A VISION FOR A CIRCULAR ECONOMY

Waste Strategy 2020-2025
CONSULTATION DRAFT

Government of South Australia
Green Industries SA

Published by:
Green Industries SA
GPO Box 1047, Adelaide SA 5001
Telephone (08) 8204 2051
greenindustries@sa.gov.au
www.greenindustries.sa.gov.au
ISBN: 978-1-921114-26-7

Acknowledgement of country

We acknowledge and respect the Traditional Custodians whose ancestral lands we live and work upon and we pay our respects to their Elders past and present. We acknowledge and respect their deep spiritual connection and the relationship that Aboriginal and Torres Strait Islanders people have to Country.

We also pay our respects to the cultural authority of Aboriginal and Torres Strait Islander people and their nations in South Australia, as well as those across Australia.

Contents

A message from the Minister

South Australia can be proud of its considerable achievements in the recycling and recovery of waste and for building a resilient resource recovery sector.

Our state has rightly earned a reputation as a global leader in innovative waste management and green industry development.

South Australia's Waste Strategy 2020-2025 reflects a firm ambition to create local solutions to our waste and recycling issues and to expand the sector. South Australia has an incredible opportunity to ensure the full value of our resources is unlocked while we build a stronger state economy.

Our objective is to support South Australia's growing transition to a 'circular economy' – an economy that is prosperous and regenerative by design. We are already taking steps to facilitate this shift but it will require continued effort to keep materials and resources in use, or 'circulating', for as long as possible. This is in contrast to the traditional linear economic system of 'take, make, use and dispose' that is wasteful and relies on using finite resources.

We have a vision to make South Australia a national centre-point for reuse, remanufacturing, recycling and composting. The draft Waste Strategy aims to provide the right settings to realise this.

The economic benefits achievable through the better management of resources have been demonstrated. The resource recovery industry is a significant sector of the state's economy, with an annual turnover of about $1 billion, a contribution of more than $500 million to Gross State Product (directly and indirectly), and employing about 4,800 people. The value of the resources recovered is each year is also significant: in 2017-18 this was estimated at $356 million.

We also know that for each 10,000 tonnes of waste recycled, 9.2 direct FTE jobs are created compared with 2.8 direct FTE jobs created for each 10,000 tonnes of material sent to landfill.

While the achievements of the waste and resource recovery sector are well understood, it is important to recognise the challenging times we are facing globally.

Bushfires devastated parts of South Australia including Kangaroo Island, the Adelaide Hills, the Yorke Peninsula and Keilira in the 2019-20 bushfire season. This generated significant waste debris requiring clean-up to help these communities rebuild and to minimise risks to public health and safety. This work was co-funded by the State and Australian governments and I wish to extend my sincere thank you to everyone involved in this considerable effort.

The impacts of COVID-19 are also being felt in varying ways. Some sectors are experiencing operational difficulties with services closed or reduced. For the waste industry, markets for recyclables may no longer be available or limited, and some sectors are experiencing increased demand for waste management, and others are experiencing less. Now more than ever, we need to recognise effective waste management as an essential service to all sectors of the economy and to the community. We must continue working to improve our infrastructure to ensure recovery of our resources locally to ensure continuity of these services, boost our markets for our recyclables, and work to support our community's knowledge in how they can support better recycling from their households.

The draft strategy suggests priority actions that will guide activity over five years and provide a resilient framework for us to manage our waste, even during uncertain and challenging times. We want to see these actions build on the resilience and capabilities of our local industry through strategic infrastructure investment, market development, education, and innovation that will boost resource efficiency and create business opportunities locally, around Australia and overseas.

These efforts must be underpinned by strong, coordinated leadership and action at the national and global levels to support market development, investment and policy directions.

I am excited by the opportunities that exist to facilitate a circular economy. However, it is a complex task requiring some shifts in the way we make and use goods in our economy. The inspired support and action of business, industry, the community and all levels of government will be needed to achieve long-term change. I thank everyone involved in developing the strategy and look forward to its implementation as the foundation of our 'circular' future.

DAVID SPEIRS MP
Minister for Environment and Water

A message from the Presiding Member

Within South Australia, we have the ability to seize significant environmental and economic opportunities associated with moving to a circular economy.

We can be proud of the state's achievements in waste management: we are diverting more than 80% of all waste generated from landfill disposal to better purposes through recycling (Rawtec, 2019). This has been underpinned by the delivery of three consecutive waste strategies spanning 2005 to 2020 and the efforts of all South Australians.

However, it is clear that there remains untapped potential in ensuring our resources circulate more within the local economy.

Along with the rest of Australia and many other countries around the world, South Australia's albeit limited reliance on overseas markets to buy our recyclables makes us vulnerable when those markets are no longer accessible through price drops or trade policy changes. This vulnerability has been heightened in response to the COVID-19 pandemic with many production and supply chains impacted and markets disrupted globally. We are however, also observing positive shifts in behaviour with many sectors adopting new business models to adapt and respond.

Our pressing and ongoing challenge is to ensure our resources circulate more within the local economy by encouraging innovation and best practice in resource recovery, and remanufacturing.

The draft 'South Australia's Waste Strategy 2020-2025' suggests a vision for a circular economy. It aims to continue our efforts to achieve environmental gains while creating jobs and boosting the South Australian economy.

It provides a foundation from which to continue work towards a circular economy, realising the economic potential from innovation. It recommends exploring new directions in food waste and single-use plastics, regulatory waste reforms, education and behaviour change, and, importantly, supporting market development in remanufacturing.

Ultimately, our aim is to help South Australian businesses become more resource efficient, resilient and competitive, which will secure economic advantage while protecting the environment.

Central to these opportunities will be continued support of and collaboration between governments, research and education institutions, industry and business within South Australia, nationally and internationally.

I wish to acknowledge everyone who has helped position South Australia as a leader in resource recovery and pursuing opportunities for a circular economy, and look forward to reviewing your comments and submissions on this draft strategy.

I wish to also acknowledge the remarkable effort undertaken to support the clean-up response following the 2019-20 bushfires experienced in parts of South Australia. The response has demonstrated the extraordinary capacity of individuals, organisations and communities to respond together under challenging conditions and I thank everyone who has been involved.

Kevin McGuinness
Presiding Member, Board of Green Industries SA

Invitation to comment

What is being decided?

The South Australian Government is seeking feedback on the *Evaluation of South Australia's Waste Strategy 2015-2020 and Draft South Australia's Waste Strategy 2020-2025: A Vision for a Circular Economy* (draft Waste Strategy).

The government has a statutory requirement to develop a waste strategy for South Australia. Section 18 (4) of the *Green Industries SA Act 2004* requires Green Industries SA to gather views and submissions and to take these into consideration before developing and adopting a waste strategy for South Australia.

Comments from state and local government agencies, waste management industry, businesses and the community will help Green Industries SA develop the waste strategy and guide the management of waste in South Australia. Receipt of submissions will be acknowledged by Green Industries SA. Key themes identified from the submissions will be summarised in a publicly available document, along with how input will be considered in finalising the strategy. The final South Australia's Waste Strategy 2020-2025 will be subject to professional design before its release.

Become involved

Comments may be provided in writing to:

Green Industries SA

GPO Box 1047

Adelaide SA 5001

or by email to greenindustries@sa.gov.au

Telephone: (08) 8204 2051

Please include your name, position, organisation and contact details with your submission.

The deadline for comments and submissions is 5pm, Friday, 28 August 2020

Important information about your submission

Submissions will be treated as public documents unless received in confidence subject to the requirements of the *Freedom of Information Act 1991*. They may be quoted in full or part in subsequent Green Industries SA reports. If you do not want the public to read your answers, please write 'confidential' on your submission.

You can make an important contribution by suggesting an alternative or more appropriate approaches to any of the initiatives discussed.

Tips for written submissions

- You may agree or disagree with, or comment on, the general issues discussed or the specific strategies or steps proposed.
- Provide reasons for your comments, supported by relevant data, and attach factual information and sources.
- List points so that issues raised are clear.
- Include a summary of your submission.
- If possible, refer each point to the appropriate section in the document.
- Keep your discussion of different sections of the document distinct and separate.

Questions we would like you to consider

General

To guide the direction of the draft Waste Strategy, we invite your feedback in response to the following questions.

Q1. Are our priorities correct? Why or why not?

Q2. What have we overlooked or needs clarifying or expanding upon?

Q3. Are there any unintended consequences of anything proposed? If so, what are they?

Q4. Can you offer alternative suggestions or solutions to those offered?

Q5. How can you support, participate or work with us in implementing the final strategy?

Stakeholder responses

In addition to the general questions, we invite you to provide additional information and ideas about your objectives, vision and expectations for waste and recycling by 2025, and for establishing a circular economy in South Australia, by responding to the following questions.

Questions for all stakeholders regarding COVID-19	**Q6 What actions or priorities should South Australia's waste strategy and future waste strategies include to respond to state and national emergencies, and global disruptions such as we have experienced with the bushfires and global COVID-19 pandemic?**
Community and householders	**Q7. What are the most important issues to you in relation to waste and recycling?** **Q8. Can you offer any ideas for how waste and recycling services could be improved in South Australia?** *You may wish to consider issues such as labelling recyclable products, billing of waste services according to services provided, transparency in councils' waste management costs, accessibility of bins and food caddies to help recycle your household waste, and 'closing the loop' on products entering the recycling stream by generating demand for recycled products.*

Government, business and industry	*Waste and recycling sector* **Q9. What would you like the waste and recycling industry to have achieved?** **Q10. What would you like your organisation to have achieved in waste management, recycling and the circular economy?** **Q11. What would need to change to achieve your objectives and what support would you need?** *You may wish to consider:* *Q9 and Q10 - Objectives in terms of job creation, investment, innovation and commercialisation, increasing export potential, research and development, regulation and certainty for investment, ensuring the beneficial use of recyclable materials, general barriers to your business.* *Q11 - Support in terms of investment, research and development, data and evidence collection, commercialisation and innovation, regulation, collaboration.* *Businesses, industry groups, not-for-profit groups and State Government* **Q12. As a business, what are the most important issues to you in terms of waste and recycling?** **Q13. What do you need to achieve better recycling outcomes from your business?** **Q14. How could you procure more recycled content materials or manufacture recycled content products?** **Q15. Do you have any ideas or solutions for improving markets for recycled-content materials or the manufacture of these products? For example, in accessing finance, product standards and specifications, or in improving market acceptance?** **Q16. Do you have any ideas or solutions for how your organisation can support South Australia's transition to a circular economy, including in product design?** *You may wish to consider:* *Q12 and Q13. Support for contracting waste and recycling services, accessibility of waste and recycling infrastructure, education materials to support recycling behaviours within businesses, labelling of recyclable products, transparency in waste management costs, general barriers to adopting better practice recycling behaviours.* *Q14 and Q15. Your organisation's views on the procurement of recycled content materials and opportunities or general barriers for business and industry.* *Q16. Innovative ideas to help the state's transition to a circular economy are welcome, including your own examples.*
Local government	**Q17. What would you like local government to have achieved in waste management, resource recovery and the circular economy?** **Q18. What would you like your organisation to have achieved in waste management, recycling and the circular economy?** **Q19. What do you see as essential in the provision of waste and recycling services to households?** **Q20. What do you see as potential barriers for encouraging further diversion of waste away from landfill?**

	Q21. What do you expect from waste management contracts? What are the key criteria used by council in awarding these contracts? *You may wish to consider issues such as bin infrastructure, including food caddies; frequency of collections; hard waste collections; education to support behaviour change in councils; contracting requirements or specifications for waste management and recycling services; support in data collection and transparency in disclosing information; support for Infrastructure (including soft infrastructure) and for educating households; consistency across local government areas; encouraging local processing; end markets for materials collected; costs and environmental benefits and whether these are taken into account when awarding contracts.*

Purpose

The success of the next waste strategy relies on an understanding of what has been achieved since 2004. This document:

1. Evaluates progress and achievements in meeting South Australia's Waste Strategy 2015-2020. This is reflected in **Part 1**.
2. Identifies proposed directions for *South Australia's Waste Strategy 2020-2025*. This is reflected in **Part 2**.

Under the custodianship of Green Industries SA, the 'South Australia's Waste Strategy 2020-2025' will form a framework of policies, strategies and plans meeting South Australia's priorities for economic growth and employing more people, investment, reducing the cost of living, and providing better services to the community[1].

About Green Industries SA

Green Industries SA is an enabler and driver of change, supporting the development of the circular economy through diverse collaborations which improve productivity, resilience, resource efficiency and the environment.

It aims to transform how South Australians use and value resources. Its objectives under the *Green Industries SA Act 2004* are to:

- promote waste management practices that, as far as possible, eliminate waste or its consignment to landfill; and
- promote innovation and business activity in the waste management, resource recovery and green industry sectors, recognising these areas present valuable opportunities to contribute to the state's economic growth.

Green Industries SA has overseen implementation of *South Australia's Waste Strategy 2015-2020*, recognising the important economic contribution and role of the waste management and resource recovery sector.

Green Industries SA is funded from the solid waste component of the waste depot levy, collected under the Fees and Levies regulations of the *Environment Protection Act 1993*. Fifty per cent of the levy is transferred to the Green Industry Fund and Green Industries SA uses a proportion of that fund as provided for in the *Green Industries SA Act 2004*. Additional funds are allocated through the State Government's budget process.

"*South Australia's Waste Strategy 2020-2025* will form a framework of policies, strategies and plans meeting **South Australia's priorities** for **economic growth** and **employing more people**, **investment, reducing cost of living,** and **providing better services to the community.**"

[1] Premier of South Australia, Message from the Premier https://premier.sa.gov.au/message-from-the-premier

PART 1

Evaluation of *South Australia's Waste Strategy 2015-2020*

South Australia: a waste management journey

Green Industries SA has invested more than $120 million from waste levy funds into the waste management and resource recovery industry over more than a decade. This has contributed to increased capacity and improved markets, and assisted the development of new products and skills. It has leveraged considerable investment by industry and local government.

The industry is a significant part of the South Australian economy. The state diverts more than 80% of the waste it generates (Rawtec, 2019) and its resource recovery industry has an annual turnover of around $1 billion, contributing more than $500 million to Gross State Product (directly and indirectly) and employing about 4,800 people (Resources and Waste Advisory Group, 2014).

The value of the resources recovered each year is also significant: in 2017-18 it was estimated to be $356 million (Rawtec, 2019).

In 2016, Green Industries SA examined the potential benefits of a circular economy for South Australia (Green Industries SA, 2017b). The review confirmed the state's achievements in resource recovery and highlighted the broader opportunities in employment, the economy and environmental benefits associated with moving to a circular economy. The benefits of a circular economy for South Australia by 2030 are discussed in this document, including progress to date that has supported the transition (from page 17).

The state's waste management journey began with legislative and policy actions in the 1970s that paved the way for ongoing action and reform.

A snapshot of South Australia's key waste achievements is shown in **Figure 1** overleaf.

1977-2004

- *Container deposit scheme introduced 1977* – Australia's first extended producer responsibility legislation
- *Waste Management Commission Act 1979*
- *Waste Management Act 1987*
- *Environment Protection Act 1993*
- *Solid waste levy introduced*
- Interim Office of Zero Waste SA established July 2003
- Data collection: litter surveys and recycling activity surveys commenced
- State-wide resource recovery rate at 61.5% in 2003-04

2004

- *Zero Waste SA Act 2004* enacted
- Waste hierarchy legislated as a guiding principle for waste management in South Australia
- Closure of Adelaide City Council's Wingfield Waste Depot

2005-2010

Waste Strategy 2005-2010

- Increase in recovered materials state-wide from 67.4% in 2005-06 to 72.7% in 2009-10
- Introduced policy position: no new landfills servicing metropolitan Adelaide
- *Environmental management of landfill facilities* guidelines commenced (2007) leading to landfill closure and consolidation to support higher environmental standards
- Local council three-bin systems roll-out, achieving source separation in all 19 metropolitan and some regional councils
- Food waste pilots introduced in councils
- Investment in recycling and reprocessing infrastructure, and regional and remote waste planning
- Economic cost benefit analysis: initiatives during 2005-2010 assessed as delivering a net benefit for SA
- Plastic bag ban took effect 2009 under the *Plastic Shopping Bags (Waste Avoidance) Act 2008*
- *Environment Protection (Waste to Resources) Policy 2010* (Waste to Resources EPP) introduced, prohibiting disposal of certain waste to landfill and enabling the EPA to publish standards to declare certain material not to be waste
- Electronic waste collection and product stewardship advocacy
- Data collection and knowledge management: Zero Waste SA Environmental User System established

2011-2015

Waste Strategy 2011-2015

- Increase in recovered materials state-wide from 72.7% in 2009-10 to 80% in 2014-15
- Resource recovery processing requirements and landfill bans take effect under the Waste to Resources EPP
- Renewed focus on *avoiding and reducing the amount of overall waste* and *maximising the useful life of materials by making them last longer through reuse and recycling*
- Cost benefit analysis undertaken of waste infrastructure investments: funded projects found to improve industry competitiveness achieved ratios of 6.7, and for infrastructure investment, between 1.4 and 11.5.
- Interventions in:
  - community information and awareness through *Recycle Right*
  - business resource efficiency assistance
  - better practice waste management for residential and mixed use developments
  - University of South Australia Zero Waste SA Centre for Sustainable Design established

2015-2020

Waste Strategy 2015-2020

- Increase in recovered materials from 80% in 2014-15 to more than 83% in 2017-18
- *Green Industries SA Act 2004* introduced in 2017 with circular economy as a guiding principle
- Potential benefits of a circular economy report prepared in 2017
- Waste infrastructure planning and investment and focus on materials affected by global policy changes for recyclable materials
- Development of hazardous waste permanent facilities
- *Reforming waste management – creating certainty for industry to grow (2015)* discussion paper released providing guidance for EPA waste reform initiatives
- *Environment Protection (Waste Reform) Amendment Act 2017* commenced
- Draft 'Energy from Waste' position statement published
- Commercialising innovation support
- Seventh Regional UNCRD 3R Forum in Asia and the Pacific held in Adelaide, 2016
- Delivery of Circular Economy Global Leadership programs.
- Direction on single-use plastics management and food waste
- Which Bin household recycling education campaign launch 2019
- Disaster waste-recovery planning and activation of GISA's role as functional lead for Disaster Waste Management under the State Emergency Management Plan in response to South Australia's 2019-20 bushfires.
- COVID-19 outbreak declared a global pandemic impacting on waste management needs and delivery of essential services.

Figure 1 – South Australia's key waste achievements – a snapshot

Policy settings and economic modelling

The circular economy has become a prominent focus for Green Industries SA over the course of *South Australia's Waste Strategy 2015-2020*. Some of the work undertaken during this period is outlined below.

Policy settings

In 2016, the *Green Industries SA Act 2004* took effect. The Act incorporated the concept of circular economy as a guiding principle, stating that:

'circular economy is a reference to an economic model that contemplates the production of goods and services—

(i) by a reduced reliance on virgin materials; and

(ii) on the basis of continuously functioning utility and an extended lifecycle; and

(iii) in a manner that eliminates, as far as is reasonably practicable, waste or pollution, or harm to the environment'.

Economic modelling

In 2017, Green Industries SA – in a joint venture with EconSearch, Colby Industries and the University of Queensland – commissioned Lifecycles to investigate the potential benefits of a circular economy in South Australia. The report, *Creating Value, the Potential Benefits of a Circular Economy in South Australia* (Green Industries SA, 2017b), measured the possible impacts of a circular economy in the state.

The report confirmed South Australia's achievements in recycling and resource recovery. It provided examples of South Australian firms setting the pace, and forecast gains to be achieved in local job creation and reductions in greenhouse gas emissions by 2030.

The report used recognised macro-economic modelling to depict the interdependencies between 78 sectors, showing how input from one sector may become an input to another. Assumptions and modelling techniques were reviewed by an international panel of circular economy experts.

To quantify the greenhouse gas emissions and employment impacts of moving to a more circular economy, assumptions were made relating to 'material efficiency' and 'renewable and energy efficiency' aspects. These assumptions involved how long materials stay in use in South Australia, energy efficiency levels, and the replacement of fossil fuel by renewable energy. For interpretation, results referenced a 'Business as Usual' scenario that assumed current state growth projections to 2030.

The benefits of a circular economy are shown overleaf in **Figure 2**.

By 2030, a **circular economy** could deliver significant ***job creation*** and ***greenhouse gas reduction*** benefits:

✓ **CREATE AN ADDITIONAL 25,700 FULL-TIME EQUIVALENT JOBS**

- 21,000 jobs by actioning material efficiency gains
- 4,700 jobs by actioning efficient and renewable energy gains

✓ **REDUCE SOUTH AUSTRALIA'S GREENHOUSE GAS (GHG) EMISSIONS BY 27%**

(Or 7.7 million tonnes of carbon dioxide (Co2) equivalent)

- 21% GHG reduction by actioning efficient and renewable energy gains
- 6% GHG reduction by actioning material efficiency gains

Source: Creating Value, the Potential Benefits of a Circular Economy in South Australia

Figure 2 – Identified benefits of a circular economy for South Australia

International leadership

Green Industries SA acknowledges recent international moves in the direction of sustainable development and the circular economy, which have been vital to understanding opportunities for South Australia.

International work that has provided the foundation for South Australia's direction in these areas includes:

- the United Nations Sustainable Development Goals (United Nations, 2015)
- the Ellen MacArthur Foundation knowledge and resources, for example:
  - *Towards the Circular Economy. Economic and business rationale for an accelerated transition* (2013).
  - *Circularity Indicators. An Approach to Measuring Circularity* (2015)
  - *The New Plastics Economy: Rethinking the future of plastics* (2016)
  - *A new textiles economy: Redesigning fashion's future* (2017)
- the European Commission's Circular Economy package (2015)
- *Wales and the Circular Economy. Favourable system conditions and economic opportunities* (2013)
- China's progress, including the *China Circular Economy Promotion Law (2009)* and its national strategy for achieving a Circular Economy (2015) (summarised at: Ellen MacArthur Foundation, 2018)
- Scotland's circular economy strategy *Making Things Last* (2016) and *A Manufacturing Future for Scotland - Scotland's Manufacturing Action Plan* (2016)
- *A Circular Economy in the Netherlands by 2050* (2016)
- Japan's *Basic Act on Establishing a Sound Material-Cycle Society* (2000) and its *4th Fundamental Plan for Establishing a Sound Material-Cycle Society* (2018).
- the Flanders' Materials Programme (2011), which supports a holistic approach to sustainable materials management within the economy.

Many of these documents outline similar findings to that estimated in South Australia's 'Creating Value' report. Wales, Scotland and the European Commission, for example, confirm the opportunities the circular economy provides. Major global businesses such as Google, Unilever, Nike, Cisco and Renault are investing heavily in the circular economy, with their actions having the capacity to influence supply chains worldwide[2]. Significantly, the World Resources Forum Asia Pacific held in Sydney in 2016 estimated the value of a circular economy to Australia at A$26 billion a year by 2025 (Florin, et al, 2015).

[2] Refer: https://www.ellenmacarthurfoundation.org/our-story/partners

Progress in work during 2015-2020 to support a transition to a circular economy

Building a circular economy will require long-term structural adjustments in areas including infrastructure investment, planning, and policy interventions and advocacy. It is recognised that South Australia is already taking steps to lead the nation with initiatives such as container deposit legislation, bans on single-use plastic bags, high-performance kerbside waste collection and recycling systems, wastewater reuse and recycling, industrial resource efficiency, the collection of hazardous waste, wind and solar energy development, and stormwater harvesting. Below are other steps South Australia is taking to lead circular economy initiatives.

Area	Actions
Waste infrastructure planning	Green Industries SA's 2018 *South Australia's Waste and Resource Recovery Infrastructure Plan* provides an understanding of the integrated waste and resource recovery infrastructure system (incorporating infrastructure, skills and capabilities) needed to support a circular economy. The plan models projections for waste generation, recovery and landfilling, potential infrastructure needs and associated investment over the next 30 years, with an immediate focus on the next 10 years. It recognises that waste and resource recovery infrastructure needs will be affected by interrelated factors including waste generation volumes, levels of resource recovery, government policy, technological advances, business expectations and community expectations and lifestyles.
Infrastructure investment	Throughout the term of the 2015-2020 Waste Strategy, continued investment in resource recovery infrastructure is enabling South Australia to deal with its waste locally and, more critically, respond to the impacts of global policy changes affecting commodity prices for recycled materials. Benefits resulting from infrastructure investment include avoided landfill costs; reduced use of virgin materials, energy and water; decreases in greenhouse gas emissions; and economic development. Support has included an infrastructure investment loan scheme, recycling infrastructure grants, transport subsidies to regional South Australian councils, circular economy market development grants, and a new recycling education program.
Shared spaces infrastructure	Green Industries SA has funded the development of shared fabrication spaces, which are open access workshops that address activities in the upper sections of the internationally accepted waste management hierarchy: avoid, reduce, and reuse. Funding has been provided to support the Mount Pleasant Men's Shed project ($29,000) and the SA Makers ($300,000) to establish a shared fabrication space in the Adelaide CBD. The Adelaide Maker Space offers a pre-incubation space where community innovators can bring together ideas, learn, explore, educate, communicate and fabricate, while fostering a culture of social and environmental entrepreneurship. Open access workshops involve 3D printing, laser cutting and digital fabrication equipment.

Area	Actions
	These spaces promote a shift in the materials life-cycle towards a circular economy through innovative approaches that deliver economic, environmental and social benefits.
Commercialising innovation	Investment in the rapid commercialisation of innovative ideas in the waste and resource recovery sector is essential to keep South Australia at the forefront of green innovation. In 2017, following a competitive tender process, Green Industries SA provided a loan of $750,000 over five years to Innovyz Institute Pty Ltd (Innovyz), a South Australian company that commercialises research and related innovations. Together with Green Industries SA, it had identified the waste and recycling sectors and related areas as key areas for new technologies and systems with global relevance that could generate economic growth in South Australia. Through its unique fast-tracked business development program, Innovyz has helped eight technologies reach the start-up phase. The innovations and technologies include wastewater filtration systems, software relating to the recyclability of packaging, wetlands treatment, infrared monitoring technology for irrigation, recycling of solid waste materials that were previously consigned to landfill disposal, PVC and other plastics recycling, improvements to recycled concrete, and agricultural wastes management. Following the success of the first commercialisation of innovation program, Innovyz will complete the delivery of a second program focusing on the recycling, resource recovery and the circular economy during 2019-20. More information is available on Innovyz's website: www.innovyz.com/waste-recycling-companies.
Global Leadership Program on the Circular Economy	South Australia has the potential to be the pre-eminent training destination for overseas governments looking to manage their waste. Business opportunities are presenting as communities seek solutions to problems relating to traditional activities such as construction and demolition, as well as growth in new waste streams such as electronic waste, plastics, packaging and tyres. Many businesses in areas such as landfill and landfill gas extraction, and energy production to composting and consulting services, are yet to realise their export potential. Many are small family businesses. Green Industries SA's pilot Global Leadership Program was launched at the Eighth Regional 3R Forum in Asia and Pacific, Indore, India in April 2018. It targets and facilitates business-to-business introductions with representatives and experts from leading companies and organisations from the Asia Pacific region. Participants hear presentations from experts and visited South Australian businesses and enable connections between participants and South Australian businesses and organisations that host site visits.

Area	Actions
Circular economy case studies	Green Industries SA has developed sector-specific case studies to demonstrate the value of the circular economy. One showcases the work of Holla-Fresh, a herb producer based in Tantanoola, through a two-part video series[3]. Holla-Fresh worked with Green Industries SA to source a replacement of an ageing boiler used to heat its glasshouses. A renewable energy pyrolysis unit was installed, resulting in benefits including the use of low-carbon/carbon sink technology, low cost and 'clean' onsite renewable energy, developing the regional bioeconomy through secondary output of biochar (which is used by local composting business Bio Gro), and the potential for increased herb growth through carbon dioxide enrichment from the pyrolysis unit. The videos showcase a practical example of the circular economy and educate businesses and industry on the economic benefits of a circular economy.
Market development	The Green Industries SA Market Development Grants Program is supporting local businesses and stimulating an increase in the quality and market demand for recyclable materials and recycled content products. The South Australian Sustainable Procurement Working Group is maximising collaboration between all levels of government, the business community and the waste sector to develop a framework to drive end-market development for post-consumer recyclables.
Disaster waste-recovery planning	Green Industries SA has received Natural Disaster Resilience Program funding for its Australian-first disaster waste management planning. Through a public tender process, a consortium of local and international experts led by a South Australian company, Rawtec, was commissioned in 2017 to develop a Disaster Waste Management Capability Plan and Guidelines. The plan clarifies roles and responsibilities for disaster waste management in the state and provides a framework for the State Government to provide advisory and operational support to affected communities. In July 2018, the State Emergency Management Committee endorsed the plan and guideline, which now form part of the State's Emergency Management Plan. Green Industries SA is the Functional Lead for Disaster Waste Management for the state. In January 2020, the government activated Green Industries SA's role as functional lead and GISA commenced implementing the plan in the response to the 2019-20 bushfires experienced on Kangaroo Island, and in the Adelaide Hills, the Yorke Peninsula and Keilira. The learnings and experience gained through implementing the plan will inform further updates required for the Disaster Waste Management Capability Plan and Guidelines.

[3] Refer: https://www.youtube.com/user/ZeroWasteSA

Area	Actions
Circular Economy Business Support Program	The Circular Economy Business Support Program helps businesses understand how they might support South Australia's transition towards a circular economy, building capacity, boosting productivity, and developing business cases for sustainable change. Target organisations include South Australian businesses, industry associations, business networks and regional business groups. In-house support is provided for commercially-focused projects that will to lead to environmental improvements. Financial assistance is available to individual businesses and industry groups requiring specialist expertise in resource efficiency (materials, energy and water), waste management and lean production. The services and grants offered through the program have been developed following consultation with other government agencies, key industry sector groups and previous clients. Key elements include: • support to understand the potential for cost savings, productivity improvements and improved environmental performance through resource efficiency (materials, energy, water), waste management, and lean production • grants for individual businesses to engage third-party technical advisers for resource efficiency and productivity assessments to identify and prioritise opportunities for improvements • additional financial support for selected implementation activities. Projects during 2015-2020 include: • partnering with Aged and Community Services Australia (ACSA) to develop the Better Practice Guide for Waste and Recycling in Aged Care Facilities, and supporting its implementation through workshops and on-site support to a range of aged care providers • partnering with Caravan Parks Association of SA to deliver a sustainability program that will provide waste, energy and water assessments for up to 16 caravan parks across South Australia • partnering with the South Australian Wine Industry Association (SAWIA) to deliver the SA Wine Industry Lean Production Program that identified more than $11 million in potential savings across 18 wineries, and delivered workshops and tools to support the uptake of lean production practices in the wineries • supporting research on energy tariff structures and energy demand management strategies for the South Australian wine industry, combined with extension seminars and site investigations to actively investigate energy demand management strategies at four wineries

Area	Actions
	• partnering with Business SA to run an Untapped Power Masterclass Program that attracted four large business participants, with attendees developing a greater understanding of their opportunities to improve energy management • supporting Adelaide Airport to compare costs and savings for food service tenants to convert to compostable food service ware, and to develop waste management plans for tenants • support to identify, prioritise and fast track improvements in waste management and resource efficiency for businesses in the manufacturing, food and beverage production, retail, and education sectors • developing a case study for Premier Insulation, showcasing an innovative approach to diverting construction waste away from landfill • developing and publishing case studies that showcase leaders in lean production, waste management and resource efficiency.
Single-use plastics management	In June 2019, the South Australian Government announced its approach to addressing the impacts of single-use plastic products. This followed feedback on the 'Turning the tide on single-use plastic products' discussion paper released in early 2019. The paper received an overwhelming response from the South Australian community, with 3,564 public responses and 68 written submissions in the six-week consultation period. Respondents were strongly supportive of increased measures to address single-use plastic products and indicated widespread support for government intervention. A report summarising feedback is available on the YourSay and Green Industries SA websites. The Single-use and Other Plastic Products (Waste Avoidance) Bill 2020 was introduced to Parliament on 30 April 2020 to implement the government's commitment to address the impacts of single-use plastic products. It prohibits the sale, supply and distribution of certain single-use plastic products and establishes a framework for adding other products in the future. In addition to the advice and opinions of a key stakeholder taskforce established to guide development of the legislation it was also released for public consultation in late 2019 to early 2020. The views of the taskforce and issues raised in public submission assisted in finalising its introduction to Parliament.
***Which Bin?* community campaign**	The *Which Bin* campaign was launched in May 2019 to provide cohesive, best-practice advice to South Australian households, including recycling tips and behaviours. It formed part of the government's China National Sword support package, with the aims of reducing contamination in kerbside recycling bins and improving the quality of recyclable materials. The campaign features a 'modern family' that deals with everyday recycling dilemmas. Green Industries SA established a working group of State Government, industry, local government and other stakeholders to inform the campaign's messages. The campaign uses television, print, outdoor and digital advertising to increase awareness of 'which bin' materials should be placed in. A

Area	Actions
	Which Bin website (whichbin.sa.gov.au) and a telephone hotline provide more information. To complement the campaign, Green Industries SA is developing a suite of resources for local government to adopt the *Which Bin* brand, including branded 'waste collection' calendars, bin stickers, signage, posters and customisable social media assets.
Hazardous waste permanent facilities	In 2018-19, Green Industries SA designed, planned and commenced construction of four facilities across metropolitan Adelaide for the disposal of household chemicals and paint. Hosted by local government organisations, the facilities are expanding the availability of free, responsible and safe collection and disposal service for unwanted chemicals. Four sites permanent sites have been established at Edinburgh North, Campbelltown, North Plympton and the Heathfield resource recovery facility hosted by the Adelaide Hills Council.
EPA waste reforms	Through its compliance efforts and reform processes, the EPA is working to establish a robust regulatory environment to support the sustainable operation of the waste and resource recovery industry by: • minimising the risk of environmental harm occurring • supporting the safe available use of secondary materials in accordance with the waste management hierarchy and circular economy principles • providing certainty and fairness for lawful operators, and promoting investment, innovation and sector growth • halting illegal operators • ensuring accurate payment of the waste levy. The EPA is pursuing an extensive waste reform program to achieve sound regulation that supports fair and equitable competition, stability, growth and innovation in the sector. It has undertaken extensive consultation with key stakeholders, in particular through: • a Waste Summit in 2015 convened to provide an update on the state of the waste and resource recovery industry and allow discussion on key issues • the release of a *Reforming waste management – creating certainty for an industry to grow* discussion paper in 2015, seeking views on a broad mix of potential reform mechanisms • stakeholder workshops conducted on a range of reforms at the 2016 Waste SA Conference

Area	Actions
	• ongoing engagement with industry stakeholders through regular meetings of the EPA Chief Executive's Waste Reform High-Level Advisory Group and the complementary Waste Industry Reference Group. **Environment Protection (Waste Reform) Amendment Act 2017** The *Environment Protection (Waste Reform) Amendment Act 2017* (Waste Reform Act) commenced in November 2017, amending the *Environment Protection Act 1993* to better support a strong resource recovery sector. The changes modernised the Act to incorporate into the Act's Objects the waste management hierarchy, circulation of materials, and a strong market for recovered resources. Amendments also strengthened the EPA's ability to prosecute illegal dumping cases, regulate excessive stockpiling of materials, and require financial assurances where there is potential for abandonment of materials. The EPA is continuing to develop detailed policies to support these powers. **Development of policy guidance for Energy from Waste facilities** The *South Australia's Waste Strategy 2015-2020* identified that the EPA should enhance the clarity of the regulatory framework relating to energy from waste and develop relevant assessment criteria to better support industry investment decisions. Following stakeholder consultation, the EPA developed a draft position statement for thermal energy from waste activities, setting out the policy framework and environmental assessment criteria and describing how these activities are to be sited, designed, and operated to ensure that they meet all requirements. The position statement also seeks to ensure that waste reduction and recycling are prioritised above energy from waste, consistent with the waste hierarchy and recommendations of the Commonwealth Senate inquiry into waste and recycling. Submissions received on the draft position statement will inform a final position for release in 2019-20. **Mass balance reporting** Mass balance reporting will require certain licensed waste facilities – including transfer stations, resource recovery facilities and waste disposal depots – to report on the monthly tonnages of materials that a site receives, stockpiles, uses onsite or transfers from the site for sale or disposal.

Area	Actions
	Feedback from stakeholder consultation of a proposed system, and information from a voluntary pilot program, are being used to finalise system design and necessary legislative amendments. Mass balance reporting will provide vital information about material movements in South Australia to aid in regulation and strategic decision making under 'South Australia's Waste Strategy 2020-2025'. **Introduction of an amended manner of collection of levy at landfills** Existing waste levy regulations do not explicitly explain resource recovery processing and the onsite use of such materials at landfill sites, or how waste levy should be collected in such circumstances. The lack of clarity provides opportunities for operators to avoid payment of the levy and possibly achieve an unfair competitive advantage. The EPA is seeking to make legislative amendments to ensure the levy continues to drive positive resource recovery outcomes and support a level playing field for industry. The EPA will consult in relation to this matter during 2019-20.

Progress in meeting 2015-2020 goals and targets

The goals and targets of *South Australia's Waste Strategy 2015-2020* were set at realistic but challenging levels. South Australia's progress in meeting them is set out in Table 1 below (overall landfill diversion target and per capita waste generation). The source sector diversion targets (Table 2) are comparable to those in other Australian jurisdictions, but are not state-wide. Overall volumes collected through kerbside diversion are provided in Table 3 and long term trends in this recovery rate in Table 4**.**

Table 1 – South Australia's Waste Strategy 2015-2020 landfill diversion targets

TARGETS	STATUS
35% reduction in landfill disposal from 2002-03 level by 2020; milestone of 30% by 2017-18	The state has achieved 29% reduction in landfill from 2002-03 levels (Rawtec, 2019).
Per capita waste generation target: 5% reduction in waste generation per capita by 2020 (from 2015 baseline)	Per capita total waste generated from all three waste sectors (Municipal Solid Waste (MSW), Commercial and Industrial (C&I) and Construction and Demolition (C&D)) in South Australia rose by 8.7% from 2014-15 from 2015 to 2017-18. It has risen by 62% since 2003-04.

Table 2 – South Australia's Waste Strategy 2015–2020 landfill diversion targets by source sector

TARGETS			STATUS
Municipal solid waste (MSW) landfill diversion			
Year	**Metropolitan (% diversion)**	**Non-metropolitan**	
2009 (baseline)	55	Not applicable	The MSW metropolitan diversion rate of 58.5% falls short of the 2020 target of 70% by more than 10%. **Kerbside bin recovery**
2012	60	Maximise diversion to the extent practically and economically	

2015	70	achievable.	Local government recovery data relating to the diversion from bins collected at the kerbside shows an overall average kerbside recovery rate in South Australia in 2016-17 of approximately 49.9% (Green Industries SA, 2019a). However, some higher-performing councils are achieving up to 58% (Green Industries SA, 2019) This recovery excludes MSW non-kerbside collected material, for example, container deposit legislation returns, material taken from householders to transfer stations, hard waste collections, electronic waste, street sweepings and textiles. Food waste is estimated at more than 150,000 tonnes a year.
2020	70*		
Commercial and industrial (C&I) landfill diversion			
Year	**Metropolitan (% diversion)**	**Non-metropolitan**	
2009	60	Not applicable	The C&I sector achieved an 82.6% diversion in 2017-18, above the 2015 and 2020 targets. This sector experienced a decrease from a diversion rate of 85.2% cent in 2016-17.
2012	65	Maximise diversion to the extent practically and economically achievable.	
2015	75		
2020	80		
Construction and demolition (C&D) landfill diversion targets			
Year	**Metropolitan (% diversion)**	**Non-metropolitan**	
2009	80	Not applicable	The diversion rate in this sector in recent years fluctuated around the Waste Strategy 2015-2020 target of 90% by 2020. In 2017-18 the target was exceeded at 91.9% overall. This is an increase from the C&D 2016-17 diversion of 90%. The 2020 target of 90% for this sector has been achieved.
2012	85	Maximise diversion to the extent practically and economically achievable.	
2015	90		
2020	90		

*MSW target comprises 60% diversion from household bin systems contributing to an overall MSW target of 70%.

Resource recovery

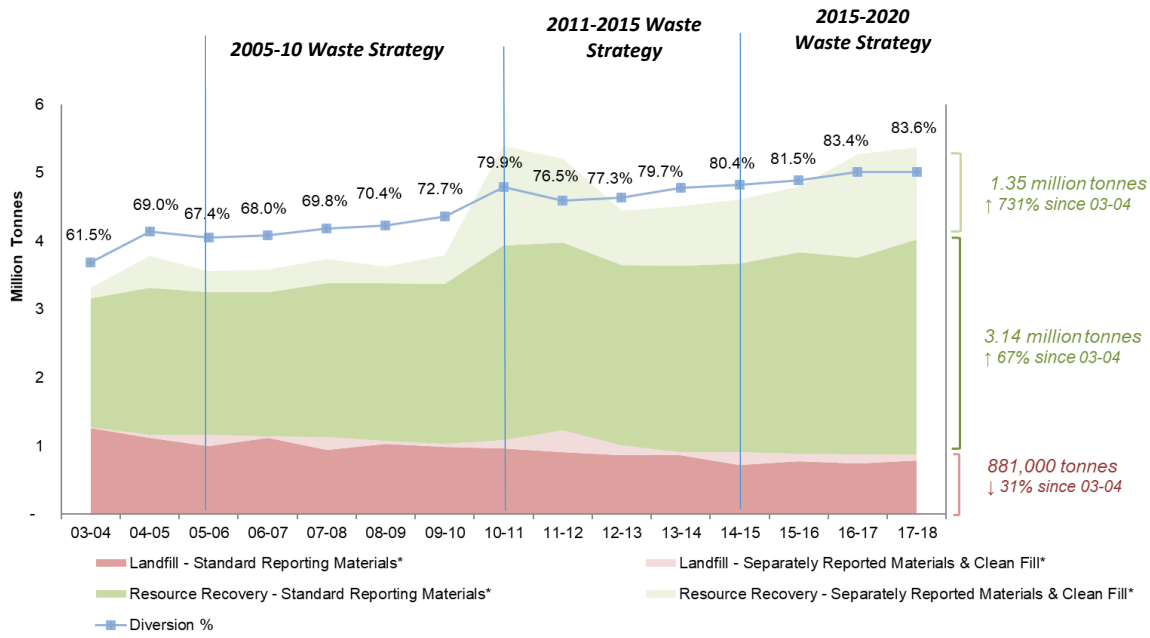


Figure 3 – Trend in resource recovery and landfill disposal in South Australia since 2003-04[4]

Estimated environmental benefits from recycling

Greenhouse gas (GHG) savings of 1.37 million tonnes of carbon dioxide emissions (CO2) considered approximately equivalent to:

- about 2 million trees absorbing the same amount of CO2
- the GHG emissions from 316,000 cars in a year
- 20% of South Australia's total community sector GHG emissions in 2011.

Cumulative energy demand saved, estimated at 15,800 teraJoules, is considered approximately equivalent to:

- energy use by 291,500 average households in one year
- the energy supplied by 2.6 million barrels of oil
- 5% of South Australia's total energy consumption reported for 2017-18.

Water savings, estimated at 8,300 megalitres, is considered to be approximately equivalent to:

- the water use of about 44,000 average Adelaide households in one year
- the water contained in about 3,300 Olympic-sized swimming pools
- 4% of metropolitan Adelaide's total water consumption in 2017-18.

(Rawtec, 2019)

Figure 4 – Environmental benefits from recycling

[4] *Reporting of both resource recovery and landfill disposal is divided into Standard Reporting Materials and Separately Reported Materials & Clean Fill categories. Source: Rawtec, 2018, South Australia's Recycling Activity Survey 2016-17 Financial Year Report, p. 12*

What did each waste sector contribute to resource recovery in South Australia?

Figure 5 below highlights that for each sector, from 2007-08 to 2016-17, the resource recovery rate has comprised construction and demolition (C&D) 62.3%, commercial and industrial (C&I) 28.5%, and municipal solid waste (MSW) 9.2%.

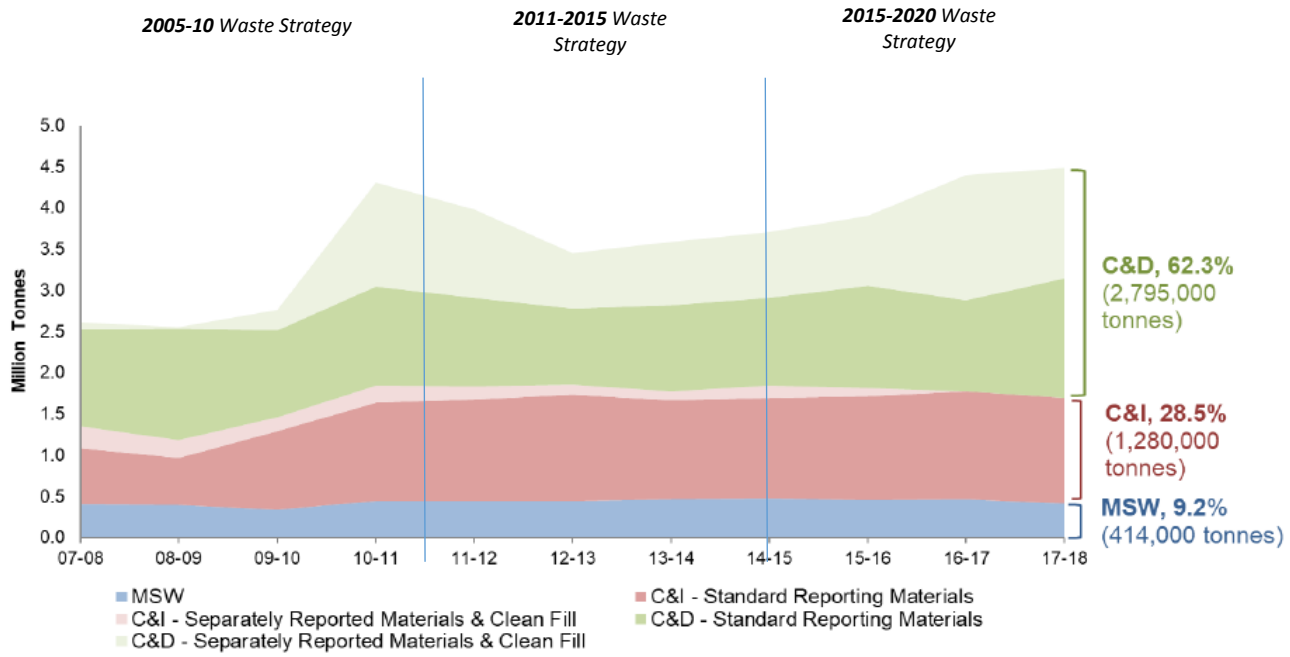


Figure 5 – Contribution to resource recovery in SA by source sector for 2017-18 and trend since 2007-08

How does South Australia compare to other Australian jurisdictions?

Compared to other Australian states and territories[5], in 2017-18 (Rawtec, 2019), South Australia had the highest:

- reported diversion at 83.6%
- per capita resource recovery at 2,585 kilograms a year[6]
- per capita resource recovery for standard reporting material only, at 1,810 kilograms a year.

South Australia reported the lowest per capita landfill disposal rate at 507 kg a year but also the highest waste generation[7] in Australia at 3,092 kg a year.

[5] Comparisons with other states should be interpreted with caution: the data is from different years and there are different methods for reporting the results in different states.

[6] Not all recycling data could be obtained for 2017-18. Furthermore, not all Australian states and territories collect and report this data in conformance with the reporting guidelines provided by Department of Environment and Energy, 2015. Estimated waste generation, recycling and landfill disposal were based on most current and best available data for each state/territory.

[7] Waste generation is the total volume of all waste recovered through resource recovery and also disposed to landfill in the state.

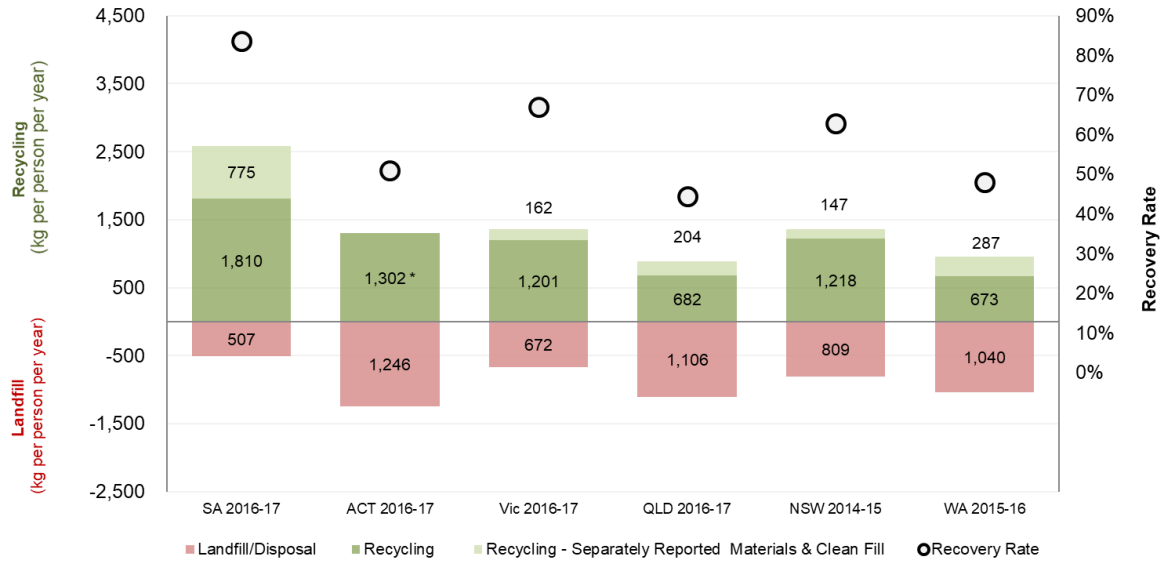


Figure 5 – Comparison of reported per capita (kg/person/year) resource recovery and landfill disposal and recovery (%) by state or territory.[8]

[8] These figures are based on the latest currently available data. The per capita data for resource recovery is differentiated according to Standard Reporting Materials and Separately Reported Materials and Clean Fill scopes in line with the national reporting guidelines provided by the Department Environment and Energy (2015). Note: Reported recovery for ACT does not show a breakdown between Standard Reporting Materials and Separately Reported Materials & Clean Fill, and thus, these quantities are aggregated in the recycling category of reported per capita data.

Municipal solid waste and kerbside performance

South Australian councils provide kerbside waste and recycling services to residential households and some small businesses and organisations. Green Industries SA understands that councils providing fortnightly collection of green organics and food organics to all residents (as well as fortnightly recycling and weekly residual waste collection) can achieve a 60% diversion rate. However, this does not include MSW quantities arising from hard waste services, street sweepings, waste collected at drop-off facilities, and council-operated commercial services where opportunities for diversion of materials also arise. Further increases in the recovery of glass, paper and plastics are possible.

This section provides a snapshot on the performance of household kerbside bin systems, including:

- overall kerbside recovery performance
- analysis of recovery rates for three-bin vs two-bin systems
- metropolitan Adelaide kerbside recovery long-term trends
- food waste diversion.

Overall kerbside recovery

In 2016-17, residents in the metropolitan area generated 530,300 tonnes of kerbside materials. Overall, metropolitan Adelaide achieved a three-bin recovery rate of 49.9%.

Table 3 – Overall volumes collected at kerbside in South Australia, 2016-17

Collection	2015-16	2016-17	% change
Residual waste	263,700	265,500	1
Organic	134,900	155,700	13%
Recyclables	110,500	109,100	-1
Total metropolitan materials	**509,000**	**530,300**	**4**
Recovery rate	**48.2%**	**49.9%**	**1.7**

Three-bin and two-bin systems

Since 2005, successive South Australian waste strategies have stated that a three-bin system (comprising recycling, organics and landfill bins) is a higher-performing system for diverting material than a two-bin system (typically comprising a recycling bin and a landfill bin). The three-bin system has recently been enhanced with food-waste diversion. Green Industries SA has assessed the assumption that the three-bin system provides further opportunities to recover material by examining the recovery rate as a performance indicator for the various existing bin systems in place in metropolitan Adelaide.

Table 4 – Monthly kerbside-bin recovery rates by metropolitan Adelaide sub-regions, 2017-18

Metropolitan Adelaide sub-region	Population	Households	Total materials (tonnes)	Recovery rate %*	
				Three-bins	Two-bins
Central eastern	265,085	114,925	106,996	54	32
Northern	358,835	141,861	141,603	46	27
Southern	328,783	138,114	136,876	49	28
Western	337,347	149,596	144,859	53	30
	1,290,050	**544,496**	**530,300**	**50**	**29**

** Figures have been rounded.*

Metropolitan Adelaide kerbside recovery long-term trends

The metropolitan Adelaide long term trends in kerbside recovery are presented in Table 5 below.

Over the 14 years to 2016-17, major changes include:

- a 17% (92,600 tonne) increase in total metropolitan kerbside waste
- a 13% (33,800 tonne) fall in the quantity of landfill
- a 57% (89,500 tonne) increase in organics diversion
- a 34% (36,900 tonne) increase in recyclables recovered.

The metropolitan recovery rate increased from 32% in 2003-04 to 50% in 2016-17, likely attributable to the roll-out of three bin systems in councils from 2004. The kerbside recycling rate has stabilised in the last three years.

Table 5 – Metropolitan Adelaide's kerbside recovery rates

Financial Year	Metropolitan %*	Waste Strategy period	Key activities contributing to kerbside recovery
2003-04	32		Varied bin systems in place across councils state-wide.
2004-05	36	2005-2010 Waste Strategy	Kerbside bin three-bin systems roll-out in councils from 2004. Food waste pilots introduced in councils from 2009
2005-06	45		
2006-07	45		
2007-08	47		
2008-09	48		
2009-10	48		
2010-11	49	2011-2015 Waste Strategy	Continued roll-out of food waste: council uptake of Green Industries SA funding covering approximately 140,000 households in metropolitan council areas.
2011-12	48		
2012-13	49		
2013-14	49		
2014-15	48	2015-2020 Waste Strategy	Minimal uptake of incentives for food-waste roll-out by councils: approximately 24,000 additional households in metropolitan council areas.
2015-16	48		
2016-17	50		

** Figures have been rounded*

Food waste diversion from households

Metropolitan Adelaide

Food waste is estimated at 3.3 kilograms per household, and comprises 19% of total household waste and 40% of residual waste after recyclables are removed, across metropolitan Adelaide (Rawtec, 2019). It is one of the largest components of collected household waste, impacting on associated landfill costs to councils.

Rollout of kerbside organics bins to all households in metropolitan Adelaide council areas is expected to be realised by 2020. Implementation in regional areas of food waste diversion systems is largely dependent on the processing infrastructure available in the region.

Support for councils to fund the roll-out of food caddies within council areas continues to be provided through Green Industries SA. This increases regional processing capacity and the acceptance of food waste streams from regional kerbside organics bins. In addition to diverting food waste, a kerbside green organics bin, combined with an internal collection point for organic material in the form of a kitchen caddy, diverts other non-food organic materials such as paper towel, tissues, serviettes and cut flowers from landfill.

Green Industries SA has explored the key factors contributing to the diversion of household food waste from landfill, including through a pilot program in 2009-10. The pilot program – the largest of its type in Australia at the time – involved more than 17,000 households in 10 South Australian councils (metropolitan and regional) and the diversion of food organics from the kerbside residual waste bin to the green organics bin, which was then collected for commercial composting. The pilot was evaluated through market research, quantitative kerbside audits and odour monitoring. It identified the most important factors contributing to the diversion of household food waste from landfill. The results demonstrated that the program increased diversion rates and had a high level of community acceptance.

The pilot informed the development of a State Government incentive scheme, which in 2019-20 operates as the Kerbside Performance Plus Food Waste Incentives program, to encourage local government's adoption of food waste systems.

Green Industries SA is aware that 19 metropolitan councils offer food waste systems in the form of organics bins combined with food waste caddies.

- In five councils they are area wide.
- Nine councils offer 'opt-in' food waste systems to interested households only, with some systems offered at cost to households.
- Four councils will offer 'opt-in' food waste systems from 2020 to interested households only, with some systems offered at cost to households.
- The Adelaide Hills Council offers food waste systems in parts of the council area where logistically practicable.

Figure 6 demonstrates that nearly all metropolitan Adelaide councils allow food waste to be placed in residents' kerbside organics bins. However, in spite of all metropolitan councils making progress in food waste diversion, data provided to Green Industries SA from the five councils that have implemented area-wide roll out of kitchen caddies indicates that only one in five households in metropolitan Adelaide has a kitchen caddy, for an estimated total of 101,000 households. (This estimate includes only those waste collection systems requested through councils).

Green Industries SA understands that councils with opt-in organics collections have recovery rates of up to 10 percentage points lower than those areas where area-wide roll out of kitchen caddies have been implemented.

A full rollout of food waste diversion systems across metropolitan Adelaide is expected to lift the recovery rate significantly and reduce the amount of materials presented in the kerbside general waste bin.

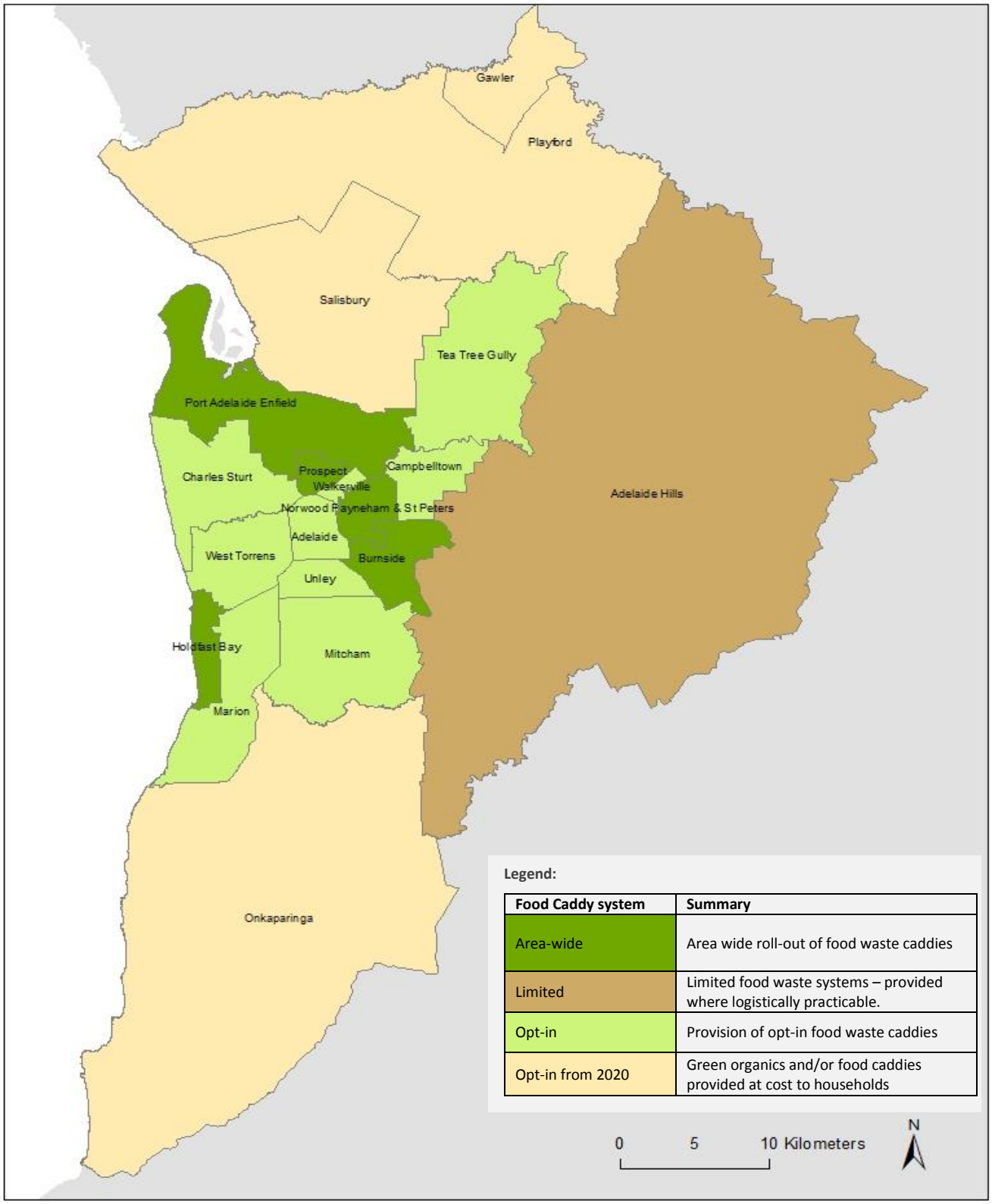


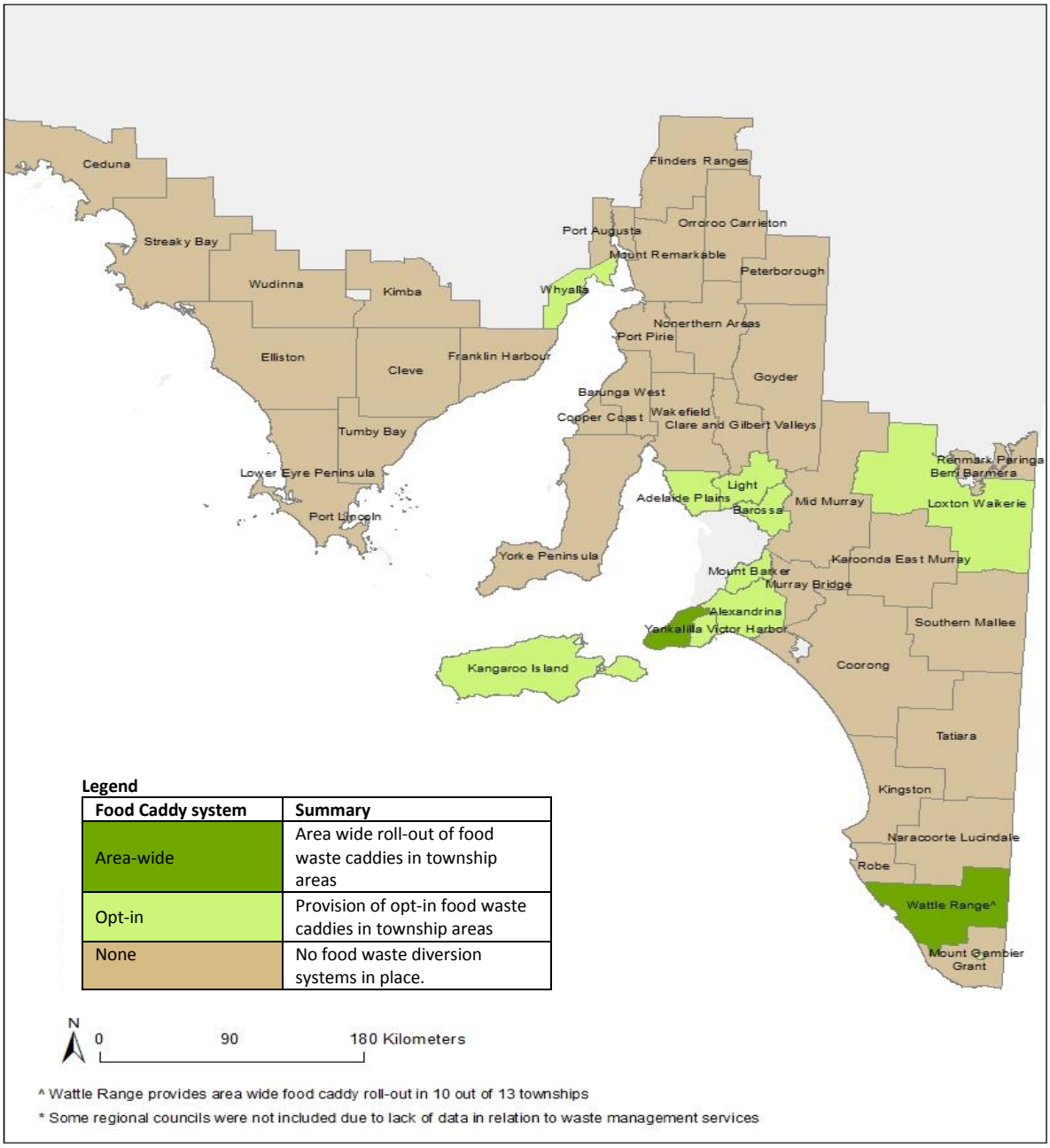
Figure 6. Metropolitan Adelaide Council food collection systems, 2018-19

Regional South Australia

While regional areas continue to face challenges in terms of location, distance and related transport costs, population base, community expectations, and the quantities that can be collected for recycling, it is understood that many regional councils have rolled-out three-bin household systems and some have adopted food waste collection systems.

Among the 49 regional councils:

- two offer area-wide food waste systems within townships
- 10 offer opt-in food waste systems within townships
- 37 do not offer any form of food waste collection.



*Not all regional councils are displayed due to lack of available data in relation to waste management services in those areas.

Figure 7 – Regional South Australia Council Food Waste Collection Systems, 2018-19

PART 2

Draft 'South Australia's Waste Strategy 2020-2025: *A vision for a circular economy'*

Contents

What will guide the 2020-2025 Waste Strategy?

Framework and principles

International framework

United Nations Sustainable Development Goals

Montreal Protocol

30 MONTREAL PROTOCOL
caring for all life under the sun

European Commission Circular Economy Framework

United Nations Framework Convention on Climate Change

United Nations Framework Convention on Climate Change

Basel Convention

BASEL CONVENTION

National framework

Australian Government

- National Waste Policy and Action Plan
- Extended producer responsibility schemes
- *Product Stewardship Act 2011*
- *National Food Waste Strategy*

State framework

Green Industries SA Act 2004

Guiding principles:

- Waste management hierarchy (refer figure 1)
- The circular economy (refer figure 2)
- Ecologically sustainable development (refer figure 3)
- Best practice methods and standards
- Policy development through open dialogue and consultation
- No new landfills servicing metropolitan Adelaide
- Source separation of waste

Environment Protection Act 1993

Objects of the Act:

- Ecologically sustainable development
- The management of waste
- Promoting resource recovery

- *Environment Protection (Waste to Resources) Policy 2010*

Key features:

- Sustainable waste management objective
- Resource recovery processing requirements for most metropolitan Adelaide waste
- Landfill bans
- Illegal dumping offence

- *Beverage Container Act 1975*
- *Plastic Shopping Bags (Waste Avoidance) Act 2008*

A framework for waste management

Key guiding principles for waste management in South Australia

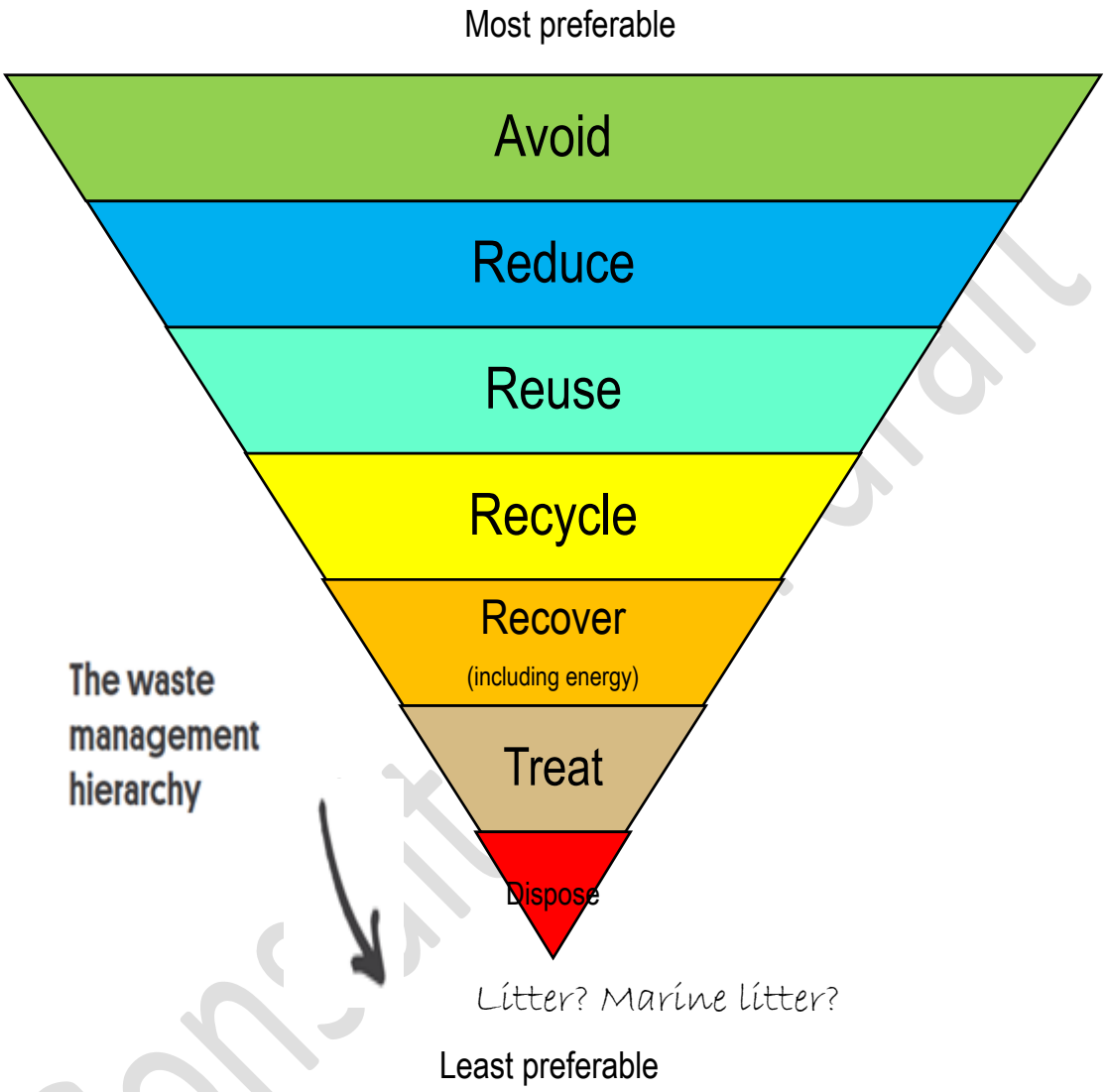
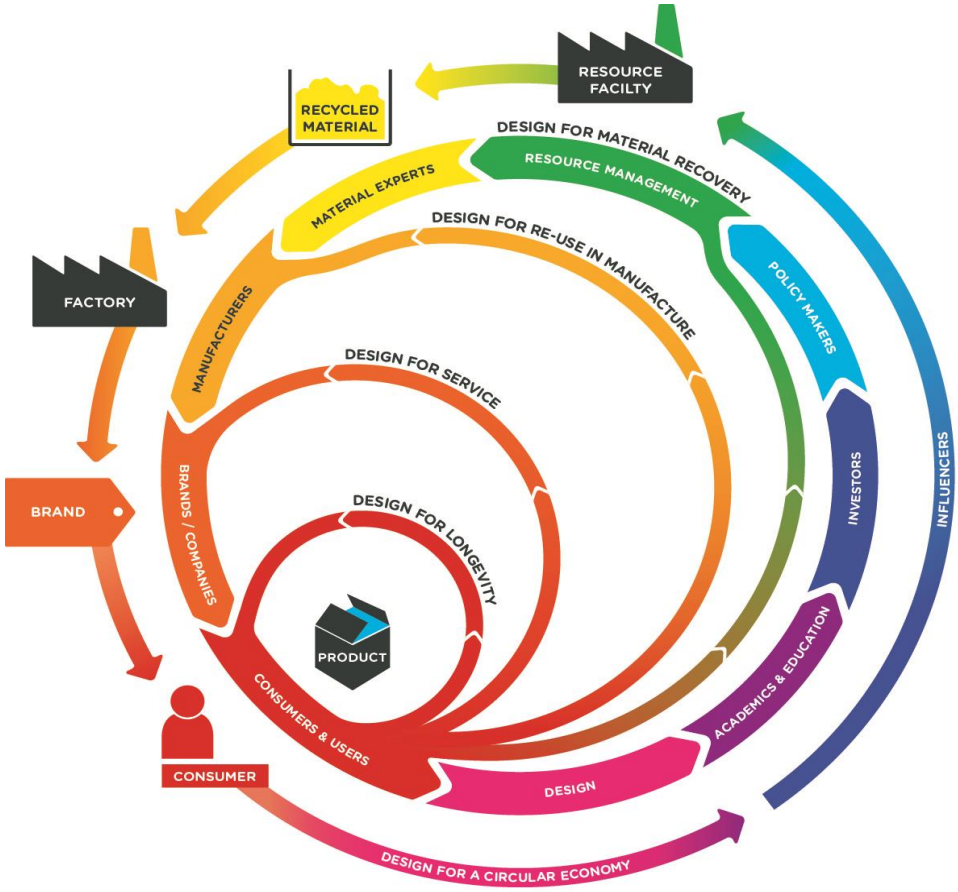


Figure 1. The waste management hierarchy

The waste management hierarchy is recognised internationally as an aspirational framework for sustainability. It implies a closed system where waste is ultimately dealt with, but it does not indicate how to manage 'leakage' from the system or the fugitive waste that may escape as litter or marine debris.

The possibility of leakage is recognised by policies and actions such as South Australia's direction on single-use plastics. The policy highlights that the hierarchy recognises litter and marine debris as being the least preferable options in waste management – that is, waste disposed of on land or into aquatic environments, whether deliberately or otherwise.

The circular economy



RSA Great Recovery: www.greatrecovery.org.uk/resources/four-design-models-for-circular-economy

Figure 2 – Circular economy systems

Ecologically sustainable development

Ecologically sustainable development means to:

- use, develop and protect the environment in ways that allow people and communities to provide for their health, safety, and economic, social and physical wellbeing
- sustain the potential of natural and physical resources to meet the needs of future generations
- safeguard the life-supporting capacity of air, water, land and ecosystem
- avoid, remedy or mitigate adverse effects of activities on the environment
- give proper weight to long-term and short-term economic, environmental, social and equity considerations in deciding matters that relate to environmental protection, restoration and enhancement.

Figure 3 – Definition of ecologically sustainable development, adapted from South Australia's *Environment Protection Act 1993*

The global landscape

Exploring opportunities and addressing the challenges in managing resources and waste more sustainably require a holistic understanding of relevant issues of global concern. The draft Waste Strategy reflects the need to conserve resources and reduce pollution and carbon emissions while reducing poverty and maintaining human wellbeing within a supportive economy. Many nations are united in their efforts. Key opportunities and challenges facing waste management and the circular economy are summarised here.

Population growth

By 2050, world population will have reached 9.8 billion people.

United Nations, Department of Economic and Social Affairs, Population Division, 2017

Raw material demand

The demand for global material resources is estimated at 90 billion tonnes in 2017 and expected to more than double from 2015 to 2050.

IRP, 2017

Growing waste

Global waste is expected to grow by 70% on current levels by 2050: from 2.01 billion tonnes in 2016 to 3.4 billion tonnes by 2050.

Kaza, S. et al. 2018

Climate change

Greenhouse gases are at their highest point in 800,000 years, with levels increasing by nearly 80% since 1970.

Meinshausen, M. et al., 2017

Ageing population

The global population aged 60 or over is growing faster than all younger age groups.

United Nations, 2017

Significant disruptive events

International market pressures, natural disasters and global disruptions such as COVID-19 can cause significant environmental, social and economic impacts.

Growing unemployment and under-employment

The number of unemployed persons globally in 2017 is estimated to be just over 201 million – with an additional increase of 2.7 million expected in 2018.

International Labour Office, 2017

Food security

With world population rising, the world is facing about a 70% increase in food demands by 2050.

Food and Agriculture Organisation of the United Nations, 2017

Global infrastructure

Total global investment in required infrastructure is forecast to be $94 trillion by 2040. A $15 trillion gap has also been forecast in the investment required to meet the world's needs.

Global Infrastructure Hub, 2018

Emerging technologies

Emerging technologies evaluated by experts as having the ability to disrupt and alter the way we operate our daily lives include bioplastics for a circular economy, social robots, smart fertilisers to reduce environmental contamination, advanced food tracking and packaging, collaborative telepresence, and utility-scale storage of renewable energy.

World Economic Forum, 2019

Waste Strategy Objective

The objective of South Australia's waste strategy is to outline actions that can contribute to the development of a circular economy – that is, an economy that realises the best or full value from products and materials produced, consumed and recovered in South Australia through:

- a clearly articulated policy and legislative framework that gives a solid platform for investment decisions and a stable and efficient market
- supporting innovation and commercialisation
- education, advocacy and awareness to support behaviour change in the way waste and resources are managed
- applying the waste management hierarchy consistently with the principles of ecologically sustainable development.

These objectives highlight that if we act in response to the global challenges facing waste management, we can:

- increase market confidence for investments in the circular economy, resource recovery and waste management
- encourage local innovation and investment, boost certainty and build resilient businesses
- increase South Australia's use of secondary materials and reduce the demand on raw material
- improve material efficiency and utility
- reduce greenhouse gases
- encourage job creation
- foster an environment where the South Australian community, businesses and institutions can thrive while reducing their impact on the environment
- maintain South Australia's leading position in waste management and resource recovery.

Targets for 2020-2025

A target of **zero avoidable waste to landfill by 2030** is proposed to guide action during and beyond the lifespan of the 2020-2025 Strategy.

This target aims to stimulate action towards a circular economy. In meeting this target, principles and requirements of the *Green Industries SA Act 2004, the Environment Protection Act 1993* and its subordinate legislation, including the Environment Protection (Waste to Resources) Policy 2010 should be upheld, including:

- The **waste management hierarchy,** ensuring that materials are separated as close as possible to their point of generation and safely used for their highest order purpose. Some materials, including asbestos, certain toxic and quarantine waste, once generated, should be removed from circulation as soon as possible, noting that some of these wastes may be suitable for processes that are higher than landfill on the waste management hierarchy, such as energy from waste.
- Ensuring that principles of **ecologically sustainable development** and avoiding environmental harm are upheld as new mechanisms for design, use and recovery are promoted and pursued.
- Ensuring that the use of **waste-derived materials** is beneficial and genuine, not posing a risk of environmental harm or undermining resource recovery markets.

Targets for South Australia's Waste Strategy 2020-2025 are proposed, as are quantitative targets for municipal solid waste (MSW), commercial and industrial (C&I), construction and demolition (C&D) waste streams, and per waste capita reduction. Broader quantitative key actions essential to achieving these targets are also defined.

South Australia's Waste Strategy 2020-2025 proposed targets

Target: Zero waste to landfill by 2030[9]

Targets

METROPOLITAN				NON-METROPOLITAN
Targets by sector			**Overall 2025 target**	
Municipal solid waste (MSW)			75% diversion	Maximise diversion to the extent practically and economically achievable
Year	**Household bin systems**[10]	**All MSW waste**[11]		
2020	55% *minimum diversion target*	60%		
2022	60%	65%		
2025	70%	75%		
Commercial and industrial (C&I)			90% diversion	Maximise diversion to the extent practically and economically achievable
Year	**Diversion**			
2020	80%			
2022	85%			
2025	90%			
Construction and demolition (C&D)			95% diversion	Maximise diversion to the extent practically and economically achievable
Year	**Diversion**			
2020	90%			
2022	90%			
2025	95%			
Per capita waste generation			5% reduction	From 2020 baseline

[9] Zero avoidable waste to landfill equates to the diversion of all waste from landfill where it is technologically, environmentally and economically practicable to do so. 'Unavoidable' waste therefore refers to wastes for which no other current treatment is available including (but not limited to) asbestos, toxic and quarantine waste.

[10] Diversion only from MSW household bin systems.

[11] Quantities arising from total MSW waste comprising household bin systems, hard waste services, street sweepings, council-operated parks and gardens, public place locations, waste collected at drop-off facilities, and council-operated commercial services.

Broader quantitative actions to achieve proposed targets	

Municipal solid waste (MSW)
Key actions supporting 75% diversion by 2025
	Household bin systems
	• Increasing the recovery of recyclables in the yellow bin.
	• Increasing the recovery of organics and food waste in the green bin and processed in accordance with Australian Standard *Composts, Soil Conditioners and Mulches – 4454.*
	• Provide minimum kerbside bin-based collection services to all households in metropolitan Adelaide:
	  ○ Organics, including food waste collections, at least fortnightly
	  ○ Recycling, at least fortnightly.
	• All kerbside bins to be compliant with Australian Standard *AS 4123.5-2008 Mobile waste containers* as soon as practicable before 2030.

	Food waste • Implement South Australia's Food Waste Strategy.
	Hard waste collection • Implement best-practice hard waste collection and treatment to maximise material recovery.
	Community engagement • Reduced contamination in kerbside collected bins. • Household source separated material placed in the right bins. • Evaluation of the effectiveness of the *Which Bin?* and other householder education campaigns.
	Plastics and packaging • 100% of packaging in South Australia is recyclable, compostable or reusable by 2025, in support of Australian Government commitment to Australian Packaging Covenant Organisation target. **Product stewardship** • South Australia to support effective product stewardship schemes.
	Further priority actions for MSW are detailed at page 66.

Commercial and industrial (C&I) **Key actions supporting 90% diversion by 2025**	**Procurement** • Increase procurement of secondary materials and recycled content products. • Increase local remanufacturing. • Implement standards for recycled content products. **Product stewardship** • South Australia to support effective product stewardship schemes. **Food waste** • Implement South Australia's Food Waste Strategy. **Plastics and packaging** • 100% of packaging in South Australia is recyclable, compostable or reusable by 2025, in support of Australian Government commitment to Australian Packaging Covenant Organisation target. Further priority actions for C&I are detailed at page 70.
Construction and demolition (C&D) **Key actions supporting 95% diversion by 2025**	**Procurement** • Increase procurement of secondary materials and recycled content products. • Increase local remanufacturing. • Implement further standards for recycled content products. **Product stewardship** • South Australia to support effective product stewardship schemes. **Waste levy** • Continued application of the levy to remain for construction and demolition materials. Further priority actions for C&D are detailed at page 72.

Partnerships

To achieve the Strategy's objective, targets and priorities for action will require commitment, focus and appropriate resourcing from all sectors. The Strategy's responsibility for implementation will be shared across governments, business, industry and the community. These responsibilities are defined in Figure 3. The Strategy has whole-of-government endorsement and strong alignment to other government activities including the South Australian Government's goals and agenda for economic development, trade and investment, emergency services (supporting disaster waste management), health, climate change, environment protection and regulation, procurement, planning and development, and developing the food, wine and agriculture sectors.

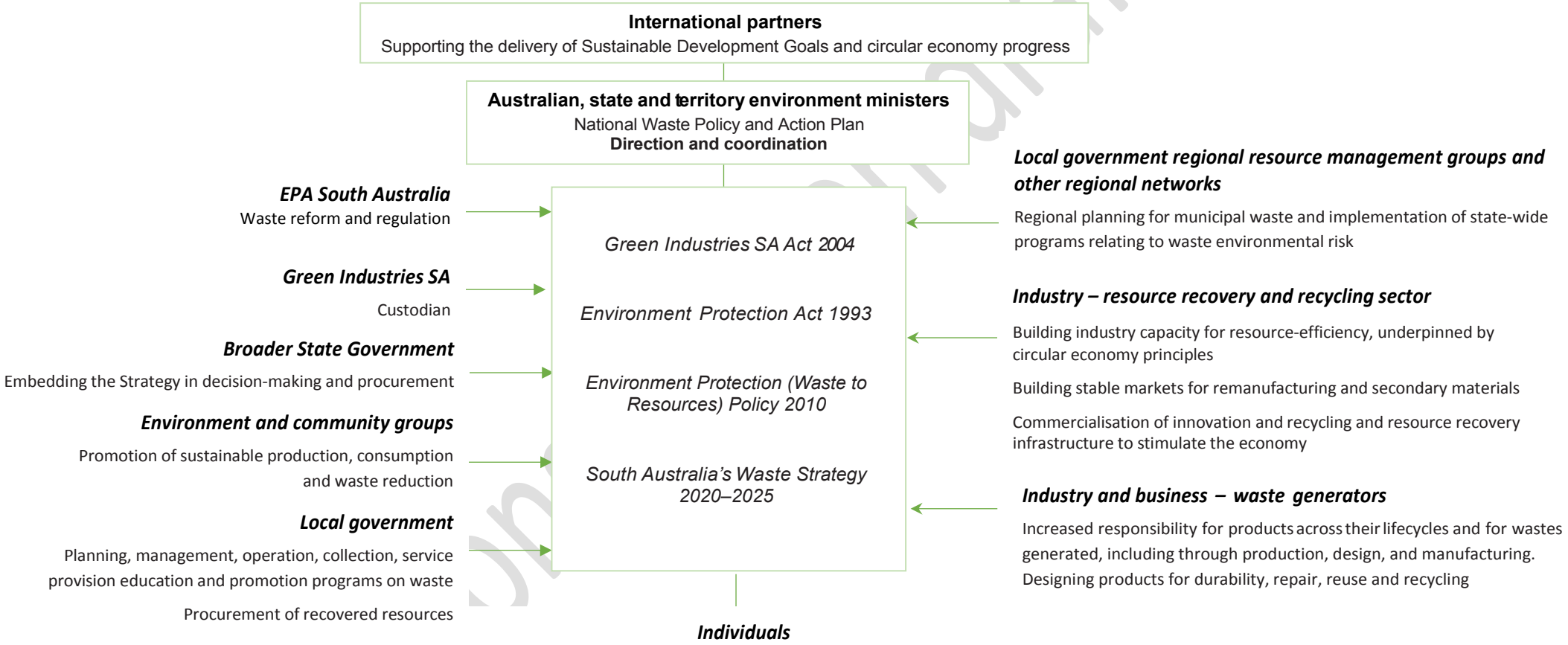


Figure 3 – Roles and relationships in delivering South Australia's waste strategy

Evaluation and reporting

Evaluation and reporting is important in building knowledge about resource recovery, waste and the circular economy, and to assess the effectiveness of projects and programs. It is important to understand economic and environmental costs and benefits, infrastructure needs, future waste streams for attention and areas needing regulatory underpinning.

Important areas of focus in evaluating programs and initiatives over the course of this Waste Strategy will include:

- developing a monitoring framework to measure the state's progress towards a circular economy
- measuring recycling activity and material flows
- measuring demand on raw materials
- increasing transparency in reporting of materials and mass flows from industry, to enable evidence-based targets relating to specific materials
- collecting and analysing litter data
- capturing, reporting and sharing industry and business experiences
- monitoring community attitudes and behaviours
- monitoring infrastructure and identifying gaps
- informing policy and design of projects with feedback
- monitoring industry investment
- measuring greenhouse gas emission, carbon, water, materials intensity and other outcomes
- investigating new and emerging opportunities to improve and reform South Australia's environmental performance in relation to waste management and the circular economy.

Priorities for action

Areas with the potential for greatest impact

Transitioning to a circular economy

Market development

Infrastructure capability and capacity

Food waste

Plastics and packaging

1. Transitioning to a circular economy

A transition to the circular economy is a priority guiding focus for 'South Australia's Waste Strategy 2020-2025'.

The *Green Industries SA Act 2004* includes the concept of circular economy as a guiding principle for an economic model that contemplates the production of goods and services:

- by a reduced reliance on virgin materials
- on the basis of continuously functioning utility and an extended lifecycle
- in a manner that eliminates, as far as is reasonably practicable, waste or pollution, or harm to the environment.

'Circular economy' is a generic term for an industrial economy that is producing no waste and pollution, by design or intention. It refers to the better use of materials within the economy and involves more remanufacturing, repair and reprocessing than the linear 'make, use, dispose' mode of traditional economies.

As the Ellen MacArthur Foundation points out (2015), the existing economic model:
'…gives rise to chronically high levels of waste and creates dependence between economic development and inputs of new virgin materials. In a world of finite resources, this model cannot work in the long run, and there are indications that it is reaching its limits.'

A truly circular economy is driven by renewable flows, rather than finite stocks. Better processes and product design help capture the full benefit of resources, and less materials and energy are used to manufacture the goods and services. Goods should be designed to last longer and be easily repaired, upgraded or used differently.

During the term of the 2020-2025 waste strategy, South Australia's work towards a circular economy will build upon current policy initiatives and activities designed to reduce waste, improve material and energy efficiency, and reduce greenhouse gas emissions.

South Australia's work to transition to a circular economy will support the National Waste Policy and Action Plan circular economy principles:

1. *Avoid waste:*
   - *Prioritise waste avoidance, encourage efficient use, reuse and repair.*
   - *Design products so waste is minimised, they are made to last and we can more easily recover materials.*
2. *Improve resource recovery:*
   - *Improve material collection systems and processes for recycling.*
   - *Improve the quality of recycled material we produce.*
3. *Increase use of recycled material and build demand and markets for recycled products.*
4. *Better manage material flows to benefit human health, the environment and the economy.*
5. *Improve information to support innovation, guide investment and enable informed consumer decisions.*

Commodity pricing and markets

A key challenge facing waste management, resource recovery and green industry sectors in South Australia, Australia and globally is in their

vulnerability to sharp drops in commodity prices, demand for resource types, and available finance. While South Australia's resource recovery industry is well established, with around 86% of all recovered material reprocessed locally and about 7% exported overseas (Rawtec, 2019), global restrictive measures that affect the trading of recycled commodities can impact the viability of South Australian recycling businesses that depend on those markets. Ultimately, a circular economy offers the opportunity to gain additional value from products and materials but also helps mitigate exposure to material price volatility and material supply (Ellen MacArthur Foundation, 2015).

It has been found that in many developed countries, a reduction in the volume of waste generated is an indication of a development towards less material-intensive production and consumption patterns, particularly as the economy moves from a heavy industry base to a more service base.

Per capita waste generation

To truly reflect the personal impact that South Australians can make in reducing their waste impact and shifting focus towards a circular economy, the Waste Strategy includes a waste generation reduction target of 5% per capita by 2025. This will require continued efforts to decouple the generation of waste from economic activity, as is the key focus globally in seeking a transition to a circular economy.

Transitioning to a circular economy

What happens if we don't take action?

- There are finite and in some cases declining amounts of the raw materials upon which economic development has depended. New methods and sources will be needed for future development.
- The resource recovery industry is vulnerable to sharp drops in commodity prices, demand for resource types and available finance.

What is possible through action?

- ✓ An opportunity for South Australia to build on achievements in reducing waste, improving material and energy efficiency, and driving growth in the waste and resource recovery sectors of its economy.
- ✓ Support for the National Waste Policy and Action Plan and its principles relating to the circular economy.
- ✓ A resilient South Australian economy that produces little waste and pollution by design or intention.
- ✓ By 2030, as many as 25,700 jobs created in a circular economy (Green Industries SA. 2017b).
- ✓ Potential reduction in the state's greenhouse gas emissions of 27%, or 7.7 million tonnes in CO2 equivalent.
- ✓ Innovation and commercialisation of new technologies that can facilitate a shift to circular economy business models.

Priority actions

Avoid waste:

- ✓ Encourage businesses and start-ups to adopt business models that support a transition to the circular economy, for example in sharing, hire and leasing, products service systems, and incentivised return asset management.
- ✓ Promote design of products and components to increase reparability, durability, upgradability and recyclability.
- ✓ Support reuse and repair.
- ✓ Advocate for product labelling standards to enable better dismantling, reuse and recycling of products and information relating to recycled content.

Improve resource recovery:

- ✓ Invest in infrastructure that supports circular economy flows, either as:
  - organic material, designed to re-enter and regenerate the environment safely (such as compost)
  - materials (such as metals, paper and plastic) that are designed to circulate for as long as possible through repair, reuse and, as a last resort, recycling, without entering the environment for disposal.

Increase use of recycled material and build demand and markets for recycled products.

- ✓ Promote manufacturing of products and components that replace virgin materials with sustainably produced materials.

Better manage material flows to benefit human health, the environment and the economy.

- ✓ Advocate for extended producer responsibility schemes that deliver recycling outcomes and achieve higher outcomes on the waste hierarchy (such as through better product design).

Improve information to support innovation, guide investment and enable informed consumer decisions.

- ✓ Encourage research and development, commercialisation and innovation in new technologies, including big data analytics, social media, trace and return systems, 3D printing and modular design technologies.
- ✓ Identify key sectors, materials and regions to benefit from the circular economy and seek to support practical consideration and actions.
- ✓ Support knowledge management and metrics for circular economy activities.

"South Australia's work towards a circular economy will build upon current policy initiatives and activities designed to reduce waste, improve material and energy efficiency, and decrease greenhouse gas emissions."

2. Market development

Increased domestic demand for local recyclable materials and recycled-content products can play a vital role in attracting investment in local remanufacturing and supporting longer-term structural adjustment of the waste sector to a circular economy business model.

The success of this Waste Strategy requires an increase in the quality and market demand for recyclable materials and recycled content products. This is especially vital as the impacts of global and national policy focuses attention on creating market opportunities for new, sustainable products made from recycled materials.

Nationally, Environment Ministers have agreed on a number of actions to reduce waste generation, improve recyclability of waste, and increase domestic recycling capacity and demand for recycled products. The Council of Australian Government, for example, has committed to banning the export of recyclable material including waste plastic, paper, glass and tyres (Council of Australian Government, 2019).

South Australia should expand market-related activities for existing recycled-content products, improve the quality and supply of waste feedstock used in manufacturing recycled-content products, and improve market confidence in the recycled materials and recycled-content products. This will generate confidence in and demand for quality recycled products.

Sustainable procurement

A nationally consistent standardised methodology for requiring supply agreements to incorporate recycled content products will increase the market for recycled products.

This aligns with the intention of the National Waste Policy to advocate for increased use of recycled materials in the goods that government and industry buy, such as paper, road materials and construction materials, and to collaborate on creating new markets for recycled materials[12].

Longer-term measures can be managed through a staged approach, for example, selected materials to be implemented first in such as use of glass fine in civil construction applications or sector-based circular economy policy and case studies.

Market development
What happens if we don't take action?
• Poor demand and local market development for recycled content products. • Sustainable products prevented from accessing or building markets. • Lost opportunities to drive innovation and market development in products.

[12] Seventh meeting of Environment Ministers, Agreed Statement – 27 April 2018, Melbourne

- Continued demand on raw materials with a higher environmental footprint, contributing to higher greenhouse gas emissions, water and energy use; greater impacts to agriculture and deforestation; and increased waste production.
- An uneven playing field for market development of sustainable products.

What is possible through action?

- ✓ Boosts to local market demand and local employment.
- ✓ Reduced demand on raw materials.
- ✓ Increased demand for recycled products.
- ✓ Increased diversion from landfill.
- ✓ 'Closing the loop' on products entering the recycling stream by generating demand for recycled products.
- ✓ Increased environmental benefits.
- ✓ Potential lifecycle benefits (value for money) compared to using virgin materials.
- ✓ South Australia continues to perform as, and is perceived as, a leader in circular economy activity.
- ✓ Development of new markets and contribution to the resilience and stability of existing markets.

Priority actions

- ➢ Investigate barriers for sustainable procurement (in state and local governments and industry) and identify measures to overcome these, including through legislation and policy.
- ➢ Identify and recommend priority recovered materials and recycled-content products to be mandated for use in the government and industry procurement system, in the short and medium term.
- ➢ Develop successful procurement case studies demonstrating benefits of using recycled-content products to government and industry.
- ➢ Identify relevant training needs for procurement practitioners and developing tools for capacity building in sustainable procurement.
- ➢ Collaborate in and advocate for nationally consistent standards and/or frameworks for the requirement of recycled-content products in government procurement.
- ➢ Support the development of accredited testing for product standards and performance to increase confidence in the quality of remanufactured products.
- ➢ Develop government fit-out requirements to support increased resource recovery and material reuse and repurpose.
- ➢ Ensure a robust regulatory environment that supports local market development for remanufactured products.
- ➢ Include recycled content measures in government infrastructure projects.
- ➢ Develop monitoring and reporting mechanisms for sustainable procurement.

"Increased domestic demand for local recyclable materials and recycled-content products can play a vital role in attracting investment in local remanufacturing and supporting longer-term structural adjustment of the waste sector to a circular economy business model domestically."

3. Infrastructure capability and capacity

South Australia's Waste Strategy 2015-20 includes a long-term strategic objective of increasing and maintaining the capacity of South Australia's recycling systems and reprocessing infrastructure. South Australia has established integrated waste management infrastructure throughout the state, with the State Government generating much of this infrastructure through support programs and co-investment. Waste and resource recovery infrastructure planning and investment will play critical roles in supporting future industry development and economic growth.

In February 2018, following stakeholder consultation, Green Industries SA released its 'Waste and Resource Recovery Infrastructure Plan'. The plan projects investment needs for waste management and resource recovery infrastructure over the next 10-30 years. It models scenarios for waste flow projections, corresponding infrastructure needs and economic impact assessments under:

- moderate additional diversion – slightly more than business as usual) over a 10-year period
- high additional diversion – aspirational goal of zero waste across metropolitan Adelaide and high diversion rates in regional areas) over a 30-year period.

Green Industries SA's Infrastructure Grants Program helps private sector, local government and not-for-profit organisations to invest in infrastructure and find innovative approaches to increasing the resource recovery and reducing the amount of waste sent to landfill.

Infrastructure capability and capacity
What happens if we don't take action?
• Reliance on volatile overseas markets for recovered recyclables. • Missed opportunities for local resource recovery capacity and to stimulate economic activity and job creation. • Infrastructure capability does not meet waste generation requirements. • Illegal activity and stockpiling of materials.
What is possible through action?
✓ Support for South Australian industry development and economic growth. ✓ South Australia's world-class recycling performance is maintained. ✓ Transition to a more resource efficient, circular economy. ✓ Continued resource recovery infrastructure investment avoid landfill costs; reduce the use of virgin materials, energy and water; reduce greenhouse gas emissions; and boost economic development. ✓ Help for the South Australian recycling industry and local government to respond to global policy changes affecting the markets for recyclable materials.

- ✓ Support for the processing of materials banned from landfill under the *Environment Protection (Waste to Resources) Policy 2010.*
- ✓ Prioritising local processing of materials.
- ✓ South Australia becomes a waste management training destination for Australian and overseas professionals (such as in behaviour change, systems design and deployment, and alternative technology policy).

Priority actions

- Encourage innovation by tackling new waste streams and assisting improvements to efficiency and targeting new market segments.
- Continue investment in resource recovery infrastructure.
- Improve knowledge and awareness of resource recovery infrastructure as being essential infrastructure for the functioning of society and the economy.
- Improve knowledge and opportunities in relation to the potential return on investment in the resource recovery sector.
- Support soft infrastructure investment in workforce planning, training and talent retention in the resource recovery industry.
- Set best practice standards for recovered resources and ensure regulatory compliance in the sector.
- Ensure planning and investment in waste and resource recovery infrastructure to provide adequate waste management resilience and continuity in response to disaster and other significant disruptive events.

"Waste and resource recovery infrastructure planning and investment will play critical roles in supporting future industry development and economic growth."

4. Food waste

The volume and value of wasted food present opportunities to further divert food waste from landfill and minimise losses throughout the food value chain.

A number of initiatives in South Australia currently contribute to food waste reduction and diversion from landfill, including:

- the application of the solid waste levy for all waste (including food waste) disposed to landfill
- dedicated facilities and infrastructure to process food waste into compost and other soil improvement products
- provision of kerbside food waste diversion incentives to councils
- segregated commercial food waste collection services available across metropolitan Adelaide
- anaerobic digestion for energy recovery and subsequent composting
- support for food recovery organisations such as Foodbank and Oz Harvest to divert fresh and non-perishable surplus food to charities.

Nationally, the Australian Government's National Food Waste Strategy requires each Australian state and territory to achieve a 50% reduction in food waste by 2030. This aligns with the United Nations Sustainable Development Goal 12.3: *'By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses'*.

In addition to diverting food waste from households, action will be required in the agricultural and commercial and industrial sectors to reduce food waste. Over-production, food spoilage (for example, due to logistical, storage or marketing and commercialisation factors), and wastage at point of sale all contribute to the problem. Collection systems, education, and possible legislative measures to reduce the amount of food waste disposed to landfill should be explored. In Massachusetts, a ban on the disposal of food waste is having significant effects on the amount of food waste diverted from landfill (Commonwealth of Massachusetts, 2018).

A Fight Food Waste Cooperative Research Centre (CRC) has been established to examine how to reduce food waste throughout the supply chain, transform unavoidable waste into innovative high-value co-products, and engage with industry and consumers to change behaviours.

Food waste

What happens if we don't take action?

- Food waste continues to create significant greenhouse gas emissions, both at the end of its lifecycle when it produces methane if disposed to landfill and through lost embodied resources.
- Internationally, it is estimated that one-third of all food is wasted between production and disposal.
- Energy, water, money and resources used to produce, process and transport the food continue to be lost in avoidable food waste.
- Costs to consumers: estimated food waste costs the Australian economy $20 billion annually (Australian Government, 2017).
- Opportunities to reduce food insecurity are lost.
- Continued over-production, food spoilage (for example, due to logistical, storage or marketing and commercialisation factors), and wastage at point of sale.

What is possible through action?

- ✓ Preventing organic material from going to landfill will preserve organic carbon and nutrients for more valuable uses in land management and food production.
- ✓ Diverting food waste to composting helps soil fertility and replenishes soil carbon and nutrient stocks, while mitigating climate change.
- ✓ Greenhouse gas savings and environmental benefits resulting from composting, including:
  - less energy needed for irrigation, due to improved water storage and water use efficiency
  - reduced demand for biocides (chemical substances including insecticides, disinfectants and pesticides used to control organisms that are harmful to health) will result in reduced greenhouse gas emissions associated with biocide production, due to improved soil and plant health
  - reduced diesel use for soil cultivation due to improved tilth
  - increased carbon sequestration from higher biomass production, due to improved soil productivity
  - reduced nitrogen loss that cause secondary nitrous oxide (N2O) emissions, due to lower nitrogen surplus and leaching
  - reduced erosion that causes loss of nutrients and organic matter and results in secondary N2O emission and those associated with replacing lost nutrients
  - less food insecurity and demand on natural resources.
- ✓ Social benefits, including support for welfare agencies.

Priority actions

Kerbside food waste diversion systems

- ➢ Provide continued financial support for roll out of area-wide, high-performing food waste collection systems.
- ➢ Pilot and evaluate models of alternative bin and collection systems for high-density dwellings where little or no garden waste is generated.

- Develop legislation to harmonise the three-bin system across all metropolitan councils and include fortnightly collection of co-mingled recyclables and fortnightly collection of organics, including food waste, as minimum services to all households.
- Work with councils to pilot more frequent collection of household organics bins.
- Research the effectiveness of kitchen caddy systems to support organic recycling.
- Require new or significant high-density developments to allocate sufficient area to store and access three-bin segregated waste and recycling services and/or vacuum technologies provided by council or private contractors.

Behaviour change

- Work with government and industry partners to research interventions that change behaviours to promote waste avoidance.
- Introduce a state-wide campaign to promote the three-bin system, including use of the green organics bin for food waste and home composting systems.
- Encourage home-based approaches for diverting food waste, including home composting, worm farms and feeding to poultry.
- Develop education and awareness tools for South Australian householders that support food waste prevention and recycling at home.

Precinct collections

- Develop and trial procurement of precinct organics collections from business premises within significant food retail areas.
- Evaluate precinct collection trials and broader application of the model.
- Investigate legislative options to:
    - restrict the disposal of organics from businesses to landfill
    - enforce food waste collection from businesses.

Events and out of home

- Adopt the minimum three-bin system for council-run or sponsored events.
- Mandate the use of compostable food service ware at events and for home delivery and takeaway food.

Food rescue

- Identify opportunities for and barriers to increased collection and distribution of surplus food through food rescue organisations, including where supply chains may be impacted (e.g. during natural disasters or other disruptive environmental, social and/or economic events).
- Support infrastructure to increase the recovery of high-quality surplus food for redistribution to those in need.

Infrastructure funding

- Provide financial incentives such as grants and loans to encourage the establishment and enhancement of resource recovery infrastructure, processes and technologies that divert food waste.

- Provide infrastructure support for anaerobic digestion and incorporating bioenergy recovery into processes where residual outputs are diverted to composting processes or applied to land following energy recovery.

Market support

- Support infrastructure investment in locally produced compostable Australian Standard-certified items.
- Support the development and expansion of viable and sustainable markets for composting products and outputs arising from the increased recovery of food and other organic wastes, including through standards, specifications and guidelines.
- Procurement of compost for public parks and gardens.

5. Plastics and packaging

The use of plastics has increased twenty-fold in the past half-century and is expected to double again in the next 20 years (Green Industries SA, 2019b). Due to their many functions and low cost, plastics have become ubiquitous and play an important role in our daily lives. For example, plastic packaging can assist in food safety and sometimes reduce food waste; bio-compatible plastics combined with 3D printing can support medical innovation; and light plastic materials used in the design of cars or planes can save fuel (Green Industries SA, 2019).

While they can deliver these benefits, the way plastics are currently produced, used and discarded has many drawbacks.

- Plastics production uses the same volumes of fossil fuels as the aviation sector, representing around 6% of global oil consumption.
- The amount of marine litter is increasing and affecting ecosystems, biodiversity and potentially human health (United Nations Environment Programme, 2016). Studies in the European Union (EU) have found plastic to be the main source of marine litter as it is almost non-biodegradable. It also has toxic and other harmful impacts.
- About 80% of marine debris arises from land-based sources (UNEP, 2016). Common marine litter items include glass and plastic bottles, cans, bags, balloons, rubber, metal, fibreglass, cigarettes and other manufactured materials, fishing gear such as line, ropes, hooks, buoys (CSIRO, 2016).
- Single-use plastics, and in particular plastic packaging, are widely available, persistent, and may enter the environment, and ultimately the marine environment, through littering.

These impacts are increasing each year as Australians generate more plastic waste.

The need to reduce the environmental, economic and social harm associated with plastics is widely recognised. Under target 14 of the United Nations Sustainable Development Goal, 'Conserve and sustainably use the oceans, seas and marine resources' (United Nations, 2015b), international governments have agreed to prevent and significantly reduce marine pollution from land-based activities by 2025. The EU announced in

late 2018 its intention to ban single-use plastic items such as plates, cutlery, straws, balloon sticks and cotton buds; for several other single-use items for which no current alternative exists, and which are not banned outright, it intends to impose reduction targets and associated timeframes (European Parliament, 2018).

The New Plastics Economy – Rethinking the future of plastics provides a vision for a system in which plastics never become waste (World Economic Forum and the Ellen MacArthur Foundation and McKinsey & Company, 2016).

In early 2019, the South Australian Government released two discussion papers, *Turning the tide on single-use plastic products* and *Improving South Australia's recycling makes cents*. These papers sought ideas about measures to protect the environment from impacts associated with single-use plastic products and to improve the effectiveness of South Australia's container deposit scheme.

Respondents strongly supported more measures to address single-use plastic products and government intervention. A report summarising feedback on the discussion paper is available on the YourSay and GISA websites.

There are policy options that could tackle problematic single-use plastic products, ranging from voluntary industry-led approaches to restricting market access for single-use plastic products for which suitable, lower-impact alternatives exist.

Legislation has been used successfully in South Australia to introduce the container deposit scheme and ban light-weight plastic bags. Similar legislation could be developed to provide a flexible and long-term framework that enables market restrictions on various single-use plastic products, with varying timeframes and impact assessments.

Further consultation – through a stakeholder working group of industry, business, local government and interest group stakeholders – has now informed associated impacts and the development of the Single-use and Other Plastic Products (Waste Avoidance) Bill 2020. The Bill was introduced to Parliament on 30 April 2020 and proposes to phase-out certain single-use plastic products.

Work will include progressing:

- Plastic-free precincts
- An immediate prohibition from sale, supply and distribution of plastic straws, cutlery and beverage stirrers following commencement of the legislation.
- Prohibition on single-use expanded polystyrene food service products detailed within the legislation, as well as oxo-degradable plastic, 12 months following commencement of the legislation.

Plastics and packaging

What happens if we don't take action?

- The potential economic and environmental benefits of a more resource-efficient and circular approach are not realised and the wasteful take-make-dispose economic model is sustained.
- Single-use plastics and plastic packaging continue to enter the environment, including the marine environment, through littering.
- If current trends continue, the ocean is expected to contain one tonne of plastic for every three tonnes of fish by 2025, and by 2050 more plastics than fish by weight. In addition to harming the environment (particularly wildlife impacts), marine litter damages activities such as tourism, fisheries and shipping (Green Industries SA, 2019b).
- Continued use of fossil feedstocks to produce plastics and packaging.
- Innovative opportunities in alternatives to single-use plastics unrealised.

What is possible through action?

- ✓ Less use of fossil feedstocks, which has a significant carbon impact.
- ✓ Reduced waste and litter in lands and waterways.
- ✓ Innovation opportunities in South Australia for market development and manufacturing alternatives to single-use plastics.
- ✓ Support for South Australia's more resource-efficient and circular approach, moving away from the wasteful take-make-dispose economic model.

Priority actions

- ➢ Implement the phase-out of single-use and other plastic products in South Australia.
- ➢ Investigate opportunities to reduce, minimise or eliminate single-use plastic products.
- ➢ Support Australian Government target of 100% Australian packaging to be recyclable, compostable or reusable by 2025, to be delivered by the Australian Packaging Covenant Organisation.
- ➢ Advocate for packaging to be covered by a regulated extended producer responsibility scheme under the *Product Stewardship Act 2011*.
- ➢ Introduce strategies to find replacements for single-use plastic products, including increasing South Australia's remanufacturing of these products.
- ➢ Review the container deposit scheme and investigate opportunities to further reduce container littering, increase resource recovery and support a circular economy, and continue to embed product stewardship obligations.

"Single-use plastics, and in particular plastic packaging, is widely available, persistent, and at best prone to disposal to landfill rather than recycling and at worst prone to littering where it may enter the environment, and ultimately the marine environment."

Priority actions by waste stream

Municipal solid waste

The draft Waste Strategy encourages action to recapture South Australia's leadership in municipal solid waste (MSW) resource recovery, including through actions detailed to support high-performing kerbside household bin systems as articulated on page 48.

Continued and consistent effort in educating householders and making producers responsible for their waste are also needed.

Examination of kerbside recycling and other services solely within an assessment of their financial costs does not consider their total financial, environmental and social costs and benefits. Benefits may include avoided costs from air and water pollution associated with landfill, avoided manufacture from virgin materials, reduced global warming impacts, and landfill disposal saving.

Standardising efforts across council areas can increase collaboration and maximise resources in technology and operational savings, better collection and sorting systems, and consistent education messaging. Further, standardisation and mandatory reporting of waste management and recycling collection data could help councils understand where cost savings could be realised. To support progress in this sector, the draft Waste Strategy proposes that a minimum diversion of 55% from household three-bin systems by 2022 be adopted for the metropolitan area, with an overall MSW diversion stretch target of 70% to be achieved by 2025. This will be challenging but it provides stimulus for action.

Increasing MSW diversion will also require encouraging diversification of materials captured and processed for recycling such as soft film plastics and packaging and a range of problematic materials including batteries, electronic waste (e-waste) and hazardous wastes.

Regional areas, including Aboriginal land holdings and outback areas

Considering the challenges in addressing recycling trends in non-metropolitan areas, it is suggested that defined intentions rather than set targets are retained.

Recycling and other waste management initiatives are often difficult to implement and sustain due to the dispersed nature of communities in regional and remote South Australia. This difficulty is often exacerbated by community priorities and expectations, as well as limited funds and resources.

Two key reports prepared by Green Industries SA outline the issues in Aboriginal land holdings and outback areas: the 2011 *Waste Management in the Anangu Pitjantjatjara Yankunytjatjara (or APY) Lands, Past, Present and Future,* known as 'The Rubbish Report', and *The Outback Waste Management Report*' (2012). Both reports provided recommendations for a strategic approach to reducing waste (including beverage containers, white goods and car bodies), increasing resource recovery, improving landfill management and promoting awareness of recycling practices across the APY Lands and in outback areas.

The success of any waste management or related initiative in these regions will require ongoing management and funding provision.

Municipal solid waste

What happens if we don't take action?

- Lost opportunities to improve diversion of materials including green organics and food organics.
- Existing kerbside diversion systems underused.
- Inconsistent collection services across metropolitan Adelaide.
- Contamination of separated materials in kerbside bins.
- Poor upfront planning in waste and recycling services.
- Minimal community awareness and adoption of required behaviour changes.
- Potential savings unrealised.

What is possible through action?

- ✓ Harmonised bin collection systems across metropolitan Adelaide.
- ✓ More diversion of material recovered from residual bins in existing systems.
- ✓ Progress in meeting National Food Waste targets.
- ✓ Reduced contamination of source-separated recycling enabling a better quality recycling stream.
- ✓ Community more aware of wasteful consumption and effective recycling and able to divert more material from the kerbside.
- ✓ Better waste-management planning for waste and recycling services in developments.
- ✓ Diversifying the type of materials capable of being diverted from households through the kerbside recycling bin.

Priority actions

Systems and technology

- ➢ Increase material diversion rates through provision of harmonised bin-based collection services and frequency of service across metropolitan Adelaide, including the regulatory introduction of minimum service standards for organics and recyclable collections.
- ➢ Continue to advocate for standardisation in collections and contracts across councils.
- ➢ Monitor and review kerbside collection systems to ensure maximum performance.
- ➢ Introduce mandatory minimum fortnightly collections for kerbside collected recyclables and organics in all councils.
- ➢ Improve flexibility for councils relating to the frequency of collections and variable price charging for residual household waste.
- ➢ Promote reduced contamination of source-separated systems.
- ➢ Encourage increased diversion of materials arising from hard waste services, street sweepings, waste collected at drop-off facilities, and council-operated commercial services.

- Support new technology for residential and mixed-se developments (for example, vacuum systems and cross-development and precinct infrastructure).
- Implement better contracting and monitoring for household collection services, including application of technology such as Radio Frequency Identification (RFID) and communication technologies for wheelie bins and truck monitoring systems, and website applications which provide data to households.
- Encourage planning in response to disaster and other disruptive events to ensure continuity of waste management services and/or adapting to changed waste management requirements.

Food waste

- Adopt and support the National Food Waste Strategy 50% reduction target by 2030 by promoting food-waste prevention measures.
- Encourage the uptake of food waste collection systems, including potential for legislative reform to increase the recovery of this material.

Planning

- Promote and encourage developers, architects, planning authorities, waste consultants and industry and strata and community corporations to adopt the 'Better Practice Guide Waste Management in Residential or Mixed Use Developments' relating to waste and recycling services in higher density urban living.
- Review best-practice waste management guidance for residential and mixed-use developments and investigate options to mandate its use for all new high-rise developments.

Recovery

- Diversify the type of materials captured and processed for recycling such as soft film plastics, packaging, batteries, e-waste from the kerbside recycling bin.
- Advocate for national solutions to problematic wastes such as packaging and hazardous wastes and consider state-based solutions if required.

Legislative reform

- Support the continued implementation of the Environment Protection (Waste to Resources) Policy.
- Develop and implement waste-reform initiatives such as mass balance reporting, waste levy collection, assessment of waste-derived materials, stockpile management controls, product bans, and landfill bans.
- Maximise recycling efficiency at all stages (collection, preprocessing – including separation and sorting – and end processing) to reduce material losses.

Regional areas, Aboriginal land holdings and outback areas

- Advocate for ongoing action and responsibility to enable coordinated and integrated waste management in regional areas, Aboriginal land holdings and outback areas.
- Encourage systems to reduce litter and improve waste management in regional areas, Aboriginal land holdings and outback areas, including the recovery of resources such as beverage containers, white goods and car bodies.
- Support awareness activities for sustainable waste management practices within the APY Lands.

Waste generation reduction: behaviour change

- Support coordinated and integrated householder recycling education campaigns and use innovative approaches to inform households and increase awareness of wasteful consumption, effective recycling and reducing contamination.
- Engage the community and business in opportunities involving collaborative consumption, industrial symbiosis, re-localisation, re-manufacturing and re-making to work towards a circular economy.
- Investigate online platforms to map waste avoidance and collaborative consumption and production activities.
- Encourage the engagement of policy makers, community leaders and businesses looking to develop strategies to incorporate circular economy thinking into their practices.

"Standardising efforts across council areas also has the potential to increase collaboration and optimisation of resources and effort."

Commercial and industrial waste

The commercial and industrial (C&I) sector is dispersed, diverse and competitive. Limitations on resources, staff and expertise can be barriers to introducing changes and managing waste, while markets for materials may be underdeveloped.

The greatest opportunity for change in the sector is through increasing the recovery of food waste.

Encouraging the use of recycling systems, resources and tools for workplaces to assist with ongoing awareness in resource recovery will also be important.

Additionally, supporting the draft Waste Strategy's objectives in Sustainable Procurement, particularly within government, will be crucial.

Continued support to priority industries and sectors requiring business sustainability assistance will also be vital.

Commercial and industrial waste

What happens if we don't take action?

- Markets for materials underdeveloped.
- Dispersed and highly varied collection arrangements and processing infrastructure.
- Opportunities to divert food waste not addressed.

What is possible through action?

- ✓ Improved separation of materials.
- ✓ Increased diversion of food waste.
- ✓ Sustainable procurement actions supported.
- ✓ Improved economies of scale in collections.

Priority actions

- Encourage improved source separation, collection systems (including weight-based charging and precinct based collection routes) and sorting infrastructure.
- Support Food Waste priority actions.
- Reduce barriers to industry and government use of recycled materials in projects or products.
- Encourage all levels of government to consider adopting Sustainable Procurement practices and policies that increase the use of re-manufactured products and coordinate procurement efforts to achieve economies of scale and strengthen recycling markets.
- Develop a waste strategy for the South Australian Government.
- Identify solutions to achieve diversion in regional areas.
- Support the continued implementation of the Environment Protection (Waste to Resources) Policy.
- Develop and implement legislative waste reform initiatives such as mass balance reporting, waste levy collection, assessment of waste-derived materials, stockpile management controls, product bans, and landfill bans.
- Encourage the use of recycling systems, resources and tools for workplaces to promote awareness.

- Work with economic development agencies to support sustainable activity in key sectors and new business opportunities to build a circular economy.
- Embed waste reduction and management practices in tertiary, vocational education and training courses.
- Mandate compliance with waste minimisation guidelines for State Government-managed or funded events.
- Promote procurement of sustainable and re-manufactured materials and products, especially in the government sector.
- Identify and support priority industries and sectors requiring business sustainability assistance.
- Encourage improved processes during commercial 'strip-outs' and refurbishments to support increased resource recovery and material reuse.
- Encourage consolidation of collection and infrastructure development in precincts.
- Investigate opportunities to increase food-waste recovery, including consideration of possible legislative measures.
- Encourage planning in response to disaster and other disruptive events to ensure continuity of waste management services and/or adapting to changed waste management requirements.

"The greatest area to encourage step change in the Commercial and Industrial sector is through investigating opportunities to increase the recovery of food waste."

Construction and demolition waste

The segregation of materials on building and construction sites to increase waste diversion will require continued efforts. The removal of barriers to market, such as the development of specifications, will also be important.

Deconstruction will be another focus. Deconstruction is an alternative to demolition that enables materials to be kept intact and separated to maximise the amount that can be reused and recycled, so reducing the amount disposed to landfill.

NSW has adopted requirements for house deconstruction and has shown the economic benefits possible through income generation and the reduced costs associated with deconstruction and landfill disposal (NSW Environment Protection Authority, 2010).

US case studies have also demonstrated benefits including significant job creation, better employment conditions and educational opportunities (Ellen MacArthur Foundation, 2013). In Japan, a new deconstruction technique enabled the recovery of 99% of the steel and 92% of the concrete from a building (Ellen MacArthur Foundation, 2013).

In the first part of 2020, South Australia's construction and demolition waste industry has been a significant contributor in ensuring the safe and efficient removal of waste debris following the 2019-20 bushfires experienced in areas across the state. The learnings from this event will assist informing an update to South Australia's Disaster Waste Management Capability Plan and Guidelines.

Construction and demolition

What happens if we don't take action?

- Continued barriers to market for secondary and processed materials.
- Poor operating standards regarding source-separation materials on site, resulting in contaminated, mixed or 'unclean' waste streams and fewer opportunities for diversion or reuse.
- Poor planning and management of waste and recovery during building demolition
- Poor understanding of new materials used during construction, including how these can be recovered at their end-of-life.
- Material savings and cost savings in construction.

What is possible through action?

- ✓ Better practice standards for built environment.
- ✓ Increased use of sustainable building materials.
- ✓ Better segregation of materials on site.
- ✓ Using sustainable procurement to create market opportunities for construction and demolition materials.
- ✓ Effective and efficient safe removal of waste debris resulting from disaster events.

Priority actions

- Addressing procurement issues, including barriers to market such as the development of specifications.
- Ensuring segregation of materials on build sites to increase waste diversion of uncontaminated materials.
- Understanding how the increasing uptake of 'prefabricated' and new material components in the construction of commercial and residential projects will impact on waste recycling.
- Integrating deconstruction requirements into planning processes and decisions, including ensuring site surveys are undertaken and approved by councils before deconstruction.
- Monitor and report waste generation and destinations for recovered materials from building sites.
- Embed deconstruction principles into tertiary, vocational education and training courses to maximise the full opportunities in building deconstruction and design.
- Encourage the responsible use of secondary materials such as concrete, aggregates, and fill materials.
- Support the continued implementation of the Environment Protection (Waste to Resources) Policy.
- Develop and implement legislative waste-reform initiatives including mass balance reporting, waste levy collection, assessment of waste derived materials, stockpile management controls, product bans, and landfill bans.
- Develop standards for 'design of the built environment' practices and the adoption of sustainable building materials.
- Support adaptive reuse and retrofitting of existing building stock where possible.
- Develop operating standards to encourage better salvaging and re-use of building materials.
- Update South Australia's Disaster Waste Management Capability Plan and Guidelines informed by learnings of the 2019-20 bushfires clean-up response.
- Encourage planning in response to disaster and other disruptive events to ensure continuity of waste management services and/or adapting to changed waste management requirements.

"Deconstruction will be another focus. Deconstruction is an alternative to demolition that enables materials to be kept intact and separated, to maximise the amount that can be reused and recycled, so reducing the amount disposed to landfill."

Other priority actions (relevant to all streams)

Natural disasters and other disruptive events

Natural disasters, and particularly large-scale natural disasters, can generate quantities of waste that vastly exceed the capacity of the affected area to manage the impacts, and which threaten public health, hinder reconstruction and impact the environment. Disaster waste management affects almost every aspect of an emergency response as well as the long-term recovery of a disaster-affected area. If planned in advance and managed effectively, the risk to the environment and health of such disasters can be prevented or minimised. At the same time, generated waste can contribute to the disaster recovery and rebuilding process, and may have a positive effect on social and economic recovery.

In 2016, Green Industries SA completed a Stage 1 Disaster Waste Management Scoping Study with funding support from the Australian Government. The study examined whether South Australia had in place disaster waste management practices and an associated regulatory framework, and developed waste profiles for selected flood, severe storm, earthquake and bushfire scenarios. It found that there is no framework for managing disaster waste in South Australia, and that disaster waste management practices have been largely reactive with little pre-planning.

With the support of Australian Government Natural Disaster Resilience Program funding, Green Industries SA commenced Stage 2 work in 2017-18. This resulted in the development of a Disaster Waste Management Plan and associated practical guidelines and an implementation plan. The project is the first of its kind in Australia.

Other disruptive events, such as significant changes to international markets and global pandemics, also have the ability to interrupt or change waste requirements and services.

On 30 January 2020, the World Health Organization declared the Coronavirus disease (COVID-19) outbreak a Public Health Emergency of International Concern (World Health Organization, 2020). For many parts of South Australia and globally, this is impacting the waste system in various ways. Perhaps for the first time, a recognition that waste management is (or at least should be) designated as an essential service alongside the likes of power and water supply has emerged strongly. In response to the pandemic, the sector has initiated business continuity measures, including risk mitigation and prevention for its workforce to ensure waste and recyclables continue to be collected and responsibly managed. While the response is regularly changing, some of the impacts have included:

- Operational and logistical adjustments to maintain services.
- Closure of or reduced operations of waste and resource recovery management facilities, sites and transportation.
- Increased waste volumes generated in some sectors (including supermarkets, health care services and households) requiring changed or increased waste requirements.
- Changed practices in handling of waste resulting from COVID-19 in hospitals and within households.

- Decreased waste volumes in some sectors where facilities or services are closed or limited. This may be affecting parts of the commercial and industrial sector, including offices, restaurants and cafes, schools and child care services, and events and venues.
- On demand services provided by local government may be reduced (for example, hard waste collections; street sweepings).
- Limited availability of personal protective equipment for those delivering waste services.
- Reduced or changed supply chains for food rescue organisations due to increased customer demand of groceries and perishables, reducing the availability of items for food donation.

This highlights a need to ensure the appropriate framework, tools and support measures are in place to ensure continuity of service delivery in waste management, ensuring compliance with public health and safety and ensuring flexibility in responding to changed waste generation volumes of patterns and available services and infrastructure.

Retaining waste management as a core focus for disaster preparedness and planning will remain as a priority area.

Natural disasters and other disruptive events

What happens if we don't take action?

- Inadequate preparedness, response and recovery following disaster situations, including in responding to increased or changed waste generation volumes or patterns and available services and infrastructure.
- Recovery and reconstruction efforts threatened.
- Impacts on the environment.
- Lack of clear roles and responsibilities in disaster waste management.
- Closure of or reduction in essential waste management services.
- Poor public health and safety outcomes.

What is possible through action?

- ✓ Capabilities for disaster resilience are built through clear responsibilities, more accessible information and greater understanding of disaster waste management issues.
- ✓ Improve outcomes by building capacity within individuals and organisations to undertake waste management activities.
- ✓ Provide local employment opportunities.
- ✓ Innovation in delivering new or changed business models, products and services associated with waste management services and infrastructure in response to disasters and emergency events.
- ✓ Prevention of or reduction in impacts of waste management in natural disasters, including through saving lives, alleviating suffering, facilitating rescue operations and minimising harm to the environment and human health.

- ✓ Waste becomes a useful resource in rebuilding and a positive effect on local employment, social and economic recovery.
- ✓ Decision-making processes, roles and responsibilities are clear and defined, including the activities to responsibly manage the waste, and the level of support the State Government can provide to help affected communities and stakeholders.
- ✓ The scale of waste impacts following a disaster is understood.

Priority actions

- Encourage waste management to be included as part of disaster preparedness and planning, including natural disasters and other events which have the ability to disrupt normal waste services.
- Develop framework and tools to support responding to changes caused by any emergency event having the ability to disrupt or change essential waste services.
- Encourage opportunities for recycled products to rebuild infrastructure in affected communities.
- Develop a framework and tools to gather and measure data and the intelligence to estimate debris volumes or changed waste generation patterns.
- Encourage new or changed business models, products and services in delivering essential waste management services and infrastructure for affected communities.
- Make available more information about disaster or emergency event waste management issues.
- Establish community education and engagement activities to support responsible waste management following emergency events.
- Update South Australia's Disaster Waste Management Capability Plan and Guidelines, informed by learnings of the 2019-20 bushfires clean-up response.

Finding solutions for emerging and problematic wastes

'*Like many of the background systems we take for granted, such as the supply of water, electricity and gas to our homes and the weekly rubbish collection, along with the roadways that enable our car-based commute to and from work, we seem to be able to focus only on the "consumption phase" in the life cycle of any particular domain. Everything outside the parameters of what we now take for granted becomes "somebody else's problem", something perhaps "they" should do something about sooner or later.'*
(Lehmann and Crocker, 2012)

Technology change and its rapid rate of obsolescence – which, at its heart, may involve intentionally designing products with limited life spans – presents challenges. Additionally, the supply of household solid waste grows proportionally with populations (van Beukering et al, 2014). Patterns of waste generation change, and so do the types of chemicals and materials used to make the products we buy. Increasing material complexity (bio-composites, conductive polymers, nanotechnology, electronics and more) adds to these challenges as current recycling processes cannot extract all the components from purchased products.

Over the past decade, there has been a growth in electronic waste, largely due to the significant growth curve of new electronic technologies combined with planned obsolescence. Under the Australian Government's *Product Stewardship Act 2011*, televisions, computers and computer peripherals became the first products to have their disposal regulated. The National Television and Computer Recycling Scheme involves a combination of government regulation and industry action to take responsibility for the collection and recycling of these items.

More recently, an observed increased uptake in photovoltaic cells (PVC), has led the Australian Government to list PVC as a priority product under consideration for a product stewardship approach.

While product stewardship provides a framework to manage the environmental, health and safety impacts of products, it alone cannot shift society from the linear 'take, make and dispose' model. Solutions are needed for future waste streams at the point of design and before a product reaches the consumer market.

The draft Waste Strategy highlights that we must recognise that the products and their components being made and used today will become the waste of the future.

For example, global consumption of and waste associated with textiles and clothing are growing, predominantly due to increased clothing production and decreased clothing utility (Ellen MacArthur Foundation, 2017). Opportunities within this industry should be investigated to ensure that clothing, textiles and fibres are kept at their highest value and utility.

In other areas, the focus must shift to potential waste streams at the design phase, in the construction of our homes and workplaces, construction of our vehicles, and manufacture of other products we use daily, including single-use items such as plastics and packaging (discussed below).

In a circular economy, products are designed for repair, reuse, disassembly, and eventually recycling. This goes beyond traditional approaches to product stewardship within Australia, which have historically focussed on end-of-life product management. It requires a shift in the producer responsibility further up the waste management hierarchy to consider the environmental consequences of making, using and disposing of a product, and for a value to be placed on the product when it has reached its end of life.

Problematic wastes

Under the National Waste Policy, the Australian Government leads a national approach to product stewardship. The *Product Stewardship Act 2011* provides the framework to effectively manage the environmental, health and safety impacts of products, and in particular those impacts associated with the disposal of products. The framework includes voluntary, co-regulatory and mandatory product stewardship.

The Australian Government is continuing to work with state and territory governments and industry to consider possible product stewardship approaches for products. National solutions are in place for a range of products including paint, mercury containing lamps, computers and televisions, and tyres. Solutions should also be identified for products such as batteries (including electric vehicle batteries and stationary batteries), wastes associated with renewable technologies (such as photovoltaic systems and fibreglass from wind turbines), electrical and electronic products, and plastic oil containers.

The Environment Protection Authority has started work relating to the banning in South Australia of hazardous materials such as certain perfluorinated chemicals and of substances such as firefighting foams containing 'PFOS' and 'PFOA' to eliminate contamination risks to waterways and groundwater.

Green Industries SA has invested in establishing four permanent facilities in metropolitan Adelaide and will significantly support priority actions within the final 2020-2025 Waste Strategy to support the recovery of hazardous waste.

"The draft Waste Strategy highlights that we must recognise that the products and their components being made and used today will become the waste of the future."

Finding solutions for emerging and problematic wastes

What happens if we don't take action?

- Responsibility for environmental impacts involved in the production, handling, purchasing, use and end-of-life management of products not defined.
- Poor planning and understanding of future waste materials at the point of design.
- Lost opportunities to encourage products to be designed applying circular economy principles for repair, reuse, and disassembly, and eventually recycling.
- The potential economic and environmental benefits of a more resource-efficient and circular approach are not realised and the wasteful take-make-dispose economic model is sustained.
- Consumers are not provided with convenient and accessible disposal options for a range of materials.
- Valuable material that could be brought back into the economy is lost.
- Continued disposal of problematic waste materials to landfill or more frequently disposed through drainage systems or directly to the environment (such as paint or oils), or devaluing the collection of other recycling streams through contamination.
- Shared responsibility of manufacturers, importers, governments and consumers in managing the impacts of a product.
- Estimated five-fold growth in clothing sales by 2050 will have significant economic, environmental and social costs (Ellen MacArthur Foundation, 2017).

What is possible through action?

- ✓ Manufacturers, importers, governments and consumers share responsibility for managing the impacts of a product.
- ✓ Product management of end-of-life disposal considered in all stages of product research and development.
- ✓ Easier access to convenient and safe collection and disposal for problematic waste materials.
- ✓ Fewer hazards, injuries and health impacts because less toxic alternatives are used.
- ✓ Management and remediation of waste fill and intermediate level contaminated soils.
- ✓ Rare and valuable materials are recovered.
- ✓ Easier access to convenient and safe collection and disposal of problematic waste materials.
- ✓ Waste fill and soil contamination are minimised, managed and remediated.
- ✓ Better understanding of design needs for products and market development.

Priority actions

Product stewardship

- ➢ Encourage product stewardship frameworks to extend beyond traditional approaches to managing disposal to those that encourage design for repair, reuse, disassembly, and eventually recycling.
- ➢ Recognise the role and responsibility of business and industry in the development and implementation of product stewardship schemes.

- Advocate for packaging to be a regulated extended producer responsibility scheme under the *Product Stewardship Act 2011*.
- Make business and industry responsible for the development and implementation of product stewardship schemes.

Textiles

- Research opportunities that may reduce the generation of textile waste and increase the recovery of textiles.
- Advocate for approaches that motivate individuals to dispose of unwanted textiles in a responsible manner.

Problematic wastes

- Provide convenient drop-off facilities for unwanted and hazardous household and farm materials.
- Encourage the recovery and treatment of oils, solvents and other valuable materials for reuse.
- Reduce hazards through hazardous waste collection, recycling and appropriate disposal.
- Encourage reuse of waste fill and intermediate level contaminated soils where appropriate as a priority and remediate low level and high level contaminated soils for reuse.
- Reduce hazards through waste collection, recycling and appropriate disposal.
- Encourage the use of less toxic alternatives in industry and in households.
- Promote the adoption of Extended Producer Responsibility, including state-based approaches where considered necessary, and encourage continuous improvement in existing producer responsibility and related schemes, for example in relation to televisions and computers (e-waste), packaging, gas bottles, batteries (including from electric vehicles), wastes associated with renewable technologies (including photovoltaic systems and fibreglass from wind turbines), tyres, hazardous wastes, mattresses and rare earth elements and compounds.

Waste reform, litter and illegal dumping

In South Australia, significant work has been undertaken through reforming the regulatory settings for the waste management and resource recovery industry to achieve industry certainty and improved environmental outcomes.

The *Environment Protection (Waste Reform) Amendment Act 2017* (Waste Reform Act), for example, took effect in November 2017; it provides strengthened powers under the *Environment Protection Act 1993* (EP Act) through:

- explicit powers to regulate material flow and stockpiling through amendments to the Objects of the EP Act and new powers regarding stockpiling conditions
- expanding the circumstances in which financial assurances (including insurance) can be used to protect against environmental, abandonment and distortion risks while supporting innovation
- improving the processes and evidentiary requirements to assess materials as approved recovered resources, to support innovative and safe resource recovery
- improving powers for tackling breaches of licence conditions
- strengthened powers for the EPA to prosecute illegal dumping cases.

The Waste Reform Act's amendments are considered the necessary first legislative step to empower the EPA to address further pressing waste reform issues, including mass balance reporting, stockpile management controls and the assessment of waste-derived materials.

The waste levy is an important economic tool for managing waste, encouraging recycling and funding environmental initiatives. The levy provides an incentive to reduce the amount of waste sent to landfill and is critical to ensuring resource recovery activities remain viable. It also provides a financial incentive for industry to seek alternatives for the disposal of waste and to facilitate investment into future technologies, processes and resource recovery systems in South Australia.

Defined incremental increases to the levies have been pursued to improve waste management practices and encourage resource recovery and reuse.

In South Australia, there is no longer a levy on the disposal of packaged asbestos and a reduced levy applies to the disposal of waste from donations to charitable recyclers. Important areas for consideration include the optimal use of the waste levy to address materials including clean fill, shredder floc, the use of materials for landfill cover (for example, for 'organic' material where it does not meet the Australian Standard for Composts, Soil Conditioners and Mulches – 4454) and waste diverted to waste to energy facilities.

"Significant work has been undertaken through reforming the regulatory settings for the waste management and resource recovery industry to achieve industry certainty and improved environmental outcomes."

Waste reform, litter and illegal dumping

What happens if we don't take action?

- Uncertainty and an unfair playing field.
- Continued issues including:
    - static or growing stockpiles
    - potentially reusable 'fill materials' ending up at landfill due to development pressures
    - illegal dumping
    - waste promoted as 'product' and waste levy avoidance
    - issues around ensuring environmental risks not properly tested
    - problematic wastes not managed appropriately.
- Poor amenity and potential for decreasing land and property values.

What is possible through action?

- A framework to provide the right settings to protect the environment, balanced with supporting the economic potential from the waste and resource recovery sector.
- A level playing field.
- Optimal operation of the waste levy, reflecting real costs.
- Continued focus to encourage greater resource recovery, rather than disposal of recoverable resources to landfill.

Priority actions

- Review financial instruments, penalties and on-the-spot fines to reflect real costs and impacts.
- Support the continued implementation of the Environment Protection (Waste to Resources) Policy.
- Continued development and implementation of waste reform initiatives including in relation to mass balance reporting, waste levy collection, assessment of waste derived materials, stockpile management controls, product bans and landfill bans.
- Implement litter reduction strategies and public place recycling.
- Preventing the development of new landfills to service metropolitan Adelaide.
- Apply financial instruments to drive change.
- Provide education, enforcement action and disincentives for dumping.
- Encourage councils to work with the Environment Protection Authority on measures to support illegal dumping prevention and prosecution and enforcement of clean-up costs.
- Ban from landfill materials that could be disposed of through strongly performing markets, having regard to metropolitan and non-metropolitan contexts.
- Identify and maximise opportunities to increase awareness and link environmental values with reduced litter, illegal dumping and associated impacts.
- Continue work through the Australian Government under the National Waste Policy and *Product Stewardship Act 2011* to advocate for better national systems in relation to e-waste, hazardous materials and product stewardship.

Competitiveness and innovation

South Australia has a vision to be internationally recognised as a leader in green industry development, the circular economy and recycling and resource recovery. Supporting innovation and business are vital to achieving this vision. Green Industries SA's Commercialisation of Innovation Program facilitates investment in globally relevant technologies and innovations.

Developing opportunities for South Australian businesses to export their expertise and develop solutions that are fit-for-purpose in other jurisdictions will contribute to growth in green industries sectors.

Leadership training and certification in the waste management sector will also be a continued focus area. An example is Green Industries SA's Global Leadership Program on the Circular Economy, which was launched at the Eighth Regional 3R Forum in Asia and Pacific, in Indore, India, in April 2018. The program facilitates business-to-business introductions to influential Asia Pacific decision-makers in environmental sectors.

Competitiveness and innovation
What happens if we don't take action?

• Missed opportunities to:
  ○ drive innovation, technologies and research into long-standing waste issues, which could contribute to a circular economy
  ○ drive potential economic benefits for South Australia in commercialising this growth.

What is possible through action?
✓ Build on South Australia's leadership and global reputation in green industry and resource recovery. ✓ Waste and resource recovery sector growth through innovation, investment in technologies, and market support. ✓ Helping businesses find markets for their technologies and services. ✓ Reducing South Australia's dependence on overseas exports of recyclable materials and import of technologies. ✓ Building knowledge and upskilling industry professionals.
Priority actions
➢ Encourage and promote the development of sustainable local, national and international markets for re-manufactured and recycled products. ➢ Help businesses find overseas markets for their waste management knowledge and skills. ➢ Identify support opportunities for business, such as national and state-based initiatives and grants that can assist businesses in relation to waste and resource efficiency. ➢ Help businesses reduce their costs through more efficient use of raw materials, water, energy and reduced trade waste disposal.

- Promote innovation in business sustainability and encourage industry-to-industry links, collaborative consumption (for example shared access/monetisation of underused assets) and supply chain initiatives for local benefits, including job creation.
- Identify business leaders who can assist with industry education and generate change across sectors and through supply chains.
- Attract and encourage business to develop and grow new, high value-added re-manufacturing enterprises.
- Investigate the potential for web-based platforms and/or mobile applications and processing technology to foster progress in generating a circular economy.
- Reduce South Australia's dependence on overseas exports of recyclable materials through enhanced reprocessing and re-manufacturing into new products for domestic consumption.
- Support the commercialisation of technologies and innovations in the waste management and resource recovery sector.
- Encourage collaborative platforms that bring together researchers, sector case studies and pilot industry projects that support progress towards a circular economy.
- Support the development of soft infrastructure, skills and capabilities to attract infrastructure investment and growth towards a circular economy.
- Support the development of programs for the waste and resource management industry to build knowledge and upskill industry professionals.

"Green Industries SA provides investment support … to facilitate the growth and establishment of globally relevant technologies and innovations."

Research and development

As we extend our knowledge and focus on transitioning to the circular economy, we begin to extend beyond known approaches to recycling and re-use. Research will underpin and inform how we address the challenges of wasteful consumption, change behaviours, and develop new technologies to address emerging challenges. Research priorities will be evaluated over time.

Research and development

What happens if we don't take action?

- Missed opportunities to develop and introduce evidence-based technologies to change waste management and resource recovery and reuse processes.
  Forced to rely on a poor evidence base to support long-term behaviour change in waste management and the circular economy.
- Inadequate planning for tertiary and training needs to build knowledge and capacity to perform future roles, particularly in the circular economy.
- Missed opportunities to connect elements of waste management and progressing a circular economy to other research disciplines.
- Loss of talent to other jurisdictions.

What is possible through action?

- ✓ Build an evidence base to support positive, long-term behaviour change, innovation and policy responses to support a transition to a circular economy.
- ✓ Establish collaborative research projects to bring together knowledge about elements of waste management, progressing a circular economy and behaviour change from a multitude of academic disciplines, from architecture to childhood development, while considering social, environmental and economic aspects.
- ✓ Build development, training and tertiary qualification opportunities and graduate capacity in circular economy, waste management and resource recovery.
- ✓ Encourage collaboration in research projects across tertiary institutions, nationally and internationally.
- ✓ Encourage local businesses to find solutions and opportunities.

Priority actions

- ➢ Identify changes within a product's lifecycle with major effects on energy, waste and materials use and greenhouse gas production.
- ➢ Attract funding partners, such as the Australian Research Council and industry, for research projects.
- ➢ Foster relationships between industry and government, capitalising on government research and innovation capabilities.
- ➢ Encourage the development of graduate and post-graduate capacity and accredited training.
- ➢ Research sustainable behaviour change and apply findings to waste generation, production and consumption.
- ➢ Support research into durable products or components that encourage re-use and refurbishment.

- Support research into new economic and business models in the circular economy.
- Encourage industry to analyse the flow of materials and other resources in a product's lifecycle.
- Encourage research into emerging waste streams.
- Encourage application of the research into new innovations.
- Identify, recognise and adopt testing, research and standards developed in other jurisdictions in relation to sustainability, waste issues and the circular economy.
- Commercialise research solutions, technologies and designs that improve sustainable outcomes.

Energy from waste

'Energy from waste' (or 'waste to energy') is a method of treating waste to recover energy from its components, and can significantly reduce the volume of materials that require landfill disposal. The technology comes in different forms, the most common being mass burn incineration, gasification, anaerobic digestion, biogas, refuse-derived fuel and pyrolysis.

A diverse range of waste streams is being targeted to produce energy. Calorific material that would otherwise be recycled (often over several or more cycles) may be burned or processed for a one-off energy dividend. Recycling and reuse are placed higher on the waste management hierarchy than energy recovery.

The efficiency of energy conversion greatly depends on the composition of the input feedstock and the specific type of energy from waste technology employed. In general, this energy conversion efficiency is lower than for typical facilities generating energy from fossil fuels.

For some 'energy from waste' processes, the business case is focussed on the fee for receiving and processing the waste (known as the 'gate fee') rather than on-selling energy into the grid. These processes can also generate by-products such as fly ash, char, slag and residues that need to be disposed of, in some cases through specialised hazardous waste facilities.
Due to high capital and operating costs, technologies such as thermal combustion plants typically require long-term (20 years or more) contracts that 'lock in' a secure supply of feedstock material. Locking-in feedstock materials over such a long period of time prevents the adoption of new tools or technologies that may emerge during the term of the contract.

The South Australian Environment Protection Authority (EPA) released its *Consultation Draft EPA Position Statement: Thermal Energy from Waste Activities* (EPA, 2019b) in April 2019. This followed consultation in 2017 on a previous paper, *Enhancing resource recovery and discussing the place of energy recovery,* which attracted feedback from industry, local government and peak bodies.

The EPA's draft position statement provides direction about:

- where and by whom 'energy from waste' technologies are used and the policy frameworks that apply
- how such proposals could be adopted in South Australia, including:
    - to safeguard the community and protect the environment by managing potential impacts (such as siting, air quality, noise and odour) from waste management
    - how to achieve maximum resource recovery
    - the role of the waste levy.

A National Waste Working group representing the heads of all state and jurisdictional EPAs (HEPA) also plays a role in supporting the development of 'energy from waste' national principles.

This Waste Strategy advocates for continued work to ensure 'energy from waste' activity and targets align with the waste hierarchy and are framed within a long-term circular economy perspective

that prioritises the prevention, reuse and recycling of waste materials.

Green Industries SA maintains there are considerable employment and economic benefits associated with resource recovery, if there is source separation of materials and where materials are circulated in the economy through reuse and remanufacturing.

As noted by Circle Economy (2017), technologies and processes such as landfill disposal and energy from waste can provide the foundation for linear consumption patterns, whereas contemporary waste management approaches such as reuse, remanufacturing, refurbishment and material recycling promote higher-value loops and promote a more circular economy. The *Creating Value, the Potential Benefits of a Circular Economy in South Australia* paper recommends more source separation of biogenic materials (organics) from other anthropogenic materials such as metals, paper, and plastics in order to maximise reuse. However, it is acknowledged that there will be a percentage of unrecoverable mixed residuals remaining within a transitioning or even an established circular economy.

The State Government will continue to promote the evidence-based view that 'energy from waste' should support viable options for higher-order beneficial uses while considering the impacts on businesses and supply chains that compete for the same feedstock materials. This Waste Strategy continues to support the efficient recovery of energy from residual waste and niche waste streams through the use of the best available technologies for local conditions. This may include small-scale anaerobic digestion plants and regional bio-gas facilities. The result will be environmental benefits and job and economic opportunities.

Energy from waste

What happens if we don't take action?

- Potential economic losses by industry due to investments in waste treatment assets not aligned with a long-term circular economy perspective.
- Potential for materials to not be used in ways that maximise their value in the waste management hierarchy (for example: avoid, reduce, reuse and recycle).
- South Australia's position on source separation and recirculating materials back into the economy will be challenged.

What is possible through action?

- Certainty and clarity on the regulatory framework within South Australia, supporting better investment decisions.
- South Australia's leadership in specific and broader waste management policies retained.
- Maximising the value of materials according to the waste management hierarchy and circular economy principles.

Priority actions

➢ Consistent with the waste hierarchy, continue to review resource-recovery businesses that source waste materials for energy recovery to ensure optimal outcomes within the circular economy.

- EPA to revise the regulatory framework to support investment decisions on ‘energy from waste’ developments and finalise its position statement on thermal energy from waste.
- Make available information on the environmental and health implications of ‘energy from waste’ technologies to support understanding and evidence-based evaluation.
- Energy sector to outline planning and grid connection requirements and processes for ‘energy from waste’ development.
- Support and encourage anaerobic digestion and other ‘energy from waste’ technology demonstration programs at precinct/clusters level, based on feasibility assessments.
- Consider how the waste levy and other financial tools can help develop or encourage ‘energy from waste’ technology development and adoption.

References

Access Economics Pty Limited for the Department of Environment, Water, Heritage and the Arts (2009), *Employment in waste management and recycling,* <www.environment.gov.au/protection/waste-resource-recovery/publications/employment-waste-management-and-recycling>

Australian Department of the Environment and Energy (2009), *National Waste Policy: Less Waste More Resources*

Australian Government (2017), *National Food Waste Strategy: Halving Australia's food waste by 2030*

Australian Department of the Environment and Energy (2018), *National Waste Policy: Less waste, more resources*

Circle Economy, (2017), *Policy Levers for a Low Carbon Economy*

Commonwealth of Australia (2018), *Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans*

Commonwealth of Massachusetts (2018), *Commercial Food Material Disposal Ban,* <https://www.mass.gov/guides/commercial-food-material-disposal-ban>

Council of Australian Government (2019), *COAG Meeting Communiqué, 9 August 2019,* <www.coag.gov.au/meeting-outcomes/coag-meeting-communique-09-august-2019>.

CSIRO (2016), *Sources, distribution and fate of marine debris,* <www.csiro.au/en/Research/OandA/Areas/Marine-resources-and-industries/Marine-debris>

Econsearch (2014), *Economic Aspects of the Zero Waste SA Strategy Review*

Ellen MacArthur Foundation (2013), *Towards the Circular Economy. Economic and business rationale for an accelerated transition*

Ellen MacArthur Foundation for the Waste & Resources Action Programme and the Welsh Government (2013), *Wales and the Circular Economy. Favourable system conditions and economic opportunities*

Ellen MacArthur Foundation (2015), *Circularity Indicators. An Approach to Measuring Circularity*

Ellen MacArthur Foundation (2016), *The New Plastics Economy: Rethinking the future of plastics*

Ellen MacArthur Foundation (2017), *A new textiles economy: Redesigning fashion's future*

Ellen MacArthur Foundation (2018), *The Circular Economy Opportunity for Urban and Industrial Innovation in China*

Environment Protection Authority (SA) (2019a), *Improving South Australia's Recycling Makes Cents*

Environment Protection Authority (SA) (2019b), *Consultation Draft EPA Position Statement: Thermal Energy from Waste Activities*

Environment Protection Authority (SA) (2017), *Enhancing resource recovery and discussing the place of energy recovery*

European Commission (2015), *Closing the loop - An EU action plan for the Circular Economy* <http://ec.europa.eu/environment/>

European Commission (2017), *Circular Economy Research and Innovation Connecting economic and environmental gains*

European Parliament (2018), *Plastic Oceans: MEPs back EU ban on throwaway plastics by 2021* <www.europarl.europa.eu/news/en/press-room/20181018IPR16524/plastic-oceans-meps-back-eu-ban-on-throwaway-plastics-by-2021>

Fight Food Waste Cooperative Research Centre <https://fightfoodwastecrc.com.au/>

Flanders Agency for Public Waste, Materials & Soil (2011), *Flanders' Materials Programme*

Florin, N., Dominish, E., Giurco, D. (University of Technology Sydney, 2015), *Action Agenda for resource productivity and innovation: opportunities for Australia in the circular economy*

Food and Agriculture Organisation of the United Nations (2017), *How to Feed the World in 2050*

Global infrastructure Hub (2018), *Global Infrastructure Outlook*

Government of the Netherlands (2016), *A Circular Economy in the Netherlands by 2050*

Government of Japan (2000), *The Basic Act for Establishing a Sound Material-Cycle Society (Act No.110 of 2000)*

Green Industries SA (2005), *South Australia's Waste Strategy 2005-10*

Green Industries SA (2011), *South Australia's Waste Strategy 2011-2015*

Green Industries SA (2011), *Anangu Pitjantjatjara Yankunytjatjara Lands, Past, Present and Future – The Rubbish Report*

Green Industries SA (2012), *The Outback Waste Management Report*

Green Industries SA (2013), *Interim Consultation Paper Zero Waste SA Position on Waste to Energy*

Green Industries SA (2014a), *South Australia's Waste Strategy 2015-2020*

Green Industries SA (2014b), *South Australian Better Practice Guide: Waste Management in Residential or Mixed Use Developments*

Green Industries SA (2017a), *Benefits of a Circular Economy in South Australia Summary*

Green Industries SA (2017b), *Potential Benefits of a Circular Economy in South Australia – report*

Green Industries SA (2017c), *Potential Benefits of a Circular Economy in South Australia – report methods*

Green Industries SA (2018), *South Australia's Waste and Resource Recovery Infrastructure Plan*

Green Industries SA (2019a), *Adelaide Metropolitan Area Kerbside Waste Performance Report 2016-17*

Green Industries SA (2019b), *Turning The Tide On Single-Use Plastic Products*

Innovyz, *Summary of Companies - Waste & Recycling Technology Commercialisation Program* www.innovyz.com/waste-recycling-companies

International Labour Office (2017), *'World Employment and Social Outlook: Trends 2017*

IRP (2017), *Assessing global resource use: A systems approach to resource efficiency and pollution reduction*

Bringezu, S., Ramaswami, A., Schandl, H., O'Brien, M., Pelton, R., Acquatella, J., Ayuk, E., Chiu, A., Flanegin, R., Fry, J., Giljum, S., Hashimoto, S., Hellweg, S., Hosking, K., Hu, Y., Lenzen, M., Lieber, M., Lutter, S., Miatto, A., Singh Nagpure, A., Obersteiner, M., van Oers, L., Pfister, S., Pichler, P., Russell, A., Spini, L., Tanikawa, H., van der Voet, E., Weisz, H., West, J., Wiijkman, A., Zhu, B., Zivy, R. (United Nations Environment Programme, Nairobi, Kenya), *A Report of the International Resource Panel*

Kaza, Silpa; Yao, Lisa C.; Bhada-Tata, Perinaz; Van Woerden, Frank (Urban Development, Washington, DC: World Bank, 2018), *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*

Lehmann, Steffen and Crocker, Robert (2012), *Designing for zero waste: consumption, technologies and the built environment*

Meinshausen, M. et al. (2017), *Historical greenhouse gas concentrations for climate modelling. Geoscience Model Development,* vol. 10, pages 2057-2116, <https://doi.org/10.5194/gmd-10-2057-2017, 2017>

New South Wales Environment Protection Authority (2010), *Household Building and Renovation* <www.epa.nsw.gov.au/your-environment/household-building-and-renovation>

New South Wales Environment Protection Authority (2012), *Preferred Resource Recovery Practices by Local Councils, Best Bin Systems*

OECD (2012), *OECD Environmental Outlook to 2050: The Consequences of Inaction*

Office for Promotion of Sound Material-Cycle Society Ministry of the Environment (Japan, 2018), *The 4th Fundamental Plan for Establishing a Sound Material-Cycle Society*

Rawtec (2019*), South Australia's Recycling Activity Survey 2017-18 Financial Year Report*

Resources and Waste Advisory Group (2014), *Review of South Australia's Waste Strategy 2011-2015*

Ricardo-AEA (2013), *Waste to Energy Background Paper*

Scottish Government (2016), *Making Things Last: a circular economy strategy for Scotland*

Single-use and Other Plastic Products (Waste Avoidance) Bill 2020 (SA).

South Australian Department of Planning, Transport and Infrastructure (2017), *The 30-Year Plan for Greater Adelaide 2017 Update*

South Australian Environment Protection Authority (2015), *Reforming waste management – creating certainty for an industry to grow*

South Australian Environment Protection Authority (2017), *Enhancing resource recovery and discussing the place of energy recovery*

The World Bank (2016), http://www.worldbank.org/en/news/video/2016/03/10/2-billion-number-of-adults-worldwide-without-access-to-formal-financial-services

United Nations (2017), *Ageing,* <http://www.un.org/en/sections/issues-depth/ageing/>

United Nations (2015), *Sustainable Development Goals,* https://www.un.org/sustainabledevelopment/sustainable-development-goals/

United Nations (2015b)*, Sustainable Development Goals. 'Goal 14: Conserve and sustainably use the oceans, seas and marine resources',* <http://www.un.org/sustainabledevelopment/oceans/>

UN General Assembly (2015), *Transforming our world: the 2030 Agenda for Sustainable Development,* <http://www.refworld.org/docid/57b6e3e44.html>

United Nations, Department of Economic and Social Affairs, Population Division (2017), *World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248*

United Nations Environment Program (2010), *Waste and Climate Change: Global trends and strategy framework*

United Nations Environment Programme (2009), *Marine Litter: A Global Challenge*

United Nations Environment Programme (2016a), *Marine Plastic Debris and Microplastics - Global lessons and research to inspire action and guide policy change*

United Nations Environment Programme (2016b), *Marine Litter Legislation: A Toolkit for Policymakers*

van Beukering et al. (2014), *The economics of recycling*

World Economic Forum (2016), *Global Risks Report 2016*

World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company (2016), *The New Plastics Economy — Rethinking the future of plastics,* <http://www.ellenmacarthurfoundation.org/publications>

World Economic Forum (2019), *Top 10 Emerging Technologies 2019,* <http://www3.weforum.org/docs/WEF_Top_10_Emerging_Technologies_2019_Report.pdf>

World Health Organisation (2020), *Coronavirus disease (COVID-19) Pandemic* <https://www.who.int/emergencies/diseases/novel-coronavirus-2019>

World Meteorological Organization (2017), *Greenhouse Gas Bulletin, no. 13, https://library.wmo.int/opac/doc_num.php?explnum_id=4022*

Zero Waste SA (2010), *Valuing our food waste - South Australia's Household Food Waste Recycling Pilot Summary Report – 2010,* www.greenindustries.sa.gov.au/LiteratureRetrieve.aspx?ID=165550