ACTION PLAN

Circular economy in South Australia's built environment

greenstar

Green Building Council Australia

Building a sustainable future

Foreword from our CEO Davina Rooney

In a resource-constrained world, where decarbonisation is one of our most pressing priorities, how we get, use, create and dispose of materials will be key for a successful and sustainable global economy.

The building materials sector accounts for 8% of Australia's total emissions and has an economic value of $70 billion a year. Construction and demolition waste accounts for over 40% of all waste in Australia. Finding ways to minimise waste and creating a supply chain that can deliver transparent, healthy, low-impact, and net zero carbon products that are part of a circular economy is urgent for the health of our planet, but will also deliver a huge range of economic and social benefits.

South Australia has long been a leader in areas of waste management, renewable energy and action on climate change and I commend the South Australian Government's commitment to achieving a circular economy - through setting targets, developing policy and regulation and investing in innovation. Government also has a critical role to play in influencing and providing certainty for the supply chain through its own commitment to responsible procurement.

We know that industry is already finding ways to innovate, and with the right policies and support in place, the opportunities are endless.

GBCA's partnership with Green Industries SA on this project harnesses the knowledge and experience of the wide and diverse group of stakeholders we work with every day to lead the sustainable transformation of the built environment. This Action Plan is the result of a detailed exploration of what has already been achieved and the barriers and opportunities that exist for a thriving circular economy in South Australia's built environment sector. It highlights areas for further investigation and investment by both government and industry stakeholders. It also acknowledges there is still much to learn from those in our industry who are already innovating, the wisdom of First Nations peoples who have been demonstrating successful circular economy principles for 70,000 years, and everyone in the built environment sector committed to finding ways to do things better.

Acknowledgement of Country

The project team wishes to acknowledge First Nations peoples of all Country throughout Australia, and their cultural, spiritual, physical, and emotional connection with their land, waters, and community. We pay our respects to all Elders past, present, and emerging.

We also acknowledge that ecologically sustainable development and circularity are not standalone concepts but intrinsic to First Nations peoples. The built environment can incorporate these concepts by embedding a Connection to Country in the design process and as part of operations.

Acknowledgements

We would like to acknowledge the following project partners.

Established in 2002, Green Building Council of Australia (GBCA) is the nation's authority on sustainable buildings, communities and cities. Our vision is for healthy, resilient and positive places for people. Our purpose is to lead the sustainable transformation of the built environment. GBCA represents more than 550 individual companies with a combined annual turnover of more than $46 billion.

Funding partner

Green Industries SA (GISA) is an enabler and driver of change, and aims to transform how South Australians use and value resources. The transition to a more circular economy is a priority outlined in South Australia's Waste Strategy 2020-2025. GISA is an advocate for the benefits this transition will provide for South Australia and has a focus on developing a robust evidence base to support it.

Technical partner

dsquared Consulting has been engaged to undertake the technical research for this project. dsquared is a specialist Environmentally Sustainable Design (ESD) consultancy firm delivering innovative and independent sustainable solutions in the built environment. dsquared are Ambassadors of the Carbon Neutral Adelaide program and have been a Climate Active Certified Carbon Neutral Organisation since 2017.

Engagement partner

The Adelaide Sustainable Building Network (ASBN) advocates the uptake of sustainable and ecologically beneficial practices within all industries linked to the built environment. We actively promote, educate, connect, collaborate, facilitate and aim to be a catalyst in sparking dialogues and positive action towards sustainable built environments in South Australia. The ASBN provided workshop facilitation and engagement support to the project.

Position & disclaimer

Transformation in the built environment to a circular economy model is a critical climate solution and requires an across government and industry response. This publication has been developed to identify collaborative opportunities with key industry players and highlight the potential for the South Australian Government to capitalise on South Australia's world leading renewable energy share and drive circular economy outcomes in the built environment. The views and opinions expressed in this publication have been developed by the Green Building Council of Australia based on industry engagement undertaken in partnership with dsquared and the Adelaide Sustainable Building Network and do not necessarily reflect those of Green Industries SA, or the South Australian Government.

GPO Exchange, SA. Charter Hall Holdings Pty. Ltd. 6 Star Green Star – Design & As Built v1.1

Executive summary

The purpose of this Action Plan is to summarise circular economy opportunities in the built environment for South Australia. It outlines key actions and stakeholders that will need to work collaboratively to drive the transition from linear to circular. Although focused on the South Australian built environment and industry, international research and examples have been integrated to demonstrate opportunities and it is expected that the key actions and opportunities identified will be replicable across Australia.

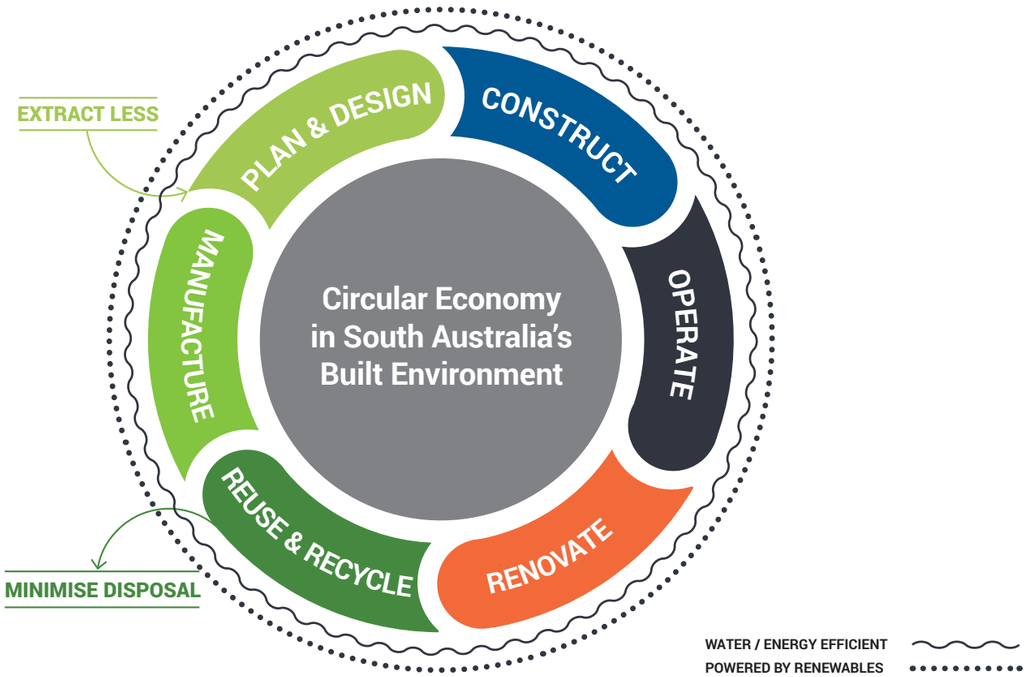
The identified actions are based on research and extensive stakeholder engagement undertaken with the South Australian (SA) Government, local government, industry, tertiary institutions, and the resource recovery sector.

The following key actions and recommendations have been identified for implementation which will require a coordinated approach with stakeholders across government, industry and academia all playing a role. The recommendations have been separated into two categories:

Government leadership, investment, and support: Identifies how the SA Government can demonstrate leadership and drive a circular economy in the built environment.

Circular economy nucleus: Identifies a collaborative approach for government and industry to share knowledge and skills and key opportunities to remove barriers.

The Action Plan has been structured around the below circular economy stages and topics in the built environment, with the aim of maximising opportunities throughout the built environment lifecycle.



Lot Fourteen Entrepreneur and Innovation Centre (EIC), SA. Quintessential Equity Pty Ltd. – Registered for Green StarDesign & As Built v1.3

Government leadership, investment & support

SA Government has a fundamental role in driving and supporting the circular economy and can drive change across industry by demonstrating leadership and sharing knowledge and resources. The following recommendations and opportunities have been identified.

Legislation & regulations: A review of legislative and regulatory conditions should be undertaken to identify innovative models to support circular economy outcomes including the *Environment Protection Act 1993* and *Planning, Development and Infrastructure Act 2016*.

Investment & design guidelines: SA Government implements mandatory circular economy requirements in procurement processes and government design standards and guidelines.

First Nations peoples engagement: A First Nations peoples engagement plan is developed based on the priorities identified in this report and meaningful engagement is undertaken to listen to and learn from a Connection to Country.

Metrics & monitoring: A standardised set of metrics and key performance indicators are adopted to value the embodied emissions in materials and track outcomes over time. It is recommended that the NABERS Embodied Emissions rating tool currently in development is adopted once released.

Sustainable materials database: Grants and co-investment funding is provided to industry, including local suppliers, manufacturing, and businesses, to develop Environmental Product Declarations or embodied carbon accounts, and align with GBCA's Responsible Products Framework.

Sustainable homes: Implement a government funded low-interest Green Loan scheme for residential home improvements (e.g., energy efficiency and thermal performance) that extend the lifespan of homes and discourages demolition.

Design review: Incorporate circular economy topics as part of Design Reviews including embodied emission reductions, reuse of materials and onsite resources, and use of locally manufactured low emission materials.

Circular economy nucleus

Circular economy initiatives are being implemented across South Australia, with opportunities to share knowledge and skills readily available if a centralised circular economy nucleus were created. The focus of the nucleus should be on bringing together government, like-minded industry groups and representatives and the education sector to increase knowledge and awareness of circular economy opportunities.

Circular built environment working group: Establish a circular built environment working group of government, First Nations peoples, tertiary and industry representatives to drive innovation, share lessons learnt, and identify and overcome barriers.

Tertiary education: Integrate circular economy into tertiary education courses and programs to ensure built environment disciplines are considering circularity and embodied emissions.

Service-based approaches: Industry is encouraged to integrate service-based offerings for the built environment including heating ventilation and air conditioning (HVAC), lighting, and fit outs to support more diverse business models and improve revenue.

Construction industry: Participate in, learn about, and engage with circular economy industries and disciplines and actively promote and suggest alternative approaches to circular design approaches and materials as part of tenders.

Industry agreements: Industry bodies and associations collaboratively develop circular economy transition plans and set industry wide targets for recycled content and circular economy outcomes.

Education & awareness programs: Develop an education and awareness campaign in collaboration with industry targeted at various industry and consumer groups providing information, case studies, material and supplier examples and strategies.

The key actions and recommendations have been developed to drive circular economy outcomes within South Australia with the aim of creating a foundation through to 2030. The actions are intended to kick-start built environment opportunities and enable longer term planning to be undertaken. The actions are only the beginning and as circular economy approaches are adopted across industry, further innovations and improvements over time are expected.

Further information on the research undertaken to inform this Action Plan is available in the *Circular Economy in the South Australian Built Environment Discussion Paper*[1] available on the GISA website.

Contents

Introduction

Purpose

The purpose of this Action Plan is to summarise circular economy opportunities in the built environment for South Australia. It outlines key actions and stakeholders that will need to work collaboratively to drive the transition from linear to circular. The paper has been developed based on a review of international research, the development of case studies and extensive engagement with government, industry, academia, and the community.

We would like to thank everyone who has contributed to the plan and previous discussion paper,[1] and emphasise that this is the beginning of the journey.

Context & definition

The context of this plan is the built environment, with particular focus on the commercial and residential sectors. It examines the opportunities to transition to a circular economy, while reducing impacts on the environment and supporting the shift to net zero emissions.

The Ellen MacArthur Foundation describes a circular economy as:[2]

"Looking beyond the current take-make-waste extractive industrial model, a circular economy aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital. It is based on three principles:

- design out waste and pollution;
- keep products and materials in use (there is no waste – all materials are resources that can be re-used); and
- regenerate natural systems."

Transitioning to a circular economy does not only amount to adjustments aimed at reducing the negative impacts of the linear economy. Rather, it represents a systemic shift that builds long-term resilience, generates business and economic opportunities, and provides environmental and societal benefits.

This plan also draws on the World Economic Forum's definition as it provides a more focused summary for the built environment:

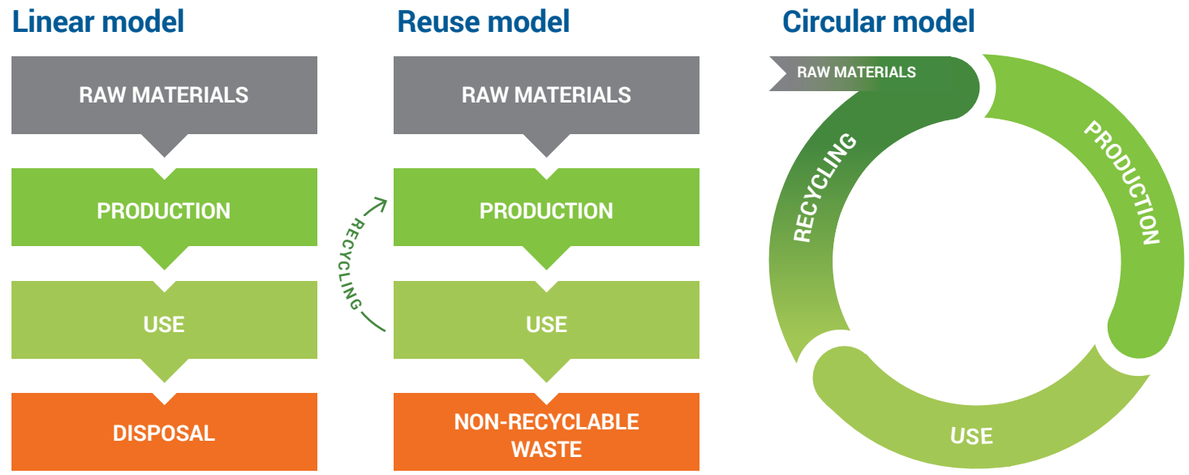
> An industrial system that is restorative or regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems, and business models.

The circular economy is an economic model that aims to retain the value of the circulating resources, products, parts, and materials. It aims to create innovative business models that promote long life, maximise reuse, encourage refurbishment, and boost the use of renewable materials.

Linear to circular economy

A circular economy model can change a linear system to a closed loop or circular system which maximises resource efficiencies, reduces waste, and saves resources. Creating a circular economy can provide benefits from an environmental, economic, and social perspective, with increased efficiencies providing greater return on investment for industry, retained value of resources in the system, and reduced resource consumption, decreasing environmental impact.

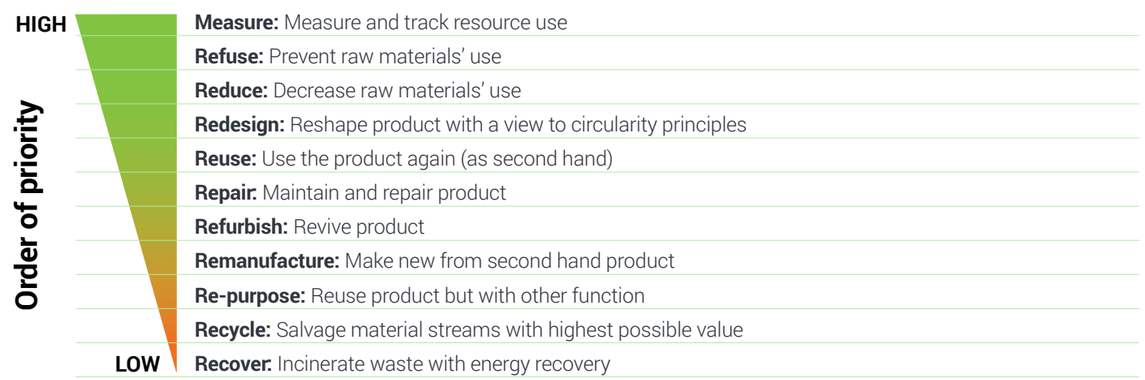
Figure 1: Linear to circular economy pathway SOURCE: Government of the Netherlands[3]



Levels of circularity

There are multiple levels of circularity, where the highest priority is to avoid or prevent the use of raw materials and the lowest priority is energy recovery.

Figure 2: Levels of circularity and 10 R's adapted from J. Cramer 2015[4]



South Australia's net zero emissions target

The South Australian (SA) Government has set a goal to:

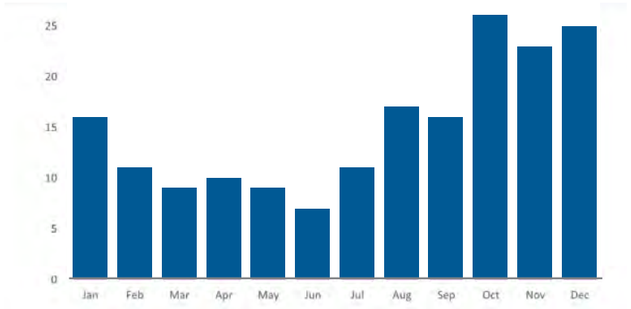
> … reduce South Australia's greenhouse gas (GHG) emissions by more than 50% below 2005 levels by 2030, and to achieve net zero emissions by 2050.

Although this goal is currently based on operational GHG emissions, circularity will play an increasing role as emissions reduce from energy and transport industries and from manufacturing and industrial processes.

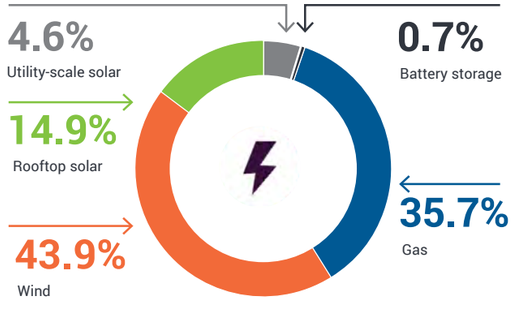
A key component of the net zero emissions goal is South Australia's world leading share of renewable energy generation, which is driving reduced energy emissions, facilitating a zero-emission transport transition by powering electric vehicles (EVs), and supporting green hydrogen and ammonia industries. In 2021 renewable energy generation in South Australia reached 63% and is estimated to have reached 68% in 2021/22 which is one of the highest renewable energy shares in a gigawatt scale electricity network in the world.

Figure 3: South Australian renewable energy generation share. SOURCE: Australian Energy Market Operator[5]

In 2021, renewable generation exceeded demand in SA on 180 days



SA's average generation by fuel source in 2021



Based on projections by the Australian Energy Market Operator (AEMO), renewable energy generation in South Australia is projected to reach 85% by 2025, with recent estimates that renewables may reach this milestone earlier. This is a key opportunity for South Australia, with renewable energy powered manufacturing and transport expected to increase competitiveness and reduce costs for industry which supports the built environment.

The rapidly decarbonising electricity grid in South Australia will support buildings, manufacturing, and transport to transition to low and zero emission technologies such as all-electric buildings, green hydrogen production for steel and cement, and electric vehicles. Renewable energy powered technologies and manufacturing is also expected to increase competitiveness and reduce operating costs which presents a strategic opportunity for South Australian industry and manufacturing.

Stakeholder engagement

Stakeholder engagement has been undertaken as part of developing this report to gain insights from across multiple sectors including:

- Commercial and residential sector workshops held with representatives from across industry, government, academia and the community. Two workshops were held to gain feedback on circular economy opportunities in the built environment and to understand where barriers are hindering uptake.
- SA Government workshop
- Local government workshop
- Material suppliers
- Resource recovery / demolition industry
- Tertiary institutions

Lot Fourteen, SA.
Renewal SA.
6 Star Green Star – Communities v1.1

Circular economy in the built environment

Developing a circular economy in the built environment will present opportunities across the whole lifecycle, from planning and initial designs through to the end-of-life considerations. The summary below outlines some of the key opportunities with the aim to extract fewer virgin materials, maximise and maintain the value of materials, foster collaboration and co-creation, regenerate nature, and minimise waste to landfill.

This report reviews each of these stages in detail to identify key opportunities and barriers, and develop a pathway for government, educational institutions, and industry to work together to embed circular economy into South Australia's built environment. Although this report focuses on the South Australian context and examples in the built environment, the concepts and approach are applicable across Australia.

Figure 4: Circular economy in South Australia's built environment summary. SOURCE: dsquared

PLAN & DESIGN FOR

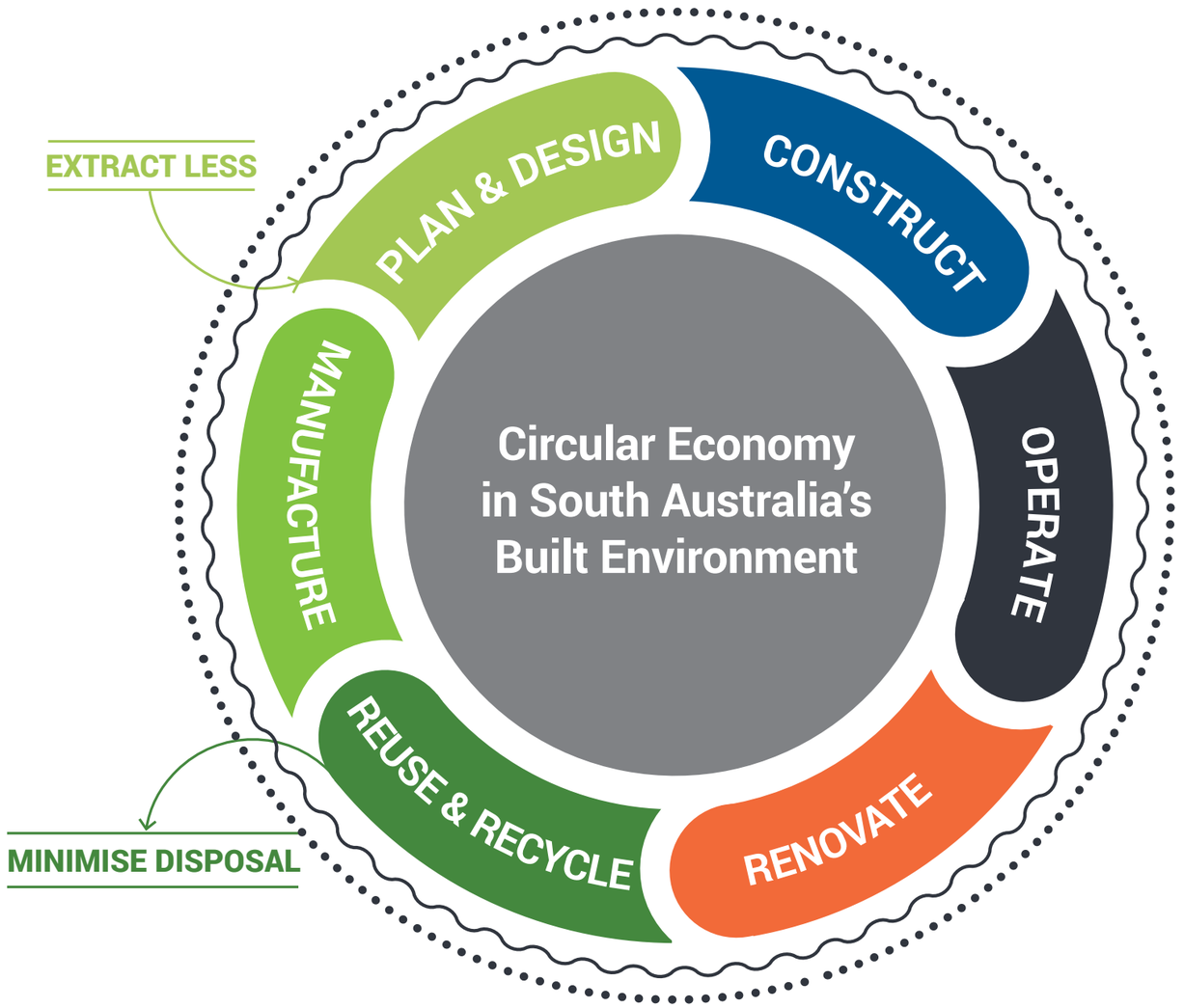
- Climate resilience
- Avoidance
- Flexibility / adaptability
- Modularity
- Low emission / sustainable materials
- Durability / longevity
- Reduced extractive materials
- Locally sourced materials
- Disassembly / reuse
- Efficiency
- Reuse
- Regenerative environments

MANUFACTURE

- Durable, repairable and recyclable materials and products
- Locally made / assembled
- Sharing material inputs / outputs
- Remanufacture recovered materials and products
- Prioritise accredited products
- Service based options

REUSE & RECYCLE

- To enable remanufacturing, repurposing and recycling
- Deconstruct and reuse
- To minimise waste and energy recovery



CONSTRUCT

- Powered by renewables
- With low emission materials
- Using locally sourced materials & prefabrication
- Recovering and salvaging materials for reuse, remanufacturing and recycling

OPERATE

- Conserve energy / water and reduce fossil fuel use / dependence
- Share resources
- Reuse, repair & refurbish
- Maintain longevity
- Reduce emissions
- Track materials and reuse

RENOVATE

- To extend asset life
- To address under-utilisation
- Improve performance
- Reimagine spaces
- Celebrate heritage

Circular economy journey

South Australia has been leading the circular economy journey in Australia with innovative legislation, policies, and programs driving resource efficiencies and recovery for over 50 years. The below summarises some of the key initiatives implemented by government and industry which is enabling a circular economy in the built environment.

1994

Waste Levy Introduced
Main Driver to Construction & Demolition (C&D) Waste Diversion

Lochiel Park Green Village Project
Commenced by Renewal SA

First SA Waste Strategy Released
(2005-2010)

Zero Waste SA Established

First Green Star Rated Building in SA
(151 Pirie Street)

2009
53.3%
of C&D Waste Diverted from Landfill

2011
57%
of C&D Waste Diverted from Landfill

SA's First Zero Carbon House Built
(Lochiel Park)

UN Acclaimed SA's Waste and Resource Management Global Best Practice

Tonsley Urban Renewal Project
Adaptive Reuse of Former Mitsubishi Main Assembly Building

2016
40%
SA's Energy from Renewables
Last coal power station closed

2018
91%
of C&D Waste Diverted from Landfill

2019
57%
SA's Energy from Renewables

Carbon Neutral Adelaide Declaration

2022
70%
SA's Energy from Renewables

Lot 14
6 Star Green Star Communities

SA's Waste Strategy 2020-2025 Released
Supporting Transition to Circular Economy

SA's First 10 Star NatHERS Home

2022

Bowden Village Urban Renewal
6 Star Green Star Communities

'Commercialisation of Innovation Program'
Facilitating Funding to Pilot XFrame

R2P Road Upgrades Used Reconophalt

U City
SA's First Carbon Neutral Certified Building

Plan

Plan for the built environment to avoid the use of raw materials, mitigate climate change impacts and reduce the duplication of assets and services.

Climate resilience

Climate change impacts on the built environment are becoming an increasing risk, resulting in damage to buildings and infrastructure, increased contaminated disaster waste, reducing asset life, and potentially resulting in stranded assets that are unable to adapt to or respond to climate change as well as high costs of repair and higher insurance costs. These impacts are resulting in significant volumes of materials, and the associated embodied emissions, to be lost if they are sent to landfill or the value of the materials reduced if sent for recycling.

As an example, the South Australian Bushfires 2019/20 resulted in over 240 houses being damaged, 547 properties being cleared and approximately 50,000 tonnes of waste being processed. Due to over 60% of the houses containing asbestos and over 75% of properties having Copper Chrome Arsenic (CCA) treated timber, this presents a significant challenge for managing waste to landfill as well as minimising impacts on the environment.

The recent 2022/23 floods along the Murray River have also highlighted disaster waste as a key risk, with flood damaged properties exposed to similar hazardous waste challenges, as well as health risks due to mould.

To reduce the likelihood of climate change significantly impacting the built environment, climate change projections should be used by all major built environment projects to improve resilience and adapt to changing conditions. Where the risks cannot be effectively controlled or managed, consider whether the project should proceed in the proposed location or in its current form to avoid the likelihood of becoming a stranded asset or damaged due to climate change impacts. Addressing climate change impacts is critical, and is now a requirement to achieve a Green Star rating.

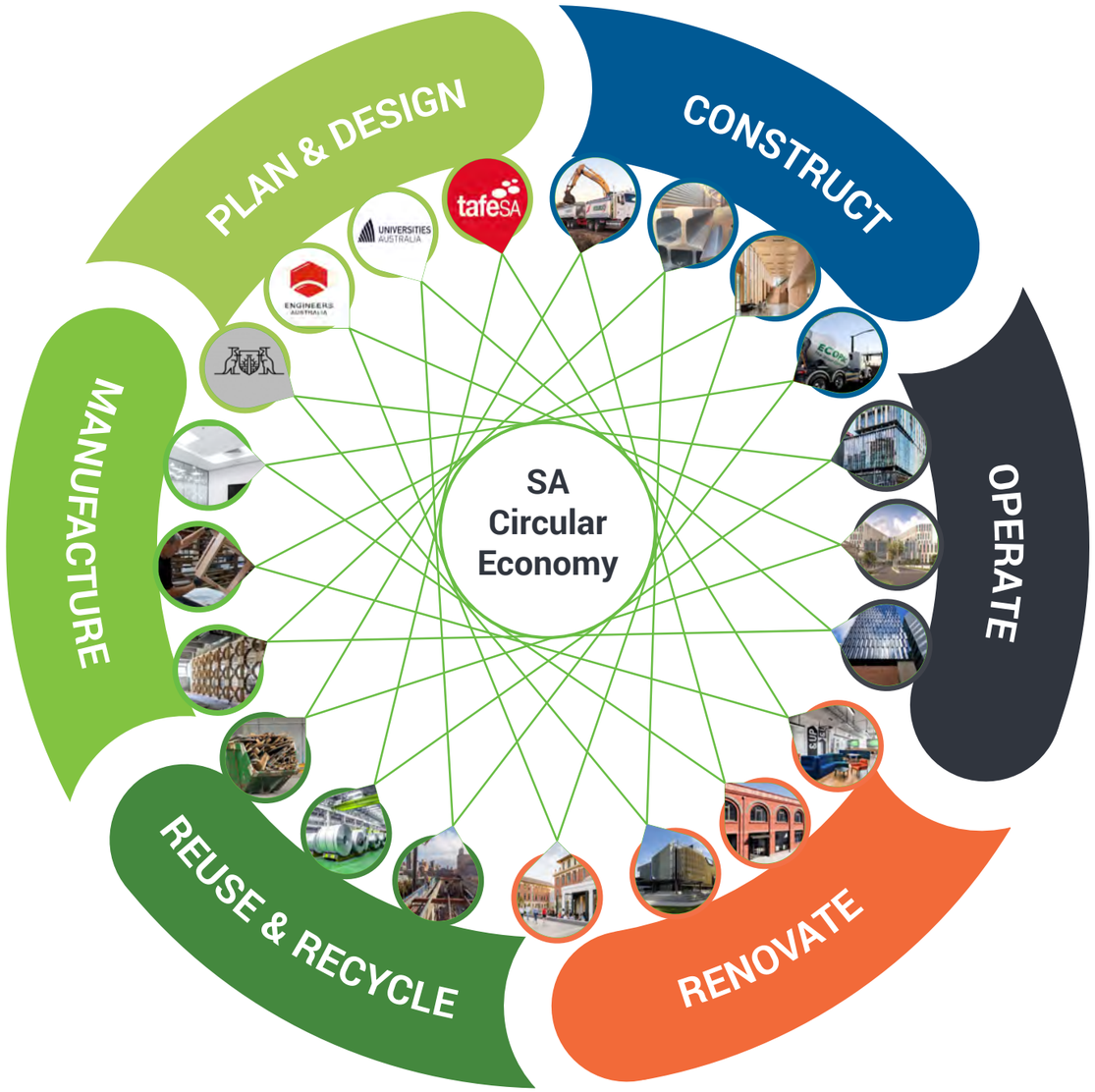
Refer to the *South Australian Climate Change Actions* document[6] and *Guide to climate change risk assessment and planning in South Australia*[7] for further information on climate change action being undertaken by SA Government, and for the latest climate change projections.

Stakeholders

For circular economy opportunities to be realised, an across government and industry approach is required. All stakeholders have a role to play in integrating and working towards a consistent approach to circular economy in the built environment. The SA Government will be a key driver and facilitator initially, with industry and other stakeholders expected to play an increasing role as the environmental, social, and economic benefits of the circular economy are realised. The following stakeholders should be considered as part of stakeholder engagement programs:

- First Nations peoples
- SA Government and Local Government
- Tertiary institutions and research/academia
- Design disciplines (architects, engineers)
- Energy generators and producers
- Construction industry
- Manufacturing and assembly industry
- Developers, building owners, operators, and tenants
- Resource recovery industry (waste, recycling, reuse)
- Community and households

Figure 4: Circular Economy – Stakeholders. SOURCE: dsquared



Connection to Country

A key opportunity for circular economy in the built environment is listening to and learning from First Nations peoples and their cultural, spiritual, physical, and emotional connection with their land, waters, and community. Throughout consultation undertaken for this report, integrating Connection to Country and a Designing with Country approach was highlighted as a priority which will require meaningful and authentic engagement.

It is recommended that engagement with First Nations peoples is effectively planned for as part of implementing the opportunities identified in this report. Critical to this will be identifying how and where a Connection to Country can contribute to circular economy in the built environment and how circular economy opportunities can empower First Nations peoples to drive outcomes and share their knowledge. This will include SA Government:

- Undertaking a First Nations peoples stakeholder analysis and developing an engagement plan before any further development of the circular economy roadmap and implementation of the recommended actions in this report.
- Identifying state-wide and local initiatives that should engage with different First Nations stakeholders.
- Considering engagement with state-wide advisory bodies, Commissioners and groups including:
  - Commissioner for Aboriginal Engagement (provides advice to SA Government)
  - South Australian Aboriginal Advisory Council (SA Government's peak advisory body)
  - First Nations of South Australia Corporation (collective of Native Title holders and claimants)
  - Aboriginal Landholding Authorities (Aboriginal Lands Trust, Maralinga Tjarutja and Anungu Pitjantjatjara Yunkunytjatjara)
  - South Australian Native Title Services (Native Title Service Provider for SA)
  - Department of the Premier and Cabinet – Aboriginal Affairs and Reconciliation
  - The Circle – First Nations Entrepreneurs Hub.[8]

An example of meaningful engagement with First Nations peoples as part of a project's design process is Yitpi Yartapuultiku, a new community facility being developed by the City of Port Adelaide Enfield in South Australia. The design team engaged early with First Nations peoples to empower them as part of the decision making process on elements such as design outcomes, materiality, and end user requirements.

The focus of any engagement should be on empowering First Nations peoples so that they may decide on how built environment initiatives integrate a Connection to Country to drive circular economy outcomes.

Collaboration and partnership will provide opportunities for First Nations peoples to identify barriers and opportunities and co-design solutions that are reflected in projects, plans and policies.

Each project will be different, so engagement and consultation should reference, adopt, and adapt successful examples of First Nations engagement by trusted agencies and groups to ensure that First Nations peoples have the opportunity to drive, contribute to, and benefit from circular economy outcomes.

CASE STUDY

Yitpi Yartapuultiku

https://www.cityofpae.sa.gov.au/

Yitpi Yartapuultiku, SA.
City of Port Adelaide Enfield.
Registered for Green Star Buildings v1.0

Project team: City of Port Adelaide Enfield with Ashley Halliday Architects, Wax Design and the Yitpi Yartapuultiku Custodian Working Group

Image credit: WAX Design

Yitpi Yartapuultiku will be a community space providing a range of activities and opportunities for both First Nations and non-First Nations peoples. It will be an authentic place to be immersed in local culture with indoor and outdoor activity and performance spaces, public amenities, office and meeting rooms, extensive landscaping, artwork and entry statements and areas with access to the water. The project includes a Living Shoreline which will return the river edge to a natural state and provide habitat for local fauna. Extensive consultation and engagement with the local Aboriginal community has been undertaken for the project, with an Aboriginal Custodian working group established to provide input and ensure the design will meet the end user requirements. This includes reviewing material and colour selections to ensure the centre is providing an authentic experience which reflects the local environment.

Design

Design buildings and infrastructure for longevity, to reduce the need for raw materials and to enable future disassembly, reuse and recycling.

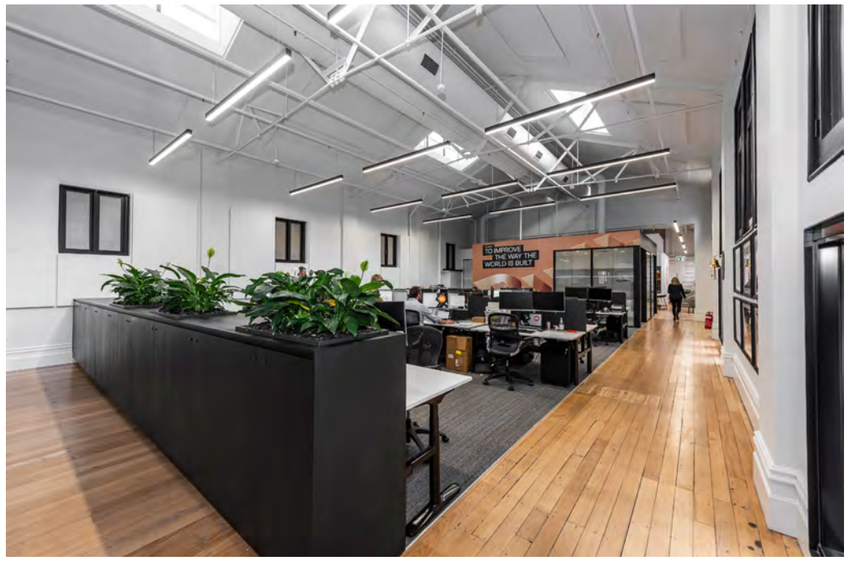
Avoidance

Avoiding the need to use materials by building less and ensuring that designs are optimised for current and future needs is a key priority. For example, pandemics such as COVID-19 can disrupt usual business and living patterns and are expected to increase in frequency due to increased urbanisation and climate change. COVID-19 has resulted in many organisations implementing a hybrid approach to working in the office and at home, which impacts the number of people attending offices and reduces demand on office space and transport infrastructure, while increasing the utilisation of homes and alternative workplaces.

It is recommended that built environment projects consider:

- Building less by optimising buildings and infrastructure to meet current and future needs.
- Designing to use less materials while achieving the same outcome, targeting high embodied emission materials e.g., optimising structural designs and the weight and complexity of the façade to reduce the use of concrete and steel.
- Avoiding the use of hazardous materials that are both a risk to health and wellbeing and that need to be treated and disposed of to landfill at end of life.
- Designing for adaptability / flexibility to reduce duplication of assets and enable building use to change over time.
- Designing for modularity and standardisation to reduce complicated installations that result in wastage through offcuts and unusual lengths.
- Incorporating offsite prefabrication and assembly which can be used to reduce wastage, improve production efficiencies, and reduce environmental impacts.
- Designing for disassembly (refer to page 18).

This approach should also be considered from a planning perspective with the aim to minimise the duplication of assets and services. In addition, effective planning can ensure facilities are built in the right place at the right time, and aren't demolished before end of life, for example, building new housing estates and community facilities to then demolish facilities for a new highway.



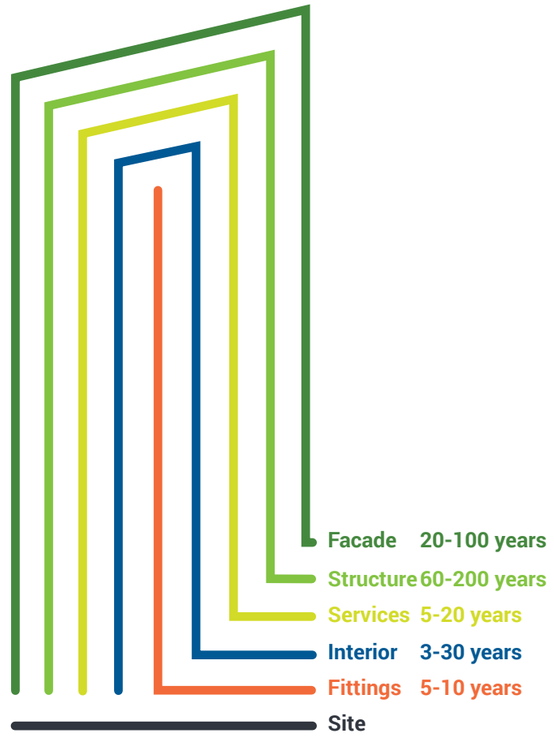
Built Head Office Adelaide, SA.
Built Pty. Ltd. 6 Star Green Star – Interiors v1.3

Designing for circularity

Consideration should be given to all aspects of the building or infrastructure design and all project stages. The ARUP Circular Economies Toolkit[9] breaks buildings into the following layers to allow the consideration of approaches that best suit the lifecycle of the built elements. It is recommended that projects consider this approach with circular economy opportunities maximised for each layer.

Site: The location of the building
Systems: Including the structure and services of the whole element
Structure: The building skeleton
Facade: The facade and exterior
Services: The pipes and wires of the building
Space: The internal fitout
Stuff: The equipment within the building

Projects should also use this approach to identify actions that will have the greatest impact over the life of the building. For example, the structure may be the layer with the greatest embodied emissions initially. However, if the building is designed for longevity and adaptability, this may reduce in proportion to the skin and services layers if these are replaced and repaired over the life of the building.



Tonsley, SA. Renewal SA.
6 Star Green Star – Communities v1.1

CASE STUDY

DAS Studio

http://www.das-studio.com.au/

An emerging Adelaide based architecture and design practice at the forefront of modular and off-site construction. Prefabricated construction techniques deliver high quality outcomes and increased construction precision, alongside reduced construction waste, as a result of off-site manufacturing in controlled factory environments. In collaboration with ESCA, DAS Studio created 'Escapod' in McLaren Vale - a movable, off grid-capable, luxury hotel suite, set amongst vineyards.

DAS Studio went on to deliver multiple school buildings with Sensum SA as part of the Department for Education's Modular Capital Works Program, reducing construction timeframes and minimising disruption to schools.

Embodied emissions

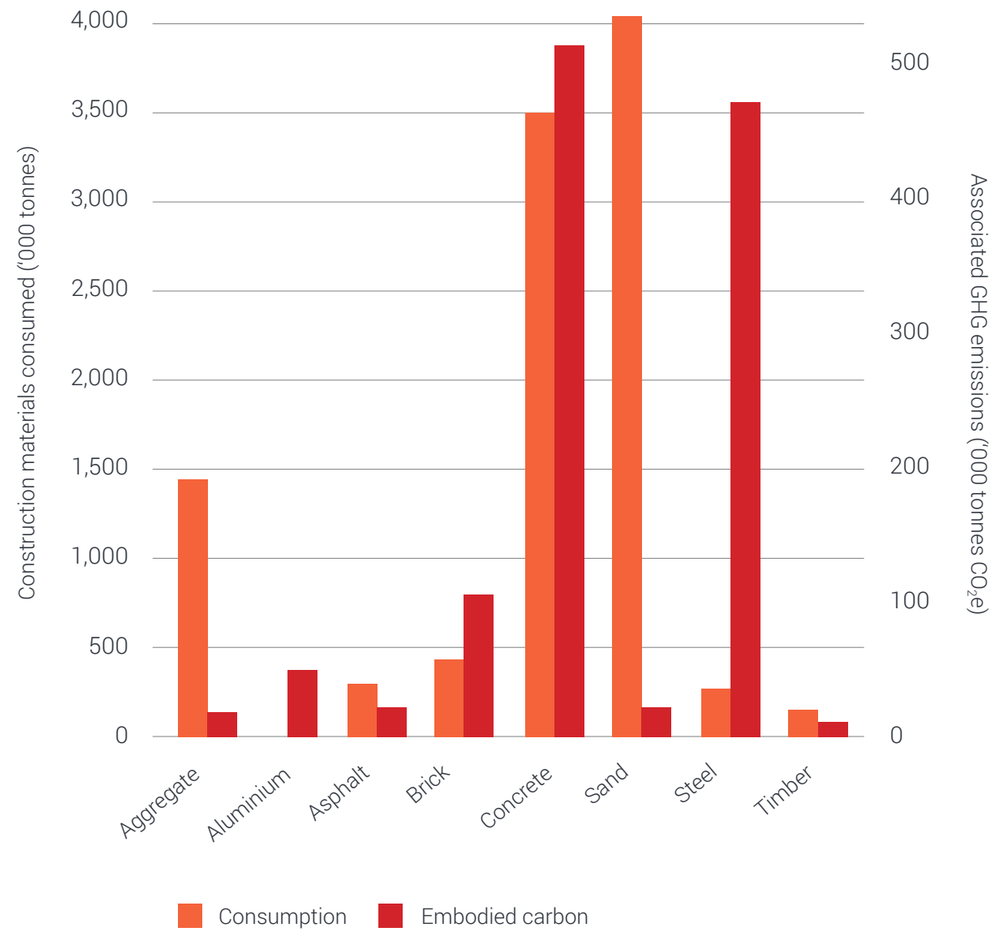
Consideration must be given to the upfront and embodied emissions associated with materials used in the built environment. There are many tools and resources available which enable designs to reduce the use of raw materials and shift to low embodied emissions, such as embodied emission databases, undertaking Life Cycle Assessments (LCA) to demonstrate emission reduction outcomes, and GBCA's A practical guide to upfront carbon reductions.[10]

The below provides a summary of the highest sources of material emissions in the built environment.

Most of these emissions occur upfront, before the building is open. These should be treated as a priority as part of the design and specification process.

However, a key constraint to addressing embodied emissions is that there is not currently a nationally adopted framework and set of metrics being used for projects. Green Star Buildings and the soon to be released NABERS Embodied Emissions tool is expected to provide consistent approach across projects in Australia while also providing additional incentives to address embodied emissions.

Figure 8: Embodied emission priorities. SOURCE: Vital South Australian material flows V1.0 EVIDENCE REPORT, Lifecycles



Upfront and embodied emissions opportunities

Key opportunities in the built environment include:

- Optimising and reducing the use of materials with high upfront and embodied emissions such as concrete and steel. This includes re-evaluating the extent of use and whether alternative materials would meet the same outcome.
- Considering appropriate structural component replacements, such as the use of cross laminated timber (CLT) and glue laminated timber (GLT), with the CLT plant at Tarpeena in South Australia a key opportunity from 2023.
- Specifying low emission concrete with Supplementary Cementitious Materials such as fly ash or slag e.g., Holcim ECOPact[11] which reduces embodied emissions by up to 60%. A key opportunity in South Australia is the Hallett green cement transformation project[12] which is aiming to access the 30M tonnes of fly ash from the closed Port Augusta coal plant, as well as green hydrogen, to manufacture low emission concrete.
- Preferencing Australian made responsible steel suppliers with ISO 14001 Environmental Management System (EMS) accreditation, Environmental Product Declarations (EPDs) and ResponsibleSteel certification.
- Reclaimed asphalt pavements (RAP) and asphalt with recycled content such as plastics and glass recovered through local landfill diversion.
- Replacing high emission outdoor materials and products with alternatives such as recycled plastic and rubber bollards, kerbs, benches, boardwalks, and wheel stops.
- Outdoor pavers with recycled content and permeable paving designs which reduce the amount of concrete used.
- Considering construction methods, with concrete and asphalt requiring large diesel-powered machinery and trucks versus paving with manual labour.

These opportunities should be assessed based on the upfront emissions to ensure that the consideration also includes transportation and construction emissions.

Key to maximising the use of low emission materials will be standardised metrics and assessment methods, key performance indicators (KPIs) and monitoring mechanisms to enable circular economy outcomes to be tracked. The NABERS Embodied Emissions rating tool should be adopted once released.

Regenerative design

Regenerative design is an approach that aims to have a positive environmental and social impact on the site, surrounding environment, and natural ecosystem. This directly aligns with a circular economy approach by reducing the extraction of resources and extends the net zero transition from simply reducing impacts and mitigating climate change, to having a net positive impact on the environment.

Key regenerative design opportunities include:

- Designing to be net zero for energy and water and working towards zero waste to landfill.
- Utilising digital technologies and simulations to prototype and optimise designs with the aim of creating positive environmental outcomes.
- Eliminating the use of hazardous materials and pollutants entering the natural environment including from waste and stormwater pollution.
- Working towards a living systems approach, where the built environment is part of closed loop system which shares materials, energy and water and ultimately can be safely returned to the biosphere when at end of life.
- Regenerating sites with a net increase in vegetation and tree canopy by integrating landscaping and plantings that improve biodiversity, soil conditions and habitats.
- Integrating learning and engagement opportunities that demonstrate how the project creates positive environmental outcomes.

Design for disassembly and reuse

Design plays a critical role in ensuring the built environment can be easily disassembled, reused, and recycled at end of life or when the built environment needs change. Projects should consider the following to reduce the complexity of the built environment and enable spaces to be more easily adapted in the future:

- Implementing material passports to track materials throughout the building life cycle and enable ‘urban mining’ at end of life.
- Designs should focus on components that are simple and easy to construct, deconstruct and reuse. These should be mono-materials or those designed to be easily disassembled for recycling if necessary. This will both reduce the use of materials and improve efficiencies during initial and subsequent constructions.
- Materials should be selected based on their ease of reuse and recyclability, with composite materials that require specialist machinery or processes and end of life disposal avoided. For example, materials such as glass reinforced concrete can have a lower embodied emissions than standard concrete but require specialised processing to recycle at end of life.
- Designs should consider how components will be disassembled at end of life to enable high value materials to be easily separated. For example, reducing the use of glues and bonding agents where mechanical fixings could achieve the same outcome.

SHAPE Adelaide Office, SA. SHAPE Australia Pty. Limited.
5 Star Green Star – Interiors v1.3

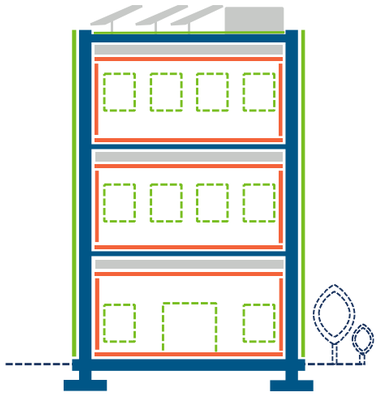
Holistic impacts

Products and materials used in construction and refurbishment have multiple impacts, beyond those that are climate related. Issues such as modern slavery, health and wellbeing, transparency, disclosure, sourcing and others should also be considered in addition to the elements mentioned above. To help identify and provide an aligned definition to industry, GBCA has developed the Responsible Products Framework. This framework is helping product manufacturers understand the holistic impacts of their products and identify roadmaps for change. Procurement officers, architects, and industry professionals are encouraged to engage with the framework to assist them in making better material choices.

In the built environment, this should focus on the following components from the Green Star Responsible products credits which also aligns with designing for circularity:

- **Responsible Structure**
- **Responsible Envelope**
- **Responsible Systems**
- **Responsible Finishes**

Figure 9: Responsible product components in the built environment[13] SOURCE: GBCA Responsible Products Framework

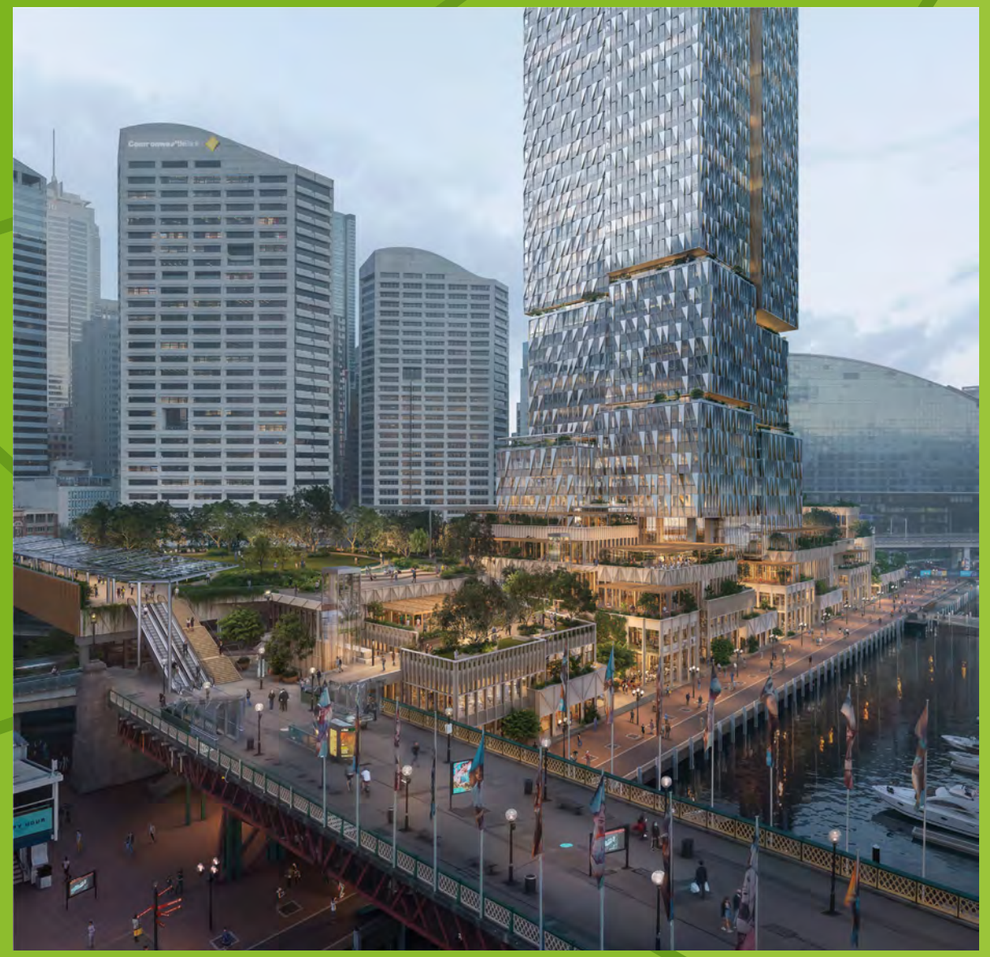


Designing with Country

A key opportunity for projects to integrate circular economy approaches in the built environment is Designing with Country which, similar to the circular economy, aims to shift from a human centred approach that prioritises people and their needs, to a Country centred approach where people are part of natural systems. This then supports the planning and design process where people, animals, resources, and plants are valued equally, similar to First Nations peoples' world view, and supports a regenerative design approach.

It is recommended that the circular economy opportunities identified in this report are shared with First Nations peoples and communities in South Australia as part of a commitment to meaningful engagement, consultation and integration of Connection to Country. A Connection to Country approach is also likely to identify further opportunities that can be integrated into circular economy initiatives in the built environment.

CASE STUDY



Cockle Bay Park Redevelopment

www.balarinji.com.au/gptgroupampcapital

Cockle Bay Park, NSW.
The GPT Group and AMP Capital Investors Ltd.
Registered for Green Star – Design & As Built v1.3

Architectus and Henning Larsen Architects

Balarinji, Australia's foremost Indigenous design and strategy studio, was engaged by The GPT Group and AMP Capital to integrate local Aboriginal culture and values within the design of Sydney's Cockle Bay Park redevelopment. Employing its innovative Cultural Design Principles methodology, Balarinji undertook a series of community workshops and interviews with locally-connected Aboriginal stakeholders, knowledge holders and creative practitioners. From this engagement process, Balarinji provided high-level translation of the local Aboriginal narrative as well as feedback from local Aboriginal stakeholders on what was wanted from the redevelopment, both specific to the project and more broadly reflecting the universal Aboriginal worldview and context. These workshops also informed themes local to Place for a conceptual approach to the redevelopments architecture, landscape design, urban furniture, and public art.

Construct

Power construction with renewable energy, maximise the use of low emission and local materials, and recover reuse, and recycle materials throughout the construction stages.

Low emission construction sites

With many organisations pursuing carbon neutral certification and focusing on their emissions sources, there is an opportunity to reduce construction stage emissions significantly. For example, diesel fuel emissions from trucks and machinery can be a significant source of emissions on construction sites and can offset the impact of using recycled materials and content.

It is recommended construction companies and industry consider the following:

- Maximise fuel efficiencies and reduce transport emissions by reducing vehicle and machinery idling time, transitioning to electric options for tools, equipment, and generators, and investigating electric, hydrogen, and renewable diesel-powered machinery.
- Power construction sites with renewables such as onsite deployable solar PV systems or accredited renewable energy contracting such as Green Power.
- Aim for zero operational waste to landfill for construction sites by developing a site-specific waste strategy that recovers multiple waste streams and reduces contamination.
- Designing site amenities to be highly efficient and for reuse and longevity. For example, investing in higher quality modular designs that will also provide improved amenity for workers.

This will assist organisations in reducing their direct and indirect emissions and enable companies to demonstrate leadership in the construction sector, improving competitiveness and social license to operate.

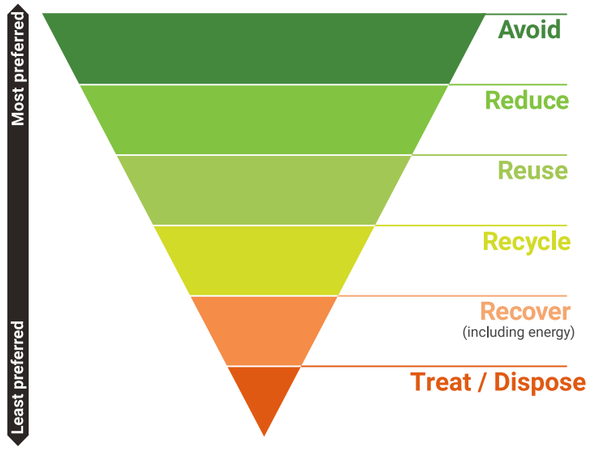
Lendlease's *Stepping Up the Pace: Fossil Fuel Free Construction* report,[14] developed in collaboration with the University of Queensland, provides further detail on the opportunities to transition to fossil fuel free construction sites in line with their Mission Zero Roadmap.

Local materials, products, and manufacturing

Construction companies and industry have a key role in supporting local and low emissions materials and suppliers during construction. It is recommended that the SA Government focus on upskilling local construction companies to:

- Prioritise local materials, trades, and suppliers as part of procurement practices, including proposing alternatives to improve outcomes.
- Increase their awareness of certified products and suppliers that have a lower environmental impact, such as EPDs, ISO 14001 Environmental Management Systems and green certification.
- Collaboratively de-risking alternative materials by sharing lessons learnt on the use of recycled content including potential budget and delivery impacts and training requirements.
- Use GBCA's Responsible Product Framework to help identify better materials.

Figure 10: Waste management hierarchy. SOURCE: Green Industries SA[15]



100% construction waste diversion

Construction and demolition (C&D) waste diversion in South Australia is already at >90% and is leading the country. However, opportunities are present to continue to divert materials from going to landfill and maximise the value of materials. This includes:

- Ensuring all projects appropriately capture and separate construction waste streams that can be reused and recycled. In South Australia all projects should separate steel (ferrous and non-ferrous), concrete, bricks, plasterboard, timber, and PVC.
- Implementing effective waste monitoring and reporting to track landfill diversion and setting a minimum 90% diversion target for commercial projects which is standard practice and consider a 70% diversion target for the residential sector.
- Investigating suppliers that offer stewardship services, delivering materials and products and taking back packaging and products for reuse, recycling, and repair.
- Investigating opportunities for demolition waste to be reused onsite, such as for infill soil, concrete crush from the demolition of slabs and blockwork, bricks in outdoor areas, and reusing timber. Alternatively, where C&D materials are unable to be used on site and are sent for offsite processing, consider opportunities for the same material processing company to provide recovered material back to the project to create a circular materials loop.
- For waste which cannot be diverted from landfill, investigate opportunities to send to a waste to energy plant as a last option before sending to landfill.
- Providing training and inductions for contractors on maintaining waste separation to maximise resource recovery.

The above options should be considered in line with the above waste management hierarchy, with disposal the final option.

Operate

Operate to work towards net zero emissions, shared resources and for reuse, repair, refurbishment, and longevity.

Net zero emissions

In line with the Paris Agreement, Australia has committed to reducing emissions by 43% by 2030 and the SA Government is targeting a 50% reduction. With the built environment accounting for approximately 40% of global greenhouse gas (GHG) emissions and 30% of energy consumption, it plays a key role in working towards net zero emissions, while also providing time for other harder to abate sectors to decarbonise. Due to South Australia's high percentage of renewable energy generation, a key opportunity for the built environment to achieve net zero emissions is transitioning to all-electric buildings.

By shifting to low emission buildings, the focus can then be placed on embodied emissions and circular economy outcomes. It is recommended that buildings in South Australia:

- Are powered by 100% fossil fuel free energy, with a mixture of onsite renewable energy such as solar PV and procuring 100% accredited renewable energy. This will also take advantage of South Australia's increasing renewable energy generation over time.
- Have all-electric, highly efficient base building services such as heating, heat pump hot water, and induction cooking. This reduces the duplication of infrastructure by removing gas reticulation, reduces material use and reserves gas as a transitional fuel for hard to abate sectors, such as industry.
- Reduce operational waste to landfill, aiming for at least three waste streams diverting >80% of waste from landfill e.g. landfill, recycling, organics, as well as specialist waste streams.
- Support sustainable transport with EV charging provisions, end of trip facilities for walking and cycling and promoting the use of public transport.
- Specify the lowest Global Warming Potential (GWP) refrigerants possible at the time of construction and designing for future changes to ultra-low and zero GWP refrigerants.
- Maximise the efficiency of plant and equipment to reduce consumption, demand, emissions, and costs.

U City, SA. Uniting Communities Incorporated. 6 Star Green Star – Design & As Built, 5 Star Green Star - Performance 1.2.0

CASE STUDY

U City

www.ucity.com.au

U City, SA.
Uniting Communities Incorporated. 6 Star Green Star – Design & As Built, 5 Star Green Star – Performance 1.2.0

Uniting Communities has developed a new vertical village in the Adelaide CBD, including retail, community use, commercial office, supported care accommodation, and retirement living apartments. Uniting Communities is a carbon neutral certified organisation under Climate Active. To showcase their commitment to sustainability and circularity, the facility has obtained a 6 Star Green Star Design & As Built rating, 5 Star Green Star Performance rating and is Adelaide's first Climate Active carbon neutral certified building.

The sustainability of this building allows its function to be future proofed against climate change and to be adaptable to the changing needs of the community over time.

Maintain, repair & recycle

To improve the longevity of the built environment and maintain the value of materials at their highest levels, the maintenance, repair and refurbishment of building components, products and systems is a priority.
To achieve this, built environment projects can:

- Select durable and higher quality materials and products for building works and fit outs. For example, specifying higher quality wall finishes that will be less susceptible to damage and can be more easily repaired.
- Designing to maintain and repair by specifying high quality materials and products with longer warranties and repair services. This includes ensuring accurate operation and maintenance manuals are developed which includes warranty information for repair and replacement.
- Procure reused materials, furniture, and equipment as part of refurbishment and fit out works. This is directly linked to selecting durable, higher quality materials and products that will last longer and be suitable for refurbishment.
- List materials and furniture for sale, donate to charities or reuse before disposing to landfill. For example, Egans' Wise Office Furniture program[16] enables used commercial furniture to be resold following office renovations and fit outs.
- Where no other option is available, materials and furniture should be disassembled and separated into material streams to enable recycling.

Low emission suppliers, materials and products

It is also important that circular economy principles and priorities are incorporated as part of procurement process and facilities management teams are effectively engaged with as part of ongoing facilities management. This includes:

- Preferencing low emission and carbon neutral products and suppliers in specifications and asset replacement programs.
- Specifying local options first for products and materials, with the Industry Advocate SA maintaining resources and supplier databases to find local manufacturing, assembly and South Australian based suppliers.
- Providing upskilling, training and guidelines or checklists to facilities management teams on how to embed circular economy in asset maintenance and replacement programs.

Share knowledge and resources

Throughout consultation and stakeholder engagement undertaken for this project, it was apparent that there was extensive knowledge and expertise across South Australia and Australia more broadly. Although each stakeholder may not see themselves as operating in a circular model, when combined there is a significant opportunity to share knowledge and resources to kick-start circular economy in the built environment.

It is recommended the SA Government:

- Lead by example by integrating circular economy targets in infrastructure and capital works projects, with over $3b invested this financial year on infrastructure and capital works projects in the education, health and infrastructure sectors.
- Create a circular economy nucleus which brings together First Nations peoples, industry, government (state and local government), and academia to share knowledge, resources, and case studies, undertake site visits and collectively work towards removing barriers for circular economy uptake. This could include events, site tours and an information sharing portal / website based on examples such as ReLondon and the Holland Circular Hotspot.

  This should build upon the stakeholder engagement undertaken for this project with many key stakeholders already identified. Ultimately, the aim is for the nucleus to be industry-led.
- Create a regularly updated directory of case studies in both the government and non-government sectors to demonstrate circular economy outcomes in South Australia. This should start with case studies of achievements by SA Government projects such as low emission concrete and asphalt in infrastructure works, modular building projects for schools, and how the net zero emissions program is driving a focus on Scope 3 emissions such as construction and suppliers.
- Support grant funding for embodied emission analyses and LCAs for real world projects that demonstrate the impact of low emission and circular economy materials, and upskill industry on the cost, longevity, and environmental outcomes of shifting to alternatives such as low emission concrete, cross laminated timber and recycled content.

  This should include a directory of local South Australian circular economy products and materials, including emission reduction opportunities and costs, to enable projects to choose materials that will have the largest impact.

Renovate & refurbish

Renovate and refurbish buildings to extend asset life, improve performance, reimagine spaces and celebrate cultural heritage.

Cultural heritage

As part of the design stage, strategic planning and asset renewal programs, preserving and celebrating cultural heritage should be a key priority which both remembers our past and values built environment materials.

A key opportunity is to celebrate local heritage within existing buildings, surrounding site and the community, and using heritage to guide the design and operation of the built environment. This includes listening to and learning from local First Nations peoples, increasing awareness and understanding of the site's history and preserving historic details.

Adaptive reuse

With 40% of the world's materials being used in the built environment, reusing existing buildings and facilities should be a key priority to extend the life of assets and retain the embodied emissions within the building structure and materials. Although adaptive reuse is often seen as a more complex and costly exercise, this is only because we currently do not value materials within the built environment based on their whole of life impact. As a result, the ease of demolition and lower cost of materials and labour when building new is often seen as the better option. However, some of the most memorable spaces and places are those that have adapted and reimagined buildings and places while preserving the history of the site.

It is recommended that circular economy metrics, targets and material passports are used to assist in quantifying the value of materials in the existing built environment so that projects can understand the benefit of retaining as much of the existing built environment as possible. This includes quantifying the monetary value of materials in existing fabrics to demonstrate both the financial and embodied carbon reduction.

A key example of this approach is the Lot Fourteen heritage buildings which have been revitalised while retaining the character and history of the site. However, all existing assets, not just heritage buildings, provide a valuable store of materials and embodied emissions which will be lost if demolished and sent to landfill.

Strategic planning

Planning for renovations and refurbishment activities can assist in managing the financial cost of building upgrades and align actions with end of life replacement of building elements. Development of a strategic plan and asset management strategy can allow for the operational savings associated with energy efficiency upgrades of building services and fabric to be invested into further refurbishments over time. This includes developing material databases for existing buildings which is a detailed inventory of materials, resources and products in a building. This then enables building owners to participate in future trading platforms when buildings reach end of life or are undergoing renovations or refurbishment.

Engaging with qualified professionals to undertake energy audits or home thermal assessments can assist facilities management teams and home owners to understand opportunities, impacts and associated costs.

This information can be utilised to target low cost and high impact refurbishments initially, and strategically plan for further renovations.

Simple and effective opportunities that can be implemented to improve thermal comfort and energy efficiency and prolong the lifespan of a building or home include:

- Building sealing and airtightness initiatives such as weather seals and draught mitigation.
- Retrofitting or replacing insulation in ceilings, walls, floor and around building services equipment (lagging).
- Exposing thermal mass and materiality to improve passive design outcomes.
- External shading and window treatments to reduce solar ingress.

Value retention

Where existing buildings are refurbished and require a level of demolition or material removal, consider how to prioritise materials at their highest and best use. This should be on site where possible, and if not, opportunities for use offsite should be investigated. For example, bricks may be recycled into aggregates and rubble through crushing processes, which can be used in road construction, but this limits the ongoing circularity of the high embodied energy material and reduces its value. Removing brickwork carefully and cleaning off mortar could allow for their reuse within building works in their original form, retaining the material value.

CASE STUDY

Lot Fourteen

www.lotfourteen.com.au

Lot Fourteen, SA.
Renewal SA.
6 Star Green Star
– Communities v1.1

The reuse of the existing buildings along North Terrace, Adelaide is an excellent example of how the adaptive reuse of existing buildings can be revitalised into new, sustainable office accommodation. The buildings are now home to innovative technology companies and start-up tech incubators, including the Space Discovery Centre, and 'Stone and Chalk', a carbon neutral innovation hub.

Lot Fourteen is a 6 Star Green Star Communities certified precinct, and the first precinct in Australia to be Precertified as a WELL Community. Each building within the precinct must obtain a 6 Star Green Star rating and the Entrepreneur and Innovation Centre (EIC) will obtain a WELL building rating.

In addition to the built environment initiatives, Lot Fourteen also incorporates the Circle - First Nations Entrepreneurs Hub which will assist the South Australian Aboriginal business sector with support and services to build and grow their business.

Reuse & recycle

Reuse and recycle building materials and products at all stages to enable remanufacturing, repurposing, and minimise waste to landfill.

Reuse & recycle the built environment

Throughout all stages of the design, construction, operation, and end of life of the built environment, maintaining materials at their highest level of value should be the priority. However, recycling will still be required to ensure materials and resources do not go to landfill, which impacts the environment and increases GHG emissions.

As a result, all projects should aim to maximise recycling to support resource recovery and enable other industries to upcycle where possible or downcycle if no other option is available.

Opportunities include aiming for 100% C&D waste diversion from landfill for all projects including maintenance programs, fit outs, refurbishments, and the demolition of buildings. In addition, buildings being identified for demolition and recovery should be treated as a material bank, with 'urban mining' used to recover all materials and components that can be reused. This includes connecting recovered materials to new projects to provide an additional revenue stream.

The following materials and fixtures can be reused and recycled for profit:

- Ferrous and non-ferrous metals which can be used as feedstock for recycled steel and manufacturing industries.
- Concrete and masonry blockwork which can be reused or crushed and reused as aggregate and backfill.
- Timber which can be reused on site or as feedstock for particleboard and building materials.
- Plasterboard which can be recycled and remade into new plasterboard.
- Carpet tiles are reused if in good condition and carpets recycled as material for new carpets.
- Air-conditioning systems such as split air conditioners are reused at alternative sites if in good condition.
- Lights including fittings and globes are reused if in good condition, and fluorescent globes and hazardous materials disposed of at collection points.
- Furniture is listed on second hand furniture websites or specialist removalist companies engaged that will reuse and sell second hand furniture. For example, Egans recover quality used furniture and on sell with an online used furniture store.
- Quality used fixtures and fittings are provided to organisations such as ReStore which sells surplus and gently used building products.

In addition to commercial projects, residential developers, builders, and home renovation projects should be supported and encouraged to improve waste separation and appropriate disposal with information and training programs targeted at this sector. This could include setting a residential construction waste diversion target.

CASE STUDY

Precycle

www.greenindustries.sa.gov.au/resources/precycle-circular-economy-in-action-in-sa-2019

Precycle is an on-demand service that concentrates on removing and recycling unwanted and surplus building materials from home construction sites. The service collects clean offcuts, discarded materials and excess materials including timber, bricks, plasterboard and steel, and enables the materials to be reused and recycled within a circular economy model. Based on a review undertaken with funding from GISA, the service increased landfill diversion rates from 10% for a business-as-usual approach to 76%.

Energy from waste

As a final stage and only if all other options have been exhausted, energy from waste should be used to recover the remaining energy in materials. Energy from waste can reduce emissions compared to landfill sites and provide a recycled material for combustion in furnaces and high temperature processes.

Energy from waste plants are operated across Australia and South Australia, such as Adelaide Brighton Cement's production facility which is replacing fossil fuels and combusting Refuse Derived Fuel[17] that is processed from materials typically sent to landfill. Any ash from the process is then used in cement products to support a circular economy approach.

ABOVE:
Refuse Derived Fuel, used at Adelaide Brighton Cement's Birkenhead manufacturing facility

Future material flows

Key to supporting a circular economy is understanding future material flows and resource recovery opportunities within the built environment. Key trends which are expected to impact the availability or resources and potentially introduce new resource streams include:

- Solar photovoltaic (PV) panel recycling, with the aluminium framing and silica recovered for recycling and remanufacturing.
- Battery storage systems, with the precious metals and materials such as cobalt, lithium, nickel and standard materials such as steel, aluminium, copper and plastic used in the housing.

  In addition, EV batteries are designed for the high energy demand and weight of a car, but even at reduced battery capacity are sufficient to power homes. Remanufacturing should focus on this as a high value option to support the development of affordable energy storage for buildings.
- Refrigerants that will be phased out over time but will still be in use in older air conditioning systems and require re-gassing to maintain efficient operation and extend the asset life.
- Wind turbines including newer designs which are being developed for ease of disassembly and recycling.
- Metal pipework and components removed as buildings transition to all electric systems, with pipework to and within buildings able to be recovered.
- New materials and composites that facilitate circular economy outcomes and can be reused, remanufactured, recycled, and recovered at end of life.

  These material flows are expected to become valuable commodities, which if planned for, could position South Australia as a leading renewable energy manufacturing and resource recovery hub.

CASE STUDY

Green Ceramics – The Smart Centre at UNSW

www.smart.unsw.edu.au

The Sustainable Materials Research and Technology (SMaRT) Centre developed a Green Ceramics MICROfactorie™ at UNSW. The green ceramics are manufactured using types of waste glass and textiles that are traditionally not subject to recycling, due to issues such as contamination and material complexity. Other waste streams that can be used to create these ceramics, include waste wood and plastics. The ceramics can be used as kitchen benchtops, tabletops, floor tiles and furnishings such as light fixtures, and were showcased in Mirvac's Pavilions project.

Manufacture

Manufacture durable, repairable and recyclable materials and products and transition to service-based options to maintain or increase the value of materials.

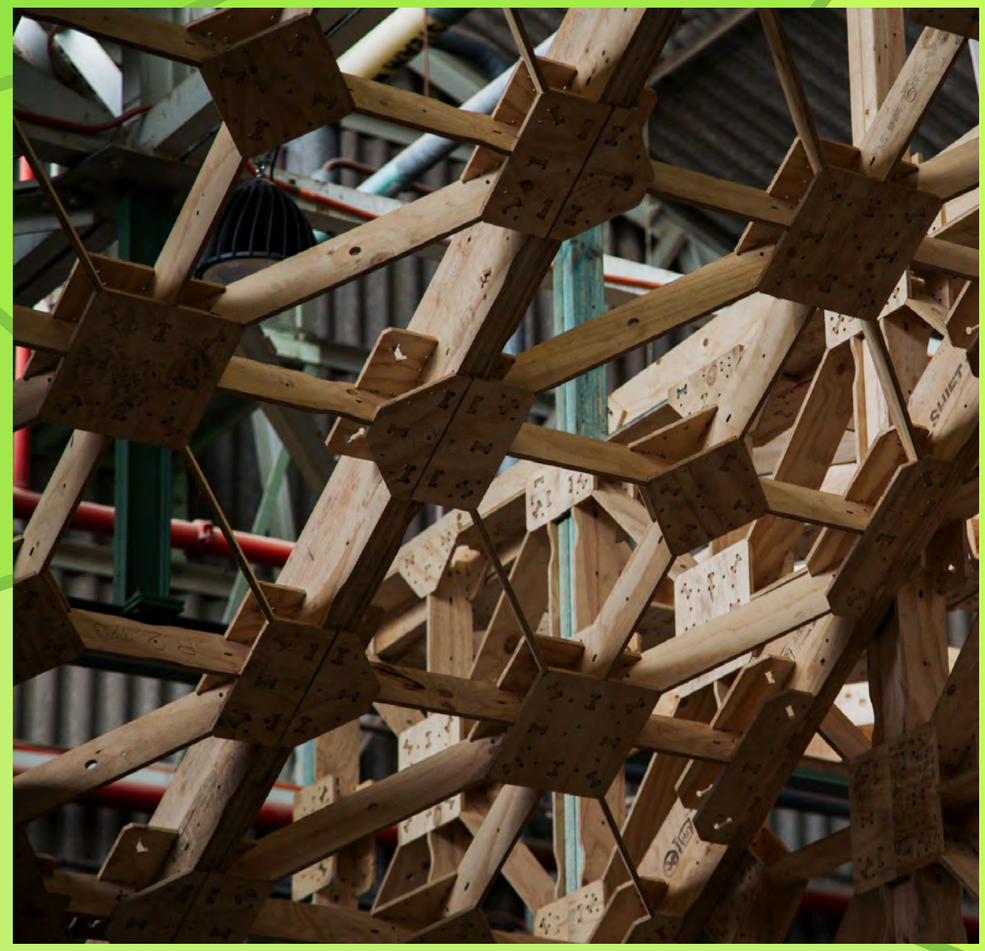
Renewable energy powered

With the South Australian electricity network decarbonising and transitioning towards 100% renewable energy generation, renewable powered buildings, industry, and manufacturing are in a unique position to lead the net zero emissions transition. This is expected to become a competitive advantage for industry and manufacturing in South Australia with both onsite renewables and offsite renewables powering low emission manufacturing.

This transition will also support improved energy sovereignty by reducing our reliance on imported sources of energy (e.g., oil and petroleum) and support the transition to low emission transport options such as EVs. However, for the competitive edge of South Australia's renewable energy to be realised, the following will be required:

- Industry and manufacturing will need to be supported to procure competitive 100% renewable electricity contracts to reduce operating costs, emissions, and exposure to volatile electricity markets.
- Innovative models for sharing renewable energy resources, such as Virtual Power Plants or Virtual Energy Networks, will need to be facilitated in the commercial and industrial sectors.
- Energy efficiency is maximised to reduce operating and manufacturing costs which will in turn support increased capabilities and support circular economy outcomes by reducing material costs.
- Shared energy and thermal networks will need to be supported in industrial and manufacturing precincts to maximise energy productivity and share resources within an industrial symbiosis model which connects material inputs and outputs from industrial processes.

CASE STUDY



XFrame

www.xframe.com.au

XFrame is a system of light-weight flexible framing parts designed to enable circular commercial fit-out solutions and modular construction framing. The system comprises 12 standard parts forming a modular braced structural matrix from precision milled engineered pine plywood components. Designed around a unique diagonal grid geometry of triangulated panels, the structure is designed for end-of-life deconstruction, reconfiguration, and reuse. XFrame's ambition is to aid the building industry to transition to a circular economy by establishing XFrame as a 'platform technology' in which supplementary technologies and systems can be developed, facilitating the recovery and reuse of almost all building layers.

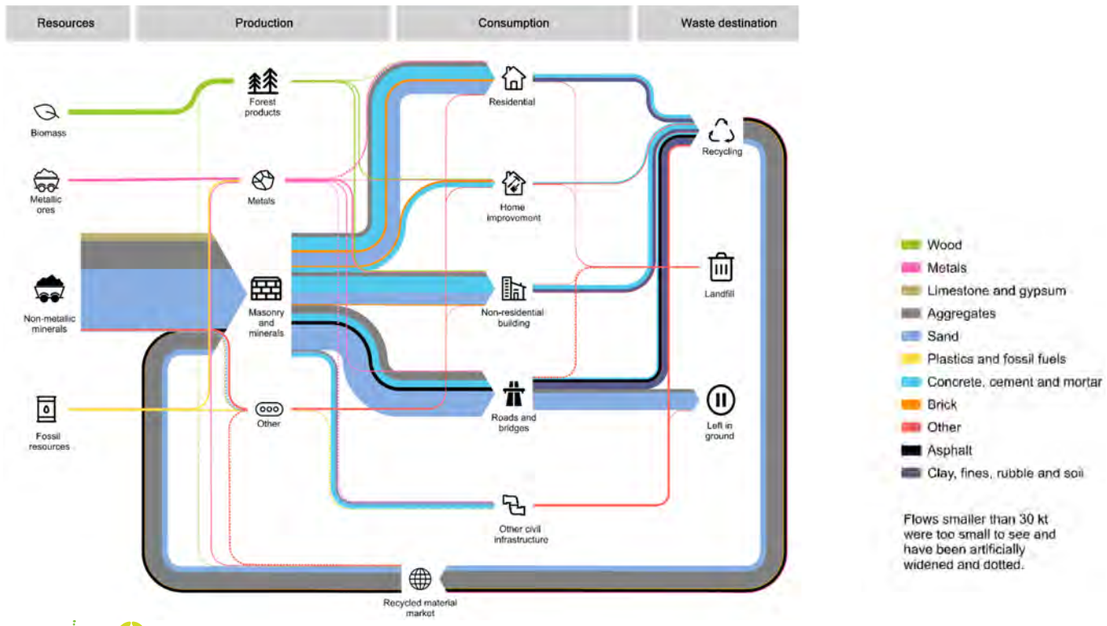
Green manufacturing & remanufacturing

To support the transition to a circular economy, the built environment will need to quickly decarbonise materials and processes and green manufacturing will play a key role. This includes:

- Continuing to undertake and refine material flow assessments with a focus on where a circular economy approach in the built environment can have the greatest impact. The below resource flow diagram (Figure 11) developed by LifeCycles on behalf of GISA is a key example of presenting material flows in a simple and easy to understand format which is expected to support industry in identifying opportunities.
- Supporting the development of local micro-factories that can capture specialised material streams and remanufacture into new materials and products to be used in the built environment.
- Undertaking more detailed material flow and industrial symbiosis studies for large industrial and manufacturing precincts to identify energy and resource sharing opportunities. It is expected that there will already be large circular economy opportunities within industrial precincts and with support from government, can be utilised to reduce costs for industry and manufacturing.
- Green hydrogen continues to be a priority for energy intensive industry and manufacturing that are unable to transition to all-electric models. Examples include incorporating green hydrogen into emissions intensive manufacturing such as cement and steel with projects such as the Hallett green cement transformation project, Holcim ECOPact low emission concrete, Whyalla green steel project[18] and the Port Pirie hydrogen hub[19] supplying the local lead smelter.
- Extending material and product lifetime through remanufacturing by disassembling, reconditioning, and replacing parts, and reassembling to be like new.
- Facilitating increased remanufacturing capacity to capture resources and increase reuse. This includes considering future industries such as EV battery recycling and refurbishment which can be used as energy storage for buildings.
- Setting minimum recycled content requirements as part of procurement processes for high embodied emission materials such as concrete and steel across industry to drive uptake and leverage collective buying power and economies of scale to kick start green manufacturing and remanufacturing in South Australia.

Figure 11: Material flows in the South Australian built environment

SOURCE: Vital South Australian material flows V1.0 EVIDENCE REPORT, Lifecycles



CASE STUDY

NeXTimber by Timberlink

www.nextimber.com.au

NeXTimber will manufacture Cross Laminated Timber (CLT) and Glue Laminated Timber (GLT) at Timberlink's Tarpeena facility in SA, from locally grown and certified (FSC and PEFC) sustainability managed plantation pine. CLT comprises alternating layers of timber laid perpendicular to each other, finger jointed with adhesive and cured under pressure. It is a highly accurate building product that can be used as roof, floor and wall structures, including lintels, in place of structural steel or concrete. Substituting these materials for a timber alternative reduces a project's embodied carbon, reduces emissions associated with overseas procurement, and will increase biogenic carbon capture in the timber.

Service-based approach

A key opportunity to facilitate a circular economy approach across all built environment stages is shifting to a service-based approach for materials, systems, and products in the built environment. In a service-based approach the manufacturer or service provider owns the assets and provides components as a service across the design, installation, maintenance, and end-of-life stages. This enables all stages of the material or product's life cycle to be managed with circular economy opportunities maximised including:

- Designing for ease of access, repair, and disassembly.
- Reducing waste by tailoring designs upfront to a service-based approach.
- Facilitating improved quality that will last longer and be easier to disassemble and recycle.
- Supporting local industries and support services by requiring a local presence.
- Increase the likelihood of materials being recovered at end of life as they are of a higher value to the manufacturer.
- Reduce upfront capital costs by shifting to operational service-based options.

Service-based models have been implemented across a number of sectors such as Mobility-as-a-Service (MaaS) models including e-bike and e-scooter hire and car share programs, Lighting-as-a-Service (LaaS), multi-function printing services, and cloud-based systems. Another example is ResourceCo that partner with large energy users to install and manage on-site alternative energy generation as a service, for example, supplying tyre derived fuels for energy generation, including supply of the fuel source and disposal.

Service-based models require a contract, similar to a Memorandum of Understanding, to be created at inception as a longer term relationship must be established between parties than with a standard purchase agreement.

Service-based opportunities in the built environment include:

- Modular buildings which are provided as part of an ongoing asset management and replacement program, with modular buildings designed for reuse, refurbishment, and disassembly.
- Heating, Ventilation and Air Conditioning (HVAC) systems where large systems can be hired or provided as a service. This enables the HVAC system to be recovered at end of life, including refrigerant gasses which can have a high Global Warming Potential (GWP) impact.
- LaaS where lighting design, installation, maintenance and recovery, reuse and recycling are undertaken by a single entity.
- Interior fit outs with partitions, cabinetry and joinery provided in a modular and flexible design which can be adapted.
- Furniture, Fixtures and Equipment (FF&E) is provided as a service such as desks, chairs, and IT equipment.

CASE STUDY

Signify Lighting

www.signify.com/global

Signify Lighting are carbon neutral in operations and offer serviceable luminaries, circular components and managed lighting or Light-as-a-Service (LaaS). Signify provide modular 3D printed customised designs, made locally on demand, reducing waste, transport, and large stock storage.

Components can also be replaced so the lifespan of the luminaire can be extended beyond the lifespan of its parts. LaaS provides design, financing, installation, maintenance, and end-of-life management as a single service to customers, which means Signify own the equipment, maintain and repair during operation, and then recover for reuse or recycling at the end of the contract.

Key actions

The following outlines the key recommended actions and stakeholders for driving a circular economy in South Australia's built environment.

Government leadership, investment & support

1. Investment & design guidelines

Action: Incorporate mandatory circular economy requirements in procurement processes for infrastructure and capital works projects. This could target major projects in the first stage (>$50M) and then a phased implementation over time. Infrastructure Sustainability (IS) and Green Star ratings should also be considered as these tools have circular economy principles, metrics and reporting embedded.

Implement design guidelines for government agencies to maximise circular economy opportunities including infrastructure, buildings, and urban design (for projects managed by Renewal SA). This can be managed in line with existing sustainability reviews and procurement processes, while implementing increased governance and oversight will ensure greater uptake of circular economy outcomes in projects.

Why: SA Government maintains and develops major public infrastructure including roads, bridges, hospitals, schools, and precincts. It can demonstrate leadership, assist industry in understanding and incorporating circular economy in project specifications, share learnings and use its significant capital investment budgets to kick start industries such as green cement, steel, and cross laminated timber. This will also provide certainty to the market that South Australia is ready for investment.

2. Legislation & regulations

Action: A review of legislative and regulatory conditions should be undertaken to identify innovative models to support circular economy outcomes. This should include:

- The *Environment Protection Act 1993* and the Environment Protection (Waste to Resources) Policy 2010, including the optimal operation of the waste levy to operate as an instrument in driving these conditions.
- The *Planning, Development and Infrastructure Act 2016* and Planning and Design Code, which although is driving efficiencies across South Australia's planning system, does not refer to a circular economy. In addition, the Development Approval process may not always support circular economy initiatives as they are often classified as landfill facilities which have stringent approvals.
- Limiting the amount of C&D waste which can be sent to alternative fuel facilities (energy from waste) and claimed as waste diversion as part of sustainability certifications and reporting.

Why: Conflicting legislation and regulations were identified by stakeholders as creating barriers to more innovative circular economy models, including land classifications and state versus local government governance and oversight.

3. First Nations peoples engagement

Action: Develop a First Nations peoples engagement plan to ensure any further development of circular economy initiatives in SA benefits from a Connection to Country approach. The engagement plan should be developed in collaboration with First Nations peoples and informed by opportunities identified in this Action Plan. First Nations stakeholders should have the opportunity to understand and be empowered to drive and contribute to circular economy opportunities in the built environment. This could be led by agencies responsible for the built environment and circular economy initiatives and all agencies should be supported in building capacity to engage and consult with First Nations peoples.

Why: First Nations peoples demonstrated successful circular economy principles for 70,000 years and there is much to be learnt from their custodianship of the land.

A Connection to Country approach and meaningful engagement will help empower First Nations peoples to drive and participate in circular economy outcomes and will support a regenerative design approach in the built environment.

4. Metrics & monitoring:

Action: A standardised set of metrics and key performance indicators should be adopted to value and track the upfront and embodied emissions in materials with circular metrics to be adopted over time. This includes aligning metrics and reporting with the NABERS Embodied Emissions rating tool to be released in 2023.

The metrics should also account for energy intensity or productivity as the electricity grid and manufacturing in South Australia decarbonises. This will ensure that industry and manufacturing continue to focus on energy performance as emissions intensity reduces. The following metrics are recommended with SA Government taking the lead on tracking outcomes as part of government projects, with support provided by universities with underpinning research.

- Waste diverted from landfill (tonnes per year / %)
- CO_2 emissions saved (kg/tonnes CO_2 per year / %)
- Material energy intensity / productivity (kWh/MJ per kg/tonnes/m^3)
- Reduced virgin materials / use of recovered materials (tonnes per year / %)
- Number of new circular economy related businesses / jobs
- Economic benefits such as increased revenue and reduced costs ($ / per year)
- Government procurement with circular economy initiatives integrated.

This action should be implemented for SA Government infrastructure and building projects initially and considered for all development as part of Action 2. Legislation and regulations.

Why: Standardised metrics and tracking will enable both government and industry to communicate outcomes in the same format and track performance. This will also reduce the likelihood of green washing and misinformation.

5. Sustainable materials database

Action: Grants and co-investment funding is provided to industry, including local suppliers, manufacturing, and businesses, to undertake LCAs, certify products with EPDs and align with GBCA's Responsible Products Framework. Data and outcomes should be collated into a publicly available online sustainable materials database for South Australian products and materials.

Why: Published local embodied emissions data allows designers, professionals, and project teams to make informed decisions when selecting products and materials for projects, allowing easy identification of low embodied emission options.

6. Sustainable homes

Action: Implement a government funded low-interest Green Loan scheme for residential home improvements. This could include development of a program for assessment and verification by qualified professionals to support applications for finance or adopting a similar program such as the ACT Government Sustainable Household Scheme. The scheme would support upgrades that improve thermal performance, energy efficiency and refurbishment activities that extend the lifespan of homes and discourage demolition.

Why: Providing an avenue to affordably renovate and improve the comfort, efficiency and liveability of houses will increase the lifespans and discourage a knock-down-and-rebuild approach, whilst also reducing operational costs and emissions, and improving health and wellbeing.

7. Design review

Action: Incorporate circular economy topics as part of Design Reviews including embodied emission reductions, reuse of materials and onsite resources, and use of locally manufactured low emission materials.

Why: The Design Review process is an effective mechanism for driving improved design outcomes in the built environment and can support designers and property developers in demonstrating leadership in circular economy outcomes.

Circular economy nucleus

Circular economy initiatives are being implemented across South Australia by government and industry, with opportunities to share knowledge and skills readily available if a centralised circular economy nucleus were created. The focus of the nucleus should be on bringing together a diverse range of stakeholders to increase knowledge and awareness of circular economy opportunities.

8. Circular built environment working group

Action: Establish a circular built environment working group of government, First Nations peoples, tertiary and industry representatives to drive innovation, share lessons learnt, and identify and overcome barriers. This could be established by SA Government with the aim of becoming self-governed and driven by industry. This could include events, site tours and an information sharing website based on examples such as ReLondon and the Holland Circular Hotspot.

Why: Knowledge sharing and collaboration was identified as a key priority during stakeholder consultation. Although there were examples of smaller groups and collaborative ventures, a centrally coordinated approach was not evident.

9. Tertiary education

Action: Integrate circular economy into tertiary education courses and programs to ensure built environment disciplines are considering circularity and embodied emissions. For example, disciplines such as architecture, engineering, project management, and construction should incorporate circular economy material and competencies.

Tertiary education providers such as universities and TAFE SA should lead this to ensure circular economy is a core part of courses and training.

This could be kick-started with SA Government incorporating preferences for this approach in government projects.

Why: Embedding circularity in early career development can support increased awareness and knowledge of opportunities and reduce barriers and misinformation.

10. Service-based approaches

Action: Industry is encouraged to integrate service-based offerings for the built environment including HVAC, lighting, and fit outs to support more diverse business models and improve revenue.

Why: Service-based approaches place a higher value on materials including repair, reuse and refurbishment and will support improved quality outcomes.

11. Construction industry

Action: Participate in, learn about, and engage with circular economy industries and disciplines and actively promote and suggest alternative approaches as part of tenders. For example, proposing low embodied emissions and responsible materials as a below the line item in tender responses and proposing streamlined or simplified construction practices to reduce material use and improve disassembly.

Construction industry and peak industry bodies and associations such as the Master Builders SA and the Housing Industry Association should be involved in this to support their members in capitalising in the circular economy transition.

Why: Embedding and proposing circular economy in projects will support improved construction outcomes while improving competitiveness and alignment with the net zero emissions transition.

12. Industry agreements

Action: Industry bodies and associations collaboratively develop circular economy transition plans and set industry wide targets for recycled content and circular economy outcomes. This could be achieved via Memorandums of Understanding (MoU) or industry agreements to share knowledge and resources, collaboratively increase local industry competitiveness and attract investment.

Peak industry bodies and associations such as the Materials and Embodied Carbon Leaders' Alliance (MECLA) could lead this approach.

Why: Industry collaboration will improve knowledge and information sharing, reduce costs associated with research and development (R&D), and increase competitive edge over interstate companies.

13. Education & awareness programs

Action: Develop an education and awareness campaign in collaboration with industry targeted at various industry and consumer groups providing information, case studies, material and supplier examples and strategies to encourage the uptake of circular economy approaches and challenge the business-as-usual way of thinking. The campaign could include a dedicated website, webinars, podcasts, in-person educational events, and tailored information targeted at the following industry and consumer groups:

- Building designers, architects, and engineering professionals
- Construction teams including contractors
- Homeowners
- Facilities Management teams/organisations
- Resource recovery and waste management
- Product suppliers and manufacturers.

This will require an across government and industry approach including SA Government and industry bodies such as GBCA, MECLA and local South Australian organisations such as the Adelaide Sustainable Building Network.

Why: Increasing awareness of circular economy approaches empowers individuals and companies to implement informed changes and creates a culture of supportive competition.

Glossary

Term	Definition
C&D Waste	Construction and demolition waste
CE	Circular economy
CO_2	Carbon dioxide as a proxy for GHG emissions
EPD	Environmental Product Declaration
GBCA	Green Building Council of Australia
GHG	Greenhouse Gas
GISA	Green Industries SA
LCA	Life Cycle Assessment
LaaS	Lighting as a Service
MaaS	Mobility as a Service
PE polymers	Pipes, drums, tanks etc
PP	Polypropylene plastic including, bags, ropes, twine, tape, carpets, upholstery, clothing and camping equipment
Scope 1, 2 and 3 emissions	Scope 1 emissions are direct GHG emissions that occur from sources that are controlled or owned by an organisation.
	Scope 2 emissions are indirect GHG emissions associated with the purchase of energy (electricity, steam, heat, or cooling).
	Scope 3 emissions are the result of activities from assets not owned or controlled by the reporting organisation, but that the organisation indirectly impacts in its value chain, including embodied carbon.

References

1. Circular economy in South Australia's built environment (greenindustries.sa.gov.au)
2. https://www.ellenmacarthurfoundation.org/circular-economy/concept
3. Government of the Netherlands www.government.nl/topics/circular-economy/from-a-linear-to-a-circular-economy
4. Cramer, J., The Raw Materials Transition in the Amsterdam Metropolitan Area: Added Value for the Economy, Well-Being and the Environment, Environment, 2017, 59, 3, 14-21, https://doi.org/10.1080/00139157.2017.1301167
5. South Australian Electricity Report 2021 (aemo.com.au)
6. South Australian Climate Change Actions (environment.sa.gov.au)
7. Department for Environment and Water - Climate science and projections
8. First Nations Entrepreneur Hub | First Nations Entrepreneur Hub (thecircle.sa.gov.au)
9. Circular Buildings Toolkit - Arup
10. A practical guide to upfront carbon - GBCA
11. ECOPact: Low carbon concrete made easy (holcim.com.au)
12. Green Cement Transformation – Hallett Group
13. Driving responsible products in the built environment
14. Stepping up the pace: Fossil free construction - Lendlease & University of Queensland
15. South Australia's Waste Strategy 2020-2025 (greenindustries.sa.gov.au)
16. Wise Office Furniture Program - Egans | Office Relocations | Sustainable Office Workstations and Furniture
17. Alternative fuels and raw materials – Adelaide Brighton Community
18. Our Whyalla Journey | GFG Alliance Whyalla
19. Trafigura Group - Port Pirie Green Hydrogen Project | Energy & Mining (energymining.sa.gov.au)

Acknowledgements

We would like to acknowledge and thank the following organisations and individuals for their contribution to the delivery of this plan.

Workshop participants and stakeholders

We would like to thank all of the participants that joined the below stakeholder engagement sessions which informed the development of this plan including SA Government agencies, local councils, industry, tertiary institutions, and the community.

- Residential workshop
- Commercial workshop
- SA Government workshop
- Local government workshop
- Industry engagement sessions

We would also like to thank the SA Government agencies and other organisations that have provided feedback and input throughout the development of this plan, including the development of case studies.

Delivery team

Green Building Council Australia

- Katy Dean, Policy Advisor
- Andrew Fischer, Head of Policy and Research
- Katherine Featherstone, Senior Manager – Products and Materials

dsquared

- Deborah Davidson, Director
- Jacob Potter, Associate
- Ashlee Duno, ESD Consultant

ASBN

- Ken Long, Chairperson
- Kerry Reed, Executive Director

Yitpi Yartapuultiku, SA.
City of Port Adelaide
Enfield. Registered for
Green Star Buildings v1.0

Green Building
Council Australia