Sustainable Built Environment National Research Centre AUSTRALIA

Using Recycled and Recyclable Products: Influencing Stakeholders through Circular Economy Practices

Final Industry Report
Project 1.95

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Preface

The Sustainable Built Environment National Research Centre, 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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Executive Summary

The construction industry has been hesitant to use products with recycled content (PwRC) in building and construction projects more extensively. It is important to gain stakeholders' confidence and adequately inform them to consider using products with recycled and recyclable content by developing a range of adequate strategies, guidelines and policies. This research project identified strategies to enhance the economic and environmental performance of projects using PwRC. It also explored how Australian organisations operating in the building and construction sector can integrate circular economy principles into their business. The Material Circularity Indicator analysis reveals that BGC Australia's (BGC) brick products, Maxibrick (0.5) and face brick (0.44), are performing on par with European circularity performances, positioning BGC as a potential leader in Australia's transition towards sustainable brick production and providing a critical benchmark for the country's brick industry. The project also developed a training package targeting the design and architecture community to foster uptake of these resources in construction projects. The training package was delivered to both an industry partner and a government partner. Lastly, the study investigated how national and state policy interventions may optimise the use of PwRC in the building and construction sector. This investigation included a survey assessing 60 key stakeholders' perceptions of the impact of 17 different circular economy policies on the use of PwRC in construction projects.

This report presents the key findings related to the four objectives outlined in the research. These findings provide insights that lay the foundation for further advancements in the industry, ensuring that stakeholders not only recognise the value of PwRC, but also harness its potential to create lasting organisational benefits. Some of the findings can be the source of inspiration within the Australian context, offering valuable perspectives for the Research and Development (R&D) sector to align its research activities with the pressing needs of industry, government and academia. The report also offers a comprehensive list of actionable strategies for four key sectors in Australia: building and construction, government, waste recovery and R&D.

1.0 Introduction

In Australia, construction and demolition (C&D) activities have substantially grown over recent decades, leading to the generation of a large amount of waste. The C&D waste stream therefore accounts for 38 per cent of the total waste generated, reaching 29 megatonnes (Mt) annually.[1] The average annual growth of C&D waste generation is currently at 2.4 per cent, and about 6.4 Mt of this waste stream is landfilled. As of 2021, the C&D waste recovery rate reached 78 per cent, meaning that a large quantity of products with recycled content (PwRC) is being produced annually. However, the latest reports from private and public sectors highlight the inadequate uptake of these valuable resources. The increasing concerns in the construction industry about the quality, performance and durability of PwRC are hindering the widespread adoption of such products.[1]

Consequently, it is essential to comprehend how the utilisation of these materials is perceived by key Australian industry stakeholders. Particularly, reassuring them of the PwRC's quality and performance through appropriate schemes that certify these products may drive their usage in the construction industry. Similarly, informing the architecture and design community through circular design guidelines that follow 'design for zero waste' (DfZw) and 'design for reuse/recycling' principles, together with developing training opportunities for other stakeholders in the industry, could offer sustainable solutions to achieve this goal.

Aim

The purpose of this project is to contribute to facilitating the use of PwRC in the Australian construction industry to make their application more mainstream in construction projects.

Industry Motivation

The inherent concerns of the industry in using PwRC are hindering the use of these products. This needs to be dealt with by developing an independent certification system, developing specific design guidelines and adopting education-related strategies to change behaviour and attitude for the better. Both the construction and building sectors will benefit from the project outcomes.

Objectives

1. Identify the strategies to enhance the economic and environmental performance of projects using products with recycled and recyclable content.
2. Explore how Australian construction organisations can integrate circular economy principles into their business model/practice to foster uptake of local products with recycled and recyclable content.
3. Develop a national training package for construction designers to foster uptake of products with recycled and recyclable content.
4. Identify what and investigate how national and state policy interventions may optimise the use of products with recycled and recyclable content in construction.

[1] Active Sustainability (2020) Expanding Reuse Opportunities for Recycled Construction Materials – Survey Findings. Perth, Australia. https://bit.ly/3ZMao0l

2.0 Research Approach

The research employed four methods of data collection: literature review, policy analysis, interview and survey. These methods were used to achieve the four objectives as outlined below.

Objective 1: First, the research team conducted an extensive literature review to offer insight into the status of using the study strategies and explore the main drivers and challenges of implementing these strategies to enhance its uptake in the Australian context. This step was completed with a series of interviews in Case Study 1 (ATCO Structures & Logistics) (ATCO S&L) and Case Study 2 (Subiaco Oval stadium).

Objective 2: This objective entailed conducting a comprehensive literature review and estimating the circularity level of two products supplied by BGC Australia (Case Study 4). The literature review focused on circular economy business models and identification of the most effective method for determining the circularity level of construction materials. The selected method was then applied to assess the circularity of BGC Australia's sample products.

Objective 3: A leading co-created/co-designed educational and training program will be developed for both infrastructure and building sectors, aimed at creating awareness which results in the change of behaviour in the area of design for more circularity. The approach built upon our existing work in Project 1.85, in which we explored various guidelines for design disassembly and DfZw. The capacity-building initiative targeted architects and design engineers. The program was pilot-tested with at least one of our infrastructure sector industry partners and one of our building sector industry partners.

Objective 4: The research approach employed to achieve Objective 4 consisted of two phases. First, a comprehensive review of the literature was conducted to identify the most relevant circular economy policies that have an impact on the use of PwRC in construction projects. These policies are classified under two major categories: those with direct impacts and those with indirect impacts. Following identification of the policies, an online survey questionnaire was administered to understand the key stakeholders of these policies and their effectiveness and relevance in the Australian C&D waste management system. The questionnaire was pilot-tested in October and November 2023 and the comments provided by four experts were considered in the final version of the questionnaire.

Image by Eruppee (Source: Adobe Stock)

3.0 Economic and Environmental Performance of Projects Using Recycled Materials

Case Study 1 – The Use of Recycled Products in Modular Construction

Modular construction is a building method where individual components, or modules, are prefabricated in a factory-controlled environment, and then transported to the construction site. These modules are typically designed to fit together seamlessly to form a complete structure, such as a home or commercial building. The use of secondary materials in modular construction is a sustainable strategy to enhance PwRC uptake in the building and construction sector. The factory setting allows for greater exploration and application of eco-friendly materials, which may be challenging to implement in conventional construction environments. This section of the report provides the findings of a case study – ATCO S&L – that provides insight into the use of PwRC in modular construction.

ATCO S&L is a private company that earns most of its revenue from the commercial and industrial building construction sector. It is engaged in the construction, sale and hire of transportable buildings.

In 2024, this manufacturing organisation is projected to hold 6.5 per cent of the market share for prefabricated metal building manufacturing, ranking as the second-largest manufacturer in Australia in this category.[2] The company operates sales offices and manufacturing facilities throughout Australia, with a particular focus on Queensland, Victoria and Western Australia (WA).

The case study drew insights from a series of interviews conducted with six key stakeholders including a technical manager; design manager; operations manager; branch manager; national health, safety, environment and quality manager; and a supplier. Interviewees were asked to share their perspectives on the challenges, drivers, strategies and benefits associated with the use of PwRC in the modular products. Their responses, reflecting a range of professional viewpoints, are summarised in Figure 1.

CHALLENGES

1. Project characteristics
2. Cost complexities
3. Industry conservative approach
4. Greenwashing and product misrepresentation
5. Limited availability of PwRC and an immature supply chain
6. Lack of organisational / regulatory targets
7. Lack of precedent in PwRC application
8. Health and safety issues
9. Lack of certification for recycled products
10. PwRC longevity and performance
11. Lack of experience dealing with PwRC supply chain
12. Reliance on mainstream supply chain
13. Varying PwRC specs in modular construction
14. Limited reporting capacity
15. Lack of precedent in PwRC application
16. Short-term thinking in decision-making process

DRIVERS

1. Supportive organisational targets
2. Financial benefits
3. Client preference and obligations
4. Securing public projects
5. Moral obligations

STRATEGIES

1. Long-term thinking
2. Historic application of PwRC and confidence-building
3. Recycled product information and certification
4. Effective marketing
5. Attitudinal changes and awareness-raising
6. Leveraging purchasing power of key players
7. Setting targets through organisational or government policies
8. Internal opportunities for material recyclability and reuse
9. Active engagement in material supply chain
10. Products buyback agreement

BENEFITS

1. Less damage to natural resources and pollution
2. Waste disposal diversion
3. Alignment with the circular economy
4. Longer life span of PwRC
5. Material cost balance
6. Supply chain relationship-building
7. Enterprise sustainability image improvement
8. Responding to the society's sustainability concerns
9. Learning experience for young people
10. Employment opportunities

Figure 1: The major challenges, drivers, strategies and benefits of PwRC utilisation in modular construction

[2] IBISWorld (2023) *Prefabricated Metal Building Manufacturing in Australia – Market Research Report (2014-2029)*. Available from https://bit.ly/4glrxHz

3.0 Economic and Environmental Performance of Projects Using Recycled Materials (cont'd)

The following model is created based on the findings' literature review and the insights captured in the interviews. The framework guides efforts in removing the identified obstacles to sustainable and optimal uptake of PwRC in modular construction. As outlined in Figure 2, the framework consists of organisational capacity, supply chain, recycled products, and regulations and policies – major components that address various challenges identified in this study.

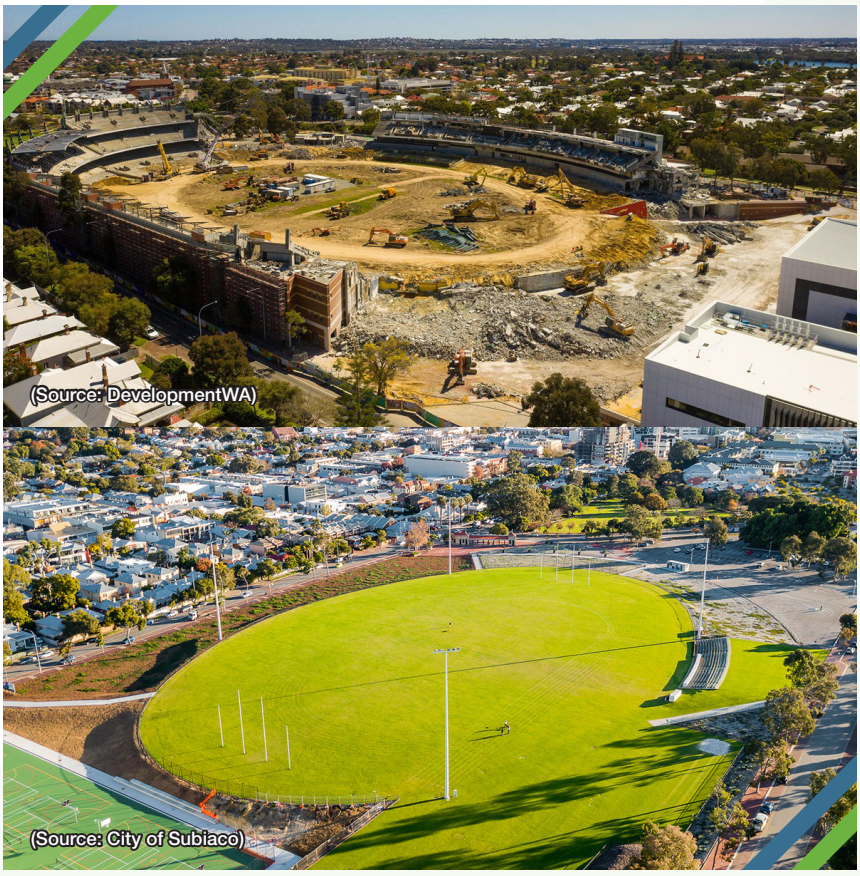
Figure 2: A framework to influence stakeholders for optimal uptake of PwRC in modular construction

Case Study 2 – Role of Local Collaboration in Using Recycled Products

Local collaboration serves as a powerful strategy, whereby various local stakeholders work together to utilise waste resources that are generated, recycled and supplied within a certain region. This approach maximises the efficient use of local materials while fostering a circular economy at the regional level, reducing environmental impact and promoting sustainability. This section of the report offers insight into the impact of local collaboration in enhancing the economic and environmental performance of PwRC utilisation in construction projects. This content is drawn from a case study analysis involving interviews that captured key stakeholders' perceptions of the Subiaco Oval stadium project in Perth, WA. Subiaco Oval, situated in the Perth suburb of Subiaco, was a sports stadium inaugurated in 1908. Its operations ceased in 2017 and its demolition started in 2019. The project involved the redevelopment of the site for mixed-use purposes, including housing and recreational spaces.

As part of a broader urban renewal initiative, the project focused on sustainable practices, particularly in waste management, including the use of demolition waste materials.

The case study highlighted how local collaboration enhanced the use of PwRC in the state's construction projects while also serving as a showcase for the environmental and economic benefits of sustainable construction practices in the state. The study interviewees included the DevelopmentWA Strategy and Innovation Manager and Project Delivery Manager, and the Principal Advisor Sustainability Strategy at Main Roads Western Australia. The major findings of these interviews – including the challenges, strategies, drivers and benefits – are provided in Figure 3.



Above: Subiaco Oval demolition in 2019
Below: Subiaco Oval redevelopment in 2022

3.0 Economic and Environmental Performance of Projects Using Recycled Materials (cont'd)

CHALLENGES

1. Time constraints caused by the urgency to utilise the demolition site
2. The government political pressure to deliver the project
3. The old characteristics of the build, making it difficult to deconstruct
4. The presence of contamination in demolition waste materials
5. Noise pollution for some onsite recycling activities
6. The physical characteristics of the project, making it hard to reuse the extracted materials
7. Difficulty for finding end-users for demolition waste materials, particularly in local governments
8. Unsupportive material specification guidelines
9. Uncertainty about the cost of deconstruction process
10. Previous negative experiences with using PwRC in projects
11. Limited experience within the construction team in utilising PwRC
12. Preference for working within the existing conventional supply chain
13. Design warranty risk related to using PwRC
14. Cost implications of implementing additional management techniques

STRATEGIES

1. Site visits with potential contractors
2. Tender process mandating demolition contractors to recycle waste generated from the project
3. Contractual requirement for using PwRC in state construction projects
4. Provision for risk-taking throughout the project life cycle
5. Landcorp sustainability policies
6. Effectively communicating with other agencies for adopting PwRC
7. Applying the learning from previous projects to avoid certain risks such as contamination
8. Establishing clear alignment between all levels of the business
9. Effective communications with prime contractor and subcontractors
10. The agency's active participation in the project
11. Reassuring the local community of the project's sustainability benefits
12. Using mist technology to address dust pollution
13. Engagement of external environmental hazmat auditors to ensure PwRC quality
14. Running pilot trials prior to full implementation
15. Offering grants to support the use of PwRC in state's construction projects
16. Granting design concessions to facilitate the utilisation of PwRC in state's construction projects
17. Providing training to the industry on the use of PwRC
18. Creating guidelines for local governments on the use of PwRC

DRIVERS

1. Government's focus on this iconic project to showcase innovation and sustainability
2. Meeting state government targets for waste recovery
3. Complying with the Act to balance triple bottom lines of sustainability
4. Responding to Global Reporting Initiative Standards Organisation
5. Following the organisation's Sustainability Framework requirements to recover waste to PwRC
6. Achieving Green Star credits for waste recovery
7. Roads to Reuse program that facilitates the use of PwRC across the state
8. Change in material specifications to allow further utilisation of PwRC

BENEFITS

1. Achieving 92% waste recovery target
2. Diverting waste materials from landfills
3. Lower environmental impact from reduced reliance on virgin materials
4. Prevention of asbestos contamination during demolition
5. Addressing dust pollution via mist technology
6. Lessons learned for future applications and projects
7. Reuse of waste materials in the existing site
8. Generating corporate value, leading to new project opportunities
9. Meeting the estimated budget
10. Cost savings from using PwRC supplied to nearby projects
11. Enhancement of recycling capabilities within metropolitan regions
12. Involvement of First Nations businesses
13. Capability-building of demolition/ deconstruction contractors
14. Addressing public opposition via transparent information-sharing
15. Fostering a positive perception of PwRC utilisation
16. Supporting local jobs within the metro region

Figure 3: The major challenges, drivers, strategies and benefits of PwRC utilisation in Case Study 2

Case Study 3 – Significance of Change Agent in the Uptake of Recycled Products

Establishing an agency dedicated to centralising efforts to drive the circular economy and enhance the use of recycled products in the building and construction sector is critical for advancing sustainability in this sector. Such an agency could serve as a focal point for coordinating research, development and implementation of circular economy principles and practices. Establishing such an agency can drive innovation, collaboration and sustainability in the building and construction sector. This section of the report presents the findings of a case study on ecologiQ – a change program in Victoria that is pushing the state's agenda for using PwRC in the major transport infrastructure sector. In 2023, ecologiQ was among the winners of Sustainability Victoria's Premier's Sustainability Awards in the Circular Economy Innovation Category.

ecologiQ has implemented a variety of strategies to promote the adoption of PwRC in major state transport infrastructure construction projects. These strategies have been developed in collaboration with key state agencies such as Sustainability Victoria, Recycling Victoria, Department of Transport and Planning, and Victoria's Big Build project offices, as well as various industries involved in C&D waste management. Figure 4 provides a visual representation of these strategies, highlighting the comprehensive approach taken by ecologiQ to drive positive change in the industry.

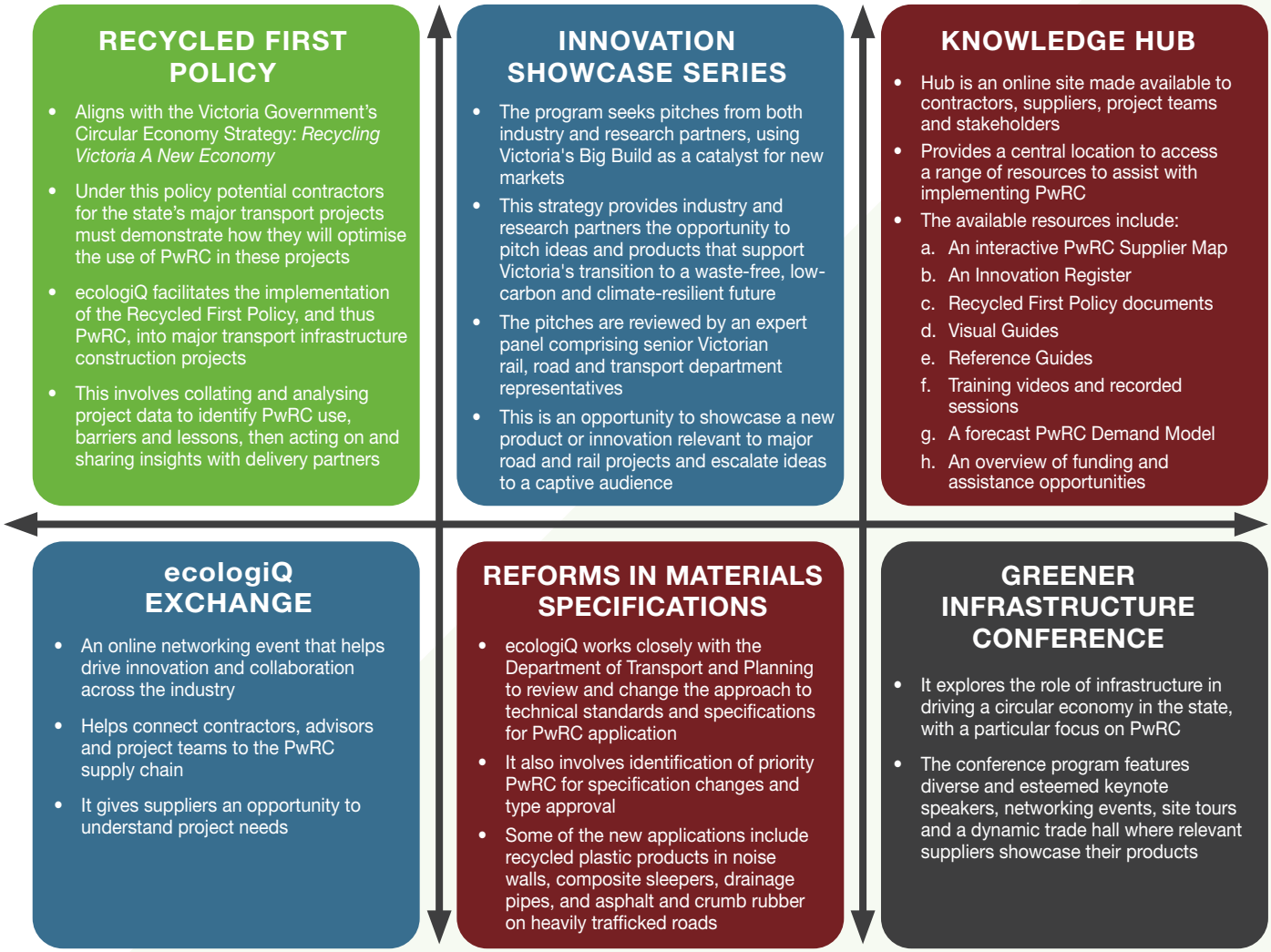


Figure 4: ecologiQ change strategies to optimise the use of PwRC in major transport infrastructure projects

[3] Sustainability Victoria (2024) ecologiQ: 2023 Winner – Circular Economy Innovation. Accessed via https://bit.ly/4eLCnVD

By implementing the strategies outlined above, ecologiQ plays a central role in driving statewide change, facilitating the sustainable use of PwRC in major transport infrastructure projects. As shown in Figure 5, ecologiQ collaborates with various organisations across Victoria to promote the adoption of PwRC in these projects.

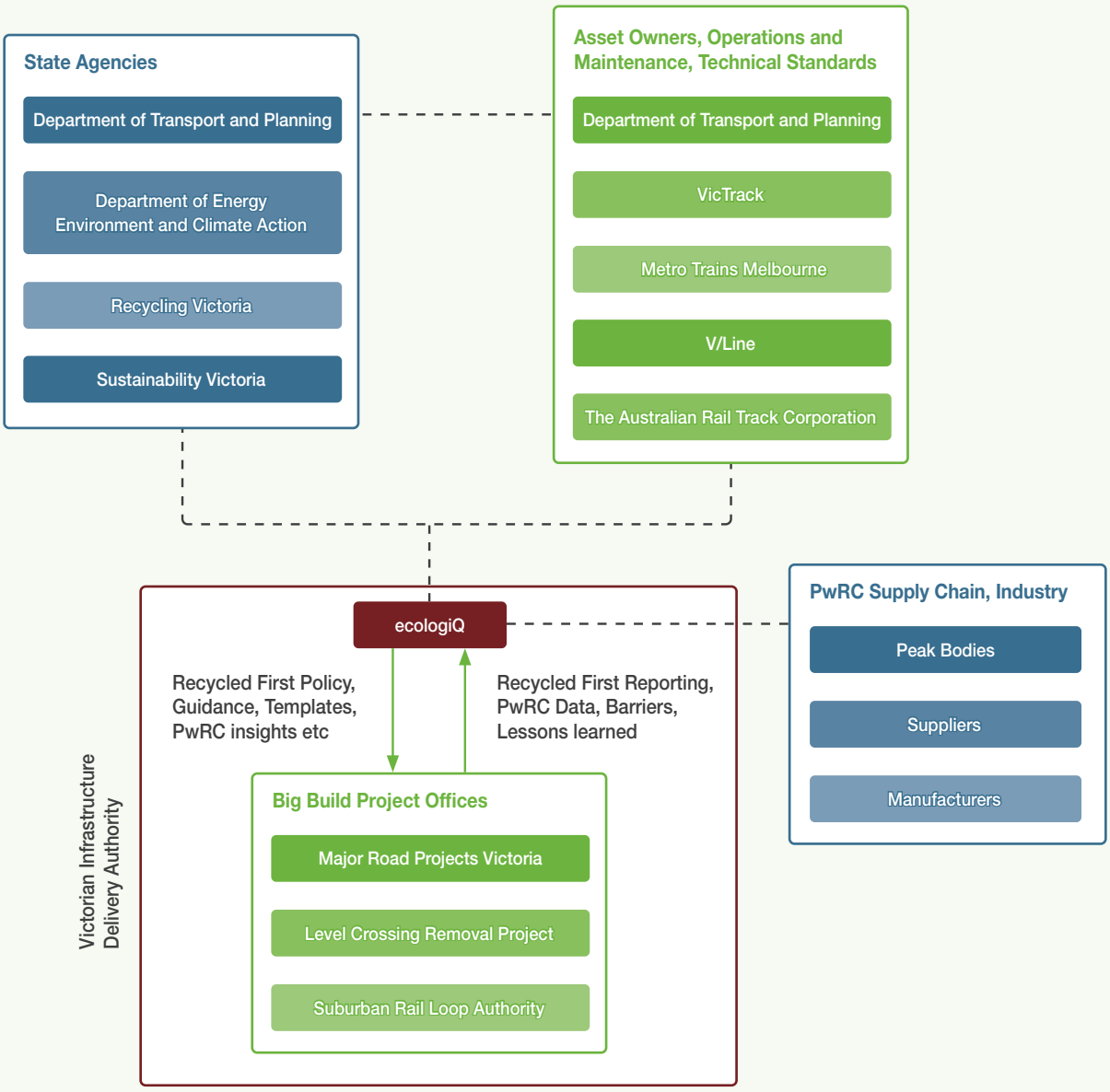


Figure 5: ecologiQ engagement model

4.0 Integration of Circular Economy Principles in Industry Business Models

Circular Business Models and Construction Industry Implications

In circular business models (CBMs), new forms of value creation and capture emerge. CBMs play a pivotal role in shaping the scope of circular practices within the construction sector. CBMs advocate for extending the use of materials and for the incorporation of recycled materials. The value proposition in a CBM can be tailored to a product or service that intentionally implements a circular strategy (for example, use of PwRC) to generate forms of value creation.

Value creation and delivery in the context of CBMs encompasses a range of key activities. These activities include optimising procurement processes, implementing efficient separation at the source and organising the collection of waste materials by material stream. Additionally, selective demolition practices are employed, and pre-demolition audits are conducted to identify reuse and recycling opportunities for materials. Take-back schemes are often utilised to efficiently collect and source materials for reuse.

Key partners, such as collaborations with the market and supply chain, play a vital role in this process, emphasising the importance of public and private partnerships. To support these activities, key resources may be drawn from other companies, although the ideal scenario involves manufacturers developing business models that emphasise resource reuse.

The value proposition of the business model revolves around achieving compliance with Sustainable Rating Schemes. This compliance serves as a significant factor in attracting specific customer segments and nurturing relationships with individuals who have a keen interest in environmentally sustainable practices and products.

Assessment of Material Circularity to Support Circular Business Models Initiatives

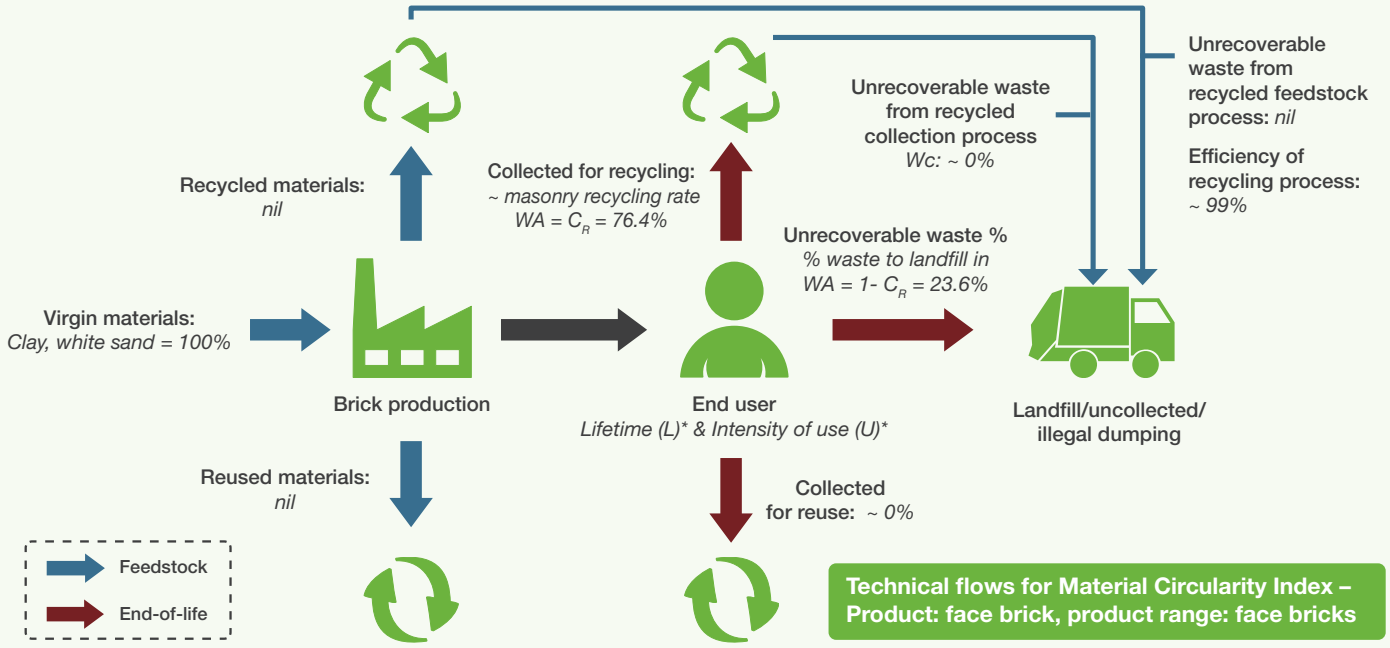
Circular strategies as delivered through new circular value proposition should have a practical assessment approach in order to understand their impacts into the new circular business model strategy. Measuring and identifying circular strategies have posed increasing methodological debates among scholars. For example, studies have found more than 50 circular indicators which are differentiated according to implementation level; that is macro, meso or micro. There are many methods that practitioners, industry and think tanks have developed to assess product-level circularity.

The Ellen MacArthur Foundation (EMF), a key global leading voice on the circular economy, developed the Material Circularity Indicator (MCI) for assessing product-level circularity. The MCI is underpinned in life cycle thinking principles; it accounts for the input, utility and output. Considering that MCI does not demand extensive data, which happens to be a challenge when measuring circularity, MCI can provide a useful first overview of product circularity performance.

On this note, the MCI is a tool that can help industry practitioners compare different material combinations, thereby assisting companies in their decision-making processes. These advantages have established the MCI as one of the most promising, practical and popular frameworks for evaluating circularity performance. The MCI was updated in 2019, reflecting its high popularity. Given the aforementioned reasons, the MCI methodology was applied in Case Study 4.

Case Study 4 – Materials Circularity in Manufacturing Industry

The MCI analysis was conducted in two of BGC's clay bricks product ranges: external bricks (face bricks) and internal bricks (Maxibricks). Materials (feedstock and after-use phase) are categorised by virgin, reused and recycled, as these are key inputs to analyse with MCI using the EMF methodology. During the use phase, the lifetime and functional units compared to industry average (utility) must be considered. In this case study, bricks are considered a man-made rock that will last indefinitely, and this is no different from other bricks in the industry. Hence, the utility is considered 1 for the purpose of this calculation. The diagrams in Figure 6 and Table 1 provide an overview of the elements assessed and the MCI outcomes for both types of bricks.



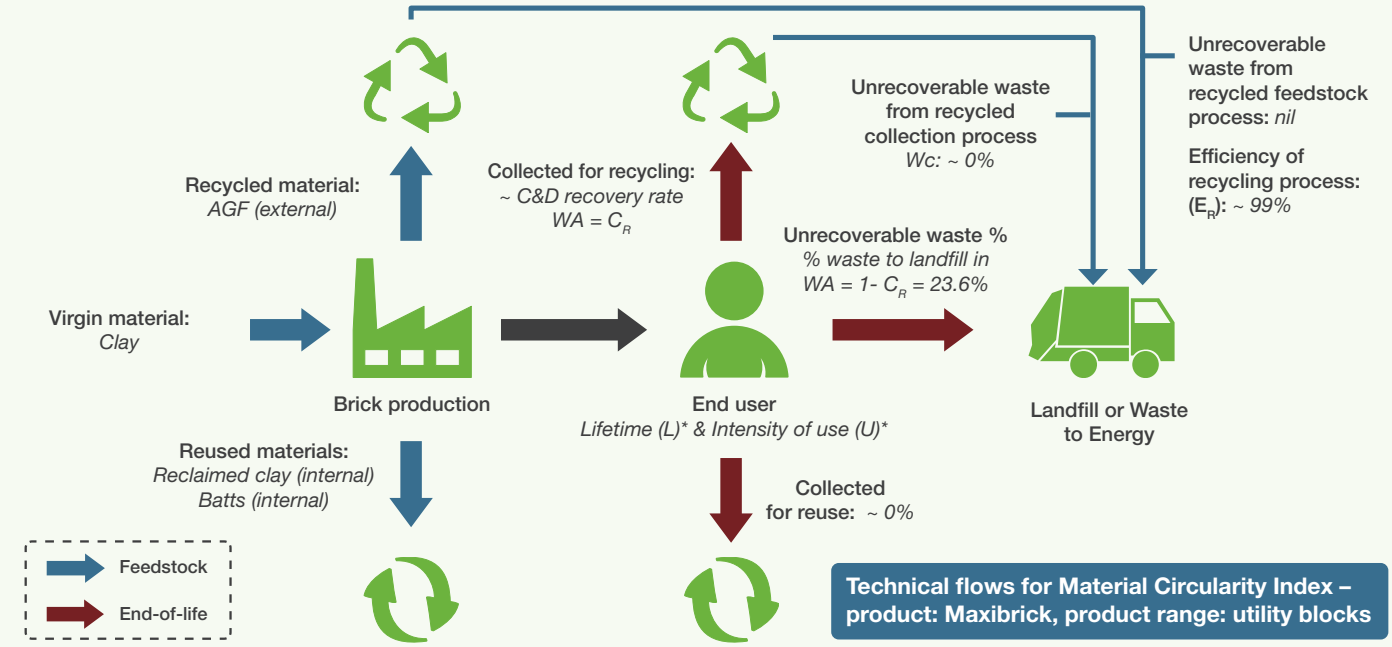


Figure 6: Technical flows of face brick (top) and Maxibrick (bottom) production in South Guildford and Middle Swan facilities, in Western Australia

Table 1: Face brick and Maxibrick characteristics – MCI baseline

	South Guildford		Middle Swan	
	Face Brick	Maxibrick	Face Brick	Maxibrick
Bill of materials	Clay Fine Sand	Clay Asphalt Granite Fines Reclaimed Clay Batts Fine Sand	Clay Fine Sand	Clay Asphalt Granite Fines Reclaimed Clay Batts Fine Sand
Feedstock materials	100% virgin materials 0% recycled materials 0% reused materials	86% virgin materials 1% recycled materials 13% reused materials	100% virgin materials 0% recycled materials 0% reused materials	93% virgin materials 1% recycled materials 7% reused materials
Destination after use	23.6% to landfill 76.4% to recycling 0% to reuse	23.6% to landfill 76.4% to recycling 0% to reuse	23.6% to landfill 76.4% to recycling 0% to reuse	23.6% to landfill 76.4% to recycling 0% to reuse
Baseline MCI	0.44	0.50	0.44	0.48

The MCI outputs provide groundbreaking insights into the circularity performance of BGC's brick products, with Maxibrick achieving a score of 0.5 and face brick 0.44. This study marks the first attempt in Australia to measure and benchmark product-level material circularity, setting a crucial baseline for the country's brick industry. While it is challenging to make direct comparisons within the Australian context due to the lack of prior studies, parallels can be drawn with global standards. For example, Dräger et al. (2022)[4] reported that the MCI for masonry brick and face brick in Germany was 0.52 and 0.47, respectively, demonstrating that BGC's bricks are performing on par with European benchmarks.

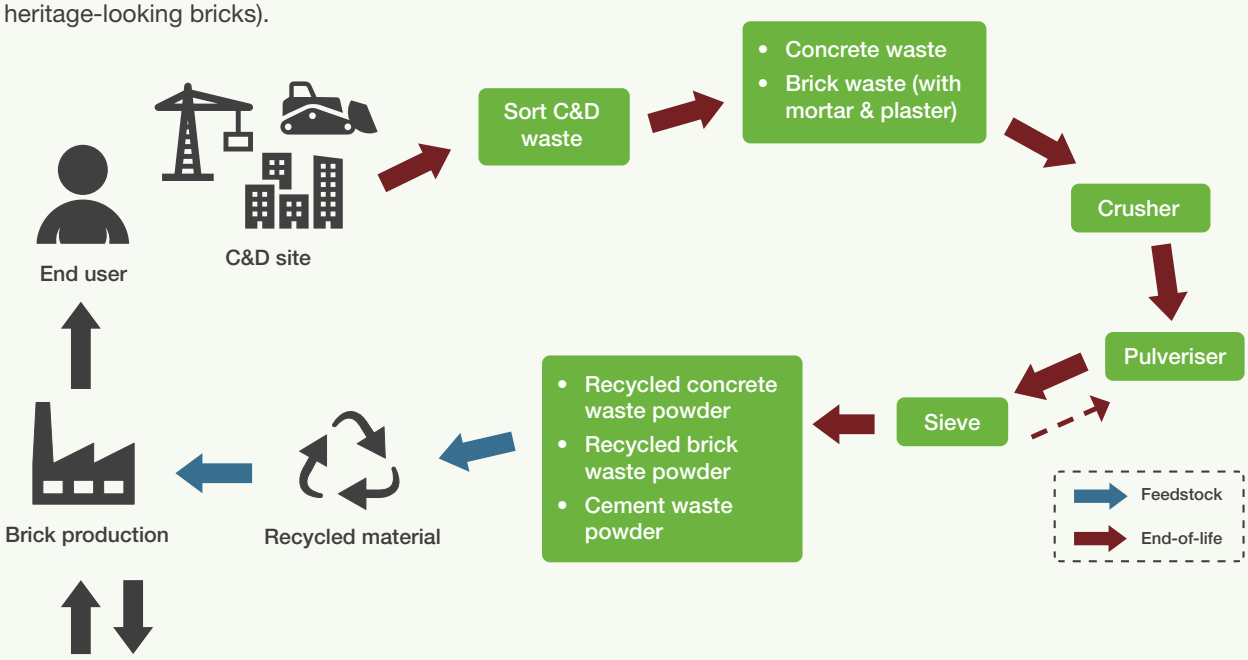
This is significant for the Australian brick industry, as it underscores the potential for local manufacturers to align with or even exceed international standards. By integrating circular economy strategies into its business model, BGC not only strengthens its competitive edge, but also positions itself as a potential leader in sustainable brick production. The findings offer valuable benchmarking opportunities for other Australian manufacturers, fostering innovation and driving the industry towards a more circular and sustainable future.

[4] Dräger, P., Letmathe, P., Reinhart, L., & Robineck, F. (2022). 'Measuring circularity: evaluation of the circularity of construction products using the ÖKOBAUDAT database'. *Environmental Sciences Europe*, 34(1), 13.

Potential Options for an MCI Improvement Considering New Circular Business Model Strategy

The three-box business model in Figure 7 indicates how BGC can incorporate the circular strategy to increase their bricks' MCI. The strategy could boost value capture and benefit the cost structure. Additionally, the strategy could help obtain Infrastructure Sustainability and Green Star credits and certifications. Moreover, it could attract customers who value environmentally friendly products. The delivery of the strategy must consider key partners (for example, WA C&D recyclers), key resources (for example, concrete or brick waste) and key activities (for example, separation at the source, exploring new markets for reused bricks, such as heritage-looking bricks).

These three essential pillars for creating and delivering this strategy can be supported by using resources available at C&D sites or construction and manufacturing areas. Figure 7 (top) exemplifies this process. Waste is sorted and processed, and then the resulting products – including recycled concrete waste powder, recycled brick waste powder or cement waste powder – can all be used as feedstock in BGC brickworks, contributing to supporting the MCI.



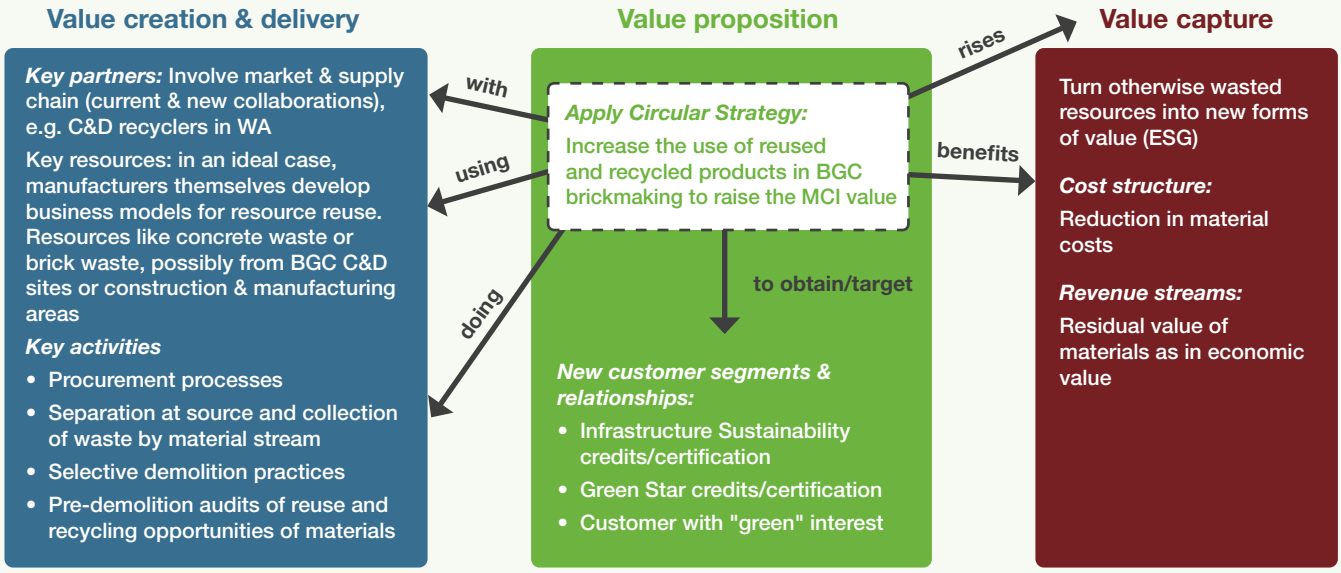


Figure 7: Top: Possible resources and avenue recovery to increase recycled content in BGC bricks; Bottom: Circular business model strategy – Increase BGC bricks MCI by extending resource use (reuse, recycle)

5.0 An Educational Program for Construction Designers

The circular economy rise has driven environmental improvements in the building and construction sector worldwide. Using PwRC has emerged as a targeted strategy to reduce C&D waste disposal and promote resource management. Despite the feasibility of a circular economy in C&D waste management, changing project designers' attitudes and behaviour towards the use of PwRC is challenging and poorly investigated on a global scale. Hence, this study examines how training can influence project designers' attitudes and behaviour changes to foster the uptake of PwRC through a systematic literature review. This study analyses both conceptual and empirical research outputs, discussing various contexts related to factors influencing the attitudes and behavioural change towards PwRC.

It also explores the theories and models enabling attitudes and behaviour change. The review highlights that psychological factors are critical in changing attitudes and behaviour towards the use of PwRC. It also suggests that the theory of Planned Behaviour and the Extended Theory of Planned Behaviour are the most widely used theories in this respect. The authors established a seven-element training framework (see Figure 8) to influence project designers' attitudes and behavioural change. This review is a springboard for further research on circular economy education for construction project designers.

Purpose	Training content focus	How does training content influence to change attitudes and behaviour	Highly referenced influential factors and its related theories
Changing attitudes and behaviour towards PwRC	Environmental benefits and concept of CE	By increasing environmental consciousness and motivation	Moral norms - Norm Activation Theory Economic Factor - Economic Theories
	Cost-benefit analysis of using PwRC	By reducing or increasing perceived cost, perceived benefit, perceived usefulness	Attitude - Theory of Planned Behaviour
	Information of certification and standards available on PwRC	By increasing awareness and confidence of using PwRC	Attitude - Theory of Planned Behaviour
	Example of successful projects that have used PwRC	By increasing confidence of using PwRC, reducing negative perception of clients and reducing perceived risk	Attitude - Theory of Planned Behaviour
	Information on existing policies, rules and regulations on use of PwRC	By increasing awareness on regulations	Subjective norms (regulatory pressure) - Theory of Planned Behaviour
	Application of PwRC in construction projects	By increasing awareness, knowledge and information about PwRC	Perceived behaviour control - Theory of Planned Behaviour Knowledge - Extended TPB
	Circular design strategies such as design for reuse or recycling	By increasing knowledge and experience, fostering design creativity	Perceived behaviour control - Theory of Planned Behaviour Knowledge - Extended TPB

Figure 8: A framework for developing a training package to change attitudes and behaviour towards the use of PwRC

Target Audience and Intended Outcomes for Participants

The focus of this training was on construction designers, at the design phase of construction. This is the designer/architect (D/A) position. Development Managers are also, therefore, key in this aspect, as they are the decision-makers and commissioners. The following five sections were covered in each training session:

1. Understanding the C&D waste problem
2. Sustainability and the circular economy
3. C&D waste materials
4. The design phase and sustainable construction strategies
5. PwRC

There was also material tailored to the industry partner from case study material collated during the SBEnrc projects. The ATCO training session had a section on their modular housing case study. The DevelopmentWA training session covered their Hamilton Hill work. The content aligned with the framework shown in Figure 8. It also built upon the training sessions in the previous SBEnrc project 1.85: *Enhancing the Use of Products with Recycled Contents in the Australian Construction Industry.*

Key Findings

The training sessions were successful with those attending. Feedback form responses are still to be analysed. A separate recording in a studio at Griffith University Nathan Campus will be undertaken in early October to generate material for the SBEnrc website.

Training Session 1

Industry partner: ATCO Structures & Logistics – Overview of participants and training expectations (Figure 9)

Date: Wednesday 18 September 2024

Location: ATCO Structures in Luscombe, South East Queensland

Delivered by: Professor Tim Ryley, in person; Dr Salman Shooshtarian joined online

Participants: 16 in room and 1 online. Most attendees completed the feedback form

Content: 35-slide PowerPoint presentation

Figure 9: ATCO S&L initial slide example

Thirteen attendees completed the survey. Most of them were in technical or professional roles, particularly in a Designer/Estimator role. Some had management or administrative roles. The most useful information from the presentation was on the recyclable materials.

For training needs moving forward, the most common response was on new materials and methods and how they could be applied to ATCO. Most attendees prefer training in-person, although some also wanted a recording afterwards.

Training Session 2

Industry partner: DevelopmentWA – Overview of participants and training expectations (Figure 10)

Date: Tuesday 24 September 2024

Location: DevelopmentWA, Perth, WA

Delivered by: Professor Tim Ryley, online

Participants: 20 online. A handful of attendees completed the feedback form

Content: 36-slide PowerPoint presentation

Figure 10: DevelopmentWA initial slide example

Four people responded. The people attending were primarily development managers. The positive elements related the information within the slides. For improvements, more specific details on materials, tools and case studies would have been beneficial. A key outcome from the session and responses is how local government can overcome the issues raised in the session.

Study Policies

Three types of policy instruments assist the industry in applying circular economy principles to the built environment sector: administrative, economic and informative. Licenses, bans, benchmarks and voluntary agreements between industry and government are examples of administrative or regulatory instruments, while economic instruments include fees, subsidies, taxes and other charges. Informative instruments comprise labelling, reporting obligations, certification initiatives and awareness-raising campaigns. Table 2 presents a short summary of the study policies, with direct (in green) and indirect impacts (in blue).

Table 2: Summary of the study on circular economy principles

Policy	Description	Policy	Description
Sustainable Procurement	It involves sourcing and purchasing recycled products while considering their environmental, social and economic implications	Penalty on Illegal Waste Dumping	It refers to a financial or legal consequence imposed on individuals, businesses or entities that engage in the improper disposal of waste materials in an unauthorised or environmentally harmful manner
Recycled Product Certification	This policy is a circular economy-based strategy that is designed to assure the quality, performance, environmental friendliness and safety of recycled products	Restriction on the Disposal of Priority Waste Resources	It refers to regulatory measures and policies implemented by governments or authorities to limit or prohibit the disposal of specific types of waste materials that are deemed valuable, scarce, hazardous or environmentally damaging
Virgin Materials Tax	It is a financial mechanism that aims to discourage or penalise the use of virgin materials and encourage the use of recycled products	Accelerated Permission for Onsite Recycling	It is a regulatory or administrative process designed to expedite or fast-track the approval and permitting of recycling facilities or practices that are conducted onsite
Financial Incentive for Using Recycled Materials	It refers to a monetary or economic benefit provided to individuals, businesses or organisations to encourage the use of recycled products	Demolition Deposit/ Refund	It refers to a financial security or collateral mandated on eligible construction and/or demolition projects, with the primary objective of guaranteeing the appropriate recycling and disposal of C&D waste materials
Harmonised Recycled Product Specifications	These specifications are designed to establish common guidelines and requirements that define the quality, composition and performance standards of products with recycled content	Proximity Principle	It is a waste management concept that emphasises the importance of handling waste as close to its source of generation as possible. It encourages minimising the transportation of waste over long distances and promoting the management of waste near its point of origin
Environmental Sustainability Rating (Recognition)	It is a systematic framework used to assess, measure and rate the environmental sustainability of various entities, such as buildings, products, services and organisations. Examples include Green Star, LEED, IS Rating	Product Stewardship	It is a comprehensive and proactive approach to managing the environmental and social impacts of a product throughout its entire life cycle, from design and production to use and disposal
Carbon Pricing Scheme	It is an economic mechanism implemented by governments or regulatory bodies to incentivise and promote the use of recycled materials in construction projects, while simultaneously imposing a tax or fee based on the carbon emissions associated with using virgin materials	Ban on the Export of C&D Waste Resources	It refers to a regulatory policy or legal measure implemented by a government or authority to prohibit or restrict the export of C&D waste materials to other countries
Landfill Levy (Tax)	A landfill levy is a financial charge or fee imposed by a government or regulatory bodies on the disposal of waste materials in landfills	Recycling Residual Waste Levy Waiver	This waiver allows a specific entity to be excused from certain requirements or obligations related to the disposal of residual waste materials when they can demonstrate a significant commitment to recycling practices
Extended Producer Responsibility	It is a policy approach that places the responsibility for the entire life cycle of a product on the manufacturer or producer, including the collection, recycling and proper disposal of the product once it becomes waste		

Survey Findings

The administration of the survey resulted in 85 responses, of which 61 were complete and therefore were included in the data analysis. Table 3 presents a summary of the survey participants' profiles. The majority of respondents were in the age groups of 35-44 and 45-54 (60 per cent), and almost half of this population had been engaged in promoting material circularity within the sector for between one and five years (54 per cent).

Their main locations of operation were in four major Australian states, with Victoria having the greatest number of respondents. The main employer sectors among the survey participants were 'Government' (24 per cent) followed by 'Consultation' (18 per cent).

Table 3: Summary of the survey participants' profiles

Gender	Female		Male		Prefer not to say			
	48%		51%		2%			
Age	18-24	25-34	35-44	45-54	55-64	>65		
	2%	20%	34%	26%	8%	10%		
Experience	Less than 1 year	Between 1 and 5 years	Between 5 and 10 years	> 10 years				
	20%	34%	26%	20%				
Employer Sector	Academia	Construction	Consultation	Government: General Infrastructure Delivery Policy Making and Enforcement	Industry Association	Material Manufacturing/ Engineering/Supplying	NGO	Waste Management: Waste Recovery
	15%	15%	18%	24%	5%	10%	6%	8%
Location	Australian Capital Territory	New South Wales	Queensland	Victoria	South Australia	Western Australia		
	2%	20%	5%	10%	6%	8%		

Respondents were asked to assess their familiarity with state and national policies that facilitate or restrict the use of PwRC in construction projects. Additionally, they were asked to indicate to what extent they agree that these policies support the use of PwRC in these projects. The results showed that most participants were generally knowledgeable about these policies and regulations and reported that they disagree the current policies enable optimal adoption of PwRC in construction projects (Figure 11).

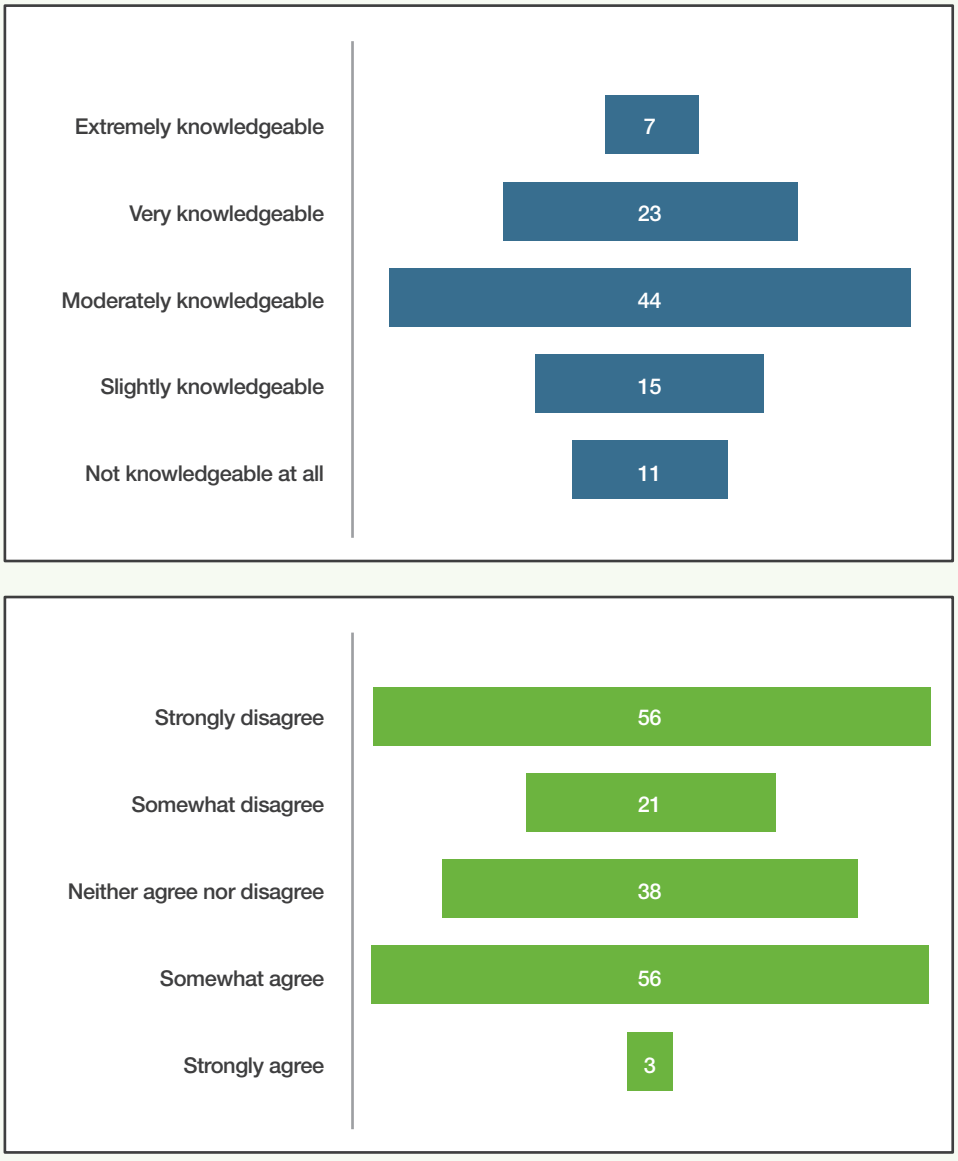


Figure 11: Top: Frequency distribution (%) of participants' level of circular economy policy knowledge. Bottom: Frequency distribution (%) of participants' beliefs on how current government policies favour PwRC use in construction projects

In the survey, the participants were also required to report the positive or negative impacts of each policy. As presented in Figure 12, all of the policies were reported to create more positive impacts than negative impacts. In particular, the three policies with the greatest positive impacts were Sustainable Procurement (90 per cent), Recycled Product Certification (83 per cent) and Financial Incentive for Using PwRC (81 per cent).

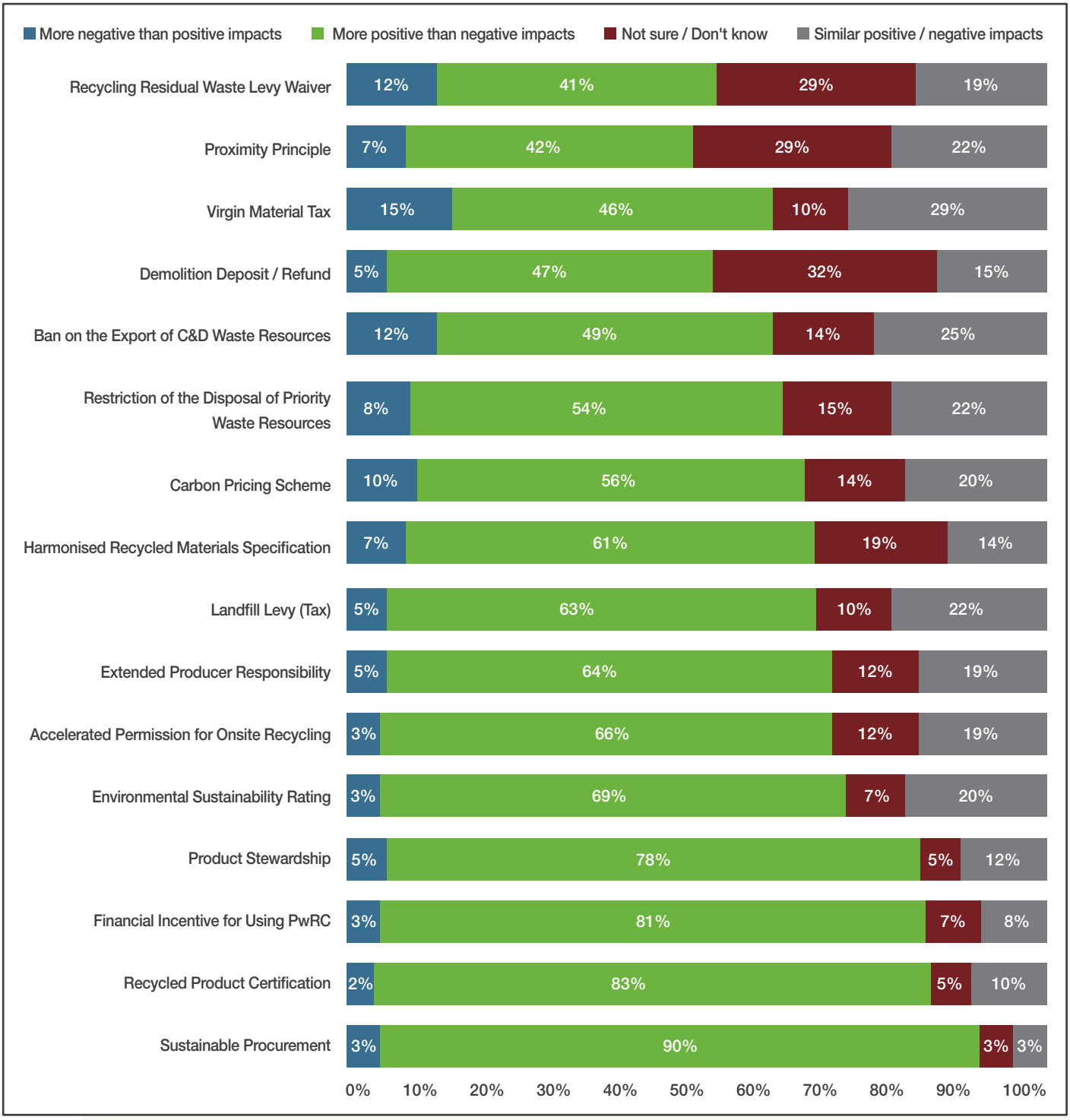


Figure 12. The frequency distribution (%) of responses on negative/positive impacts of study policies

7.0 Conclusion

This research highlights the critical need to inform, empower and engage key stakeholders to advance the agenda for increased utilisation of PwRC in both government and industry sectors. Such efforts are pivotal for supporting Australia's transition to a more circular economy. The findings from this comprehensive 18-month national research project reveal how a multifaceted approach – including education, the development of supportive policies, the establishment of change agents, the promotion of local collaborations, the transformation of construction industry practices and the demonstration of sustainability benefits – can significantly enhance the performance of construction projects that incorporate PwRC.

These insights lay the foundation for further advancements in the industry, ensuring that stakeholders not only recognise the value of PwRC, but also harness its potential to create lasting organisational benefits. Some of the findings can be the source of inspiration within the Australian context, offering valuable perspectives for the R&D sector to align its research activities with the pressing needs of industry, government and academia.

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8.0 Moving Forward

This research provides an excellent opportunity to develop an action list for Australian organisations to move towards a sustainable future in alignment with circular economy principles and objectives. The actions listed in Table 4 focus on key innovative strategies designed to enhance resource efficiency in the building and construction sector.

Table 4: Recommendations for various sectors: next steps

Building and Construction Sector	Government	Waste Recovery Sector	R&D Sector
1. Review construction processes to identify how, where and when PwRC can be effectively utilised 2. Assess how their business models can be transformed to embrace circular economy practices 3. Educate design and architecture community to champion actions and decisions leading to optimal use of PwRC in construction projects	1. Investigate the development and implementation of new circular economy policies to support PwRC use nationwide 2. Use the survey findings to reform and strengthen existing circular economy policies 3. Establish or strengthen national and state change agencies to collectively drive public sector transformation towards optimal PwRC uptake 4. Emphasise local collaboration in decision-making processes to keep waste close to its source of generation	1. Enhance capacity to address industry needs for the utilisation of high-quality PwRC 2. Build capacity for managing deconstruction processes to enable onsite utilisation of PwRC 3. Engage with construction and demolition project teams early to plan for the recovery and supply of PwRC in those projects	1. Assess how various circular economy policies impact various stakeholders operating across PwRC supply chains 2. Collaborate with construction organisations to conduct pilot studies demonstrating successful applications to industry audiences 3. Support the construction manufacturing sector in producing high-quality PwRC that meets the standards of existing circularity indices

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Find out more:

Project webpage:

Using Recycled and Recyclable Products: Influencing Stakeholders through Circular Economy Practices
https://sbenrc.com.au/research-programs/1-95/

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