

Creation and Stimulation of End-markets for Construction and Demolition Waste in Australia

Final Industry Report, Project 1.75

April 2022

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Acknowledgments

This research has been developed with support provided by Australia's Sustainable Built Environment National Research Centre (SBEncr). The SBEncr develops projects informed by industry partner needs; secures national funding; project manages the collaborative research; and oversees research into practice initiatives. Core Members of the SBEncr include BGC (Australia) Pty Ltd, Government of Western Australia, Queensland Government, Curtin University, Griffith University, RMIT University and Western Sydney University. This research would not have been possible without the valuable support of our core industry, government and research partners.

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Preface

The Sustainable Built Environment National Research Centre (SBEnc), the successor to Australia’s Cooperative Research Centre (CRC) for Construction Innovation, is committed to making a leading contribution to innovation across the Australian built environment industry. 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 draw on the results of this 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.



A handwritten signature in black ink, appearing to read 'John V McCarthy'.

John V McCarthy AO
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A handwritten signature in black ink, appearing to read 'Keith Hampson'.

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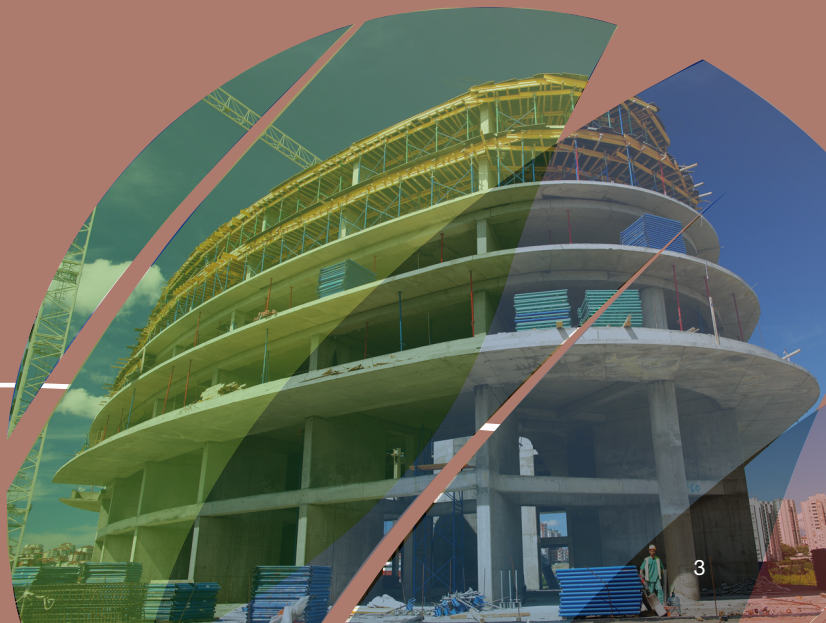




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Executive Summary

The generation of construction and demolition (C&D) waste from infrastructure, and building and housing activity across Australia is increasing, leading to C&D waste management becoming a high priority for federal, state, territory and local governments, private industry and the general public. In response to industry and public concerns related to unsustainable C&D waste management, this project aimed to enhance understanding of the operation and capacity of end-markets for C&D waste recyclables in Australian jurisdictions. This understanding involves the integration of circular economy principles and a cradle-to-cradle approach into C&D waste management systems in the Australian context.

Drawing on the extensive review of various national and international literature, analysis of relevant policies and guidelines, and evaluation of key stakeholders' sentiments, the project provided valuable insight into five key areas. These areas include (1) analysis of national and jurisdictional policy frameworks that affect creation and stimulation of end-markets for waste materials, (2) assessment of the operation of existing end-markets for five strategic construction materials (that is, brick, concrete, asphalt, steel and glass), (3) exploration of the application of sustainable procurement policies and practices at state, national and international scales, (4) identification of the main factors affecting C&D waste end-market creation and stimulation, and (5) building a framework for waste

market development. Notably, the interviews with 27 key stakeholders across four major Australian states (Queensland, Western Australia, Victoria and New South Wales) who have a crucial role in the utilisation of recycled products (for example, government, recyclers and construction professionals) resulted in identifying the main factors affecting the creation and stimulation of end-markets for C&D waste recyclables.

Lastly, the information derived from the literature review, policy analysis and interviews were used to develop a framework for a waste market. This framework involves multiple strategies that facilitate waste trading and are clustered into five categories concerning the policy development activities and work practices of key stakeholder groups – namely construction industry, government, waste recovery sector, independent (quality assurance) auditors and sustainability organisations. Development of such a framework theoretically contributes to a conception of the determinant factors of waste market development. Notably, the framework proposes pragmatic recommendations for overcoming any challenges posed. This framework can be also used by other nations seeking to develop effective management systems for C&D waste recyclables and potentially other waste streams.





Introduction

Rapid population growth, migration and urbanisation have led to a significant increase in construction and demolition (C&D) waste, prompting government and industry bodies to develop better waste management practices.

Australian Bureau of Statistics (ABS) data shows that the value of work undertaken in building construction activities substantially increased by 33 per cent from 2012 to 2018. In the construction engineering sector, the annual value of work commenced (all subdivisions) had an average annual growth rate of 19.9 per cent between 2015 and 2018 (June). This increase is reported to be significantly larger in some states such as Victoria (up to 80 per cent) and Western Australia (39 per cent). All of these activities have resulted in substantial growth in C&D waste that needs to be sustainably managed

Aim

This project aimed to provide a better understanding of the operation and capacity of end-markets for C&D waste in Australian jurisdictions, involving circular economy principles and a cradle-to-cradle approach for the sustainable management of C&D waste.

Industry Motivation

The generation of C&D waste from infrastructure, building and housing activity across Australia is increasing, leading to C&D waste management becoming a high priority for federal, state, territory and local governments, private industry and the general public. The management of C&D waste continues to be adversely influenced by internal and external factors, including inconsistencies in regulation across Australia and the fragmented operation of end-markets in various jurisdictions. Well-operated and integrated end-markets are key to tackling Australia's C&D waste problem. Such end-markets will result in the waste being a resource that can be circulated back into a supply chain employing circular economy principles. The research investigated the capacity of existing end-markets in Australian jurisdictions and the potential for the development of new markets. It identified a range of barriers and enablers that are affecting the successful operation of end-markets. This study presents a framework for creating and stimulating end-markets for C&D waste in Australia.

Objectives

- Review and identify jurisdictional regulations/specifications/guidelines/standards affecting the development and operation of end-markets for C&D waste streams.
- Analyse the operation of existing end-markets in Australian jurisdictions and identify related economic and technical barriers, facilitators and potential for new markets.
- Review how sustainable procurement guidelines in Australia may enhance the operation and size of C&D waste end-markets.
- Develop and validate a framework for creating and stimulating end-markets for C&D waste in Australian jurisdictions in the context of related regulations.

Jurisdictional Policy Framework

Impact on End-market Development and Operation

Australia

At the national level, efforts to stimulate end-markets for recycled products are typically led by the federal Department of Agriculture, Water and the Environment (DAWE). The DAWE has published a sustainable procurement guideline,¹ which is based on the Commonwealth Resource Management Framework, National Waste Policy: Less waste, more resources, 2018 (National Waste Policy 2018) and the United Nations Sustainable Development Goals. The guideline maps the pathway to the government sustainable

procurement approach, including consideration of the purchase of goods and infrastructure that can be re-used, repaired and recycled, and contain recycled content. The DAWE also published a guide² analysing the supply chain of C&D waste resources to help develop effective end-markets for materials derived from the C&D waste stream. The guide provides several case studies from across Australia in which the sustainable outcomes of using recycled products in construction projects are highlighted.

Australian Capital Territory

The regulatory framework that governs/guides market creation and stimulation activities in the Australian Capital Territory (ACT) has been reviewed. The key pieces of legislation are the Waste Management and Resource Recovery Act 2016 and the Environment Protection Act 1997. The leading ACT organisations responsible for creating and stimulating the C&D waste market are the Environment Protection Authority (EPA), Transport Canberra and the City Services Directorate. Included in the review are strategies, standards,

legislation and specifications. The primary pieces of legislation do not account for the end-of-life options, and waste is always considered waste regardless of its value. However, in the Development Control Code,³ mandatory requirements are specified, stating that development projects with more than 20 m³ of waste generation must recycle and re-use C&D waste materials. The ACT has no specifications for the application of C&D waste recycled products in infrastructure projects.

New South Wales

The New South Wales Environment Protection Authority (NSW EPA) and Transport for NSW (TfN) are the leading organisations responsible for guiding the creation and stimulation of C&D waste material end-markets. The NSW EPA provides leadership to ensure the state has a fair, modern and well-regulated waste industry. This organisation provides several C&D waste resource-specific exemption documents that outline how the consumers of recycled materials are exempted from waste levies across the state. The state's sustainable procurement policy prioritises the use of recycled materials in government projects. The policy advocates procuring eco-labelled goods and services (for example, environmental declarations) that are

compliant with environmental-based standards and registered in recognition programs and systems (for example, sustainable choice, sustainability advantage and recycled content). Furthermore, recently the state government released several policies,^{4,5} that emphasise the utilisation of recycled content and market development for C&D waste materials. TfN has released a technical guide⁶ for using and re-using various waste streams including C&D waste materials in road construction activities. Besides providing the best waste management practice, the Guide shows the pathway to obtain EPA approval/exemption to serve such purposes.

¹ Australian Government. 2020. Sustainable Procurement Guide: A practical guide for Commonwealth entities. Retrieved from <https://bit.ly/3ynJNtP>

² Edge Environment Pty Ltd. 2012. Construction and Demolition Waste Guide: Recycling and re-use across the supply chain. Retrieved from <https://bit.ly/3IEj9BF>

³ Transport Canberra and City Services Directorate. Development control code for best practice waste management in the ACT 2019. Retrieved from <https://bit.ly/3C6tROY>

⁴ NSW Government. 2021. NSW Waste and Sustainable Materials Strategy 2041. Retrieved from <https://bit.ly/3IYmlhu>

⁵ NSW Government. 2020. Cleaning Up Our Act: The future for waste and resource recovery in NSW. Retrieved from <https://bit.ly/39Jv5Sw>

⁶ Transport for NSW. 2016. Technical guide management of road construction and maintenance wastes. Retrieved from <https://bit.ly/3qxanyh>



Northern Territory

The Northern Territory (NT) waste regulatory framework builds on the Waste Management and Pollution Control Act 1998. The leading government agencies that support market creation and stimulation are the Department of Environment, Parks and Water Security (DEPWS), the Department of Infrastructure, Planning and Logistics (DIPL) and the Northern Territory Environment Protection Authority. The DEPWS

prepares the main pieces of legislation. The NT does not have a sustainable procurement policy focusing on government commitment to procure goods with recycled content; however, sustainable outcomes are emphasised in its Procurement Governance Policy 2019. Furthermore, the application of C&D waste recycling is encouraged in two standard specifications developed by the DIPL.

Queensland

Queensland is the first state in Australia to separate waste from a recoverable resource in its regulatory framework. The state legislative framework effectively facilitates stakeholders' engagement in waste management and resource recovery through several consultation opportunities throughout the development of legislative documents. The primary public organisations that contribute to C&D waste materials end-market development are the Department of Environment and Science (DES), the Department of State Development, Tourism and Innovation, and the

Department of Transport and Main Roads (DTMR). The state has specified the end-of-waste (EoW) framework in the Waste Reduction and Recycling Act 2011 that promotes resource recovery opportunities and aims to transform the perception of waste from being seen as waste to being valued as a resource. A waste producer may supply waste as a resource under an EoW code provided they have registered with the DES and can comply with the requirements of the code. The DTMR developed two specifications for using recycled glass aggregates and reclaimed asphalt pavement material.

South Australia

South Australia (SA) is a leading state in the operation of an effective C&D waste management system. The state recycling target was set to reach 90 per cent by 2020.⁷ Green Industries SA, the Department for Infrastructure and Transport and the EPA South Australia are the government agencies that deal with the C&D waste issues and market development. The primary Act in this state has excluded recovered resources that are being dealt with following the declaration of that resource. The declaration regarding any material is specified in a government gazette. SA is among the first of the states and territories to put a sustainable procurement

policy in place for government procurement practices. Green Industries SA offers market development research grants to stimulate an increase in the quality of and market demand for recyclable materials and recycled content products. In 2013, EPA South Australia released a standard for using waste materials as waste-derived fill; the standard describes the processes and approval requirements of applying the C&D waste stream in development activities. Overall, the regulatory framework in this state is in favour of a circular economy and market development.

⁷ Green Industries SA. 2015. South Australia's Waste Strategy 2015-2020.



Tasmania

Tasmania is the state that currently has the least number of waste regulations and policies concerning market development in Australia. The Environment Protection Authority Tasmania and the Department of Natural Resources and Environment Tasmania are the government agencies responsible for waste management in the state. One Act and one Regulation

are the main legislative instruments that affect C&D waste market development. However, limited support is provided through these two pieces of legislation. Currently, there is no standard, current strategy, policy or guidelines that affect C&D waste creation and stimulation. In this state, waste is always considered waste regardless of its value.

Victoria

Victoria is a leading state in market development for C&D waste materials. Sustainability Victoria recently introduced the Buy Recycled Directory, in which state recycled product suppliers are identified and featured. Despite the lack of a current waste strategy in Victoria, the state agencies have published various guidelines and strategies that inform waste management and

resource recovery activities and decisions across the state. The Department of Environment, Land, Water and Planning, Waste and Resource Recovery Groups, Environment Protection Authority Victoria, Sustainability Victoria and VicRoads are the leading government agencies that play a role in developing C&D waste end-markets in Victoria.

Western Australia

Western Australia (WA) is vast and located a considerable distance from waste end-markets, which can impact investment in waste and recycling infrastructure and overall recycling rates. However, WA does have a heavily regulated waste management regulatory framework. The organisations with the most impact on C&D waste market development in the state are the Department of Water and Environmental Regulation, the Waste Authority, the Environmental Protection Authority

and Main Roads WA. The state regulatory framework considers waste as a resource and provides an exemption for the application of waste in construction and maintenance work in licensed landfills. The framework also provides regulatory supports for the application of 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.

⁸ Tasmania Environment Protection Authority. Environmental Management and Pollution Control Act 1994.

⁹ Tasmania Environment Protection Authority. Environmental Management and Pollution Control (Waste Management) Regulations 2020.



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Australia

The waste management and resource recovery sector contributes to 0.3 per cent of Australia's Gross Domestic Product (GDP). In 2019, 36,000 jobs were recorded in the sector, which increased by 16 per cent from 2016 levels. The sector has contributed A\$4.866 million to the economy over a fiscal year (2018-2019). The ABS (2020)¹⁰ reports that the construction industry spent A\$2 billion on waste collection, treatment and disposal services among various sectors. These expenditures are calculated through the indicator of waste intensity, which quantifies the amount of waste generated per million dollars of value added to the economy. The indicator for the construction industry is 87 tonnes per million dollars. These figures highlight the magnitude of the C&D waste economy and the potential for the development of domestic markets.

Market development activities for C&D waste significantly vary across the Australian states and territories. However, most Australian jurisdictions have now acknowledged the benefits of a circular economy in the construction industry and seek to transition to non-linear construction material end-of-life management. In some states, such as Vic, WA and NSW, large public infrastructure projects have unlocked the potential of using recycled C&D waste in construction projects and present an opportunity to develop sustainable end-markets for these materials. The following review of market conditions in each jurisdiction provides an insight into the main factors affecting local market creation and stimulation. It can be used to establish a national platform to facilitate C&D waste trading across Australia.

Australian Capital Territory

The ACT has a population of 400,000 residents living in about 145,000 households in one of the fastest-growing regions in Australia. This territory is one of the leading jurisdictions in waste management, with about 70 per cent of waste being re-used and recycled.¹¹ In 1996, the ACT was the first jurisdiction in the world to employ a 'no waste' strategy (NOWaste). This important initiative promoted the idea, between 1996 and 2000, of considering waste as a resource. Governance and regulation of C&D waste in the ACT is performed by the EPA, Transport Canberra and the City Services Directorate. In 2018, the ACT Government set a 95 per cent target to recover C&D waste in this territory. The rate of waste generation has a linear relationship with construction activities. Since 2014, the construction industry's value in the ACT has surged, and the total value of work undertaken reached A\$766,681 in 2020¹² – an increase of approximately 36 per cent from 2014.

The market for certain C&D waste materials such as concrete, brick, steel and glass is well-established in the ACT. Conversely, the market for Energy from Waste (EfW) recovery (extraction and combustion of methane gas) has been diminished due to the change in the government policy following public concerns about the pollution associated with the operation of EfW facilities, notably West Belconnen Resource Management

Centres and Mugga Lane Resource Management Centre.¹³ Currently, the Business Recycling Program¹⁴ provides critical information on C&D waste recyclers in the capital. The report prepared for the Canberra Business Chamber has made some recommendations to improve the C&D waste management system in the ACT. Some of the recommendations are relevant to the scope of this report. Furthermore, in the National Waste Data Reporting Cycle 2017-19 report,¹⁵ some suggestions to improve the C&D waste market are provided. Below are the selected recommendations from both reports:

- Establish a website or mobile application to develop a market for exchange in the soil (the most relevant to the scope of this report).
- Establish a regional website or mobile application to provide information about the location, opening hours and restrictions of all landfill sites.
- Require tenders for government contractors to have criteria that favour the recycling of materials.
- Determine and fix a standard and protocol for the collection of C&D waste data.
- Revisit the ACT's EfW policy to reinstate the government support for EfW activities for combustible C&D waste materials.

¹⁰ Australian Bureau of Statistics (ABS). 2020. Waste Account, Australia, Experimental Estimates. Retrieved from <https://bit.ly/3ppc7r1>

¹¹ Meegan Fitzharris MLA. 2017. Waste and recycling industry in Australia – Submission 20: ACT Government's response.

¹² ABS. 2020. Building Activity, Australia. Retrieved from <https://bit.ly/3pdAokx>

¹³ ACT NoWaste. 2018. Waste feasibility study: Discussion paper. Prepared for the ACT Government.

¹⁴ Planet ARK. 2020. Business Recycling. Retrieved from <https://www.businessrecycling.com.au/>

¹⁵ Blue Environment. 2019. National Waste Data and Reporting Cycle 2017-19. Retrieved from <https://bit.ly/2S4cbAZ>

New South Wales

NSW is a south-eastern Australian state, distinguished by its coastal cities and national parks. It has a total area of 800,642 km² and covers 10.4 per cent of Australia. NSW is also known for having the largest population in Australia, reaching 8.196 million in 2021.¹⁶ The construction industry is required to provide residential builds and infrastructure to accommodate and provide urban amenities for the growing population. The construction industry, therefore, plays an important role in the state's economic profile. The industry is the fourth contributor to NSW's gross state product (GSP). Except for 2019, the value of building work undertaken (all construction sectors and building types) in NSW has steadily grown over the last few years,⁹ reaching A\$10.68 billion. NSW has commenced work on the largest infrastructure upgrade program in Australia. The state government has committed to spending A\$80 billion on new economic infrastructure over the next four years from 2020.¹⁷

Below are selected recommendations to create and stimulate markets for recycled C&D waste products in NSW. These recommendations are extracted from expert views published in different sources.^{18,19,20}

- Deliver creative incentives such as fee waiver programs for local governments and businesses that use recycled content/process recyclables.
 - Provide support via the waste levy for recycling, such as transport subsidies for regional areas, until market failures are addressed, rather than leaving everything to the market.
 - Mandate minimum recycling content in all large-scale construction projects.
 - Share recycling market information.
 - Create markets for recycled content at the design and tender stages of state-significant developments.
 - Give priority access to government markets if companies can demonstrate above-target resource recovery levels.
- Phase in NSW Government recycled content procurement targets and associated baselines, monitoring and reporting systems.
 - Provide support to Local Government Procurement to enhance the Sustainable Choice Database to include recycled materials and more products containing recycled content, and provide the functionality to track and report on local government expenditure on recycled materials and products containing recycled content.
 - Take a staged, individual approach towards introducing recycled content targets for Local Government Procurement to enable supporting tools and databases to be developed, and for regional and local variations to be taken into account.
 - Fund further research, development and delivery of recycling technologies and products generated from recyclables, particularly by local or regional councils.
 - Establish a clearing house/brokering service (virtual), matching waste/resource materials to potential users/manufacturers of recycled products to address some of the uptake barriers.
 - Develop and financially support a mechanism to facilitate the generation/bulking-up of volumes at an appropriate geographic distribution through cooperative arrangements across suppliers, including support for infrastructure (this may be needed both at state and regional levels).
 - Work with stakeholders across supply chains to find opportunities to not only reduce waste, but also ensure recycled content is valued and used over and over as a renewable resource through new clean technologies.
 - Improve onsite separating and processing to support improved diversion rates and reduced contamination.

¹⁶ Population Australia. 2020. Population of New South Wales 2021. Retrieved from <https://bit.ly/3irLnDB>

¹⁷ NSW Government. NSW Industry Report. 2020. Infrastructure and construction. Retrieved from <https://bit.ly/3sHEGC4>

¹⁸ Local Government NSW. 2020. Submission to the NSW 20 year waste strategy issues paper. Retrieved from <https://bit.ly/3uHKi15>

¹⁹ Local Government NSW. 2020 Recycled Materials in Roads and Pavements: A technical review. Retrieved from <https://bit.ly/35VCZXX>

²⁰ PWC. 2019. NSW Waste Sector Volume II: Situational Analysis. Retrieved from <https://bit.ly/359MvJO>



Northern Territory

The NT is a vast federal territory in Australia located in the arid Red Centre. This territory has a tropical monsoonal climate, which features a dry and a wet season. The NT economy is mainly concentrated around a few industries. These include construction, government and community services, and the mining sectors, which account for around half of the NT total economic output. In 2020, the construction industry employed 11,158 people; 23 per cent down from the previous year.²¹ The latest report by the ABS shows that the value of building work undertaken in the NT has been on a sharp decline since 2014.¹² Unlike most jurisdictions, the value in the NT has steadily shrunk from A\$418 million in 2014 to about A\$183 million in 2020; a 128 per cent decrease. This figure contributed 6.3 per cent²² to the total NT GSP in 2018-19.

Queensland

Queensland is an Australian state covering the continent's north-east, with a coastline stretching nearly 7,000 km. Queensland is Australia's second-largest state, following WA, with a total area of 1,730,648 km². The state is the country's third-most populated state, and the population is increasing at one of the fastest rates in the nation. Based on Population Australia's estimation,²⁴ Queensland's population will reach 5.257 million by the end of June 2022. The second-largest employer in the state is the construction sector, with 245,100 people employed in the industry in 2019-20. The construction industry contributed A\$27.3 billion (8.1 per cent of total output) to Queensland's economy in 2019-20, making it the state's third-largest sector.²⁵ Since 2016, the value of building work undertaken (all construction sectors and building types) in Queensland has consistently decreased, after it had reached its historical peak. A fall in major projects and reduction in the waste received from interstate are the main contributors to such low figures. Reduced construction activities have resulted in a lower amount of C&D waste generated annually. Furthermore, the state has one of the lowest waste recovery rates in Australia.²⁶

The market for C&D waste is not fully developed in Queensland due to several reasons including a lack of incentives, insufficient recycling facilities, geographically spread cities and towns, and a low landfill levy. However, it is considered that a newly introduced landfill levy, currently set at A\$75 per tonne, will positively impact the development of end-markets for C&D waste resources.²⁷ It should be noted that reinstating a waste levy might shock the waste management and resource recovery sector, as it is still

Currently, there is no functional market for recycled C&D waste across the NT, and much of what is generated at the construction and demolition sites is destined for landfill. The lack of information on C&D waste management makes it difficult to examine market development and stimulation capacity in this territory.²³ Following are the main reforms we propose to boost C&D waste market development in the NT:

- Mandate minimum recycling content in all large-scale construction projects.
- Share recycling market information.
- Create markets for recycled content at the design and tender stages of state-significant developments.
- Distribute the levy revenue to increase the capacity of recycling facilities across the state.

dealing with the consequences of the imposition of the new landfill levy.²⁸

Below are selected state-specific recommendations that would drive the creation and stimulation of end-markets for C&D waste resources. The recommendations are based on expert views provided in different sources.^{29,30}

- Ensure the waste and resource recovery infrastructure planning is aligned with the waste strategy, market development strategy and any other upcoming regulatory decisions.
- Develop standards for materials, as well as specifications for particular products and end-markets.
- Change procurement practices to incentivise and encourage (or mandate, as appropriate) the use of recycled content where it is available.
- Review the landfill levy rate annually to ensure its functionality can obstruct all loopholes and will be in favour of end-market development and stimulation.
- Take advantage of interstate waste transfer to provide sustainable feedstock for recycling facilities.
- Guarantee that a full levy exemption will apply to residual waste materials created, producing trade-exposed recycled materials.
- Distribute the levy revenue to increase the capacity of recycling facilities across the state.

²¹ Department of Treasury and Finance. 2020. Northern Territory economy. Retrieved from <https://bit.ly/3bRa0Z3>

²² City of Darwin. 2020. Overview – Shoal Bay Waste Management Facility. Retrieved from <https://bit.ly/38XYzwB>

²³ Mathur, D., O'Leary, R., and Gerritsen, R. 2016. Reducing Building Waste in Alice Springs. Charles Darwin University.

²⁴ Population Australia. 2022. Population of Queensland 2022. Retrieved from <https://bit.ly/39LqxLj>

²⁵ Queensland Treasury. 2020. About the Queensland Economy. Retrieved from <https://bit.ly/2Kw4QGH>

²⁶ Queensland Government. 2019. Recycling and Waste in Queensland 2019. Retrieved from <https://bit.ly/38ZhojI>

²⁷ Baird, L. 2020. 'Cleanaway can negotiate rocky regulatory road'. Financial Review. Retrieved from <https://bit.ly/3sEblmU>

²⁸ Australian Landfill Owners Association. 2018. Landfill levy for Queensland. A submission to the Department of Environment and Science. Retrieved from <https://bit.ly/2Nn30SL>

²⁹ Queensland Treasury Corporation. 2018. Economic Opportunities for the Queensland Waste Industry: Final report. Retrieved from <https://bit.ly/2LNmMx2>

³⁰ Waste Management Review. 2018. 'Levy Loopholes'. Retrieved from <https://bit.ly/2XTd92p>



South Australia

SA, with a total land area of 983,482 Km², is the fourth largest of Australia's states and territories by area, and fifth largest by population.³¹ It has a total of 1.77 million people. Waste management and resource recovery is an important industry in SA. Leading the country in terms of waste recovery rate, SA has great potential for creating new and stimulating existing markets for certain C&D waste materials, notably brick and asphalt. SA is at the centre of waste interstate transport for recycling in Australia. Several states and territories (NT, NSW, Vic and WA) transport their waste to this state to recycle and repurpose. For example, SA receives metal and glass from the NT and NSW.³² The latest reports^{20,21} show that this state also exports some C&D waste (that is, 1,954 tonnes of plastic recovered from C&D waste) interstate for recycling. University of Adelaide researchers²² have argued that the reason for such a business pattern is the financial benefit gains through waste trading, which highlights the significance of an efficient domestic market in the state. A newly published report by the SA Government³³ indicated that in 2017-18 about 86 per cent of all waste streams were recovered in the state, and the remaining were sent overseas (7 per cent) and interstate (7 per cent). The exported materials included mainly metals, cardboard and paper and, to a lesser extent, plastic.

The recommendations below are to increase the capacity of existing markets for recycled C&D waste products and to develop new end-markets across the state. These recommendations are extracted from various sources,³⁴ in which experts' views are considered.

- Build stable markets for re-manufacturing and secondary materials.
- Increase market confidence for investments in the circular economy, resource recovery and waste management.
- Increase the use of recycled material and build demand and markets for recycled products.
- Promote manufacturing of products and components that replace virgin materials with sustainably produced materials.
- Develop successful procurement case studies demonstrating benefits of using recycled-content products to government and industry.
- Support the development of accredited testing for product standards and performance to increase confidence in the quality of re-manufactured products.

³¹ ABS. 2020. National, state and territory population. Retrieved from <https://bit.ly/3o1599S>

³² Wu, H., Zuo, J., Yuan, H., Zillante, G., and Wang, J. 2020. 'Cross-regional mobility of construction and demolition waste in Australia: an exploratory study'. Resources, Conservation and Recycling, 156, p.104710.

³³ Green Industries SA (GISA). 2020. South Australia's Recycling Activity Survey 2018-19 Report. Retrieved from <https://bit.ly/3qBQQdP>

³⁴ GISA. 2020. Supporting the Circular Economy: South Australia's Waste Strategy 2020-2025. Retrieved from <https://bit.ly/3iyFUvC>

Tasmania

Tasmania lies about 240 km south of the state of Victoria, from which it is separated by the shallow Bass Strait. The state comprises a main island, namely Tasmania; Bruny Island, nestling close to the south-eastern coast of the main island; King and Flinders islands in the Bass Strait; numerous smaller islands off the coast of the main island; and sub-antarctic Macquarie Island, about 1,450 km to the south-east. The main island is roughly heart-shaped, with a maximum length and width of 320 km. The state produces a major portion of Australia's hydro-electric power and possesses a great diversity of natural resources.³⁵ Tasmania has long maintained a higher birth rate than most other states, although birth rates have generally been lower in the cities than in the smaller towns and rural areas.

Tasmania has mineral, forest, water and tourist resources. It has a diversity of economic activity and relatively stable labour relations. Its economy, however, suffers markedly from the small scale of much of its resource base, restricted local markets and problems with transport to external markets. Production and processing of minerals and metals furnish nearly half of the total value of Tasmania's exports. Another third of export value is split about equally between food and beverage products (especially meat and dairy), and wood and paper products.

The construction industry has demonstrated a steadily uprising trend since 2014.⁹ In 2020, the value of building work undertaken in this state reached A\$417 million; a 36 per cent increase from the 2014 figure. A recent

report by *Inside Construction*³⁶ estimated that the total worth of the construction projects in 2020-21 in the state would amount to A\$2.8 billion a year.

Several recommendations can improve the operation of the limited existing market for C&D waste across Tasmania. Some of these were extracted from the *Feasibility Study into a Statewide Waste Management Arrangement*:³⁷

- Consider circular economy principles as being core to Tasmania's operations and a natural fit for its circumstances.
- Develop strategies for priority materials.
- Implement and improve statewide data collection, analytics and reporting.
- Establish coordinated education, engagement and marketing.
- Ensure local governments' engagement and procurement support to lock in demand for new services and facilitate efficient use of assets.
- Establish market development measures including sustainable procurement.
- Coordinate advocacy and policy input.
- Encourage infrastructure funding to stimulate investment in recovery assets.
- Devise a market and/or statutory instrument to address gate fee differentials.
- Introduce a statewide waste levy to encourage waste recovery and market development.

³⁵ Scott. P. 2017. Britannica. Tasmania: Island and state, Australia. Retrieved from <https://bit.ly/3IEKNh4>

³⁶ Inside Construction. 2019. Skills and construction boom in Tasmania. Retrieved from <https://bit.ly/36l7N1k>

³⁷ Urban EP. 2019. Feasibility Study into a Statewide Waste Management Arrangement. Retrieved from <https://bit.ly/3bVp9Zq>



Victoria

Victoria is the second-most populated state in Australia. Victoria has a total area of 227,416 km², which accounts for three per cent of Australia's total landmass and makes it the smallest mainland state. Victoria's coastline is 1,800 km long and it borders the Bass Strait, the body of water that separates the mainland from Tasmania. Based on the latest estimations, Victoria's population will reach 6.74 million by the end of June 2022.³⁸ Victoria's construction industry employs almost 240,000 people and contributes A\$21.6 billion to the Victorian economy. The industry is driven by a continuing increase in Victoria's population and the need to provide housing and related infrastructure.³⁹ The Victorian construction industry has continued to grow over the last decade, reaching A\$9.92 billion in 2020. As a result, C&D waste is the largest contributor to the state's total annual solid quantity. In 2018, compared to Commercial & Industrial and Municipal Solid Waste, more C&D waste was recovered than was landfilled.

Compared to other states, Victoria has a strong market for recycled products. Hence, recycling facilities such as Bingo Industries and Repurpose It offer lower base prices. Furthermore, major infrastructure projects executed across the state provide a great opportunity for stakeholders to use recycled products in construction projects. For instance, in 2019, the City of Bayside⁴⁰ used recycled asphalt in roadworks in four suburbs, in the form of 12,000 tonnes of sustainable asphalt that

contained waste materials. It is estimated that the state's waste recovery sector transition to a circular economy will help to create more than 3,900 new jobs and establish new skills in design, repair, efficiency and material usage across Victoria.⁴¹

The following are selected recommendations to improve the operation of Victoria's existing market for recycled products. The recommendations are made according to experts' views published in different sources⁴² and should emerge from collaboration between key stakeholders including the government, the construction industry and the resource recovery sector:

- Work with local and other relevant stakeholders to develop sustainable end-markets for recovered recyclables to reduce exposure to price volatility of international commodity markets.
- Recommend the use of recycled and recovered material in infrastructure design and build, and the purchase of products that are made from or contain recycled or recovered material.
- Establish a framework for monitoring progress towards the circular economy, including the identification of indicators and metrics.

³⁸ Population Australia. 2022. Population of Victoria 2022. Retrieved from <https://bit.ly/3ojnLCt>

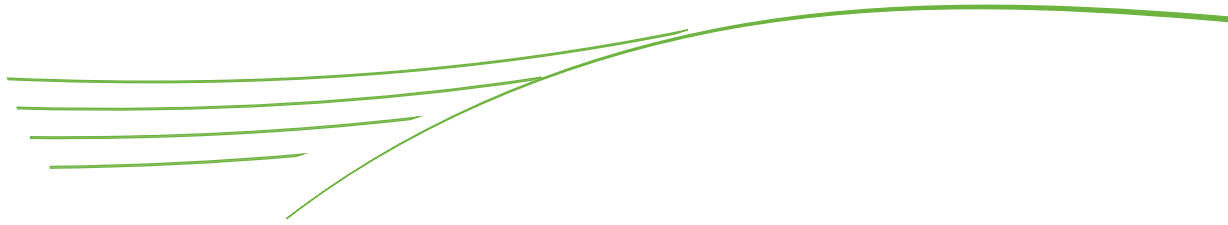
³⁹ Live in Melbourne. 2021. Transport, defence and construction technologies Retrieved from <https://bit.ly/3pnYPEj>

⁴⁰ Waste Management Review. 2019. Alex Fraser opens high recycled technology asphalt plant. Retrieved from <https://bit.ly/3IBjKmW>

⁴¹ Department of Environment, Land, Water and Planning. 2020. Recycling Victoria: A new economy. Retrieved from <https://bit.ly/3j4pEBV>

⁴² Sustainability Victoria. 2019. Guide to Better Practice at Resource Recovery Centres. Retrieved from <https://bit.ly/3L7ZLxO>





Western Australia

Western Australia (WA), the largest state in Australia, covers the entire western third of the country. WA is made up mostly of the arid Outback and its total area is 2,529,875 km², which accounts for 33 per cent of Australia's total landmass.⁴³ Its population is concentrated in its fertile south-west corner, home to the Margaret River wine region, and the riverside capital, Perth. Based on the latest estimations, WA's population will reach 2.84 million by the end of June of 2022.⁴⁴ WA's GSP of A\$285.6 billion in 2018-19 was 15 per cent of Australia's GDP. Construction is the third major contributor to the state GSP following mining, business and property services.⁴⁴ However, the latest data shows that construction activities in WA have consistently declined since the start of 2015 in all construction sectors. In 2020, the value of building work undertaken (all construction sectors and building types) dropped to about A\$2 billion; a 72 per cent decrease from that of 2015, making it the largest detractor from GSP growth.³¹ Unsurprisingly, this resulted in a significant reduction in the amount of C&D waste generated in the state. In WA, C&D waste materials are considered as priority waste management resources.

With more than 1.5 million tonnes of C&D materials processed annually in WA, there is a large supply of usable materials, and recently there have been some successes in developing new markets for these recycled materials.⁴⁵ Currently, the largest end-market for C&D waste materials is public projects. These projects have unlocked the potential for a domestic market for the extensive application of recycled products. Particularly,

the Waste Authority's initiative Roads to Reuse,⁴⁶ established in 2020, outlines the state's effort in the use of recycled C&D waste. The organisation's vision is to encourage state government organisations, local governments, regional councils and the private sector to use recycled C&D products in civil applications, such as road construction.

Selected recommendations for improving the existing end-market and creating potential markets for C&D waste materials are provided below. These recommendations are extracted from waste management and resource recovery experts' opinions published in different sources.^{32,47}

- Implement uniform waste levies across the state, ideally applying them in a manner that minimises 'border' market distortions.
- Monitor and prevent illegal waste dumping activities to encourage more material recovery.
- Develop technologies that assist authorities to identify and control illegal dumping across the state.
- Facilitate the process of obtaining licences and approvals necessary for the establishment of new facilities.
- Remedy contamination of raw materials and poor source separation.
- Increase customers' awareness of recycled products and their safety.

⁴³ Population Australia. 2022. Population of Western Australia 2022. Retrieved from <https://bit.ly/36e0dZB>

⁴⁴ WA Department of Jobs, Tourism, Science and Innovation. 2020. Western Australia Economic Profile. Retrieved from <https://bit.ly/39Rwvdx>

⁴⁵ Active Sustainability. 2020. WA Construction Resources – Recovered Construction and Demolition Materials Resource Guide. <https://bit.ly/36a9Po1>

⁴⁶ Waste Authority. 2022. Roads to Reuse. Retrieved from <https://bit.ly/391jhvz>

⁴⁷ Waste Recycling Industry Association of Western Australia (WRIWA). 2019. WRIWA. Retrieved from <https://bit.ly/3iuZwzO>



C&D waste end-market snapshot

Potential end-markets for various C&D waste resources in three states of Australia – NSW, Victoria and WA – are shown in Figure 1. These three states have the largest quantity of waste materials, based on available information.



Figure 1: Potential end-markets for C&D waste

Sustainable procurement

Australia

National environmental impacts of government procurements have been emphasised through various policies and guidelines. For instance, the re-use of recycled materials is strongly encouraged under ecologically sustainable development and sustainable procurement (SP) programs. The first policy on SP was published by the Australian Government in 2003, titled the *Environmental Purchasing Guide*.⁴⁸ This guideline sets the priority areas for government agencies to consider the environmental impacts of their procurement activities. However, the guideline does not present any strategy to procure recycled C&D waste.

The *National Waste Policy 2018*⁴⁹ sets a target to reduce waste generation through prevention, reduction, recycling and re-use. This policy has also emphasised the application of the principles of a circular economy to support better and repeated use of 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 products containing recycled content.

The government, through the *National Waste Policy Action Plan 2019*,⁵⁰ defines several key action areas to deliver against the targets, including advice on governments' purchasing power to increase recycling. The plan assumes that SP can stimulate demand for recycled materials relative to virgin materials; encourage innovation and investment in recycling to meet demand from new markets; support domestic jobs and industries by retaining the value of recycled materials; and encourage economy-wide behavioural change.

Following the 2010 version of the Sustainable Procurement Guide, the Australian Government published a new Sustainable Procurement Guide: A practical guide for Commonwealth entities in 2021.¹ This document provides a framework for the Australian Government to build on efforts to improve sustainability outcomes and mainstream sustainability principles in future procurement. It provides a list of benefits to the purchaser (government), market, society and environment that are achieved through buying recycled content.

Australian States and Territories

Among the Australian states and territory governments, only the ACT, NSW, SA and WA have developed an SP guideline. Each of these guidelines are underpinned by several other jurisdictions' regulations and policies (Table 1). For instance, the *Sustainable Procurement Guide: for local government in NSW*⁵¹ builds on the Local Government ACT 1993 (NSW), Local Government (General) Regulation 2005 (NSW), NSW Government Procurement Policy Framework, NSW Government

Procurement Policy Framework,⁵² *Tendering Guidelines for or NSW Local Government (2009)*,⁵³ and the local council's policies and vision statements. Furthermore, procurement of recycled C&D waste materials should comply with material specifications developed and administered by public agencies in each state/territory (Table 2). Among the jurisdictional policies, Victoria's Recycled First Policy (2021) is the most relevant driver to use recycled C&D waste products.

⁴⁸ Australian Government. Environmental Purchasing Guide. Retrieved from <https://bit.ly/3uqCh02>

⁴⁹ Australian Government. National Waste Policy 2018. 2018. Retrieved from <https://bit.ly/3v3NQcX>

⁵⁰ Australian Government. National Waste Policy Action Plan 2019. 2019. Retrieved from <https://bit.ly/3bD6q3W>

⁵¹ Local Government NSW. 2021. Sustainable Procurement Guide: for local government in NSW. Retrieved from <https://bit.ly/34tPmJs>

⁵² NSW Government. 2021. Procurement Policy Framework. Retrieved from <https://bit.ly/356EIBQ>

⁵³ NSW Government. 2009. Tendering Guidelines for NSW Local Government. Retrieved from <https://bit.ly/3JDIDAS>

Table 1: Sustainable procurement in state and territory guidelines and policies

State/ Territory	Guideline policy	Issuing Organisation	C&D Waste-related content
ACT	Sustainable Procurement Policy 2015 ⁵⁴	ACT Government	Advises that waste should be viewed as a resource opportunity, where products can be reintroduced into another product life cycle
NSW	Sustainable Procurement Guide: for local government in NSW	Local Government NSW	Provides general advice on how to sustainably procure goods and services
SA	SA Sustainable Procurement Guideline ⁵⁵	SA Government	Urges the state procurement experts to consider both the end-of-life disposal of assets and the waste produced by these products and services throughout their life
VIC	Social Procurement Framework Recycled First Policy (2021)	State Government of Victoria	Social Procurement Framework: incorporates sustainable procurement practices, including requirements as relevant on recycled content, waste management and energy consumption for (government agencies) buyers Recycled First Policy: outlines that all bidders on major transport projects will be required to demonstrate how they will optimise the use of recycled or re-used Victorian materials; provides government with data on recycled materials for a better understanding of the supply chain
WA	Environmental Procurement Guide 2017 ⁵⁶	Department of Finance	Seeks to reduce waste and by-products (e.g. waste avoidance, re-use, use of recycled products or products with recycled content, recycling and resource recovery)

Table 2: State and territory organisations with responsibility for SP implementation and promotion

State/ Territory	Organisation	Webpage
ACT	ACT Government	https://www.procurement.act.gov.au/
NSW	NSW Government Local Government NSW	https://buy.nsw.gov.au/
NT	Northern Territory Government	https://nt.gov.au/industry/procurement
QLD	Queensland Government	https://www.forgov.qld.gov.au/finance-and-procurement
SA	Procurement Services SA Green Industries SA	https://www.procurement.sa.gov.au/ https://www.greenindustries.sa.gov.au
TAS	Tasmanian Government	https://www.purchasing.tas.gov.au/
VIC	Victorian Government Purchasing Board Sustainability Victoria VicRoads	https://www.buyingfor.vic.gov.au/ https://www.sustainability.vic.gov.au https://www.vicroads.vic.gov.au
WA	Waste Authority Main Roads WA Department of Finance Western Australian Local Government Association	https://www.wa.gov.au/organisation/departments-of-finance/procurement https://www.wasteauthority.wa.gov.au https://www.mainroads.wa.gov.au https://www.wa.gov.au/organisation/departments-of-finance https://www.walga.asn.au

⁵⁴ ACT Government. 2015. Sustainable Procurement Policy 2015. Retrieved from <https://bit.ly/3vx4GAT>

⁵⁵ SA Government. 2012. SA Sustainable Procurement Guideline. Retrieved from <https://bit.ly/3fqFGFX>

⁵⁶ WA Government. 2017. Environmental Procurement Guide. Retrieved from <https://bit.ly/3qz29pD>

Stakeholders' Perception

Research Methodology

A purposive sampling strategy was employed to recruit a wide range of participants across the C&D waste supply chain. Recruitment was executed according to the National Statement on Ethical Conduct in Human Research (2007) (National Health and Medical Research Council, 2007), RMIT University and Griffith University Human Ethics Committee instructions and requirements. The project industry partners, the Australian Sustainable Built Environment National Research Centre (SBEnc) and the Waste Management and Resource Recovery Association of Australia (WMRRAA), assisted with the recruitment process by providing their network contact details. WMRRAA's members consist of businesses and experts who are engaged in recycling and waste management activities. SBEnc members include experts from government, industry and academia involved in built environment issues, most notably C&D waste management. The WMRRAA is the primary industry stakeholder for this work, while the SBEnc funded the research project. In 2020, RMIT (2020-23224-11666) and Griffith University (GU Ref No: 2020/497) both received approval from the relevant university research ethics committees.

Since the study required experts in the field, one of the main selection criteria was adequate experience in dealing with the management of waste in Australia.

Email communication was the method of recruitment. In the first round, an email with the project information sheet was sent to a list of participants compiled by the research team. This covered 60 individuals with relevant experience in waste management and the resource recovery sector. The list consisted of the two organisation members and other experts identified by researchers. A reminder email was also sent to those who did not respond in the first round. Interview participation was voluntary, and attending the interview implied informed consent. The investigators maintained the privacy and confidentiality of all interview information as per the human ethics requirements.

The interviews were conducted online, using the Microsoft Teams application, which is freely available to everyone. Each interview took, on average, 45 minutes, which included a brief description of the study objectives and the interview structure. The interview consisted of several questions covering the main issues and opportunities regarding the development of the market for the recycled C&D waste materials. As presented in Table 3, the questions sought participants' experience, their opinion on the impact of COVID-19 on C&D waste recovery activities, issues around the development of the market for recycled C&D waste materials and other information provided by participants.

Table 3: Research questions used in the study

Theme	Questions
Experience	<ul style="list-style-type: none">• Could you please introduce yourself and describe your role in your organisation? Prompt: involvement/ experience in C&D waste management• How long have you been involved in C&D waste management?
COVID-19 and waste management	<ul style="list-style-type: none">• In terms of the development of a market for recycled C&D waste products, please share your views on the conditions after COVID-19• How has COVID-19 affected your organisation/industry?• How did/does the industry respond to COVID during and after the outbreak?

Recycled C&D waste market development	<ul style="list-style-type: none"> • Do you think that creating a marketplace for C&D waste could be used as an intervention to manage C&D waste better? • What is your opinion about the operation of existing end-markets in your jurisdiction? • What can be improved to facilitate creating and stimulating efficient end-markets for C&D waste in your industry/state? • Which C&D waste materials have the most potential for new markets? Prompt: concrete, brick, steel, glass, timber, asphalt and clean fill • In your opinion, how can we enable the creation of a marketplace for C&D waste? • What are the main factors impacting C&D waste end-of-life management? How are they influencing C&D waste management according to the status quo? • What are the main barriers to implementing a sustainable marketplace for C&D waste in your industry/jurisdiction? • What do you think of the current legislation about C&D waste end-of-life management in your jurisdiction?
Others	<ul style="list-style-type: none"> • Did I forget anything? Is there anything you would like to share? • Can I get back to you if I have further questions about the data analysis? • Lastly, do you know anyone in the sector who might be willing to participate in our research?

Data Analysis

The audio data (1,000 minutes' worth of data) were carefully transcribed by a professional transcriber verbatim. The research team further verified the quality of text data. The analysis of transcripts was performed

using the NVivo Pro 12 application.⁵⁷ This application facilitates codifying text-based qualitative data.

Participants' profiles

The primary stakeholders who have a crucial role in the utilisation of recycled products (for example, government, recyclers and construction professionals) are well-represented in the sample size. As shown in Figure 2, most of the participants were government

officials (9), followed by recyclers (8), professionals working in the construction industry (5), experts employed in the construction materials manufacturing sector (3) and consultants with relevant experience (2).

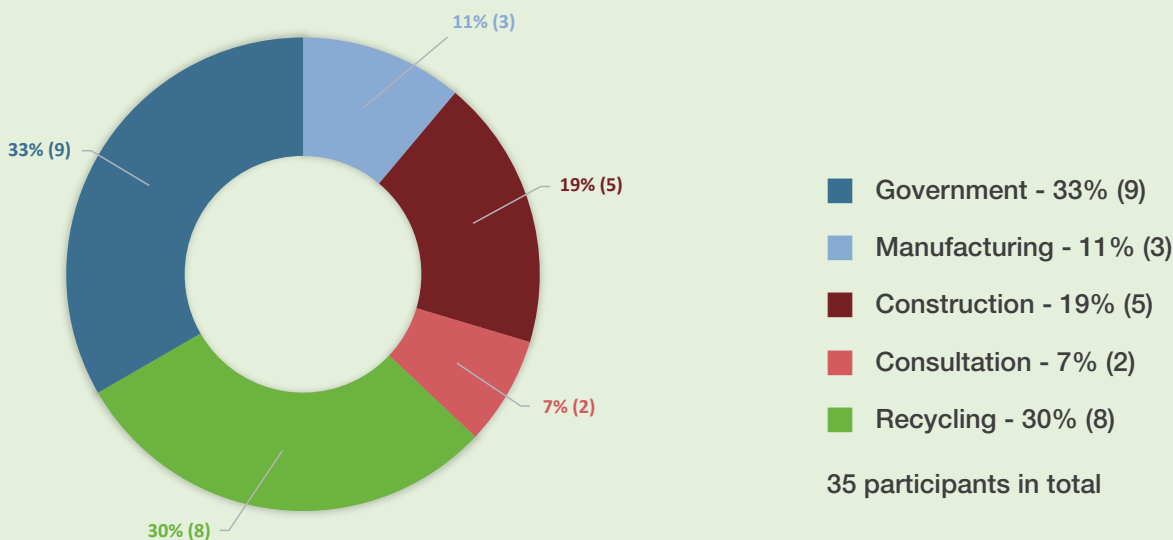


Figure 2: The composition of stakeholder groups among the interviewees

⁵⁷ QSR International Pty. Ltd. 2020. NVivo (released in March 2020). Retrieved from <https://bit.ly/3Me3smV>

Key Findings

Figures 3, 4, 5, 6 and 7 highlight key findings of the interviews with C&D waste experts in five Australian states. These findings outline participants' views on

COVID-19 impact and response, C&D waste end-markets, enablers and barriers towards market development, and stimulation.

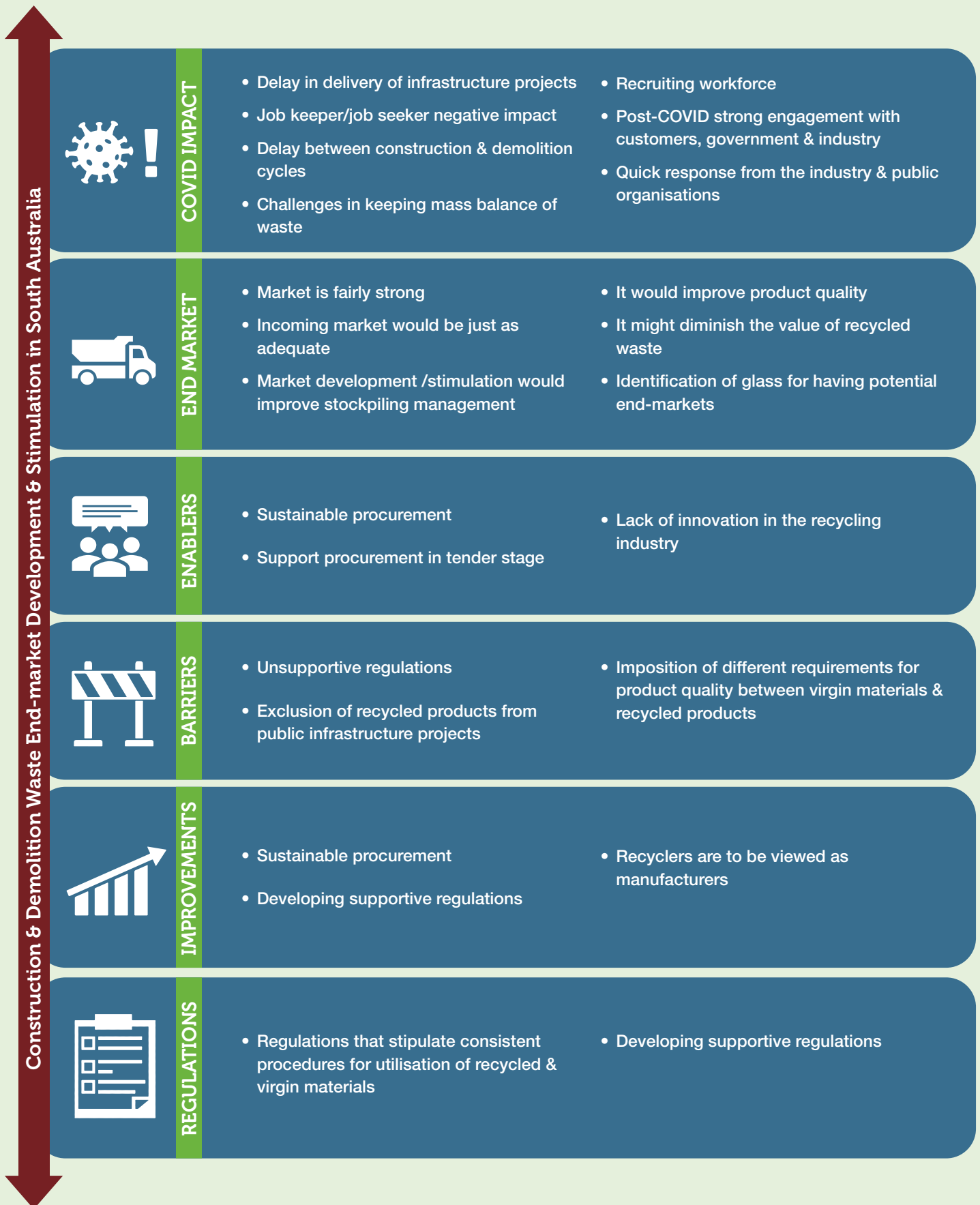


Figure 3: Key findings from interviews conducted in South Australia

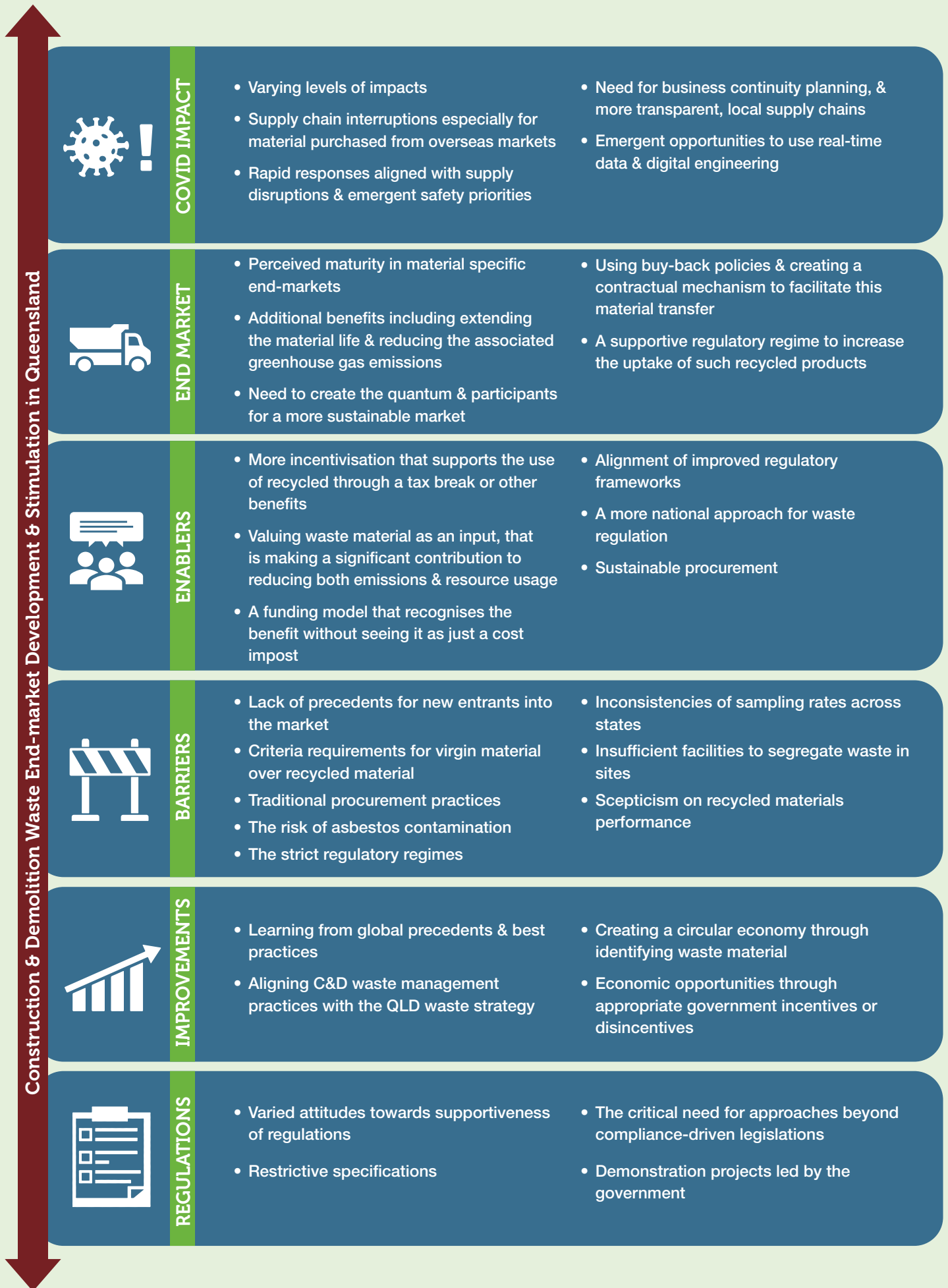


Figure 4: Key findings from interviews conducted in Queensland

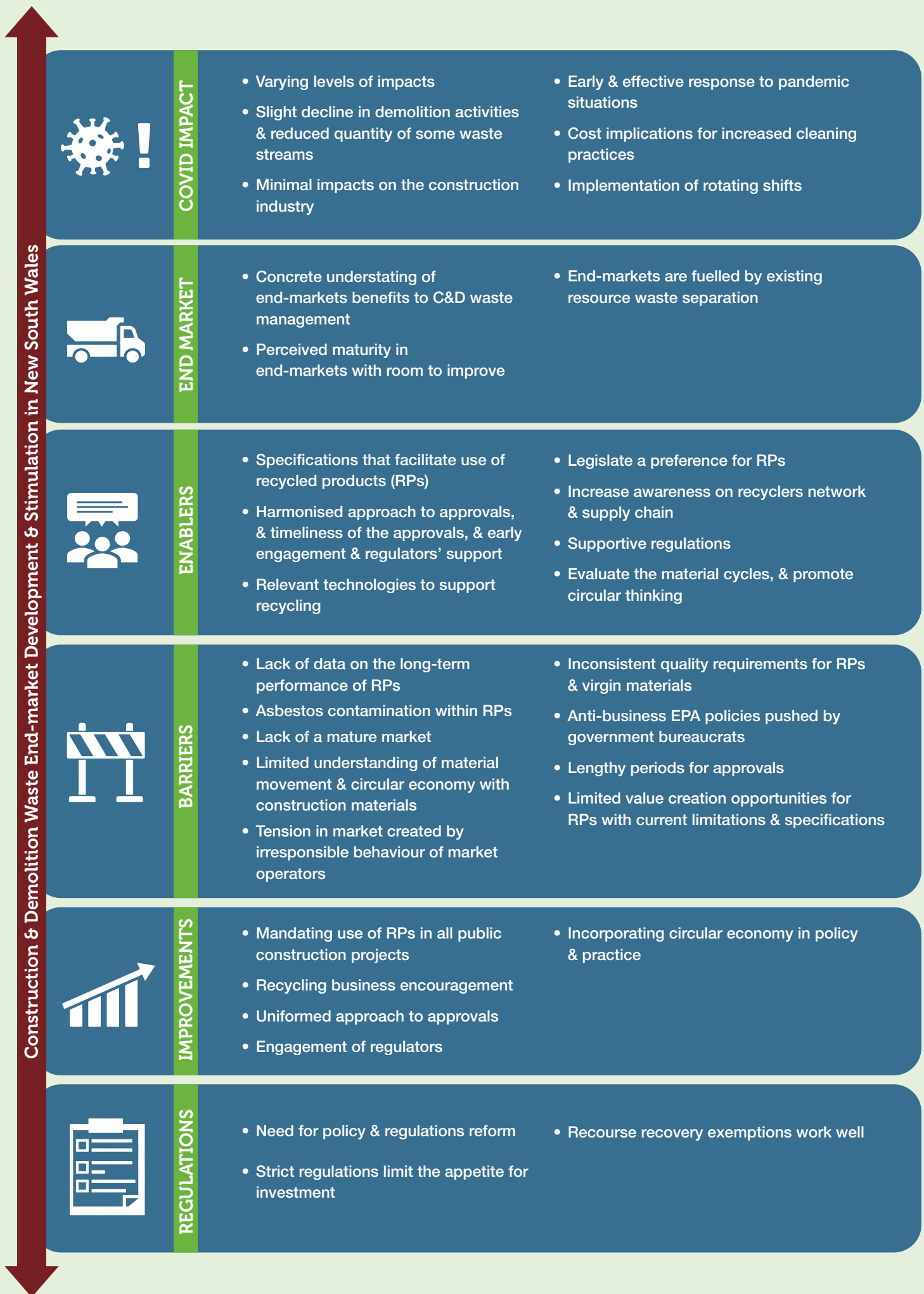


Figure 5: Key findings from interviews conducted in NSW

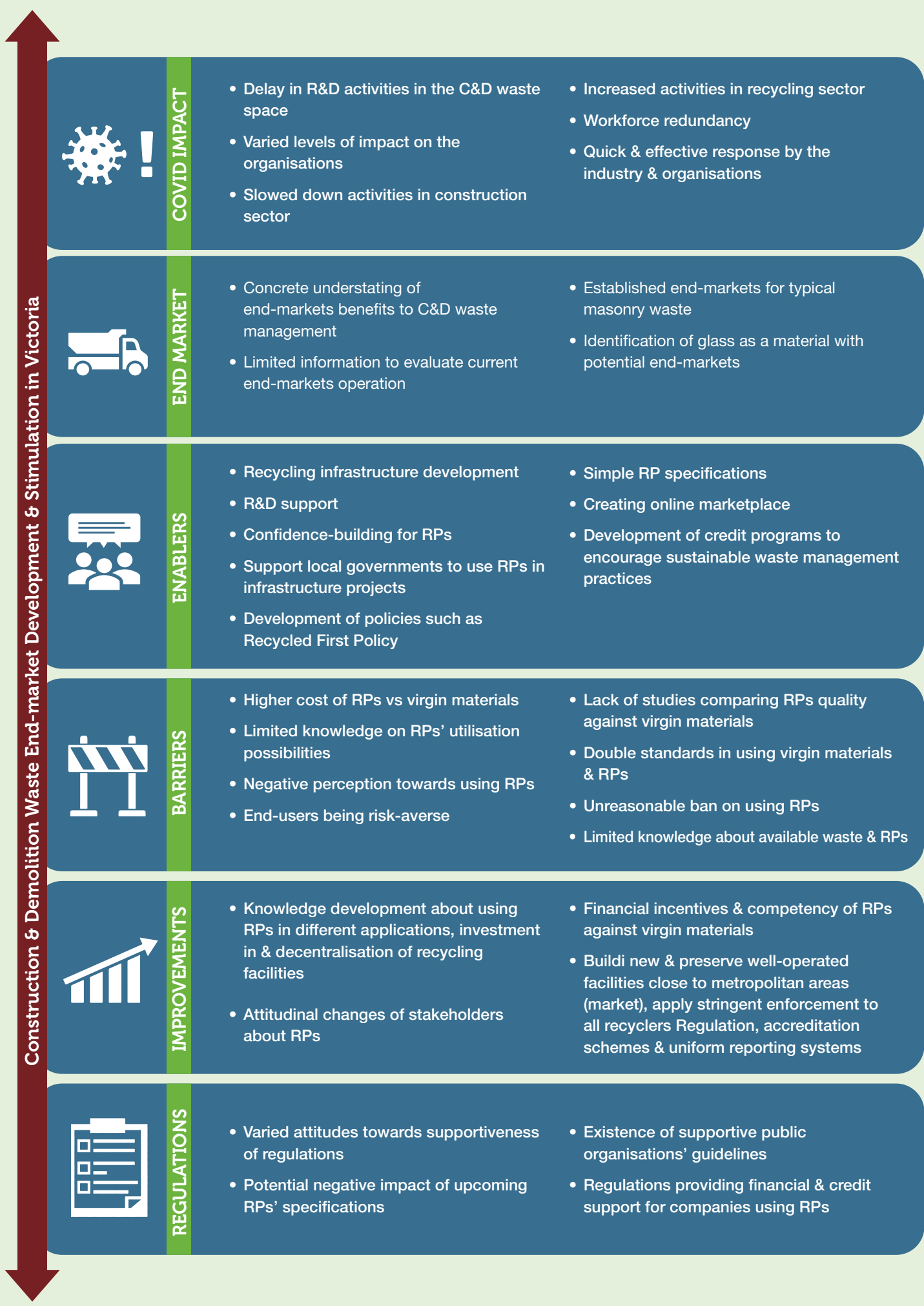


Figure 6: Key findings from interviews conducted in Victoria



COVID IMPACT

- Varied levels of impact
- Initial shut down with no to minimum impact
- Recycling is considered an essential service
- Pressure on the recycling industry to perform better
- Shortage of resources (materials & human)
- Changes in the number of people attending workplace
- Negative impact on project programming & delivery due to short project shutdowns
- Increase in businesses activities notably in infrastructure projects



END MARKET

- Varying perceptions on the operation of the market described from very poor to growing
- Reluctance among councils to use RPs
- Main Roads WA promote the use of RPs in low value applications
- Benchmarking with other states can outline its performance
- Inconsistency in the quality of RPS by different suppliers
- Issue with glass recycling in the state
- Asset owners have different perceptions on using RPs
- Inconsistent demand for RPs Construction



ENABLERS

- Consistent approach in testing requirements & other obligations
- Increase the knowledge of recycled products: risks & benefits
- Revisiting regulations
- Recycling facilities closer to metropolitan areas
- Motivate local governments to use recycled products
- Advancing the technicality of application of recycled materials
- Clarification on decision-making processes about recycled products
- Creating a centralised waste trading platform
- Application of strict quality control
- Collaboration between industry & approving authorities
- Providing subsidisation
- Improving onsite source waste separation
- Creating material guidance (catalogue) with some clear examples (case studies) of what materials can be used
- Providing confidence in recycled materials through environmental standards
- Implementing independent audit
- Setting clear targets & requirements for preference for recycled materials
- Sustainable procurement & setting contract conditions in favour of using recycled products
- Use of sustainability rating tools to drive the market
- Government funding to enhance recycling capability



BARRIERS

- Inconsistent & conservative state government's approach in supporting using RPs
- Unwillingness to improve infrastructure projects design & construction requirements to embrace new products such as RPs
- Public organisations' reluctance to seek innovations due to imposed inflexible compliance requirements & to be risk-averse
- The state government inactivity & lack of leadership in pursuing sustainability & awareness raising about waste recovery
- Risk of change in government policies & priorities with change in political parties
- Lack of attention to RPs in councils' development projects
- Ineffective implementation of carrot & stick approach in market development efforts & policies
- Lack of clarity on the definition, origin, handling & destination of waste materials
- Limitations within government procurement policies
- Lack of information on RPs' characteristics & costs
- Difficulty in using some RPs in mass production in the construction industry
- Production of low-quality RPs by some waste processors
- Abundant cheap virgin materials in metropolitan areas as opposed to expensive RPs
- The low economy of scale in the market, low operational & technical capability of the recycling industry & low competition discouraging improving the quality of RPs
- Abuse in the use of government financial support for buying RPs
- Inadequate obligations for processing & using RPs around residential developments
- Unfair competition between waste materials from unlicensed onsite processing & recycling facilities
- Lack of collaboration & information-sharing across construction material supply chain such as asset constructors & maintenance team
- Lack of confidence in RPs & interest in paying more for RPs
- Developers' tendency to follow customers need, which may exclude the use of RPs
- Promoting the interim solutions that may preclude better solutions in future
- Established commercial agreements between end-users & virgin materials suppliers
- Difficulty in supply chain optimisation to accommodate new RPs
- Unreasonably complex & outdated testing requirements & specifications



Figure 7: Key findings from interviews conducted in Western Australia



The analysis of interviews showed there are 37 factors that enable the creation and stimulation of C&D recycled waste products in Australia. Furthermore, 36 barriers were identified to have a negative impact on end-market development for waste materials. Figure 8 and Figure 9 show these key barriers and enablers.

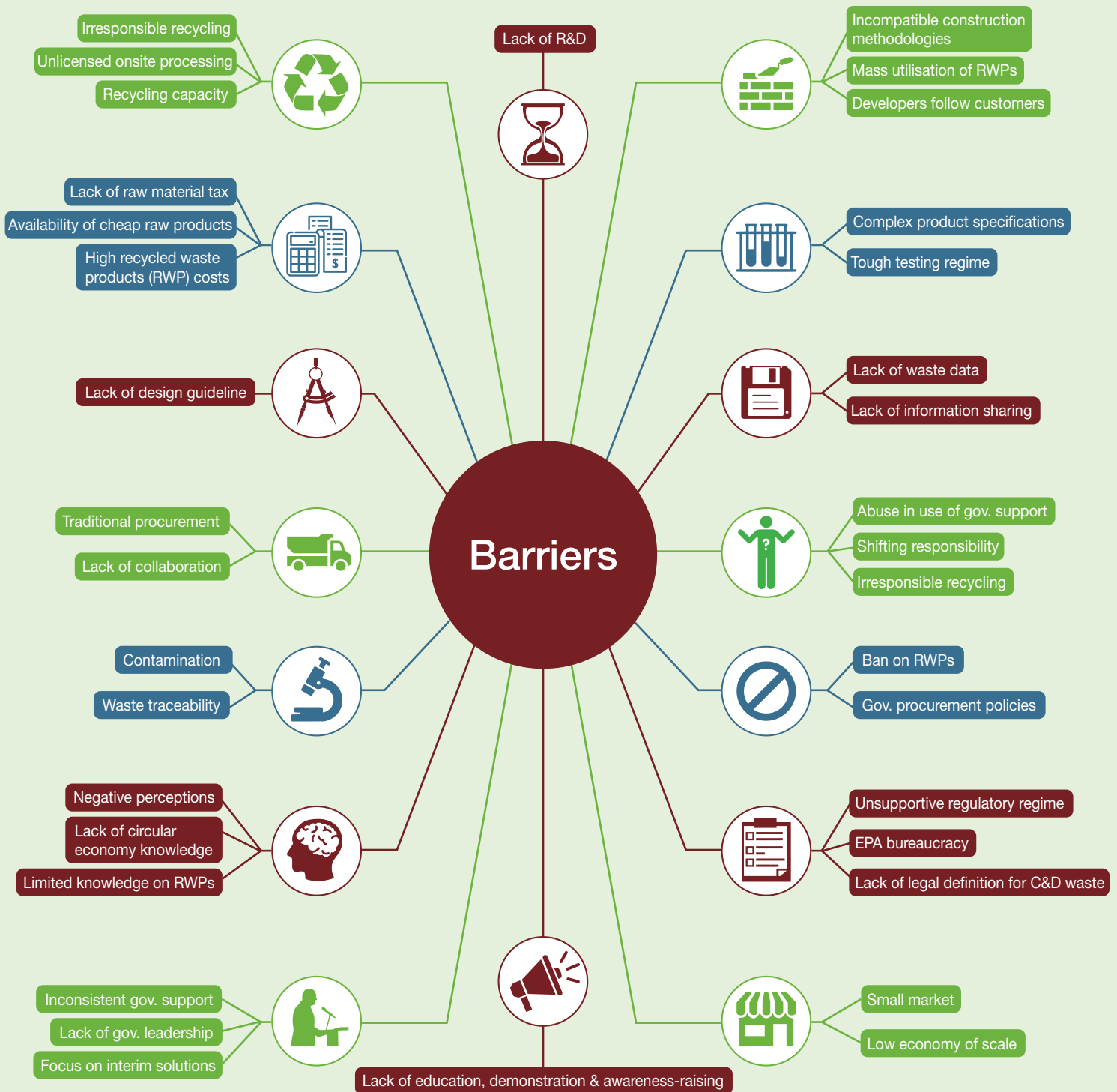


Figure 8: Main barriers towards the creation and stimulation of markets for C&D recycled waste products

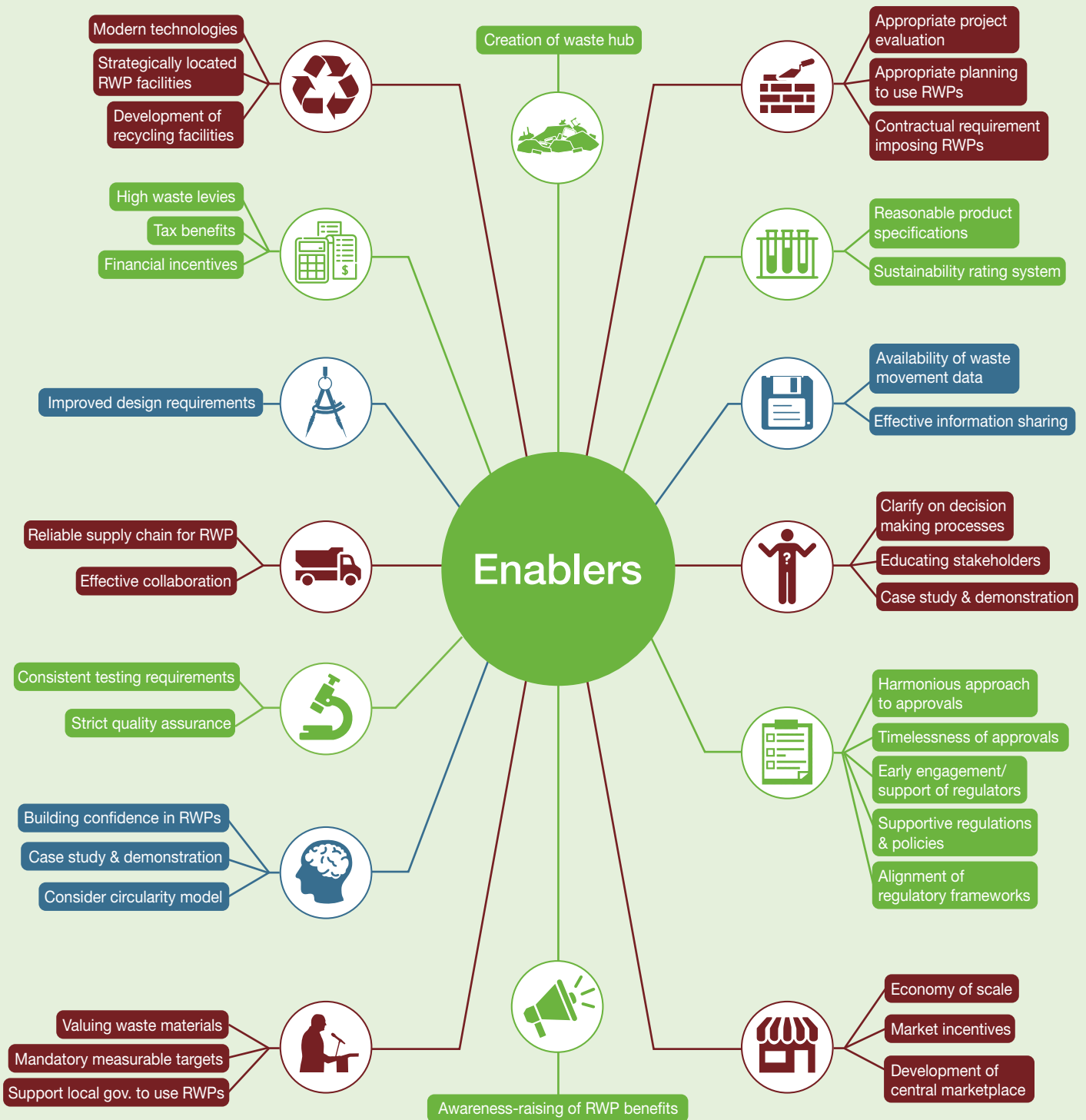


Figure 9: Key enablers of the creation and stimulation of markets for C&D recycled waste products



A framework for Waste Market Development

The key findings from the literature review and the stakeholder interviews (Figure 8 and Figure 9) were used to develop a framework (Figure 10) that facilitates optimisation of the creation and stimulation of C&D waste end-markets. The framework maps out how various enablers of market development can be implemented to improve the interplay among various stakeholders in the C&D waste space. The stakeholders in this framework include the government sector (public organisations and policymakers), recyclers, construction and demolition professionals, and sustainability rating system and quality assurance auditors. As proposed in this framework, the government sector has a significant role in facilitating waste market development. The government can enhance sustainable procurement; raise awareness; establish effective recycling approvals; ensure simple and effective material specifications; leverage contract conditions to use recycled products; and provide financial support. The secondary government-enabled improvements include stopping illegal dumping; providing a clear definition of waste; developing supportive regulations; imposing a properly designed landfill levy; contributing to a national approach;

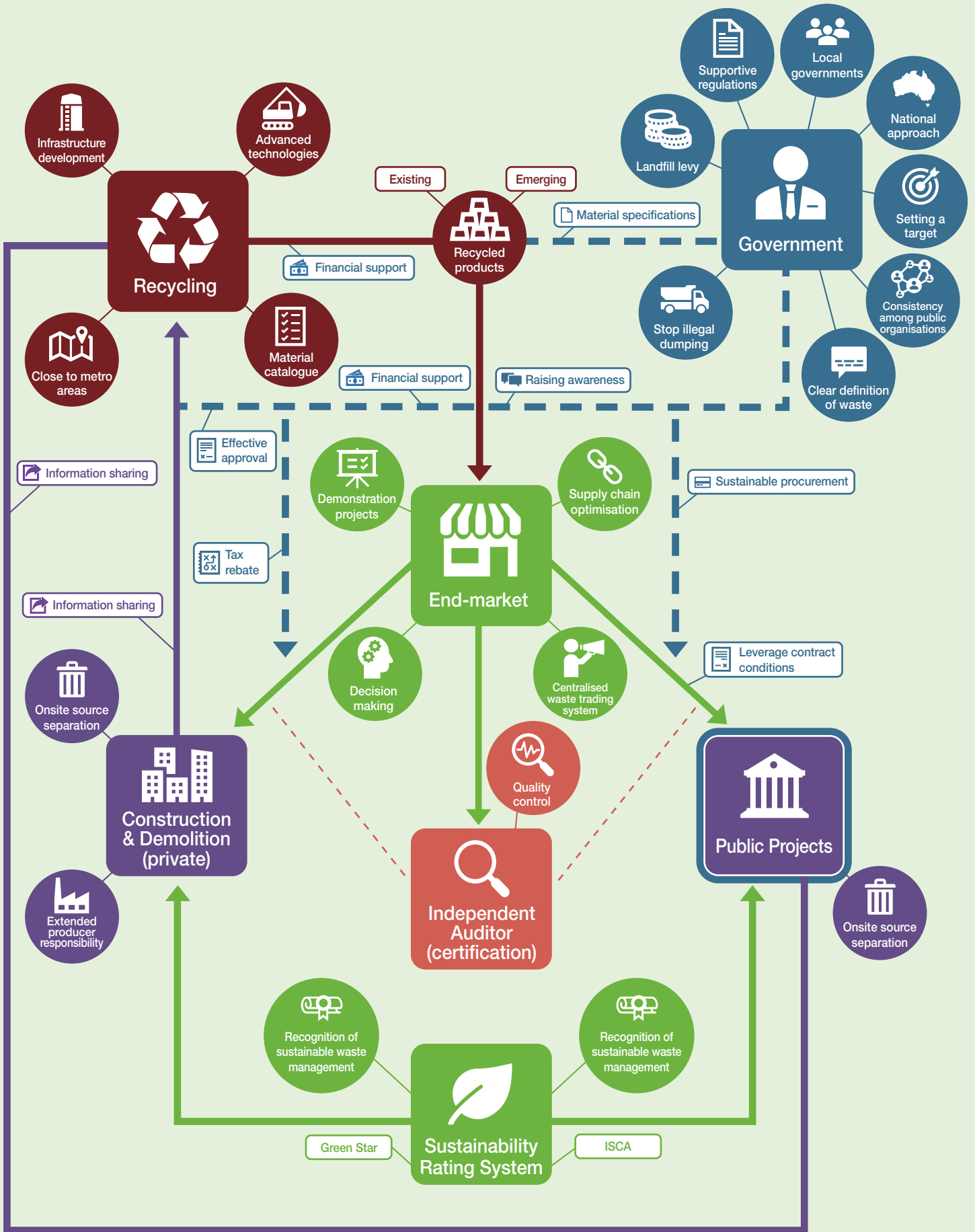
setting targets to use recycled products; and building consistency among various public organisations in valuing (using) recycled products, including encouraging local governments to purchase recycled products.

In the recycling sector, the four priority actions are to: 1) invest in advanced processing technologies; 2) develop infrastructure with a suitable capacity to manufacture to the scale of economy; 3) establish such facilities close to metropolitan areas; and 4) generate material catalogues that detail recycled product information.

In the C&D industry, for both private and public projects, the improvements include enabling information-sharing with the recycling industry; onsite source separation; and collaborating with manufacturers to implement an extended producer responsibility policy. Furthermore, independent auditors should be supported to assure the quality and performance of recycled materials after testing. Lastly, sustainability rating systems such as Green Star⁵⁸ and IS⁵⁹ should be leveraged to drive change in the waste management ecosystem and endorse the use of recycled products in private and public construction projects.

⁵⁸ Green Building Council of Australia. 2022. Rating System. Retrieved from <https://bit.ly/3urBPYg>

⁵⁹ Infrastructure Sustainability Council Australia. 2022. IS Rating. Retrieved from <https://bit.ly/3qz8dhT>



- Government
- Construction industry
- Waste recovery industry
- Independent Auditor
- Sustainability organisations

Figure 10: Framework for waste market development



Conclusion

This SBEnc project provided a detailed synopsis of end-markets' operation and set-up for C&D waste recyclables in Australia. The project examined the national and jurisdictional policy frameworks that facilitate or hinder waste exchange at state and national levels. The results demonstrate differences and similarities in the Australian jurisdictions' policy frameworks concerning the development and stimulation of end-markets for C&D waste recyclables. The project uncovered the barriers to and enablers of market development of C&D waste recyclables; the current operation of existing end-markets; areas for improvement; and the impact of regulations and COVID-19 on such markets. Building on the information extracted from the research activities in this project, a

framework was developed to facilitate C&D waste end-market creation and stimulation. The framework involves multiple facilitating strategies that theoretically contribute to a conception of the determinant factors of waste market development. Notably, the framework proposes pragmatic recommendations for overcoming any challenges posed. This project may drive circularity of waste recyclables in the housing, building and infrastructure sectors in Australia and improve the demand for C&D waste recyclables. The outcomes of this research may assist policymakers to identify the opportunities and challenges in sustainable waste management; encourage the industry to reduce its impact on the environment; motivate waste recovery facilities to find demand for their products; and help the public to benefit from a sustainable society.

Moving Forward

In this project, we focused on developing an understanding of trading C&D waste recyclables in Australia. The next challenge is to bridge the missing link for enhancing the sustainable use of recyclables in construction projects. Chief among other challenges, are identifying factors affecting the use of products with recycled content; developing a certification program assuring their quality and performance;

creating design guidelines to increase their uptake; and exploring education-based strategies to change behaviour among stakeholders towards their increased application in construction projects. Such efforts are needed to ensure increased business opportunities and benefits for manufacturers of such products and to achieve circular supply chain sustainability.

Publications

1. Shooshtarian, S., T. Maqsood, S. Caldera, and T. Ryley. 2022. The impact of regulations on construction and demolition waste market creation and stimulation: an analysis of stakeholders' perceptions in Australia. *CIB Conference: Building Our Future: Informing Practice to Enhance the Life of Current and Future Generation*. 27-30 June, Melbourne, Australia. RMIT University.
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Recommended citation:

Maqsood, T., Shooshtarian, S., Wong, P.SP., Ryley, T., Caldera, S., Khalfan, M., Yang, R., and Zaman, A. (2022) *Creation and Stimulation of End-markets for Construction and Demolition Waste in Australia – Final Industry Report Project 1.75, Sustainable Built Environment National Research Centre (SBEnc), Australia.*



This research would not have been possible without the ongoing support of our core industry, government and research partners:

