

Analysis of sustainable procurement in supplying recycled content: A case study in Western Australia

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Abstract. Extensive construction activities across Australia have resulted in an unprecedented rate of construction and demolition (C&D) waste generation. A fraction of this waste is currently being recycled and supplied to the market. However, the reports indicate that the Australian market is not prepared to uptake such a quantity of recycled content (RC). A successful policy approach in increasing RC uptake in the construction industry is sustainable government procurement. However, the benefits of this policy instrument have not been fully realised in Australia. Therefore, this study aims to understand the dynamics of sustainable procurement using Roads to Reuse Program managed by Western Australia Main Roads as a case study. This public organisation is responsible for managing road networks across Western Australia. The study employs an interview with a senior sustainability advisor of this organisation. The interview is guided by a framework for enabling sustainable procurement seeking transformation in behaviour, culture, context and processes in the government and industry sectors. The results of the study shed light on sustainable procurement opportunities and challenges in the Australian context. Furthermore, a series of recommendations proposed to improve the status quo towards a more sustainable future. The findings can be used by policymakers, government procurement experts, and industry practitioners to drive sustainable procurement planning and practices changes.

1. Introduction

According to the C&D waste key stakeholders, issues such as the introduction of new policies by foreign countries banning the import of waste from Australia, overregulation, strict acceptance criteria, culture, poor education (attitude and behaviour) and acceptance, lack of domestic market for C&D waste, cheaper virgin materials and high cost of reprocessing; and increased landfill levies have hindered implementation of effective waste management across Australia (2). As a result, Australian federal, state and territory governments, through various waste management strategy documents, started to shift from the linear make-take-dispose waste management approach towards more circular economic thinking and the adoption of innovative solutions to tackle these issues. The effective management of waste resources ideally follows a hierarchy model of reduction, reuse, recycling/upcycling, and energy recovery (3).

Environmental and ecological impacts of construction activities have become an ever-increasing concern, especially the considerable amount of waste generated on construction sites. The large quantity of waste generated from construction activities denotes that SP will have a significant environmental impact. SP can act as a demand-side market force influencing local producers and encouraging the development of sustainable products and practices. SP is regarded as a pivotal market-based instrument that delivers enormous environmental and social benefits to resource efficiency, controlling operational costs, enhancing compliance with environmental regulations, tackling environmental risks, and creating end markets for C&D waste products (4). The consideration of SP as part of the tender and contract process ensures compliance that will benefit the environment, society and economy (5). SP generally creates a greater demand for recycled products as a policy instrument. As a result, the C & C&D waste recycled market evolution can be used as an indirect indicator of the success of SP. policy implementation.

1.1. Contextual background

The use of recycled materials in the construction industry reduces the need for raw material extraction, which results in material depletion and other environmental problems. In 2011, one of the first reports (6) highlighting the role of SP in the market development for recycled C&D waste recommended that public organisations should favour procurement of material containing recycled C&D content where they meet defined performance criteria/specifications. In the Australian construction industry, one of the issues regarding applying SP of recycled products is the higher total costs of properties built with environmentally sustainable materials. The cost of housing is an essential element to consumers, especially for the lowest- to middle-income earners. Homebuyers deem that the high cost of environmentally sustainable products pushes up the cost of properties, discouraging capital investment in such products (7). It is projected that this cost should reduce in future as accessibility to building techniques and materials becomes easier (8). It is reported that Sustainable Procurement 2006, from the Australian and New Zealand Government Framework, has influenced the policies of lower levels of government. The reuse of recycled materials is strongly encouraged under ecologically sustainable development and sustainable procurement programs. At the national level, National Waste Policy (9) sets a target to reduce waste generation through prevention, reduction, recycling, and reuse. This policy has also emphasised applying the principles of a circular economy to support better and repeated use of the nation's resources. Two strategies to promote sustainable procurement in Australia are at the forefront of this policy: Strategy 8 (Sustainable Procurement by Governments) and Strategy 9 (Sustainable Procurement by Business and Individuals). These two strategies urge the public and private sectors to promote demand for recycled materials and RC products.

1.2. Research objectives

The research aims to provide insights into the implementation of sustainable procurement policy in Australia, using a case study analysed on a public organisation in Western Australia. This study is part of a larger national research project (Project 2.76. Sustainable Procurement) that aims to identify industry challenges by examining key issues across the procurement life cycle to improve environmental, social and economic sustainability outcomes in the housing, building and infrastructure sectors in Australia. The specific objectives of this paper include

1. To analyse the implementation of sustainable procurement in the Australian context
2. To explore how public organisations can successfully enable sustainable procurement in construction projects
3. To identify strategies to improve the adoption of sustainable procurement policy in public construction projects

The remainder of the paper is structured as follows. First, the research methodology is described. Next, the analytical findings are provided that are followed by results discussion, conclusions and some recommendations.

2. Research methodology

Case study research provides an in-depth understanding of unique phenomena that could not be studied outside the context in which they occur (10). The following sections describe an Australian case study selected for this study, provide information on a framework developed to enable sustainable procurement, and detail the data collection and analysis procedure.

2.1. Case study context: Road to Reuse

The WA state is one of the Australian states and territories with a heavily regulated waste management regulatory framework. The organisations with the most impact on C&D waste market development in WA are the Department of Water and Environmental Regulation (DWER), the Waste Authority, the WA Environment Protection Authority (EPA) and WA MainRoad. The state regulatory framework considers waste as a resource and provides an exemption for applying waste in construction and maintenance work in licenced landfills. The framework also provides regulatory support for applying a range of waste management strategies such as polluters pay, product stewardship, extended producer responsibility, and end-users liability for material whole life cycle costs. According to the National Waste Report (11), the state's C&D waste recycling in 2019 increased by 26% compared to that in 2017, while the C&D waste disposal saw a comparatively slight decrease (3%). The C&D waste-based energy from waste (EfW) was recorded at 2 kt. The most recent data reported by the Waste Authority (12) shows an 80% resource recovery rate for the C&D waste stream, which is 24% more than the average resource recovery in the state. Among the priority materials, concrete had the most significant recycling rate. The data for waste disposal for brick, concrete, asphalt, and steel are non-existent. With over 1.5 million tonnes of C&D materials processed annually in WA, there is a large supply of usable materials. Recently, there have been some successes in developing new markets for these recycled materials (13). Currently, the largest end-market for C&D waste materials is public projects. These projects have unlocked the potential of a domestic market for extensive application of recycled products. Notably, the (RtR) outlines the state's effort in the use of recycled C&D waste. However, the reduced construction activities are estimated to cause a decline in supplying feedstock for recycling facilities and thus affect the market development in the future (13).

2.2. Theoretical framework

The case study is guided by a framework (14) that enables sustainable procurement. This framework (Figure 1) focuses on transforming public organisations to adopt sustainable procurement policy in procuring specific materials and services that deliver environmental, social and economic benefits. The main components of this framework are awareness, alignment, organisation and process enabling, which prepares public organisations to achieve the benefits mentioned above. In this paper, the four components are analysed according to these components.

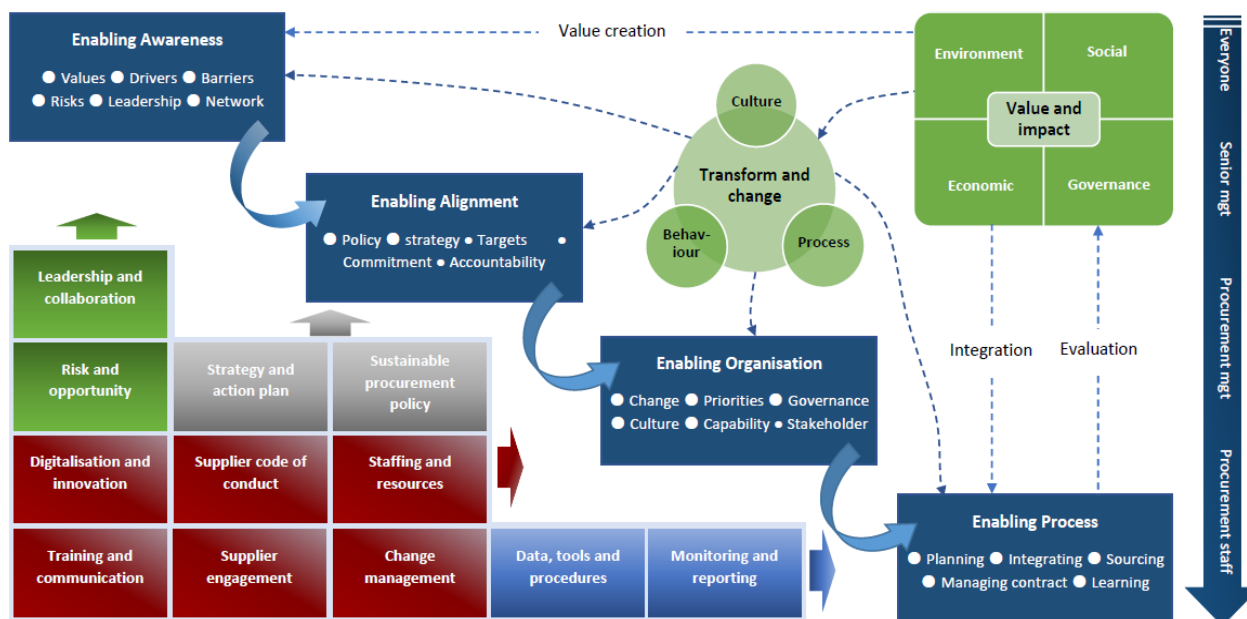


Figure 1. Framework for Enabling Sustainable Procurement. Source: Feng, Papastamoulis (1).

2.3. Data collection and analysis

This study employed a qualitative approach to achieve the research objectives using both primary and secondary data. Desktop research was performed to identify various aspects of sustainable procurement management overseas, Australia and particularly WA MainRoad. The desktop research analysed various literature, including journal and conference articles, government reports, policies, standards and regulations. To obtain real-time primary data, an interview was scheduled with a WA MainRoad principal sustainability advisor who was fully aware of various aspects of this organisation's activities in using RC in infrastructure projects in WA. The interview schedule included the organisation's capacity to enable sustainable procurement in C&D waste management. Western Sydney University approved the interview scheduled of the Human Research Ethics Committee. A thematic analysis was applied to the literature review and the interview data. The results are presented in five themes: an overview of sustainable procurement application in the case study, awareness enabling, alignment enabling, organisation enabling and process enabling. The following section provides the key findings from these themes.

3. Findings and discussion

3.1. Analysis of progress to date

The DWER and the Waste Authority, in partnership with Main Roads Western Australia, deliver this initiative. Les Merchant, the WA MainRoad Manager of Materials Engineering Pavement and Surfacing, reported that about 65,000 tons of crushed glass, 34,000 tons of crushed recycled concrete (CRC), 2,400 tons of crumbed rubber, and 20,000 tons of rubber through this project were used in WA infrastructure developments in 2020. The following table provides some statistics on the use of CRC in civil construction projects in WA against the original targets as set by MRWA (Table 1).

Table 1. Statistics on the use of CRC in civil construction projects facilitated by the RtR program.

Project	Original Target	CRC (T) 2019/20	CRC (T) 2020/21	Forecast CRC
Armadale Road to Northlake Road Bridge	17,355		28,014	0
High St/Stirling Hwy	12,000		12,236	0

Murdoch Drive Connection	4,000	7,287	0	0
Kwinana Freeway Northbound Widening	16,000	24,263	0	0
Leach - Welshpool	8,900	0	2,351	6,549
Karel Avenue	0	3,332	857	0
Tonkin Gap	20,000		3,531	20,000
Total		34,882	46,132	

Source: Main Roads Western Australia

3.2. Enabling awareness

A few factors were identified as enablers: government department support, the closeness of recycled products to market, the appropriate scale of production, and final product cost. In WA, the Department of Treasury is currently promoting the use of CRC to share the associated economic benefits and encourage carbon emission and waste reduction. Furthermore, Waste Authority, the public organisation responsible for waste issues in the state, imposes a commitment on WA MainRoad to use recycled products. WA MainRoad leads a demonstration of using these materials to local government to motivate them to start using them. The cost of recycled products hinges on several factors, including the size of the order, the distance between a construction site and a recycling facility, the quantity of (waste) feedstock they receive for recovery, the landfill levy for residual waste, and the recycling facility ability to produce materials to standards. The interviewee specified the main barriers to implementing sustainable procurement of RC. The barriers include the risk of contamination (e.g., asbestos in the case of C&D waste) and change in the engineering properties of the waste resources during waste recovery activities. Indeed, these two factors may make the final product fail to meet the requirements of the current standards, making them commercially unsuitable.

The other important barrier specified by the interviewee was the organisation barrier; for example, constructors may heavily rely on the existing supply chains that are believed to work best for them. To enable sustainable procurement effectively, cultural changes must convince stakeholders about recycled materials' reliability and consider these more sustainable alternatives. In most cases, cultural changes will lead to changes in behaviour and process. Stakeholders who may significantly influence the implementation of sustainable procurement include clients or/and government organisations, suppliers, designers, contractors, and professional bodies such as the National Asphalt Association and Waste and the Recycling Industry Association of Western Australia. Interestingly, the interviewee mentioned that those constructors who can manage public infrastructure projects have quarries and manufacturing facilities. There are two major working arrangements in the WA context, through either a consortium or collaboration between different parties such as designers, constructors, and other consultants. The end-users concerns are mostly related to the consequences of using the recycled products, such as the unpredictability of material behaviour in the application, additional costs, and the need for necessary changes in construction methodologies to handle the recycled products. Notably, for the government organisations as the client of public infrastructure projects, the reputational risk when using unreliable material is the most significant concern.

Table 2. Summary of the study organisation (WA MainRoad) efforts in enabling awareness.

Findings	
Leadership & collaboration	<p>MRWA, as the largest state asset owner, co-leads efforts aiming to promote the uptake of RC in civil construction projects. The agency collaborates with other parties involved in sustainable procurement primarily through a Waste Forum platform that constitutes representatives from Main Roads Western Australia, DWER, Waste Authority and the waste management and resource recovery industry. The Forum has different functions, including connecting various parties, defining and operationalising actions in the state waste strategy document (Waste Strategy 2030), mitigating any regulatory issues preventing success and risk, managing the entire sustainable procurement, and reviewing and providing guidance to stakeholders in meeting product specifications.</p>
Risks	<p>While there is a consensus about the benefits of using RC in civil construction projects in the state, its sustainable procurement involves several perceived risks, including:</p> <ul style="list-style-type: none"> • Risk associated with unpredictable material behaviour in applications (technical) • Risk of contamination in RC (technical) • Risk concerning changing the construction methodology to handle recycled materials (commercial) • Risk emerging from changes in design and subsequent cost implications due to variation in the contract scope of work (commercial) • Risk of failure to meet requirements of product specifications (commercial) • Risk of negative impact on reputation when unreliable RC are used (reputational risk) • Risk involved in working with new supply chains providing recycled materials (technical & commercial) • Risk of diversion from committed recovery activities by RC suppliers
Opportunities	<p>Opportunities for using RC across the state include</p> <ul style="list-style-type: none"> • Receiving credits from sustainability rating systems (e.g. ISCA) • Learn lessons from previous or demonstration construction projects using RC through effective knowledge sharing channels • Government support and guidance to enable suppliers to produce quality recycled contents at a large scale • Setting targets for using RC by public organisations • Project contract that can mandate or incentivise the use of RC. • Employing independent auditing contractors to review recyclers' recovery activities and provide assurance as required by clients

3.3. Enabling alignment

WA MainRoad works with stakeholders in different supply chains to deliver its commitments. In 2020, the agency engaged with over 4,900 suppliers and made \$1.753 billion in payments (15). WA MainRoad incorporates several policies in their purchases to develop a culture for sustainability through their supply chains and improve the overall outcome for sustainability. WA MainRoad follows the State Supply Commission Policy on sustainable procurement to demonstrate that the agency has considered sustainability in the procurement of goods and services. In WA, Waste Recovery and Resource Strategy is the overarching policy that drives the change in the C&D waste space. The DWER developed the policy in consultation with Waste Authority and WA MainRoad. According to the interviewee, the policy has been able to push the agenda of using RC at the state level. This policy is the foundation of the Waste Strategy 2030 document, which outlines the WA government mechanism for defining waste management related actions. In the WA context, the actions are defined in a Waste Forum platform established in 2018. The Forum consists of DWER, Waste Authority, WA MainRoad representatives, and experts in the waste and recycling industry. Other parties involved include Tyre Stewardship Australia, the Waste and Recycling Industry Association of Western Australia, the Department of Health

and Finance. The Waste Forum initiative has been the facilitator in addressing the long-standing impediments inhibiting the use of CRC in WA infrastructure projects. The Waste Forum is a multi-disciplinary sustainability group formed by WA MainRoad in 2018 which has delivered outstanding outcomes through a commitment to innovation and collaboration. Interestingly, the context allows the latter group to project manage the whole process to ensure that upcoming challenges as identified by them are dealt with appropriately.

One of the main policy-based actions for implementing sustainable procurement is to develop and improve product specifications. The Waste Forum also provides a communication platform between the government and industry to build capability to decide on strategies to evaluate product specifications for recycled materials. The platform brings together recycling businesses to promote and make the product specifications known to all parties involved in the recycled cornet supply chain. According to an interviewee, the Forum, in collaboration with the industry in the network, periodically facilitates training courses to educate the stakeholders about the requirements of recycled products. Such networking has enabled government organisations to connect to other waste groups such as the Infrastructure Sustainability Council of Australia (ISCA) WA Working group to better capture the issues from a holistic perspective. As a prominent asset owner in the state, WA MainRoad enables CRC in infrastructure projects in certain circumstances through contract clauses that are either incentive or mandatory. The mandates are applied through the scope of work and technical criteria specified in tender project documents. However, mandating comes with technical and commercial risks. In the case of change in design required for using unreliable recycled materials, there is a technical risk that leads to commercial risk as the constructor mandated to use these products is not prepared to contribute to sharing the risk with the agency. In this case, they would seek variation compensations which, according to the interviewee, the agency has no choice to accept the additional costs. The interviewee believes that the best way to approach this issue is twofold. The first is to acquire sufficient information on how much CRC is to be used during the front-end planning stage, either mandatory or incentivised in a project. The second is to enable cultural change to let the project team decide on the quantity of RC be used. The latter is currently supported through sustainability tools such as ISCA that rate and credit environmentally sustainable civil construction projects. The loophole with these tools is that constructors are allowed and may choose to use other recycled materials that are more cost-effective than CRC.

Table 3. Summary of the study organisation (WA MainRoad) efforts in enabling alignment.

Findings	
Strategy & action plan	WA MainRoad often refers to Waste Recovery and Resource Strategy as the overarching document to drive behavioural and attitudinal changes in this space. DWER developed this document in negotiation with the Waste Authority and Main Roads Western Australia. This document has been a catalyst to push the agenda of using RC at the state level. This policy is the foundation of the Waste Strategy 2030 document, which outlines the WA government mechanism for defining waste management related actions. Several short, mid-and long terms action plans are delivered by MRWA to improve sustainable procurement of RC. These actions include financial support (short term), training courses, technical support, roundtables and specialised conferences (mid-term), and pilot trials and revisions in waste regulations (long-term).
SP policy	WA MainRoad incorporates several policies in their purchases to develop a culture for sustainability through their supply chains and improve the overall outcome for sustainability. In addition to Waste Recovery and Resource Strategy, Waste Strategy 2030 and the State Supply Commission Policy are the main state-based policies informing procurement practices; the agency draws on Sustainability Policy and Environmental Policy to ensure that civil construction projects are delivered most sustainably.

WA MainRoad also has a Sustainable Policy and an Environmental Policy which are reviewed every two years. The sustainability policy document outlines six primary objectives that MRWA has committed to achieving. Sustainable procurement has a pivotal role to play in achieving these objectives.

3.4. Enabling organisation

In WA, the state government establishes progressive targets to use recycled products which are negotiated with contractors. These targets are currently set as a milestone rather than time-dependent and are actioned by various government parties, including WA MainRoad. For instance, in 2020, the agency committed to using 100,000 tonnes of CRC within 2021-2022 and 200,000 tonnes in subsequent years. Beyond the scope of this study, the interviewee also mentioned that the state government plan to use recycled materials other than CRC such as rubber, asphalt, sand and glass to a lesser extent. Another barrier to establishing a market for using CRC is that sometimes pre-agreed commercial arrangements dictate constructors to procure these products from certain suppliers regardless of quality and travelling distance. The capability development for all stakeholders in WA begins with identifying necessary steps to meet product specification requirements. Next, government organisations such as WA MainRoad encourages recyclers to work with consultants and other experts to demonstrate the ability of the industry to deal with the risk associated with using recycled products. As part of this encouragement and in the form of short-term action, public organisations provide financial support. For instance, WA MainRoad facilitated a \$100,000 funding grant from the Waste Authority to WA MainRoad to offset, up to a \$4 per tonne, increased cost emerging from using the CRC product. Also, the DWER provides ongoing financial support to suppliers to cover the costs of sampling and testing products against the current product specifications.

A mid-term action to provide insight into the waste and recycling industry is pilot trials. It is reported that the practices facilitated by the agency have initiated a mind-shift in the industry to understand WA MainRoad requirements and helped the agency to understand the industry's capabilities and will assist the State Government and private sector to make large strides towards reducing WA's 700,000 tonnes of crushed concrete yet to be recycled. However, according to the interviewee, such development needs further improvements, particularly in identifying well-operated recyclers with the ability to produce reliable products, establishing platforms to promote the RtR program, sharing technical knowledge learned from current and previous projects, and strengthening staff responsible for capability development. In Main Roads Western Australia, the strategies employed to address some of the issues mentioned above include promoting RtR program objectives to stakeholders through seminars such as waste and recycling conferences, organising government-held roundtables, and conducting pilot trials, enabling acquiring and sharing lessons learned as the standard practice.

Table 4. Summary of the study organisation (*WA MainRoad*) efforts in enabling organisation.

Findings	
Governance	WA MainRoad is strongly committed to sustainability and identifies and applies strategies to overcome hurdles preventing the use of RC in civil construction projects. This support has emerged in different shapes from technical and financial support, knowledge sharing, product specification development, and pilot trials. WA MainRoad works with DWER, Waste Authority, Department of Finance, Department of Health, and Department of Treasury and waste and recycling industry to push sustainable procurement agenda.

Training & communication	<p>WA MainRoad, through networks established in Waste Forum, organises some training courses and specialised conferences, and roundtables are covering a range of relevant topics to improve stakeholders understanding of WA MainRoad requirements of using RC and best management practices in the production and application of quality recycled materials in civil construction projects. Furthermore, the Waste Forum has allowed the industry to communicate better challenges (i.e., technical knowledge to pass WA MainRoad product specifications, contamination, and performance) and will enable the government to fill the capability gaps by offering training and implementing robust implementation quality management practices.</p>
Supplier engagement	<p>WA MainRoad, through Waste Forum, engages suppliers in risk management of various processes of the RC supply chain. One of the most successful outcomes of this Forum is the RtR program which supports pilot trials. Pilot trials engage suppliers in different ways: evaluate their ability to produce RC according to product specifications, assess the adequacy of the independent audit process in verifying their processes and products to provide confidence to the market, and explore their products purchases' confidence in using RC.</p>

3.5. Enabling process

The complementary component of the RtR program is to employ independent audits to improve assurance about the quality of recycled materials. Such audits aim to ensure that various recyclers adhere to their committed waste management processes and address the associated risks accordingly. Furthermore, this quality assurance process reduces tension between a client and a supplier by transparency to recycling activities and operations. The primary mechanism to capture the lesson learnt in WA MainRoad is formal pilot trials reports. These reports are often exchanged between the organisations to review wins and losses. These reports are now a standard process in which crushed CRC is an essential component. Other mechanisms include using rating tools (i.e. ISCA) reports knowledge sharing credits and site visit tours. The interviewee stated that another effective mechanism that needs to be further pushed is the Environmental Product Disclosure (EPD). EPD in the case of CRC can be used to capture environmental benefits such as carbon emission saving of its application.

Table 5. Summary of the study organisation (MRWA) efforts in enabling process.

Findings	
Data, tools & procedures	<p>WA MainRoad, in collaboration with other public organisations, uses various tools and procedures to collect, process and report data from using RC in civil construction projects. Currently, ISCA WA Working Group offers sustainability certification to projects using RC. WA MainRoad has planned to effectively employ EDP to realise environmental benefits associated with RC application in civil construction projects across the state.</p>
Monitoring & reporting	<p>WA MainRoad uses five major ways to monitor and report progress in using RC in civil construction projects.</p> <ul style="list-style-type: none"> • Employing independent auditors to check in whether suppliers adhere to plan for producing recycled products that meet product specifications • Communicating results of using RC in pilot trials • Capturing lessons learned from current and previous construction projects using RC and circulating among involved stakeholders • Using ISCA credits to evaluate and report the use of RC in construction projects • Organising site visits to projects using RC

3.6. Strategies to promote adoption of sustainable procurement policy

Following analysis of the case study, some strategies are identified that can assist decision-makers in enabling public organisations to adopt sustainable procurement to increase RC uptake in government-led public construction projects. As depicted in Figure 2, these strategies concern enabling organisations in awareness, alignment, organisation and process areas.

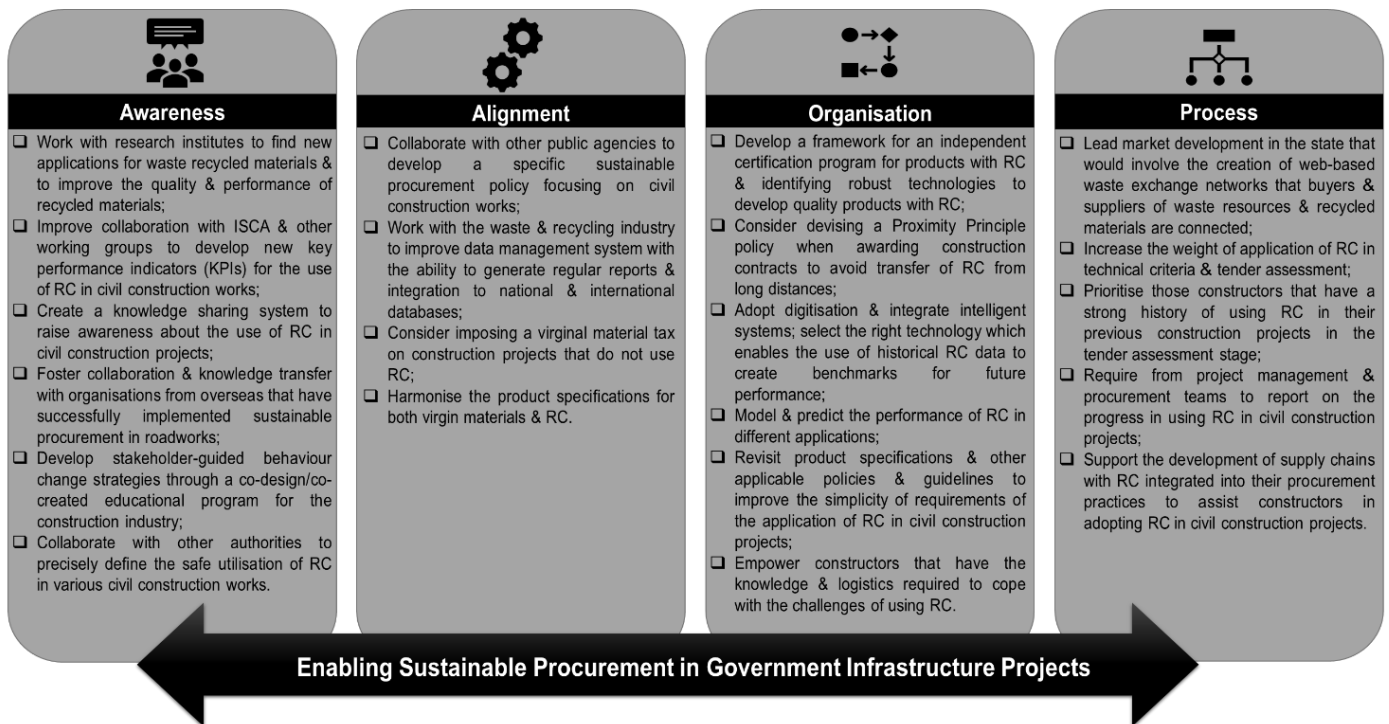


Figure 2. Recommendations to enable sustainable procurement in government-led construction projects.

4. Conclusions and Further Research

The application of recycled C&D waste products in construction projects is one of the main areas in the government's sustainable procurement policy, and practices can have a decisive role. WA MainRoad has made significant progress towards integrating sustainability in its procurement planning and practices. This progress can inspire other public organisations across Australia to shift their current procurement policies and practices to improve sustainability. This study contributes to the empirical literature on CE transition by exploring the stakeholders' awareness and attitudes towards its implementation in Australia. Further studies need to investigate the risks associated with the performance of CE in the AEC industry. This is particularly important as this industry entails a wide array of businesses that could be negatively affected. The research findings can help decision-makers set objectives and targets for a sustainable CE across the industry supply chain. Furthermore, policy developers at different government levels (local, state and national) can benefit from this study by developing and understanding stakeholders' perception of CE to create policies that will provide a level playing field for various actors across the industry.

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