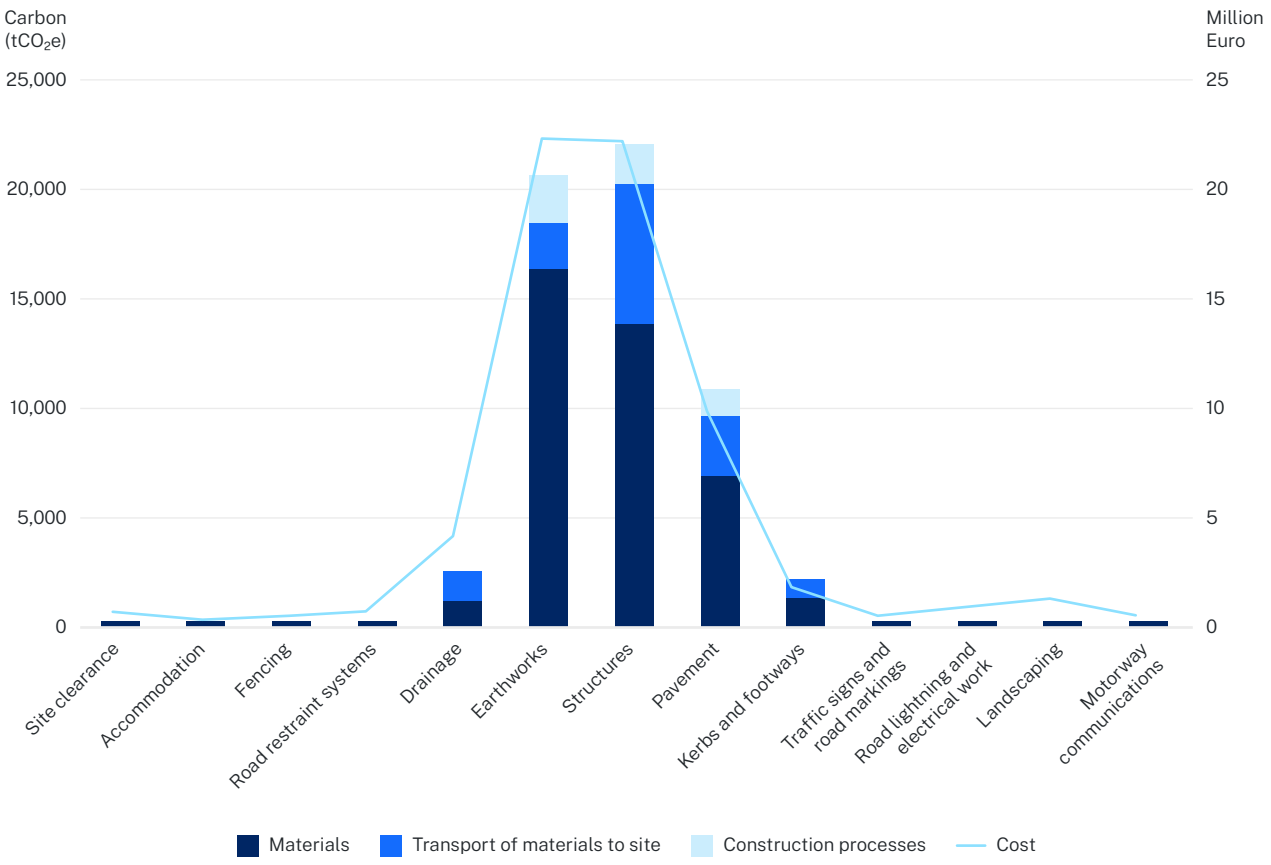
Box 10: Carbon and cost savings at the Glasgow Airport Investment Area[22]

In the Glasgow Airport Investment Area, carbon reduction was worth 5% of the quality score at the prequalification stage and contractors were challenged with a savings target of 2,000t of carbon (about 20% of the total carbon footprint) at the tender stage.

Post design, a 30% reduction against baseline design was achieved with a corresponding reduction in cost (overall savings from baseline design were over €14 million).

Aggregated data from engineering firm Sweco (a supporting partner to the Glasgow Airport Investment Area) suggests that efforts to reduce embodied carbon in a typical UK road scheme may also yield significant cost savings.

Carbon and cost correlation (Road Scheme, UK)



22 Construction Leadership Council, Infrastructure Carbon Review: 7 Years On, 2021; Sweco, Carbon Cost in Infrastructure, 2020.

Actions

5.1 Assess embodied emissions performance measures as part of tender criteria

Agencies should request embodied carbon estimates as part of the assessment of tenders and include performance on embodied carbon reduction explicitly within the criteria. There are a range of options, such as inclusion in non-price criteria, a pass/fail requirement or inclusion in price criteria.

Commitments to embodied emissions reduction should then be incorporated into the final contract for the successful tender.

5.2 Assess embodied emissions reduction performance measures as part of Contractor Performance Reporting

Agencies should require successful tenderers to measure and report on actual embodied emissions throughout the project.

Following the successful completion and delivery of the project, contractor reporting will then be used to inform and improve embodied emissions estimates for future projects, as well as opportunities for more ambitious reductions.

6 Improve education and capability on carbon reduction across the asset lifecycle

When does the principle apply?	
Project Stage	Ongoing
IIAF Review Gate	n/a

Government delivery agencies and the construction industry have varying levels of skill and knowledge in relation to measuring, managing and reducing embodied carbon. This poses challenges in the ability to set embodied emissions reduction targets, adopt alternative design approaches or use alternative building materials and construction methods. Targeted and ongoing capability building is required to transition to a construction sector where embodied emissions reduction is 'business as usual'.

Advice received from industry and government stakeholders is that professional development, training and other resources will be critical to ensuring agencies are aware of and address gaps in capability or other barriers to decarbonising infrastructure delivery.

Actions

6.1 Build knowledge and capability across the infrastructure delivery community

Agencies should support knowledge and data sharing on common challenges and uplift capability across the sector. Relevant forums, including the NSW Government Construction Leadership Group (CLG) and other Communities of Practice, can be utilised as opportunities for sector uplift across the NSW Government and to encourage industry participation.

6.2 Identify and address staff capability gaps

Agencies should conduct a review of staff capability to identify gaps in existing capability development and training frameworks. Agencies may develop additional guidance or training to help staff identify applicable risks and opportunities through design, business case development, procurement and construction processes. Opportunities to share and disseminate good practice should be taken through the Construction Leadership Group and other forums.

Next Steps

Not all principles can be fully actioned today and will require a progressive and proportional implementation. Short, medium and long term milestones are provided below to give agencies and industry time to adapt processes and approaches.

Action	Short Term (end of 2023)	Medium Term (2024 – 2027)	Long Term (by 2030)
1.1 **Adopt a whole of NSW Government approach to measuring and managing infrastructure emissions**	Adopt a consistent scope and approach to considering embodied emissions in infrastructure projects All agencies measure embodied emissions in new projects	Align method of calculating embodied emissions across NSW Government and routinely measure embodied emissions across projects	
2.1 **Use options analysis to consider non-build solutions or augmentation of existing assets**	Project teams use options analysis and design optimisation to apply a hierarchy of approaches that seek to avoid and minimise embodied carbon.		
2.2 **Establish a BAU carbon baseline and set a minimum target for emission reduction from the earliest design phase**	All projects establish an embodied carbon baseline for the project and seek to reduce from the design phase	Minimum targets for embodied emissions reductions are routinely set from the design phase	Embodied emissions reductions targets are increased in line with increasing capability
2.3 **Engage with industry as early as possible on low emission designs and approaches**	All agencies engage in early and structured market interaction models to ensure adequate time to design and procure reduced carbon options		

Action	Short Term (end of 2023)	Medium Term (2024 – 2027)	Long Term (by 2030)
2.4 Maximise use of recycled and low emissions building materials where possible and regularly review whether standards are constraints	Produce catalogue of recycled and low emissions building materials, including materials' characteristics and use cases Agencies collaborate with the OECC and EPA to pilot recycled and low emissions building materials Work with market to identify key barriers to availability of low emissions building materials, and work with industry where market failure warrants Government action	Ongoing development of standard specifications for the use of recycled and low emissions building materials	Agencies routinely use recycled and low emissions building materials as the market for materials matures
3.1 Include carbon emissions and reduction plans in business cases	Business cases include embodied carbon and mitigation approaches		
3.2 Value carbon emissions — including embodied emissions	Carbon emissions, including embodied emissions, are valued for project options in the business case		
3.3 Prepare carbon management plans to demonstrate how carbon reductions will be achieved		Carbon management plans for large and State Significant projects are prepared as part of the final business case as agency capability matures	
3.4 Adopt consistent carbon reporting requirements via policy or regulatory instruments and work towards future carbon intensity targets	Develop consistent requirements for reporting of embodied emissions and undertake processes required for policy and/or regulatory instruments to come into force	Adopt consistent reporting requirements for embodied emissions under policy and/or regulatory instruments	Use data and evidence to inform carbon intensity targets for infrastructure sectors

Action	Short Term (end of 2023)	Medium Term (2024 – 2027)	Long Term (by 2030)
4.1 Set minimum requirements for reducing embodied emissions	Draw on lessons learnt from Transport's introduction of 'baseline sustainability requirements' to inform broader Government sustainability requirements	Establish minimum expectations for tenderers to achieve embodied carbon reductions	
4.2 Update standard contracts to enforce carbon reductions	Develop template contract terms to support agencies who wish to draw on these	Emissions reduction commitments form part of the terms of the contract that is awarded.	
5.1 Assess embodied emissions performance measures as part of tender criteria		Performance on embodied carbon reduction is explicitly included as part of the assessment criteria, as either price, non-price criteria, or a pass/fail requirement.	
5.2 Assess embodied emissions reduction performance measures as part of Contractor Performance Reporting		Contractors are required to report on carbon reduction commitments throughout the project.	
6.1 Build knowledge and capability across the infrastructure delivery community	Knowledge sharing continues through the NSW Government Construction Leadership Group, other Communities of Practice and the Materials and Embodied Carbon Leaders Alliance.		
6.2 Identify and address staff capability gaps	Agencies review employee capability to measure and reduce carbon reduction through design, business case development, procurement and construction processes and commence training related to carbon reduction opportunities.	Agency employees receive regular training and education related to carbon reduction opportunities.	

Appendix 1: NSW Government initiatives addressing embodied emissions

Embodied Carbon Calculations and Reporting

- *National Australian Built Environment Rating System* (NABERS), which currently measures the operational energy efficiency of buildings, is working to incorporate the assessment of embodied emissions performance into their rating system. NABERS is managed by the NSW Government for the benefit of all Australian jurisdictions.
- The *State Environmental Planning Policy (Sustainable Buildings)* requires embodied emissions to be measured for residential and certain types of non-residential development, to satisfy BASIX requirements, prior to development consent being granted. The policy will come into effect on 1 October 2023, allowing time for industry to adapt.
- The Office of the Building Commissioner is collaborating with the Department of Customer Service and Schools Infrastructure NSW to create an embodied carbon calculator Minimum Viable Product (MVP) as part of their Building Assurance Solution. They will pilot it with the newly built modular public-school building (Fern Bay Public School).
- Transport for NSW has a Carbon Estimate and Reporting Tool (CERT) which is being updated to improve project teams' ability to set a carbon baseline for new projects.

Recycled and Low Emissions Building Materials

- The EPA's $37 million Carbon Recycling and Abatement Fund will support innovative circular economy approaches to manage waste and materials more efficiently and reduce emissions, including projects that will
  - trial the innovative use of low-carbon recycled materials
  - trial new approaches to reducing and recycling of waste generated through construction and demolition activities — such as modular design, digital materials passports, and novel uses of 'products as a service'
  - help businesses co-locate in areas like the Clean Manufacturing Precincts and Special Activation Precincts where they can beneficially reuse each other's by-products, reducing their waste and carbon footprints.
- The OECC and infrastructure delivery agencies are progressing research initiatives to explore barriers to use of certain low emission and recycled materials, including looking at information, procurement and industry development policy levers.

Procurement Policy initiatives

- The Transport for NSW draft *Sustainable Procurement in Infrastructure* initiative proposes introducing baseline sustainability requirements and changes to specifications to support the uptake of low carbon design solutions.
- The *Waste and Sustainable Materials Strategy* requires NSW Government departments to preference products that contain recycled content, including building materials and office fit outs and supplies, on an 'if not, why not' basis. Complementary to this, the NSW EPA *Waste Delivery Plan* outlines the actions to implement the *Waste and Sustainable Materials Strategy* focusing on reducing carbon emissions by building a resilient circular economy, managing the risks of problematic, harmful and unnecessary waste and supporting councils and communities to safely manage waste. As part of this work, the EPA has also identified priority waste materials for the purpose of developing a carbon abatement cost curve that will assist in identifying carbon abatement opportunities of waste recycling initiatives.
- The Government Resource Efficiency Policy 2019 sets mandatory requirements for NSW Government agencies to achieve operational efficiency. It is currently being reviewed and updated to further expand the scope of its application for infrastructure delivery agencies.