

Sustainable Built Environment National Research Centre AUSTRALIA

Bringing Consistency and Enhancing Circular Economy Practices in the Built Environment

Final Industry Report
Project 1.10.4

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Preface

The Sustainable Built Environment National Research Centre (SBEnrc) Australia, the successor to the Cooperative Research Centre for Construction Innovation, remains committed to making a leading contribution to innovation across the Australian built environment industry after more than two decades of operation. We are dedicated to working collaboratively with industry and government to develop and apply practical research outcomes that improve industry practice and enhance our nation's competitiveness.

We encourage you to continue to draw on the results of our Centre's applied research to deliver tangible outcomes for your operations. By working together, we can transform our industry and communities through enhanced and sustainable business processes, environmental performance and productivity.



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List of Abbreviations

Abbreviated Form	Full Form
CE	Circular Economy
DBS	Delithiated Beta Spodumene
EPD	Environmental Product Declaration
ESG	Environmental Social and Governance
ISO	International Organization for Standardization
LCA	Life Cycle Assessment
PESTEL	Political, Economic, Social, Technological, Environmental and Legal
MCI	Material Circularity Indicator

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Svet (Source: Adobe Stock)

Executive Summary

As major contributors to greenhouse gas emissions, the construction and infrastructure sectors face increasing pressure to reduce emissions, improve resource efficiency and demonstrate measurable progress towards net zero and circular economy (CE) outcomes. Despite growing policy ambition, CE practices remain inconsistently applied across the built environment, particularly regarding materials, procurement and performance measurement. This industry report, developed under SBEnrc Project 1.10.4, addresses this challenge by examining how CE principles can be practically embedded into construction and infrastructure delivery to enable the uptake of local products with recycled and recyclable content.

The research found that CE practices vary widely across Australia, largely because industry understanding of CE terminology – and of the R-strategies that underpin it, such as reducing, reusing, repairing, refurbishing and recycling – is inconsistent. The case studies also showed clear differences in how CE is applied across the building and infrastructure sectors. Most importantly, the evidence shows that successfully scaling CE outcomes depends on procurement practices, business models and lifecycle responsibility being closely aligned.

What is working:

- Policy-led procurement and clear government signals are effectively driving uptake of recycled and low-carbon materials, particularly in infrastructure delivery.
- Technical capability across the supply chain has matured, with recycled and alternative materials consistently meeting performance, durability and safety requirements.
- Demonstration projects and alliance delivery models are accelerating learning, reducing perceived risk and enabling suppliers to scale proven solutions.
- Service-based and asset-stewardship business models are delivering strong circular outcomes by extending asset life and retaining material value.

What is holding the industry back:

- CE definitions, R-strategies and performance metrics remain inconsistent across jurisdictions, creating uncertainty and limiting transferability.
- Procurement frameworks often prioritise upfront cost over whole-of-life value, particularly in building construction.
- Circular practices are still dominated by recycling, while higher value strategies such as reuse, refurbishment and service-based models remain underutilised.
- Limited data transparency, traceability and consistent use of Life Cycle Assessment and circularity metrics constrain confident decision-making.

What needs to change:

- Shift from recycled-content targets to outcome-based, whole-of-life circular performance metrics embedded in procurement and standards.
- Normalise business models that retain lifecycle responsibility including leasing, buy-back, refurbishment and redeployment.
- Align CE taxonomy, definitions and approval pathways nationally to enable scalability and investment certainty.
- Invest in digital traceability, materials passports and verified performance data to support market confidence and comparability.
- Move beyond pilots by institutionalising proven circular solutions into standards, specifications and long-term delivery programs.

1.0 Introduction

A 2025 industry report by Coreo, Green Building Council of Australia, Clean Energy Finance Corporation and NSW Government found that, on average, new construction projects generate approximately 141 kg of waste per square metre of gross floor area, at a cost of approximately A$384/m² in wasted materials and resources. Considering circular economy (CE) practices in the construction process could have saved resources. Thus, the necessity of the CE in the built environment is undeniable; however, its narrow scope of application and inconsistent industry practices hinder its wider uptake, as highlighted by the *Circular Economy Ministerial Advisory Group: Interim report* (Department of Climate Change, Energy, the Environment and Water (DCCEEW), 2024).

1.1 Aim

This project aims to provide the evidence base for the effective transition to a nationally consistent CE taxonomy and to improve CE business models by demonstrating their whole-of-life benefits.

1.2 Industry Motivation

The built environment industry requires standardised CE practices to reduce waste generation, optimise resource use and minimise environmental impact, while enhancing the long-term sustainability of infrastructure and buildings. In addition, consistency in the CE taxonomy, along with a better understanding of the ecosystem and the identification of necessary adjustments in standards and regulatory policies, are urgently needed for the industry to foster CE practices in Australia.

1.3 Project Objectives

The project aims to achieve the following key objectives:

1. Analyse current practices and develop a consistent CE taxonomy based on various R-strategies.
2. Examine effective business models to foster uptake by industry and influence relevant policies and standards.
3. Enhance the lifecycle circularity performance of the construction material supply chain.



2.0 Research Approach

The project employed a mixed-methods approach, incorporating both qualitative and quantitative data collection and analysis as appropriate to achieve the research objectives.

2.1 Literature Review

A systematic literature review was conducted to examine current CE practices with respect to taxonomy, the structured classification of CE concepts and activities, and various R-strategies – the hierarchy of resource retention approaches such as refuse, rethink, reduce, reuse, repair, refurbish, remanufacture and recycle. The thematic analysis identified widespread inconsistencies in CE definitions and taxonomies, highlighting a critical gap between theoretical frameworks and practical implementation. While recycling and reduction dominate current CE practices, higher value strategies such as reuse, repair, refurbishment and remanufacturing remain underutilised due to technical, economic and regulatory barriers.

This review identifies six key gaps hindering CE adoption in the built environment: (1) limited empirical implementation of CE models; (2) lack of standardised frameworks, tools and circular business models (CBMs); (3) fragmented and insufficient policy and regulatory support; (4) weak multi-stakeholder collaboration and behavioural readiness; (5) limited integration of digital technologies (for example, Building Information Modelling (BIM), Internet of Things, material passports); and (6) insufficient life-cycle thinking across design, construction and maintenance phases.

2.2 Case Study Analysis

The project employed four case studies, out of which two – Main Roads Western Australia (MRWA) and One Project – were related to road infrastructure projects, and ATCO and BGC case studies were related to building construction projects. Table 1 shows the data toolkit used in the case study.

Table 1. Data collection toolkit used in each case study

Case study	Data collection tool used
Main Roads WA	Review of qualitative and quantitative secondary data available on project website, in reports and presentations, and Environmental Product Declaration (EPD) applications
	Interview with the relevant stakeholders involved in the supply chain
One Project	Review of project documents, case-study websites and related materials for qualitative data
	Interview with the relevant stakeholders involved in the project delivery and completion
ATCO	Review of project documentation and desktop study of the modular space rental circular business
	Desktop document review
BGC Masonry	Collection of material and process data of the masonry brick manufacturing in BGC bricks to analyse the baseline Material Circularity Indicator (MCI) tool of the Midland masonry bricks
	Analysis of lifecycle inventory data from resource extraction to the manufacturing of masonry bricks using the Life Cycle Assessment (LCA) tool (SimaPro software)

2.3 Material Circularity Indicator (MCI) and Life Cycle Assessment (LCA)

The project applied both the MCI for assessing product-level circularity (Ellen MacArthur Foundation, 2015) for BGC/Midland Brick's Mansory Products, along with the LCA.

3.0 Circular Economy Taxonomy and R-Strategies

The case study indicates that the underlying principles of the CE have been considered and applied across both construction and infrastructure projects in Australia. However, the level of application and maturity varies. Table 2 presents comparative rating scores for the seven circular economy dimensions of the case studies, based on the level of CE application and the maturity of CE implementation. The following four-level maturity scales were used:

- A score of 0 (absence) indicates that the circularity principles and dimensions are not considered, and absent in the case study project.
- A score of 1 (implicit or ad hoc) indicates that the dimension is acknowledged or partially addressed, but implementation remains informal, inconsistent or dependent on individual initiatives rather than structured processes, with evidence primarily qualitative or descriptive in nature.
- A score of 2 (explicit and implemented) indicates that the dimension is clearly articulated and implemented through defined practices, specifications or processes, supported by documented procedures and measured outcomes, although application may be limited in scale, scope or consistency.
- A score of 3 (institutionalised and scalable) indicates that the dimension is embedded within formal governance, procurement or organisational systems and applied consistently across projects or product lines, supported by verified measurement, repeatable processes and demonstrated scalability beyond a single project or pilot.

Table 2. Cross-case maturity assessment of circular procurement interventions in built-asset value chains

Dimensions	Main Roads WA	One Project (VIC)	ATCO (QLD)	BGC (WA)
1. CE principles adoption	3	2	2	2
2. R-strategy implementation depth	3	3	3	2
3. Circular procurement leverage	3	3	3	1
4. Evidence and performance measurement	2	2	2	3
5. Traceability and data readiness	2	1	1	2
6. Value-chain coordination	3	2	2	2
7. Scalability and transferability	2	2	2	1



3.0 Circular Economy Taxonomy and R-Strategies (cont'd)

The overall score should not be used to compare case studies, as they differ significantly and are subject to varied jurisdictional requirements; it is rather a good indicator of where the opportunities for future improvements lie. Table 2 makes it clear that data availability, accessibility, scalability and transferability are the key areas that require urgent improvement.

The cross-case analysis of the core CE principles (ISO 59004), presented in Table 3, revealed that these principles are most deeply embedded when integrated as a system-level operating logic rather than when applied at the project or product level. In the MRWA case, circularity is embedded through whole-of-lifecycle thinking, performance-based specifications and long-term asset management objectives.

Table 3. Adoption of the circular economy principles

ISO 59004 CE principle	Main Roads WA	One Project (VIC)	ATCO (QLD)	BGC (WA)
System perspective (life-cycle thinking)	Whole-of-life approach links tyre recovery, asphalt production, construction and long-term road performance; decisions based on durability, emissions, maintenance and lifecycle cost	Integrated design and procurement under Recycled First to optimise outcomes across the infrastructure value chain	Whole-of-life building system perspective, with assets designed for multiple deployment cycles, disassembly, relocation and reconfiguration across sites and projects	LCA applied across sourcing, manufacturing and product performance to evaluate material substitution impacts
Value creation, retention and sharing	Value created by tyre waste as well as longer pavement life (20–30%), reduced maintenance and emissions; retained through local sourcing and long-term procurement; shared via collaborative R&D and specifications	Value created through carbon reduction and recycled procurement; benefits mainly accrued to suppliers via increased demand	Value created through extended asset life and avoidance of new construction; retained via asset ownership and redeployment; shared through reduced delivery time, cost certainty and waste avoidance for clients	Value created by reducing virgin cement through alternative binders; retained via waste valorisation; shared through lower-carbon products for public projects
Resource stewardship and transparency	Controlled use of recycled materials under a formal framework; aggregate tracking of recycled inputs; digital traceability is emerging	Stewardship is primarily contractual; limited post-delivery monitoring and no system-level traceability	Strong physical stewardship of modules through asset tracking and maintenance regimes; limited material-level transparency and formal CE reporting	Active stewardship through reuse of internal and external by-products; LCA documentation supports transparency and future EPDs
Resilience and adaptability	Strengthens local recycling and manufacturing capacity; reduces reliance on imports; long-term resilience dependent on policy continuity	Not explicitly addressed	High adaptability through modular relocation and reuse, enabling rapid response to housing, education and disaster-recovery needs	Improves supply security by diversifying binder sources and reducing dependence on cement through the use of local by-products

Analysis of the case studies revealed that various CE R-strategies are evident within them. However, a significant degree of inconsistency was observed (as shown in Table 4) relative to the ISO-specified definitions of various R-strategies and current industry practices. Currently, lower level R-strategies, such as recycling and resource recovery, are widely considered, whereas higher level R-strategies are treated primarily at the conceptual and aspirational levels, rather than as core operational drivers.

Table 4. Level of various R-strategies considered in the cross-cases

R-strategy	ISO 59004-2024 definitions	Main Roads WA	One Project (VIC)	ATCO (QLD)	BGC (WA)
R0 – Refuse	Make solutions redundant by abandoning its function or by offering the same function with a radically different solution	Procurement and specifications discourage exclusive use of virgin binders by favouring crumb-rubber-modified asphalt	Virgin options deprioritised under Recycled First procurement	Refuses single-use, fixed-location buildings by prioritising relocatable modular assets	No explicit refusal strategy
R1 – Rethink	Reconsider design and manufacturing decisions; make service use more intensive through sharing or multifunctionality	Tyres reframed from waste to high-performance infrastructure input; roads delivered as long-life assets rather than short-term builds	Project functioned as a live testbed, enabling approval of new recycled products (e.g. plastic void formers)	Buildings are reconceptualised as reusable products and service assets rather than one-off constructions	Product formulations are rethought via alternative binders and recycled inputs
R2 – Reduce	Increase efficiency in product manufacture or use by consuming fewer natural resources and materials	20–30% pavement life extension; fewer resurfacing cycles (less materials); resulting in around ~6% lower lifecycle greenhouse gas emissions	38% concrete reduction (void formers); up to 90% carbon reduction in geopolymer elements	Reduced material demand and construction waste through offsite fabrication, standardisation and repeat use	Reduced virgin cement demand and embodied carbon via binder substitution
R3 – Reuse	Use a product or its component parts after their initial use, for the same purpose for which they were originally designed	Reclaimed Asphalt Pavement is routinely reused (≈20–25%) under established specifications	–	Primary strategy: modules reused, relocated and reconfigured across multiple projects and lifecycles	Internal reuse of concrete by-products and spent lime for block and paver production
R4 – Repair	Restore a defective or damaged product so that it can be used in its original function	Crumb-rubber spray seals and resurfacing extend asset life by repairing without full reconstruction	–	–	–
R5 – Refurbish	Restore to a useful condition during expected service life with similar quality and performance characteristics	–	–	Modules are refurbished and upgraded between deployments to extend service life	–

3.0 Circular Economy Taxonomy and R-Strategies (cont'd)

Table 4. Level of various R-strategies considered in the cross-cases (cont'd)

R-strategy	ISO 59004-2024 definitions	Main Roads WA	One Project (VIC)	ATCO (QLD)	BGC (WA)
R6 – Re-manufacture	Return an item to a 'like-new' condition from both a quality and performance perspective using an industrial process	Tyre rubber reformulated into new asphalt binders, replacing virgin polymers	–	Selective remanufacture of modular components (panels, services, interiors) during refurbishment cycles	–
R7 – Repurpose	Adapt a product or its component parts for use in a different function than it was originally intended for, without making major modifications to its physical, chemical or mechanical structure	End-of-life tyres are repurposed for use as binders and in asphalt applications	Plastics and glass are repurposed in new construction products	Modules repurposed for different functions (e.g. classrooms → offices → accommodation)	Industrial by-products Delithiated Beta Spodumene (DBS) repurposed as cement substitutes for block production
R8 – Recycle	Activities to obtain recovered resources for use in a process or a product, excluding energy recovery	>2,800 t/year of crumb-rubber recycled, diverting ~380,000 tyres from landfill	Large-scale use of recycled aggregates, plastics and glass; ~50,000 bottles diverted	Recycling is secondary; it occurs primarily at end-of-life for damaged components	Recycled concrete is integrated as a secondary material input
R9 – Recover	Generate useful energy from recovered resources	Not pursued; focus on higher value material recovery over energy recovery	–	Not pursued; material value preservation prioritised over energy recovery	–



4.0 Circular Economy Business Models

The case studies showcase diverse business models and supply chain approaches that support CE principles and R-strategies (as shown in Table 5). The key characteristics of the business models represented include:

- Product-as-a-service and asset stewardship
- Extension of product life through design
- System-level infrastructure circularity
- Policy-led circular procurement
- Alliance and shared-value delivery model
- Circular manufacturing
- Circular supply chain (varied practices).

Table 5. Circular economy business models in the case studies

CE business model	Primary case study	Core value proposition	Dominant R-strategies	Value creation & retention mechanism
Product-as-a-service & asset stewardship	ATCO – Modular Space Rental-(MSR) (QLD)	Provision of buildings as a service rather than one-off products	Reuse, repair, refurbish, repurpose, remanufacture	Value retained through continuous ownership, multiple deployment cycles and extended asset life
Circular design construction	ATCO MSR (QLD)	Design construction with longevity, disassembly and recoverability in mind	Rethink, reuse, repair, refurbish, repurpose, reconfigure	Reduce resource intensity by extending the lifespan through design
System-level infrastructure circularity	Main Roads WA – Crumb- rubber asphalt	Improved lifecycle performance of infrastructure assets	Reduce, reuse, repurpose, recycle	Value created via longer asset life, reduced maintenance and avoided emissions
Policy-led circular procurement	One Project (VIC), Main Roads WA	Market creation for recycled and reused materials	Reuse, reduce, recycle, repurpose	Value created through demand certainty and supplier innovation
Alliance & shared-value delivery model	One Project (VIC), Main Roads WA	Risk-sharing to enable circular innovation	Reduce, recycle, repurpose (selective reuse)	Value shared across client, contractor and suppliers
Circular manufacturing	BGC – Masonry (WA)	Lower carbon, recycled-content construction products	Reduce, recycle, repurpose	Value created through material substitution and waste valorisation
Circular supply chain (supporting model)	All cases (varying maturity)	Resource efficiency and take-back scheme	Reuse, repurpose, recycle, recover	Partial value retention through recycling and waste diversion

4.0 Circular Economy Business Models (cont'd)

Due to the competitive nature of the business and supply chain operations, CE business models in the building and infrastructure construction sectors differ. For example, CE business and supply-chain practices in the building construction industry are driven by market demand; thus, uptake is shaped by companies' aspirations, tangible commercial benefits and corporate requirements (for example, decarbonisation, eco-block, Environmental Product Declaration (EPD) and Environmental Social and Governance, known as ESG). Conversely, the CE in the infrastructure sector is driven by regulatory and procurement requirements (for example, Recycle Right, recycled targets) and by alliance-based cooperation and co-development of the supply chain.

The case studies were further analysed to identify potential improvements to current business models and to foster the principles of the CE. Figure 1 shows ATCO's current (left side) and potentially improved (right side) space-rental CBMs.

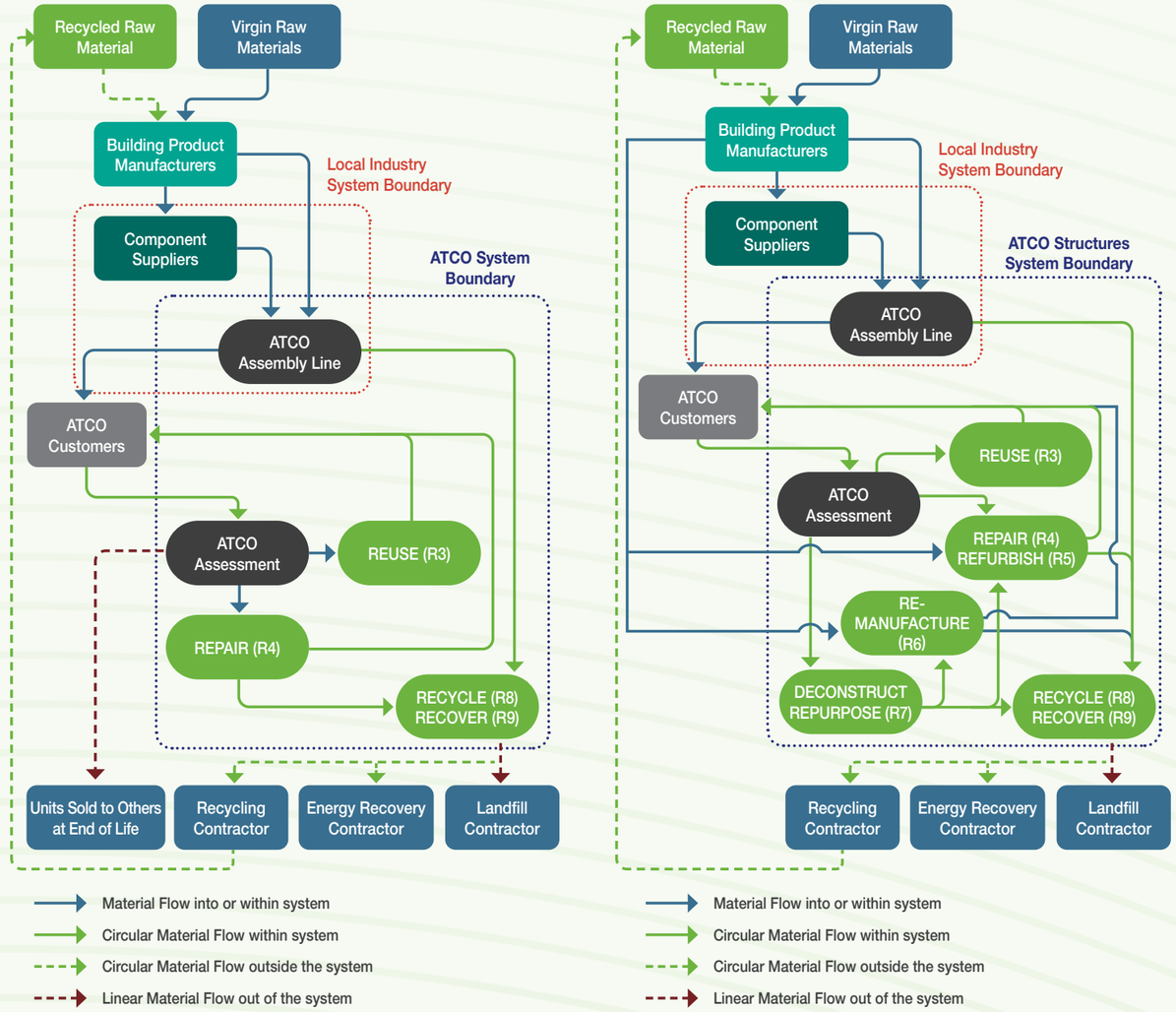


Figure 1. ATCO's current (left side) and the potentially improved (right side) space-rental circular business models

The circularity performance is analysed in the project by considering two quantitative approaches.

1. MCI developed by Ellen MacArthur Foundation.
2. LCA guided by ISO 14040 and ISO 14044.

5.1. MCI of BGC's Blokstones and Pavers

The MCI analysis of the BGC masonry blocks and pavers indicates a high level of circularity (see Table 6).

Table 6. Blocks and pavers characteristics – MCI baseline

Location	Plant A		Plant B
Product	Blokstone as is*	RC Blokstone	Paving and masonry blocks
Bill of materials	Pea gravel (Virgin): NE Limestone (Virgin) Addicrete (Virgin): LS Quarry dust (Virgin) Addicrete (Virgin): GN Off-white cement (Virgin): LS, NE, GN	Crushed recycled concrete (i.e. Non-Blokstone & Blokstone – crushed byproduct) (Recycled) Spent lime (Recycled) Grey cement (Virgin)	Addicrete (Virgin) Quarry dust (Virgin) Grey & off-white cement (Virgin) Sand (Virgin) Pigment additives (Virgin)
Feedstock materials	100% virgin materials 0% recycled materials 0% reused materials	9% virgin materials 91% recycled materials 0% reused materials	100% virgin materials 0% recycled materials 0% reused materials
Baseline MCI	0.44	0.85	0.44

NE = Natural earth (laterite) block; LS = Limestone block; GN = Granite block; RC = Recycled block
** = end-use application (e.g. lifetime and intensity of use)*

Figure 2 and Figure 3 present the input and output materials (Bill of Materials) for the current manufacturing of masonry blocks and pavers, and Figure 4 and Figure 5 present possible scenarios for integrating recycled content and improving circularity.

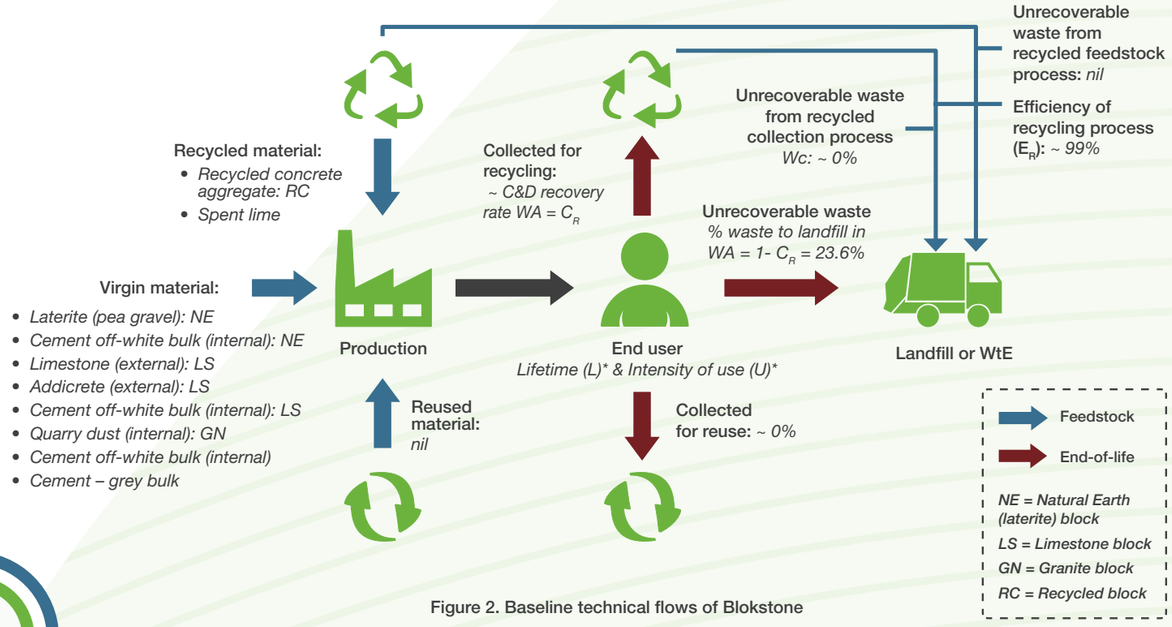


Figure 2. Baseline technical flows of Blokstone

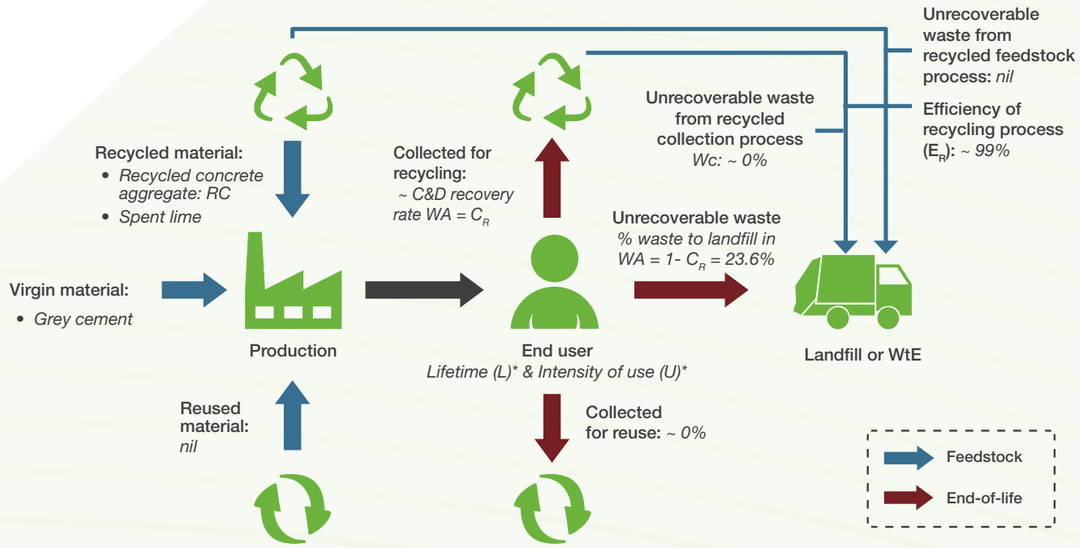


Figure 3. Improved (scenario 1 with DBS) technical flows of Blokstone

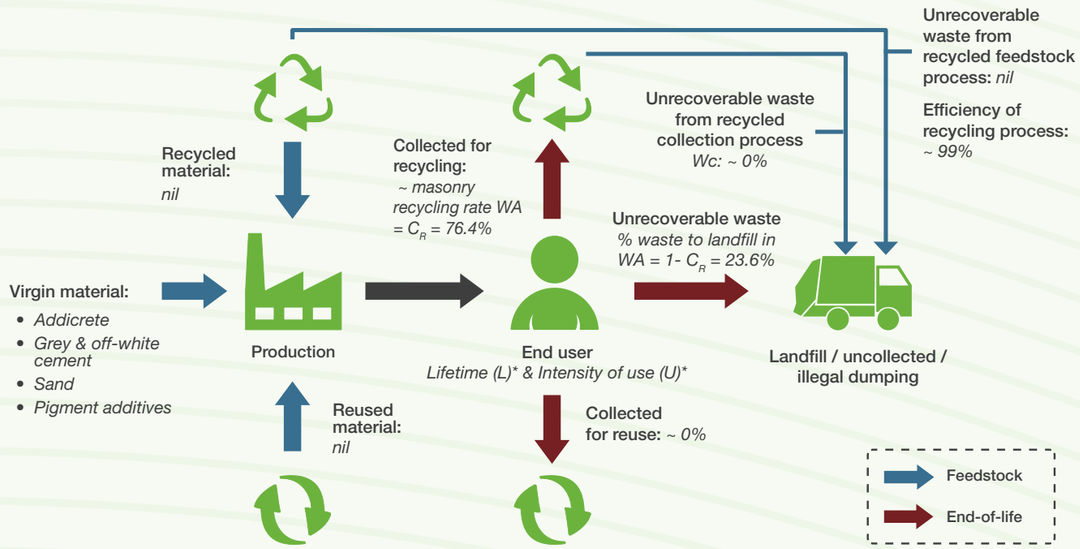


Figure 4. Baseline technical flows of pavers

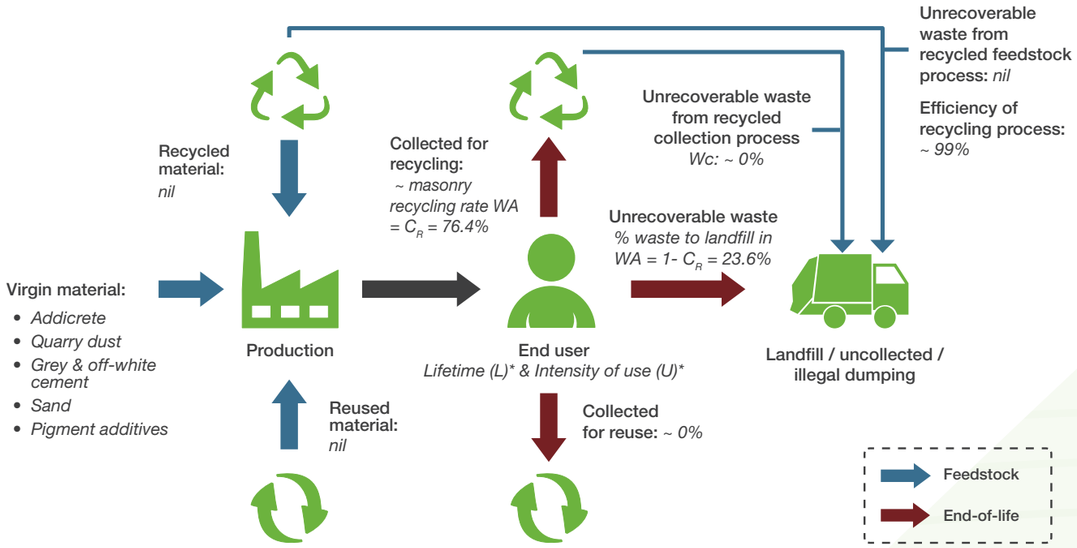


Figure 5. Improved (scenario with eco-sand) technical flows of pavers

The MCI results highlight differences in the potential for circularity improvement across the two product lines, as shown in Table 7. Recycled block (RC) Blokstone already exhibits high circularity (MCI 0.85) due to its high recycled content, with the Delithiated Beta Spodumene (DBS) scenario delivering only a marginal increase to 0.87, indicating limited scope for further gains under current constraints. In contrast, pavers exhibit a much lower baseline circularity (MCI 0.44), with the eco-sand scenario achieving a substantial improvement to 0.59, demonstrating that the greatest circularity gains are achieved by targeting virgin-intensive products for which recycled material substitution is feasible.

Table 7. Baseline and improvement scenarios inputs and their MCI

	Virgin input (%)	Recycled input (%)	Reused input (%)	MCI
Baseline – RC Blokstone	9	91	0	0.85
Scenario – DBS (RC Blokstone)	4.8	95.2	0	0.87
Baseline – Pavers	100	0	0	0.44
Scenario – Eco-sand (Pavers)	67	33	0	0.59

5.2. LCA of BGC's Blokstones and Pavers

The LCA analysed the overall environmental burdens associated with the BGC blocks and pavers across different scenarios. The LCA study used 1,000 kg of masonry blocks and pavers as the functional unit, with a system boundary extending from cradle-to-gate (Table 8). Baseline results provide information in regards to the materials and processes that are responsible for global warming (Table 9). Cement being the main contributor to CO_2, the scenario modelling will focus on a solution to substitute cement.

Table 8. The scope and system boundary of the LCA study

Components	Description
Functional unit	1,000 kg of masonry
System boundaries	Cradle-to-gate
Geographic scope	Australia
Process included	Raw material; transportation of raw materials; manufacturing; packaging and storage
Process excluded	Distribution to the construction site; construction and use phase of bricks and the end-of-life (demolition, recycling, disposal)
Temporal scope	2024
Data source	Primary-sourced from industry partner

Table 9. Comparative baseline global warming potential (fossil)

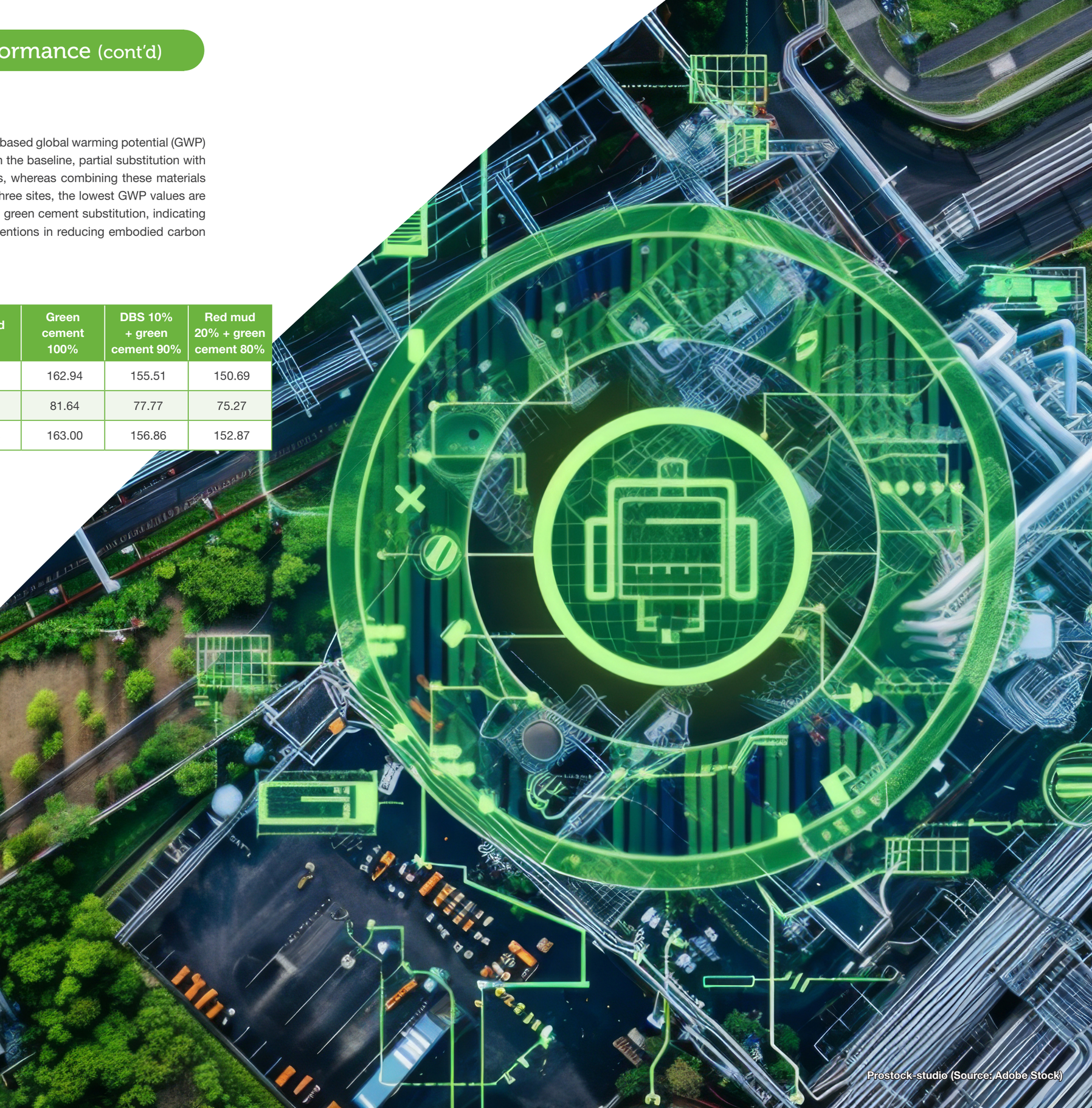
Category	Site 1 (masonry/pavement)	Site 2 (Blokstone)	Site 3 (masonry/pavement)
Cement	73.91 %	76.69%	61.34%
Sand	6.61%	-	18.36%
Stone	5.21%	1.99%	5.38%
Additive	0.91%	0.09%	3.19%
Transport	4.66%	3.16%	2.92%
Energy	6.87%	3.95%	7.94%
Packaging	1.83%	0.14%	0.88%
Cement substitution	-	1.99%	-
Recycled integration	-	12%	-

5.0 Circularity and Sustainability Performance (cont'd)

The scenario modelling (Table 10) shows a consistent reduction in fossil-based global warming potential (GWP) across all sites when alternative binders are introduced. Compared with the baseline, partial substitution with DBS (10%) or red mud (20%) yields moderate reductions in emissions, whereas combining these materials with green cement yields the largest overall improvements. Across all three sites, the lowest GWP values are achieved under the combined scenarios, particularly red mud with high green cement substitution, indicating that blended approaches are more effective than single-material interventions in reducing embodied carbon in masonry and pavement products.

Table 10. Global warming potential (fossil – Kg CO_2 eq.) – scenario modelling

Sites	Baseline scenario	DBS 10%	Red mud 20%	Green cement 100%	DBS 10% + green cement 90%	Red mud 20% + green cement 80%
Site 1: (masonry/pavement)	166.88	159.06	153.85	162.94	155.51	150.69
Site 2: (Blokstone)	83.69	79.62	76.91	81.64	77.77	75.27
Site 3: (masonry/pavement)	166.25	159.79	155.48	163.00	156.86	152.87



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6.0 PESTEL Framework – Key Barriers and Enablers for Circular Economy in Construction

On the one hand, infrastructure construction is often driven by strong government leadership, particularly through policy-led procurement, long-term investment pipelines and whole-of-life governance frameworks that support innovation at scale. On the other hand, progress in building construction is more closely shaped by market demand, client expectations, design innovation and the influence of voluntary certification (for example, EPD) and rating systems that reward sustainable and circular outcomes.

Despite these differences, both sectors face a common challenge: without alignment of definitions, standards and performance metrics, efforts to advance CE practices risk fragmentation, limiting learning, comparability and broader uptake across the construction and infrastructure industry, including transport portfolio and broader government. Table 11 shows the key enablers for building and infrastructure construction following a PESTEL (Political, Economic, Social, Technological, Environmental and Legal) framework.

Table 11. Key enablers for building and infrastructure construction

PESTEL framework	Key enablers for building construction	Key enablers for infrastructure construction
Political aspects	• State and local government sustainability and CE strategies integrated into planning and building approvals • Government-led procurement policies (e.g. recycled content requirements for buildings) • Alignment with national housing, net zero and urban sustainability agendas	• Strong state-level leadership through infrastructure agencies (e.g. transport authorities) • Policy-led procurement mandates (e.g. Recycled First, recycled content targets) • Long-term infrastructure pipelines enabling innovation and market certainty
Economic aspects	• Market demand for low-carbon and circular buildings (mainly recycling content) for sustainability performance credit • Cost savings from modularity, prefabrication and material reuse • Incentives and grants supporting sustainable building materials and retrofits	• Whole-of-life costing frameworks justifying higher upfront costs • Economies of scale in large infrastructure projects (e.g. road infrastructure) • Stable funding models enabling long-term investment in circular materials and technologies
Social aspects	• Growing public and client awareness of sustainability and circular buildings • Demand for healthy, adaptable and resource-efficient buildings • Opportunities for local employment through refurbishment, retrofit and prefabrication	• Community expectations for reduced waste, emissions and disruption • Social licence to operate strengthened through visible circular outcomes • Job creation in recycling, materials processing and maintenance over asset life
Technical aspects	• Advances in modular construction, design for disassembly and adaptive reuse • Availability of BIM, material passports and digital tools for circular design • Standardised building components enabling reuse and refurbishment	• Proven performance of recycled and alternative materials (e.g. rubberised asphalt, recycled aggregates) • Established testing, piloting and monitoring frameworks • Integration of performance, durability and lifecycle metrics in asset management

6.0 PESTEL Framework – Key Barriers and Enablers for Circular Economy in Construction (cont'd)

Table 11. Key enablers for building and infrastructure construction (cont'd)

PESTEL framework	Key enablers for building construction	Key enablers for infrastructure construction
Environmental aspects	• Pressure to reduce embodied carbon and construction waste in buildings • Strong alignment with net zero buildings and climate adaptation goals • Urban land-use efficiency and resource conservation benefits	• Large-scale potential for waste diversion and emissions reduction • Lifecycle durability reduces maintenance frequency and resource use • Contribution to state and national emissions and waste targets • Restriction on no new landfills, bans on exporting waste, limited landfill life remaining and transporting distances
Legal aspects	• Building codes and standards are gradually incorporating sustainability and circular principles • Certification schemes (e.g. Green Star) encouraging circular practices • Need for clearer guidance on reuse and secondary materials	• Clear regulatory authority and standard-setting by state agencies • Established specifications and approval pathways for materials (with scope for innovation) • Contractual mechanisms supporting alliance and risk-sharing models



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7.0 Key Circular Economy Lessons for Policymakers

The project revealed a distinct difference between CE practices in the building and infrastructure sectors, as evidenced by the application of R-strategies and business model considerations. Thus, Table 12 aims to capture sector-specific key lessons for policymakers.

Table 12. Sector-specific circular economy lessons

Policy dimension	Infrastructure sector (Main Roads WA, One Project (VIC))	Building sector (ATCO, BGC Masonry)
Primary adoption driver	Demonstrated performance and durability at asset scale (e.g. longer service life, reduced maintenance)	Business models and material choices that retain value over multiple lifecycles
Role of procurement	Policy-led, lifecycle-based procurement is the dominant lever; uptake occurs only when whole-of-life value is rewarded	Procurement remains upfront-cost driven, limiting adoption despite the availability of technologies and business models
Importance of demonstration	Demonstration projects are essential and must be designed for replication, not merely as proof of concept	Demonstration already exists in practice (e.g. leasing, reuse) but remains under-recognised and unscaled
Collaboration model	Alliance and collaborative delivery models reduce risk, accelerate approvals and build supplier capability	Collaboration occurs within firms and supply chains, but sector-wide coordination is inferior
Circular value focus	Circularity justified through whole-of-life performance and public value	Circularity driven by asset ownership, reuse cycles and material substitution
Key technical lever	Performance-based approvals enable innovation while standards evolve	Standardisation and design for disassembly enable reuse, repair and refurbishment
Main constraint	Inconsistent procurement signals and fragmented policy application across jurisdictions	Regulatory uncertainty, clarity on liability, and lack of recertification pathways for reused/refurbished assets
Carbon reduction pathway	Carbon benefits emerge indirectly through extended service life and reduced maintenance	Carbon reduction depends directly on cement substitution and material circularity
Supply-chain role	Local circular supply chains improve resilience and reduce delivery risk	Supply chains are technically capable, but procurement and standards limit scaling
Data, metrics & definitions	Lack of consistent metrics limits comparability across projects and states	Inconsistent definitions and boundaries make circular leadership invisible to markets and regulators

8.0 Key Recommendations by Stakeholder Group

Based on the findings in the literature and the case study analysis, the project presents in Table 13 the stakeholder-specific key recommendations for mainstreaming CE practices, thereby achieving consistency and upscaling of industry-wide best practices.

Table 13. Key recommendations by stakeholder group

Stakeholders	Recommendations
Infrastructure agencies and asset owners	• Shift from recycled-target (e.g. percentage of recycled content) to whole-of-life circular performance (e.g. outcome-based metrics such as life extension, lifecycle emissions etc.) • Normalise reuse-oriented asset models which are modular and reusable and relocatable (as demonstrated in ATCO) • Invest and develop digital traceability infrastructure, including materials passports, asset tracking and EPDs
Manufacturers and suppliers (industry/ business)	• Move from product sales to asset stewardship by expanding a service-based business model including leasing, buy-back, refurbishment, redeployment, etc. • Prioritise higher R-s (such as refuse, reuse, refurbish and repurpose) beyond recycling to deliver greater economic, material and carbon benefits • Strengthen capacity and transparency by incrementally developing LCA, EPDs and asset tracking systems aligned with ISO 59004
Designers, engineers and project delivery units	• Design for future disassembly and reuse beyond current design compliance • Embed circular thinking and collaborate across the value chain
Regulatory, standards and compliance bodies	• Create regulatory ‘safe spaces’ for CE innovation in design, standards and compliance • Align ISO 59004 and relevant standards and translate them into operational procurement practices • Support proportional compliance rather than a rigid ‘one-size-fits-all’ requirement to foster CE innovation
Researchers, think tanks and professional bodies	• Shift research emphasis from pilot or demonstration project to longitudinal performance evidence across the asset lifecycle • Develop and enable comparative CE metrics applicable to benchmark cross-sectoral areas and to support procurement decision-making • Co-develop guidelines, templates and decision support tools with agencies and industry

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Find out more:

Project webpage:

Bringing Consistency and Enhancing Circular Economy Practices in the Built Environment
https://sbenrc.com.au/project/1-10-4-bringing-consistency-and-enhancing-circular-economy-practices-in-the-built-environment

For further information:

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