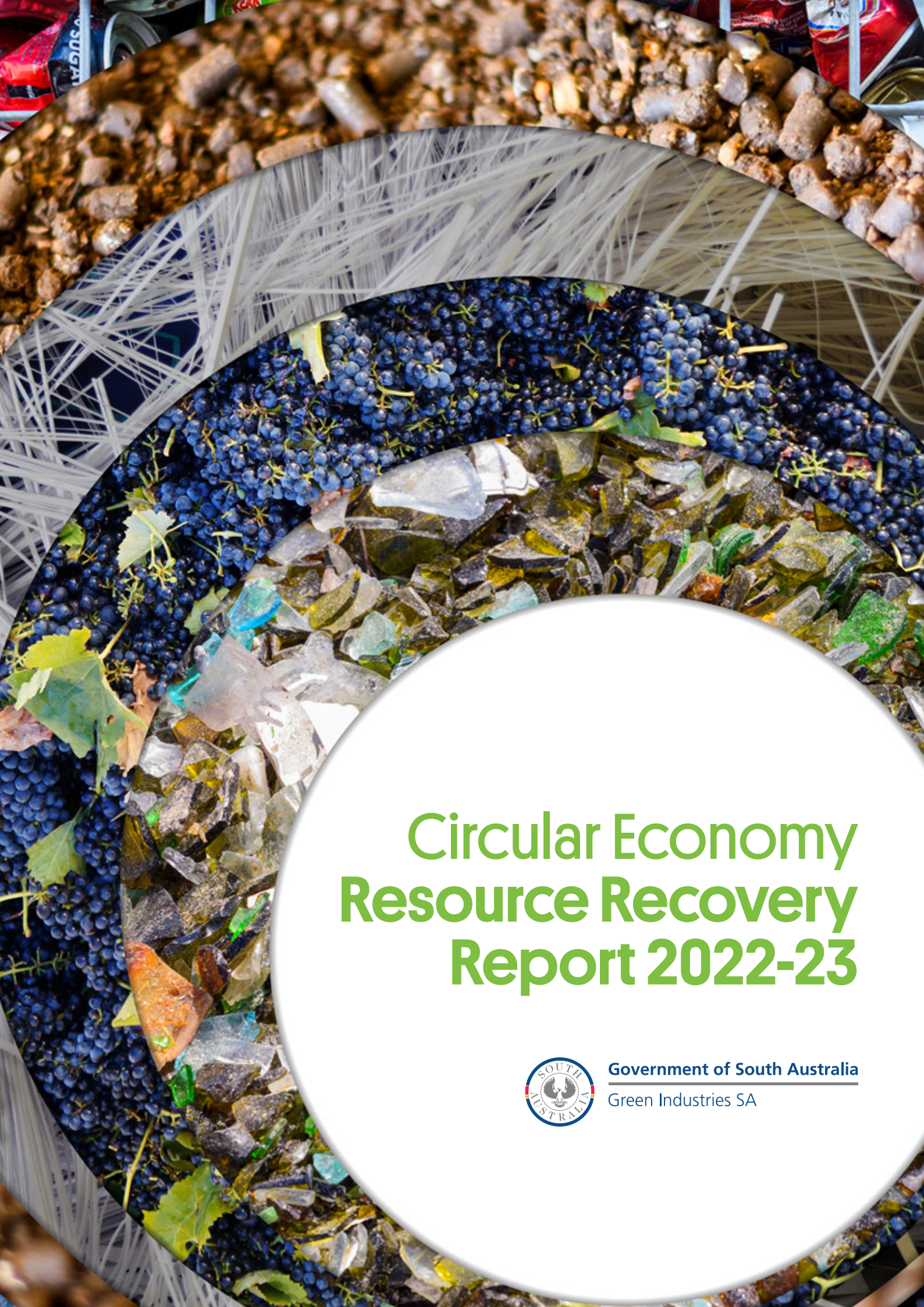

Circular Economy
Resource Recovery Report 2022-23

Government of South Australia

Green Industries SA

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10 September 2021, and is based on the assumptions and exclusions set out in our scope of work. Information in this document is current as of 26 April 2024. While all professional care has been undertaken in preparing this report, Blue Environment Pty Ltd cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

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Abbreviations and glossary

Alternative fuels and raw materials	Non-traditional fuels and raw materials that are co-processed in cement kilns or other thermal facilities, potentially including refuse derived fuels, solid recovered fuels, spent catalysts and others
Biosolids	Waste organic solids derived from biological wastewater treatment plants
C&D	Construction and demolition
C&I	Commercial and industrial
CDL	Container deposit legislation
CERRR	Circular Economy Resource Recovery Report
Circular economy	Looking beyond the current take-make-waste extractive industrial model, a circular economy aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources, and designing waste and pollution out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital. It is based on three principles: design out waste and pollution; keep products and materials in use (ideally at their highest and best value); and regenerate natural systems.
CO_2-e	Carbon dioxide equivalent
Diversion	Sending waste for recycling or energy recovery instead of landfill
Energy recovery	Processes through which wastes are collected, sorted and processed to recover energy in usable form, for example process heat, steam or in electricity generation.
EPA	Environment Protection Authority
GHG	Greenhouse gas
GSP	Gross state product
kg	Kilogram
kt	Kilotonne
LDPE	Low density polyethylene
LHV	Lower heating value
MFA	Material flow analysis
ML	Megalitre
MSW	Municipal solid waste
PET	Polyethylene terephthalate
PP	Polypropylene
PS	Polystyrene
PVC	Polyvinyl chloride
Recovered materials	Waste materials separated, sorted or processed for the purposes of reuse, recycling or energy recovery

Recycling	Material that has been reprocessed from recovered (reclaimed) material by means of a manufacturing process and made into a final product or into a component for incorporation into a product. The term recycling is used to cover a wide range of activities, including collection, sorting, reprocessing, and manufacture into new products. Waste materials that are reclaimed and reutilised within the same manufacturing processes that generated it as a matter of course to the efficient operation of the site (i.e., process scrap) are not defined as recycling for the purpose of this study. Recycling does not include waste materials that have been received at a recycling facility but have not been processed.
Reprocessing	Processing of recovered materials to make raw materials for use in making new products or direct use. May also be called 'secondary processing'
Resource recovery	Activities through which wastes are collected, sorted, processed (including through composting), and/or converted into raw materials for use in a production system. For data reporting purposes, the quantity of waste allocated to the fate 'resource recovery' is the sum of the quantities allocated to waste reuse, recycling and energy recovery.
Reuse	Reallocation of products or materials to a new owner or purpose without reprocessing or remanufacture, but potentially with some repair (for example, repair of pallets for resale, tyre retreading)
Solid waste	Waste materials ranging from municipal garbage to industrial waste, but excluding gaseous, liquid, hazardous, clinical, and intractable wastes
The survey	The Circular Economy Resource Recovery Survey 2022-23
TJ	Terajoule

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Boral Resources SA Ltd

Born Again Pallets

Ceduna Can & Bottle Pty Ltd

Chevron Glass P/L

City of Adelaide

Clare Valley Waste

d'Arenberg

Downer EDI Ltd

Ecoplas Australia

Electronic Recycling Australia

Enviro Friend Solutions (EFS)

FOAMEX South Australia

Green Triangle Recyclers Pty Ltd

Hallett Resources Pty Ltd

Infrabuild Recycling

Intercast & Forge Pty Ltd

J Mathews Pty Ltd

JA Brauns Investments

JBS Australia - Bordertown

Jeffries

Close the Loop

McMahons Services

Mobius Farms

Mulbarton Transport

Northern Adelaide Waste Management Authority (NAWMA)

Nyrstar

Opal Recycling

Orora Group

ResourceCo

REMONDIS Australia Pty Ltd

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Recycling Plastics Australia

South Australian Water Corporation (SA Water)

Shred-X Pty Ltd

Sims

Southern Materials Recovery Facility

Statewide Recycling

YCA Recycling

Foodbank SA

Ozharvest

Save the Children Australia

Salvos Stores

Thread Together Limited

Summary

Introduction

Each year, Green Industries SA measures recovery and disposal activity in South Australia (SA) to assess how the State is performing on waste management and resource recovery. The findings are used to track progress against SA's waste targets. This report presents the results for the 2022-23 financial year.

Summary of 2022-23 results

SA's recovery rate in 2022-23 was an estimated 82.3%, which is slightly higher than the previous year. SA recovered about 4.24 million tonnes of material in 2022-23 which is a 6% increase compared to 2021-22; and disposed about 914 kilotonnes (kt, or thousands of tonnes) of waste to landfill in 2022-23. Disposal increased by 3% compared to 2021-22. Overall waste generation was approximately 5.16 million tonnes – a 5.7% increase from last years.

Headline statistics for resource recovery, landfill disposal and waste generation are provided in Table S1. This includes:

- Standard reporting materials, comprising masonry (excluding clay, fines, rubble and soil), metals, organics, cardboard and paper, plastics, glass, foundry sands, leather and textiles, and tyres and other rubber.
- Separately reported materials, comprising clay, fines, rubble, soil and fly ash. These materials are reported separately because they can fluctuate significantly across years and between jurisdictions.

Table S1 Summary of resource recovery, landfill disposal and waste generation, SA, 2022-23

	Standard reporting materials	Separately reported materials	Total
Resource recovery (million tonnes)	3.18	1.06	**4.24**
Landfill disposal (million tonnes)	0.89	0.03	**0.91**
Waste generation (million tonnes)	4.07	1.09	**5.16**
Recovery rate (%)	78.2%	97.4%	**82.3%**

Recovery by material

When comparing 2022-23 resource recovery data to 2021-22 data:

- **Masonry** (including clay, fines, rubble and soil) recovery was 2.29 million tonnes, an increase from 2.03 million tonnes. Reported recovery of most material types in this category declined except for waste fill (recovered by C&D recyclers) which almost doubled from 2021-22; bricks recovery decreased the most with 42% less reported recovered when compared to 2021-22.
- **Metals** quantities increased to 507 kt from 329 kt with strong increases in all types.
- **Organics** recovery fell with about 1.10 million tonnes of organic materials recovered in 2022-23, a decrease from the 1.35 million tonnes recovered in 2021-22.
- **Cardboard and paper** recovery reversed a three-year decline, increasing by 32% on 2021-22. This was mainly due to strong cardboard recovery compared to 2021-22. Overall, about 216 kt of cardboard and paper were recovered in 2022-23.
- **Plastics** recovery of about 30 kt in 2022-23 was similar to quantities recovered over the past five years.
- **Glass** recovery increased from 54 kt in 2021-22 to 74 kt in 2022-23, indicating a return to the higher recovery volumes of the late 2010s.
- **Other materials** include fly ash, foundry sands, leather and textiles, and tyres and other rubber. The combined recovery of these materials in 2022-23 was about 26 kt, while in 2021-22 it was about 34 kt.

Figure S1 summarises the material composition and destination of recovered materials in SA in 2022-23.

Performance against state waste targets

In 2020, Green Industries SA released *South Australia's Waste Strategy 2020-25*. The strategy sets waste diversion and reduction targets which are guided by an overall target of zero avoidable waste to landfill by 2030. 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, quarantine waste and some hazardous waste. A summary of progress so far based on 2022-23 data is provided in Table S2.

Table S2 Summary of state waste targets and progress on them

Topic	Target	Progress
Landfill diversion	Zero avoidable waste to landfill by 2030	SA disposed about 914 kt of waste to landfill in 2022-23, an increase from 885 kt in 2021-22.
Waste generation	5% reduction in waste generation per capita from a 2020 baseline	Waste generation per capita showed 4% reduction in 2022-23 compared to 2021-22. The long-term trend is downwards.
Metropolitan diversion	Diversion by 2023: - MSW 65% - C&I 85% - C&D 90%	Diversion rates achieved by metropolitan SA in 2022-23: - MSW 62% - C&I 76% - C&D 97%

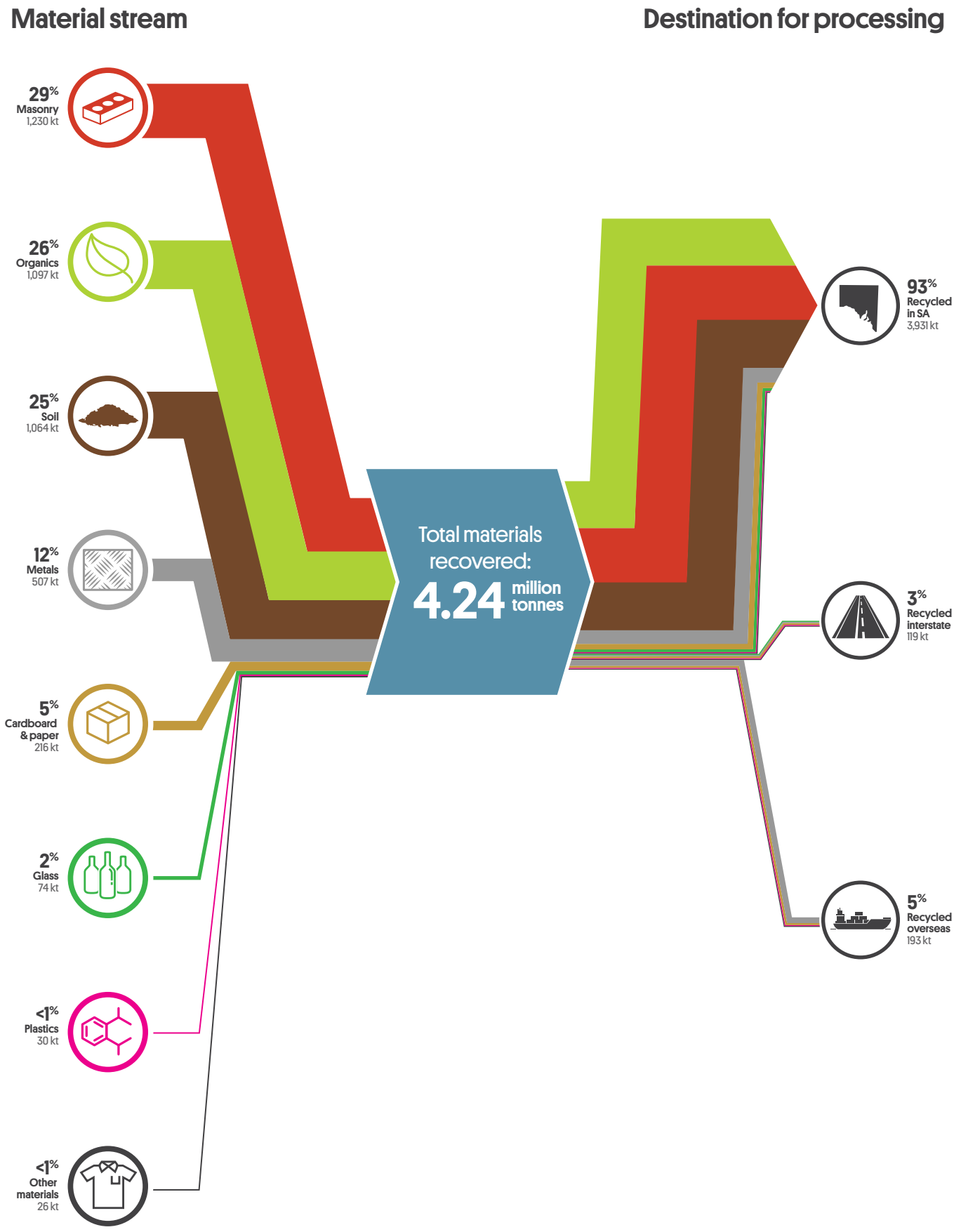
Local government kerbside recovery

About 697 kt of waste materials were collected at kerbside in SA, including 535 kt from metropolitan councils and 162 kt from regional councils. SA's estimated recovery rate for kerbside waste in 2022-23 was 51%, slightly higher than the 2021-22 rate of 49%. Recovery was higher for metropolitan councils (54%) than regional councils (44%). Compared to 2021-22, overall quantities of waste relatively similar with a slightly higher proportion of residual waste.

Material flow analyses

Material flow analyses were conducted for 2022-23. Section 4 of this report contains summaries for flows of metals, cardboard and paper, plastics, glass, textiles and tyres for SA in 2022-23, covering consumption, waste generation and recovery and a Sankey chart, in which material flows are represented using arrows proportional to the scale of the calculated material flow.

Figure S1 Resource recovery, including energy recovery, SA, 2022-23, by material and destination, not including e-waste or materials reused



1 Introduction

- The *Circular Economy Resource Recovery Report 2022-23* presents the findings of a survey of SA's resource recovery sector for the 2022-23 financial year.
- It shows data on SA's waste generation, landfill disposal and resource recovery, including progress against targets set in *South Australia's Waste Strategy 2020-2025*.

A circular economy utilises resources to their fullest potential. Waste avoidance, reuse and recycling are maximised while raw material extraction and landfilling are minimised. This is illustrated in Figure 1.

South Australia (SA) continues to lead the way on resource recovery performance as it pushes towards a circular economy. This report provides a summary of the status of SA's resource recovery sector, including data on reuse, recycling and energy recovery, as well as the environmental, social and financial benefits that the sector provides. The findings are used to assess progress on the State waste targets set out in *South Australia's Waste Strategy 2020-25* (Green Industries SA 2020), which defines targets for waste reduction and waste diversion[1] from landfill to 2025. Table 1 (overleaf) summarises SA's waste targets.

This report is the third edition of the *Circular Economy Resource Recovery Report* (CERRR). The CERRRs are a new iteration of Green Industries SA's previous *Recycling Activity Survey Reports*. The CERRR 2022-23 builds on the findings of previous years and is mostly consistent with the *Australian standard for waste and resource recovery data and reporting* (DCCEEW 2021) with some differences in reporting of some hazardous wastes.

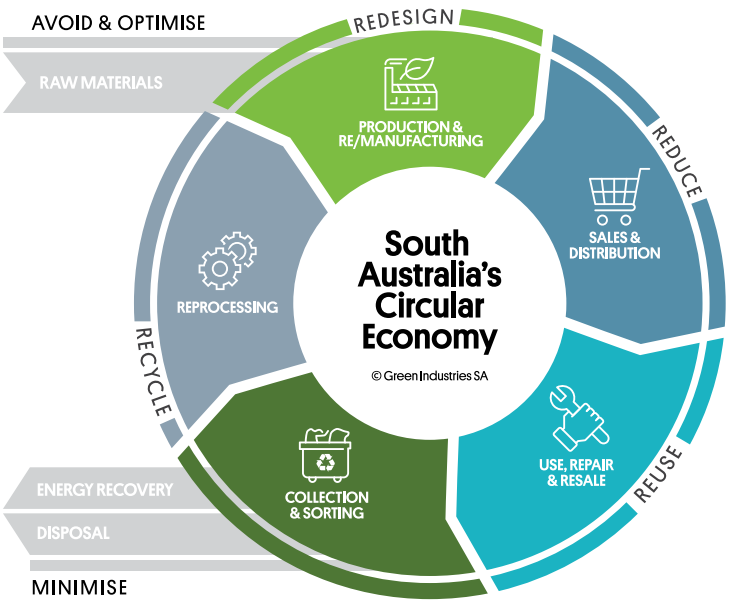


Figure 1 South Australia's circular economy

Source: South Australia's Waste Strategy 2020-2025 (Green Industries SA 2020)

1 In this report, 'diversion' means sending waste for recycling or energy recovery instead of landfill.

The *Circular Economy Resource Recovery Survey 2022-23* (the survey) asked recyclers, reprocessors, the reuse sector and the energy recovery industry in SA about their operations in 2022-23. Data were sought on tonnes of materials recovered, including information on:

- source stream – municipal solid waste (MSW), commercial and industrial (C&I) waste, or construction and demolition (C&D) waste
- geographical origin – metropolitan or regional SA
- final reprocessing location – in SA, interstate or overseas
- value of recovered materials
- proportion of material derived from post-consumer packaging
- the type of productive use made of the recovered material.

Survey participants were also asked about the status of resource recovery, barriers to their operations and employee figures.

On 1 July 2021, the South Australian Environment Protection Authority's (SA EPA) mass balance reporting requirements came into effect for waste depots that receive over 20,000 tonnes of solid waste per annum.

While significant effort has been taken to verify the survey responses, it is acknowledged that some quantities are based on estimates with large margins of error. This is discussed in Appendix A.

Table 1 Summary of SA's waste targets

Overall targets				
2025	Per capita waste generation 5% reduction from a 2020 baseline			
2030	Zero avoidable waste to landfill by 2030			
Metropolitan waste targets				
	% diversion household bin system	% diversion all MSW[2]	% diversion C&I	% diversion C&D
2023	60%	65%	85%	90%
2025	70%	75%	90%	95%
Non-metropolitan waste targets (all source streams)				
2020	Maximise diversion to the extent practically and economically achievable			
2023	Regional Waste Management Plans are in place for all South Australian regional local government areas and/or regional city clusters and set regionally appropriate and progressive waste diversion targets			

Material flow analyses were conducted for 2022-23. Section 4 of this report contains summaries for flows of metals, cardboard and paper, plastics, glass, textiles and tyres for SA in 2022-23, covering consumption, waste generation and recovery and a Sankey chart, in which material flows are represented using arrows proportional to the scale of the calculated material flow.

2 Quantities arising from total MSW material 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.

2 Circular economy resource recovery statistics

This section summarises the results of the *Circular Economy Resource Recovery Survey 2022-23*, including:

- resource recovery and landfill disposal
- SA's performance against state targets for waste management
- local government recovery
- SA's reuse sector and the transition towards a circular economy.

2.1 Resource recovery and landfill disposal

Overview

SA recovered about 4.24 million tonnes of material in 2022-23, a 6.3% increase compared to 2021-22. Disposal to landfill increased this year; about 914 kilotonnes (kt, or thousands of tonnes) of waste was landfilled in 2022-23 compared to 885 kt in 2021-22. Overall waste generation was 5.16 million tonnes, an increase from 4.88 million tonnes in the previous year. SA achieved a recovery rate of 82.3% in the 2022-23 financial year which is higher than the 2021-22 rate of 81.9% and slightly lower than rates achieved since 2016-17.

Table 2 (overleaf) summarises the key statistics for resource recovery and landfill disposal in SA in 2022-23, including records from the past five years and from 2003-04 (the first year SA conducted a recycling activity survey). Data are considered in two groups

1. Standard reporting materials, which includes masonry (excluding clay, fines, rubble and soil), metals, organics, cardboard and paper, plastics, glass, foundry sands, leather and textiles, and tyres and other rubber.

2. Separately reported materials, which includes clay, fines, rubble and soil and fly ash. These materials are reported separately because they can fluctuate significantly across years as they are strongly influenced by large infrastructure projects.

Table 2 shows that the recovery of standard reporting materials fell by 6.2% in from 2021-22 and the recovery of separately reported materials increased by 76%.

Waste generation increased from 2021-22 in absolute terms and, slightly, on a per capita basis (2.79 tonnes per person in 2022-23 compared with the previous 2.68 tonnes per person). However, the new per capita rate value is generally consistent with the declining trend seen since the 2017-18, when 3.09 tonnes per person was recorded.

The data source for several organisations was from mass balance reporting from EPA instead of a voluntary survey response. It was not always straightforward to map the reported materials to the material categories reported here, which could lead to some variation in the reporting of recovery.

Parameter	2003-04	2018-19	2019-20
Resource recovery (kt)			
Standard reporting materials	1,880	3,123	2,994
Separately reported materials	162	1,215	1,140
Total	**2,042**	**4,338**	**4,134**
Landfill disposal (kt)			
Standard reporting materials	1,258	675	631
Separately reported materials	20	165	196
Total	**1,278**	**840**	**827**
Waste generation (kt)			
Standard reporting materials	3,138	3,798	3,625
Separately reported materials	182	1,380	1,136
Total	**3,320**	**5,178**	**4,961**
Recovery rate (%)			
Standard reporting materials	59.9%	82.2%	82.6%
Total	**61.5%**	**83.8%**	**83.3%**
SA population (persons)	**1,534,000**	**1,751,700**	**1,769,300**
Per capita recovery (kg/person/yr)			
Standard reporting materials	1,230	1,780	1,690
Total	**1,330**	**2,475**	**2,335**
Per capita disposal (kg/person/yr)			
Standard reporting materials	820	390	360
Total	**830**	**480**	**465**
Per capita waste generation (kg/person/yr)			
Standard reporting materials	2,050	2,170	2,050
Total	**2,160**	**2,960**	**2,800**
SA Gross State Product (GSP) ($ millions)	**$91,029**	**$117,925**	**$116,749**
Performance metrics per GSP (t/$ million GSP)			
Total recovery	22.4	36.8	35.4
Total disposal	14.0	7.1	7.1
Total waste generation	**36.5**	**43.9**	**42.5**

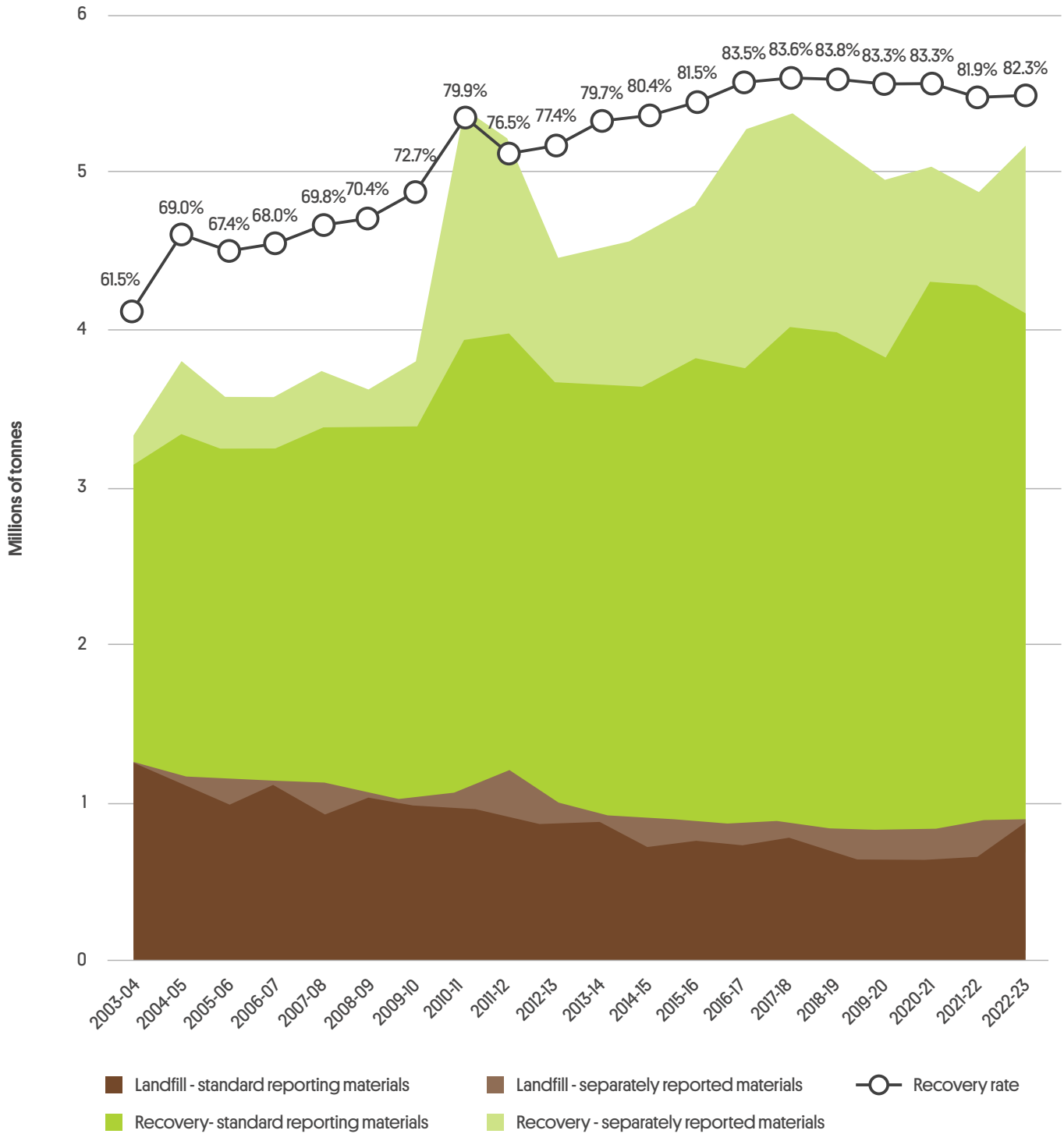
Table 2 Annual SA resource recovery and landfill diversion performance for 2022-23 and previous years

			Change	
2020-21	2021-22	2022-23	21-22 to 22-23	03-04 to 22-23
3,472	3,389	3,179	-6.2%	69%
729	604	1,064	76.2%	557%
4,201	**3,994**	**4,244**	**6.3%**	**108%**
641	676	886	31.2%	-30%
199	209	28	-86.6%	40%
840	**885**	**914**	**3.3%**	**-28%**
4,114	4,065	4,065	0.0%	30%
928	813	1,092	34.3%	500%
5,042	**4,878**	**5,158**	**5.7%**	**55%**
84.4%	83.4%	78.2%	-6.2%	31%
83.3%	**81.9%**	**82.3%**	**0.5%**	**34%**
1,773,000	**1,821,000**	**1,852,000**	**1.7%**	**21%**
1,958	1,861	1,717	-7.8%	40%
2,370	**2,193**	**2,292**	**4.5%**	**72%**
362	371	478	29.0%	-42%
474	**486**	**494**	**1.6%**	**-41%**
2,320	2,232	2,195	-1.7%	7%
2,844	**2,679**	**2,785**	**4.0%**	**29%**
$122,455	**$129,272**	**$134,209**	**3.8%**	**47.4%**
34.3	30.9	31.6	2.4%	41.0%
6.9	6.8	6.8	-0.5%	-51.5%
41.2	**37.7**	**38.4**	**1.8%**	**5.4%**

Progress since the first survey year (2003-04)

Figure 2 presents the trend for resource recovery and landfill disposal in SA since 2003-04, the first survey year. The trend shows increasing recovery and declining disposal over time. The recovery rate has been consistently around 82-83% for the past five years.

Figure 2 Trend in resource recovery and landfill disposal in SA since 2003-04



Recovery by material type

A summary of trends in recovery by material type is shown in Figure 3 and Table 3. A more detailed breakdown is provided in Section 3. When comparing 2022-23 to the previous year:

- **Masonry** (excluding clay, fines, rubble and soil) recovery fell slightly, notably for bricks, but plasterboard recovery increased significantly on last year.
- **Metals** recovery grew, with reported increases in all material types from 2021-22.
- **Organics** recovery was lower than the previous year, with due to significantly less timber and 'other organics' reported.
- **Cardboard and paper** recovery increased in 2022-23 following two years of low recovery in 2020-21 and 2021-22.
- **Plastics** recovery dropped slightly compared to last year due to a drop in low density polyethylene recovered.
- **Glass** recovery increased from the low quantities in 2021-22. Volumes recovered were similar to reports from 2018-19 and consistent with long term trends.
- **Other materials** recovery decreased from last year with lower recovery in all material types.
- **Separately reported materials** recovery increased mostly due to larger volumes of clean fill reported as received by resource recovery facilities.

Table 3 Summary of SA resource recovery by material type in kilotonnes

Material type	Recovery (kt)						Change (%)
	2003-04	2018-19	2019-20	2020-21	2021-22	2022-23	21-22 to 22-23
Standard reporting materials							
Masonry							
Asphalt	100	269	238	339	284	208	-27%
Bricks	165	74	41	44	27	16	-42%
Concrete	877	1,049	975	1,283	1,114	1,005	-10%
Plasterboard	0.0	1.1	1.0	0.9	0.2	1.8	612%
Subtotal	**1,142**	**1,393**	**1,255**	**1,666**	**1,425**	**1,230**	**-14%**
Metals							
Iron and steel	264	297	248	327	281	433	54%
Aluminium	19	14	11	12	29	41	43%
Non-ferrous metals	13	18	19	11	19	33	67%
Mixed metals	-					0.4	
Subtotal	**296**	**329**	**278**	**351**	**329**	**507**	**54%**
Organics							
Food organics	0.0	12	13	16	30	47	59%
Garden organics	130	257	250	277	290	332	14%
Timber	117	242	315	202	238	68	-71%
Other organics	0.0	529	528	634	794	651	-18%
Subtotal	**247**	**1,040**	**1,106**	**1,129**	**1,351**	**1,097**	**-19%**
Cardboard and paper							
Cardboard and waxed cardboard	91	160	134	138	60	106	76%
Liquid paperboard	0.0	0.8	0.6	0.8	0.2	0.5	201%
Magazines and newsprint	33	54	47	31	70	75	6%
Printing and writing paper	12	14	12	12	33	35	6%
Subtotal	**136**	**229**	**194**	**181**	**164**	**216**	**32%**
Plastics							
Polyethylene terephthalate	0.0	5.0	4.7	8.9	9.2	9.1	-1%
High density polyethylene	0.0	5.9	6.0	12.0	11.7	12.0	3%
Polyvinyl chloride	0.0	0.1	0.1	0.0	0.0	<0.1	
Low density polyethylene	0.0	2.0	3.0	4.5	6.7	2.4	-64%
Polypropylene	0.0	0.6	1.1	4.9	5.5	5.1	-7%
Polystyrene	0.0	0.5	0.6	0.4	0.1	0.5	334%
Mixed and/or other plastics	8.6	17.0	14.2	1.7	0.2	1.0	411%
Subtotal	**8.6**	**31**	**30**	**32**	**33**	**30**	**-10%**
Glass							
Glass	46	74	87	84	54	74	37%
Subtotal	**46**	**74**	**87**	**84**	**54**	**74**	**37%**

Material type	Recovery (kt)						Change (%)
	2003-04	2018-19	2019-20	2020-21	2021-22	2022-23	21-22 to 22-23
Other materials							
Foundry sands	0.0	6.0	24.0	8.2	4.2	2.4	-43%
Leather and textiles	4.1	2.4	0.9	1.6	4.9	2.8	-43%
Tyres and other rubber	0.1	19	19	19	25	21	-17%
Subtotal	**4.2**	**27**	**44**	**29**	**34**	**26**	**-24%**
Total standard reporting materials	**1,879**	**3,123**	**2,994**	**3,472**	**3,389**	**3,179**	**-6%**
Separately reported materials							
Fly ash	0	0	0	0	0	0	
Clay, fines, rubble and soil – clean fill	162	937	874	659	551	1,050	91%
Clay, fines, rubble and soil – intermediate waste soil	-	278	266	70	53	14	-73%
Total separately reported materials	**162**	**1,215**	**1,140**	**729**	**604**	**1,064**	**76%**
Grand total	**2,042**	**4,338**	**4,134**	**4,201**	**3,994**	**4,244**	**6%**

Figure 3 Trend in resource recovery in SA since 2003-04 by material category, including tonnes per million dollars of gross state product (GSP)

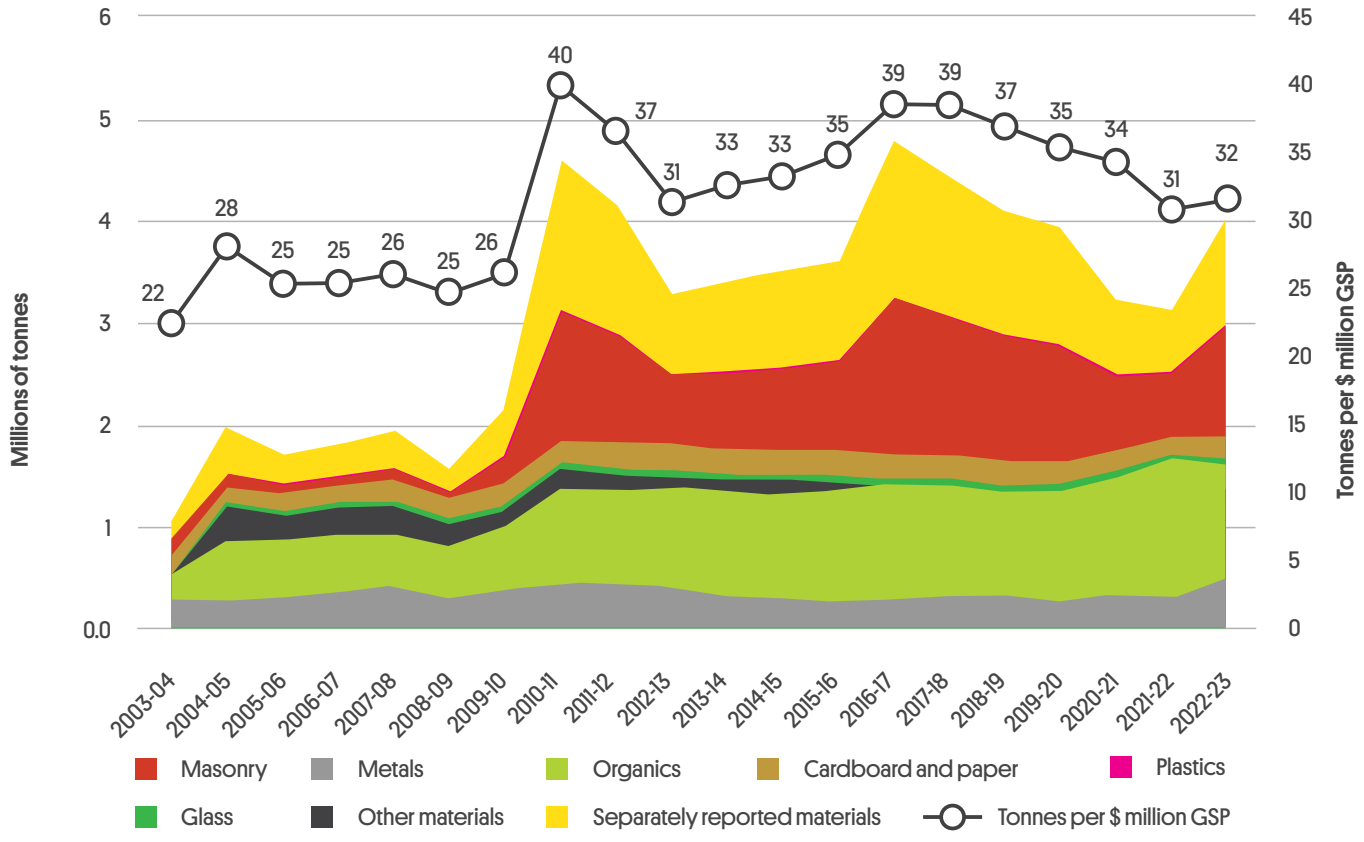
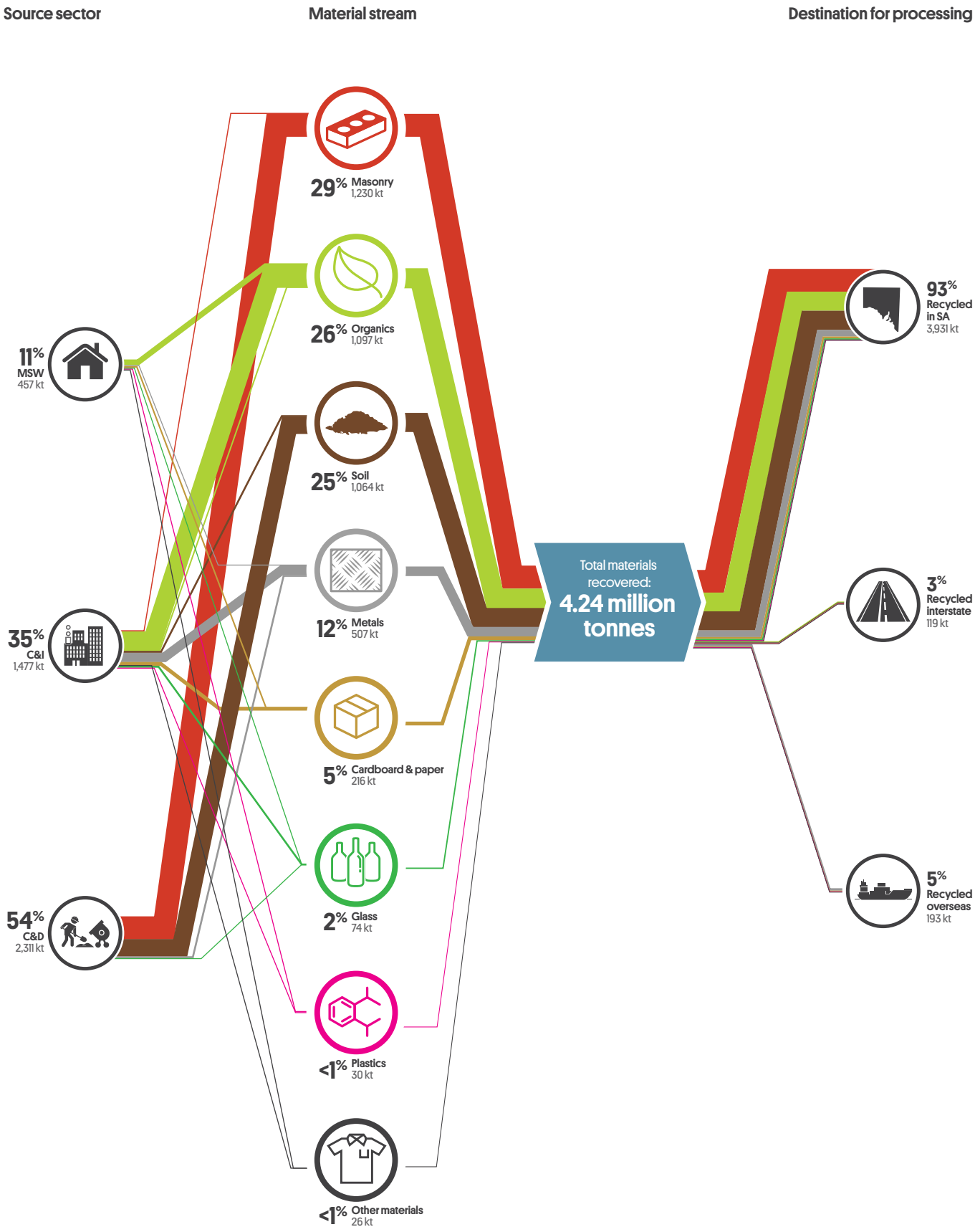


Figure 4 Resource recovery, including energy recovery, SA, 2022-23, by material, source stream and destination, not including e-waste or material reused

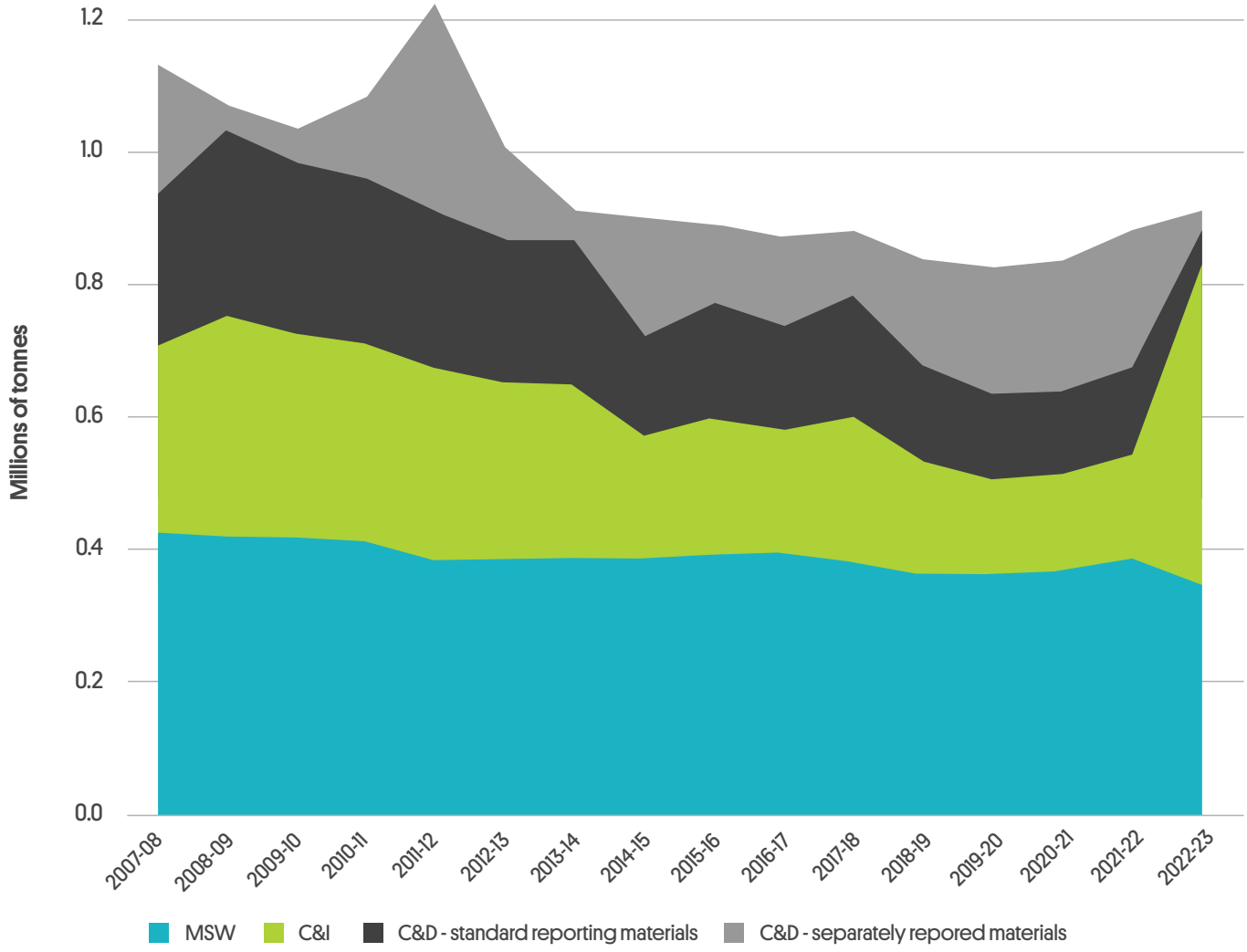


Landfill disposal

SA disposed about 914 kt of waste to landfill in 2022-23, an increase from the 885 kt landfilled in 2021-22. No deduction is made for cover materials.[3] Figure 5 displays trends for disposal by source stream, and shows that, in a departure from historical trends, most landfill waste is from the C&I stream.

The major increase in C&I waste to landfill in 2022-23 is primarily due to a change in the way the source streams of waste to landfill were assessed. The new partitioning method is based on an audit conducted at several C&I transfer stations in 2022 in which materials were weighed to determine waste composition and tonnages. This was blended with SA EPA mass balance reporting data. The new method is more accurate than the previous model, which was based on a much older landfill audit that relied on volumetric estimates and assumed densities.

Figure 5 Landfill disposal in SA since 2007-08 by source stream



3 In accordance with Schedule 4 of the Environment Protection Regulations 2009, SA EPA provides for a discount levy rate for daily cover at landfills required to use cover in their licence. The discount applies to 10% of the leviable tonnes received. The *Australian Standard for Waste and Resource Recovery Data and Reporting* states that 'the quantity of waste allocated to the fate 'disposal' includes waste used for landfill cover and capping'. As the default 10% deduction does not clarify the proportion of non-waste used as cover, this analysis includes all material reported by SA EPA as being sent to landfill in 2022-23 as waste.

Source stream

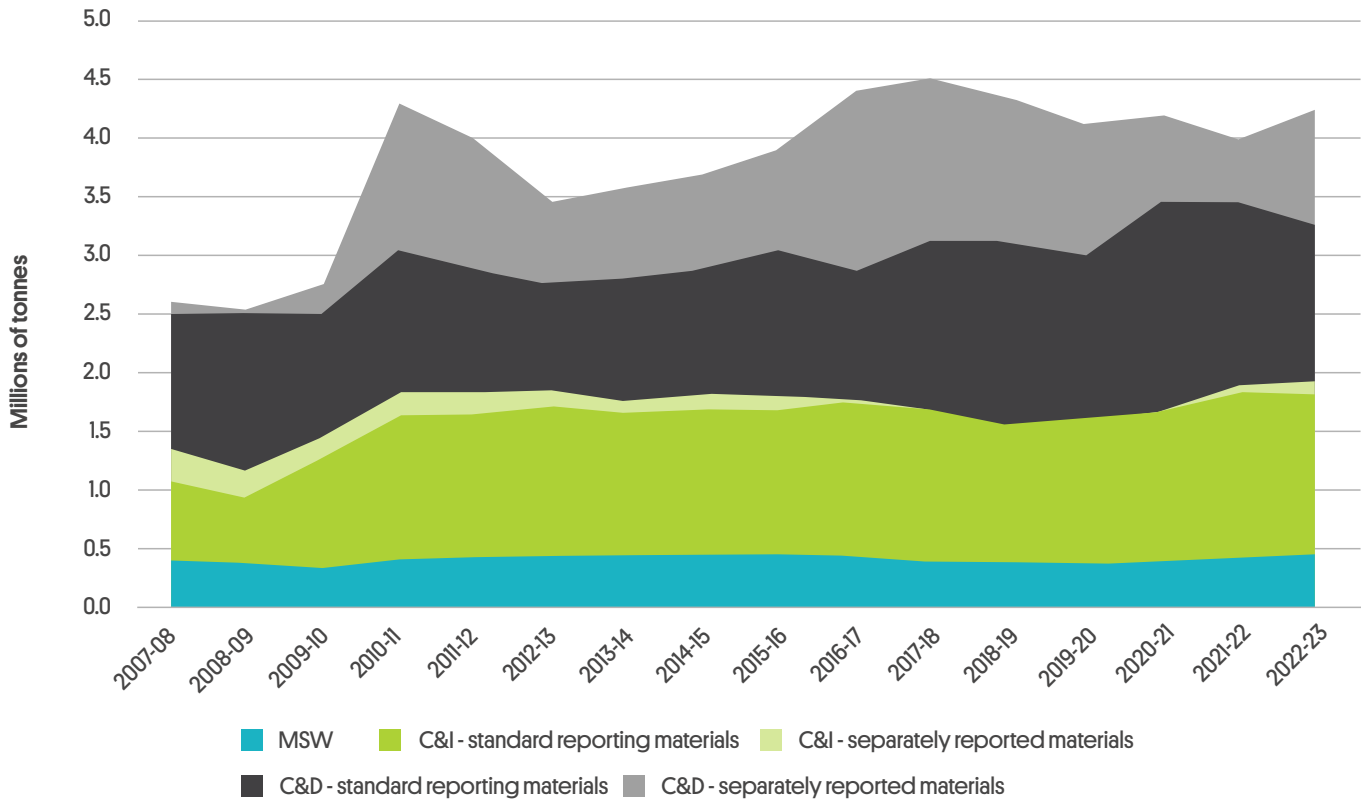
The source stream origin for SA waste and recovered materials in 2022-23 is shown in Table 4, Figure 6 and Figure 7. Like previous years, recovered materials mostly comprised C&D waste (54%), followed by C&I (35%) and MSW (11%).

The estimated recovery rate for C&D was the highest in 2022-23 at 97%, followed by C&I at 75% then MSW at 57%.

Table 4 South Australia recovery and landfill disposal by source stream in 2022-23[4]

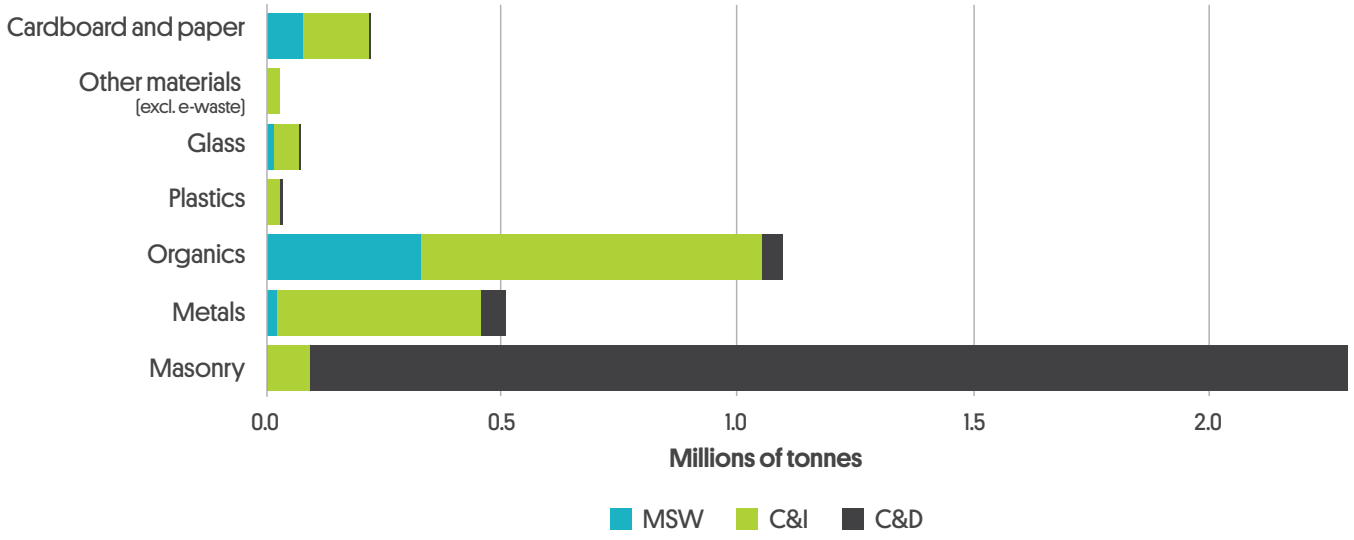
Source stream	Recovery		Landfill disposal		Recovery rate
	kt	% of total	kt	% of total	
MSW	457	11%	347	38%	57%
C&I	1,476	35%	494	54%	75%
C&D	2,311	54%	73	8%	97%
Total	**4,244**	-	**914**	-	**82%**

Figure 6 Resource recovery in SA since 2007-08 by source stream



4 Recovery rates by source stream listed in Table 4 include material from metropolitan and regional SA. In contrast, only metropolitan recovery is included in Table S2 and Table 12.

Figure 7 Source stream of recovered materials by material category, SA, 2022-23



Geographical origin

Metro SA contributed about 3,421 kt (81%) of the state's total recovered materials in 2022-23, and 656 kt (72%) of total disposed waste. About 84% of waste generated in metropolitan SA was recovered.

Material recovery reported in regional SA contributed 823 kt (19%) of total recovered materials in the 2022-23 financial year. Regional SA deposited about 258 kt (28% of all SA disposal) of waste to landfill, achieving a recovery rate of 76%.

When comparing 2022-23 to 2021-22:

- Metropolitan recovery increased from 2,868 kt to 3,421 kt and disposal tonnes increased slightly from 641 kt to 656 kt, which resulted in an overall increase in the recovery rate from 82% to 84%.
- Regional recovery fell to 823 kt from 1,126 kt and regional disposal rose slightly from 244 kt to 258 kt, resulting in a slight decrease in recovery rate from 82% to 76%.

Table 5 SA recovery and landfill disposal by geographical origin in 2022-23

	Recovery		Landfill disposal		Recovery rate
Sector	kt	% of total	kt	% of total	
Metro	3,421	81%	656	72%	84%
Regional	823	19%	258	28%	76%
Total	**4,244**		**914**		**82%**

The locations of SA's recycling and reprocessing facilities are shown overleaf in Figure 8 and Figure 9. The figures were accurate at the time of preparation in 2019-20.

Figure 8 Approximate geographical location of main sites of recyclers and reprocessors in SA

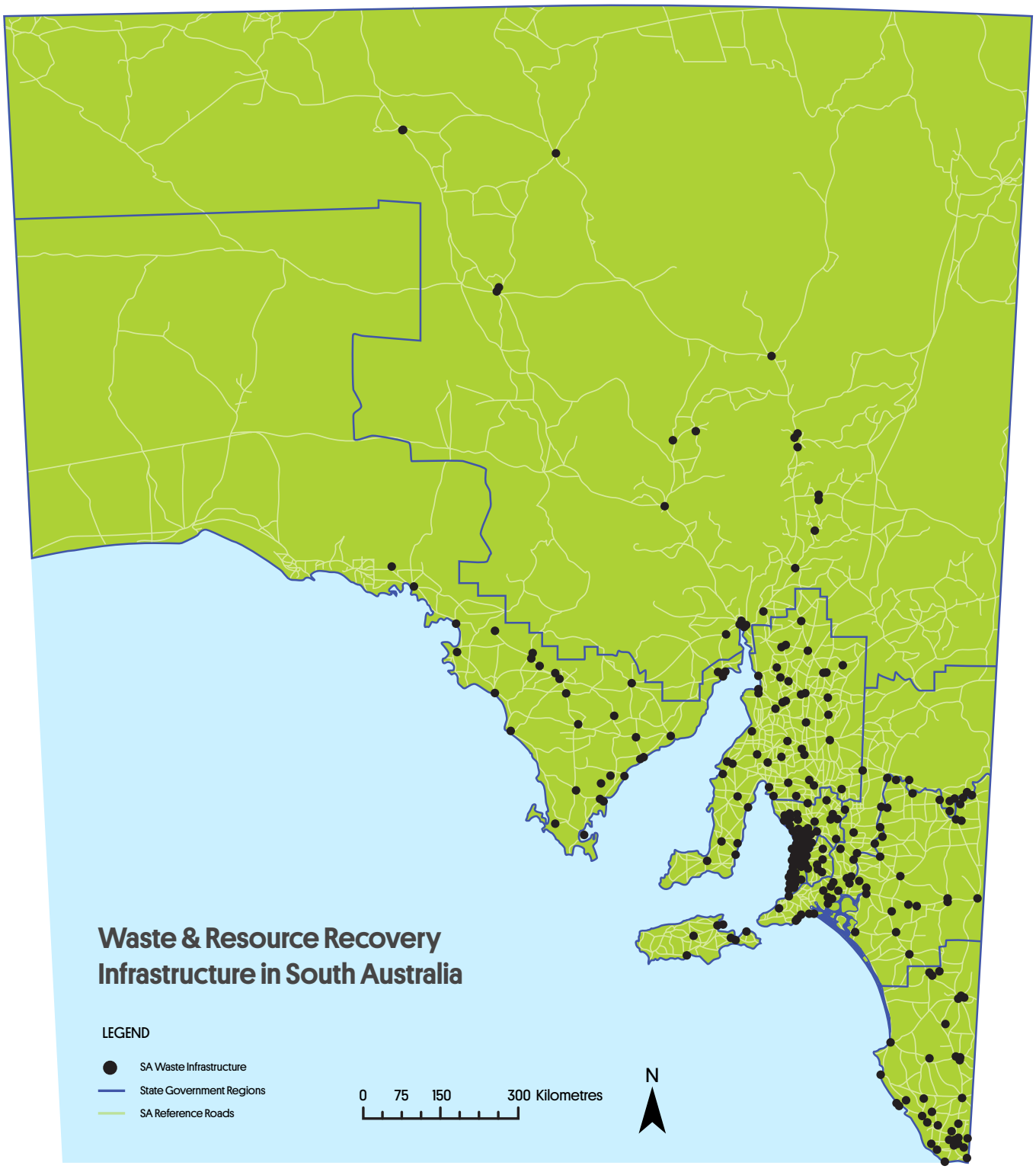
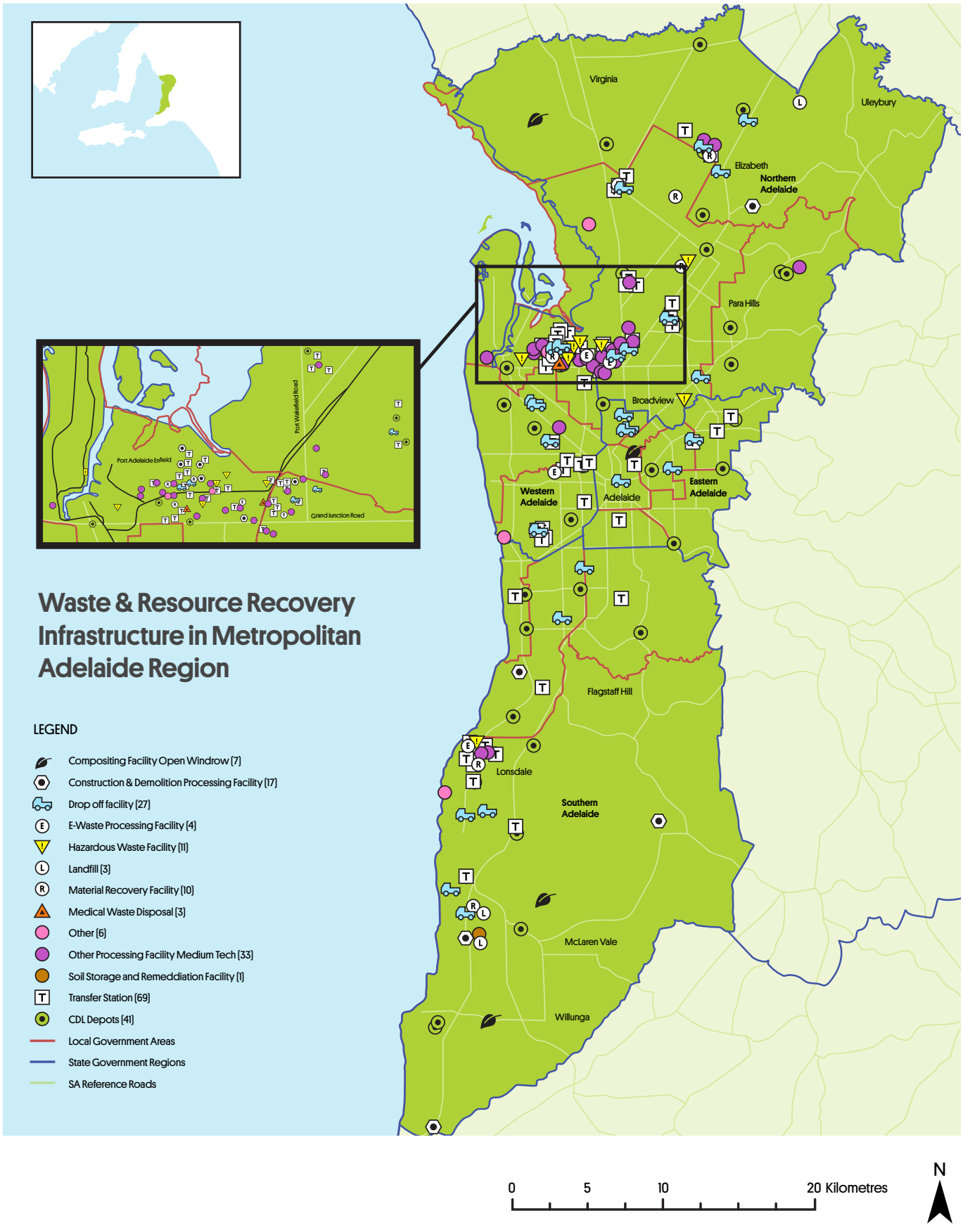


Figure 9 The locations of main sites of recyclers and reprocessors in Adelaide



Destination for recovered materials

Most recovered materials are reprocessed within the state (93%). In 2022-23, about 2.8% of materials were reported as reprocessed interstate and 4.6% reprocessed overseas. In comparison, in 2021-22, 2.3% was sent interstate and 6.0% sent overseas. Table 6 summarises recovery of SA materials by reprocessing destination and Table 7 provides a more detailed breakdown by material category.

Survey data was supplemented by data on exports from the Australian Bureau of Statistics. Waste materials exported from SA were counted as recovered as they were assumed to be sent overseas for recycling. The levels of contamination in exported materials has, in most cases, greatly reduced in recent years due to Australian Government regulation of these flows.

Table 6 Destination of SA sourced materials in 2022-23

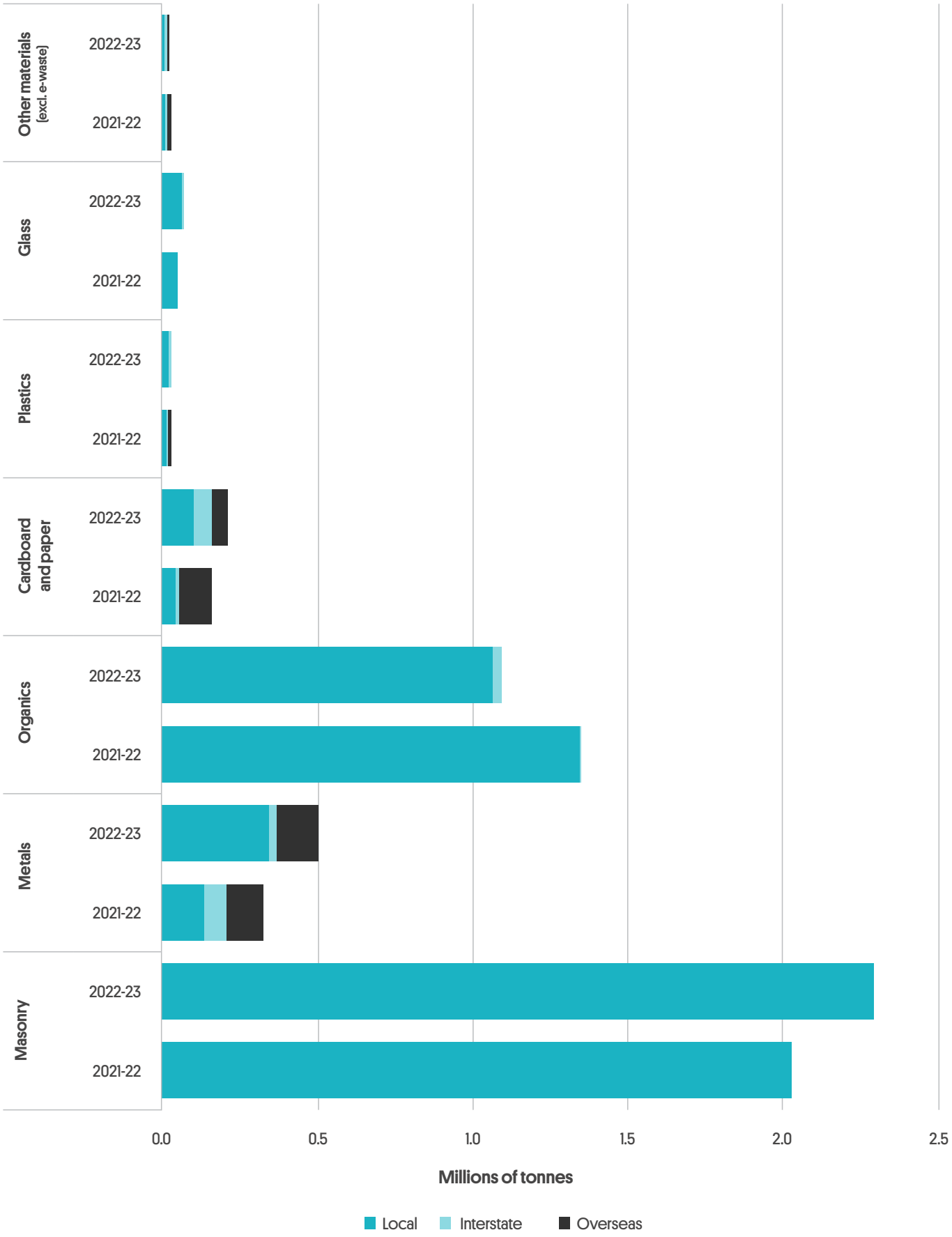
	Recovery	
Destination	**kt**	**% of total**
SA	3,931	92.6%
Interstate	119	2.8%
Overseas	193	4.6%
Total	**4,244**	**-**

All masonry and separately reported materials (clay, fines, rubble and soil) was reprocessed locally in SA. A high proportion of organics (97%), glass (97%), plastics (85%) and metals (69%) were also reported as reprocessed in SA in 2022-23. Most cardboard and paper was processed locally (51%), 24% was sent directly overseas from SA ports and the remainder was sent interstate (25%). 'Other' materials were mostly reprocessed in SA (55%) but with notable quantities sent overseas (30%). About 26% of metals were also sent overseas for reprocessing. Some materials sent interstate may have been subsequently exported overseas.

Table 7 Destination of SA sourced materials in 2022-23 by material category

	Percent of material recovered (%)		
Material category	**SA**	**Interstate**	**Overseas**
Masonry	100%	0%	0%
Metals	69%	5%	26%
Organics	97%	3%	0%
Cardboard and paper	51%	25%	24%
Plastics	85%	12%	3%
Glass	97%	3%	0%
Other materials	55%	15%	30%
Total	**92%**	**3%**	**5%**

Figure 10 Destination of SA sourced materials by material category in 2021-22 and 2022-23



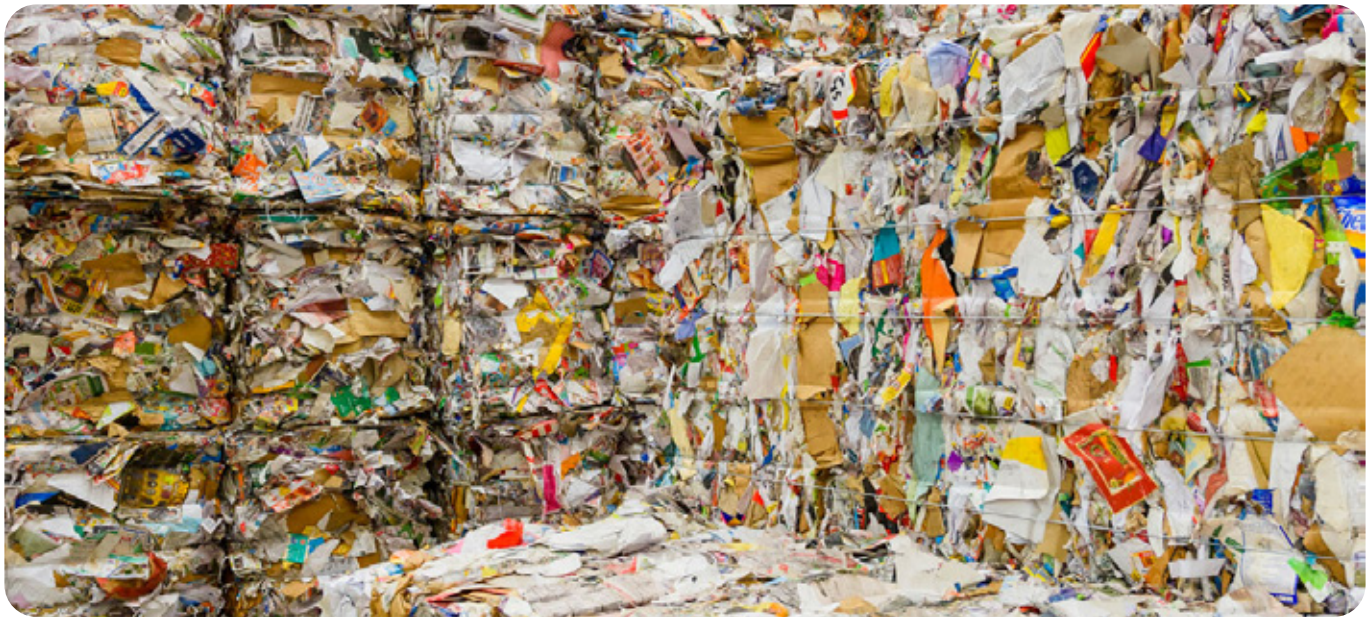
Energy recovery

Table 8 shows total resource recovery of SA materials in 2022-23, split between recycling and energy recovery. Energy recovery is defined as processes through which wastes are collected, sorted and processed to recover energy in usable form, for example process heat, steam or in electricity generation.

About 194 kt of SA materials were estimated as recovered for their energy value in 2022-23, compared to 308 kt in the previous year.

Table 8 Material and energy recovery, SA, 2022-23

Recovery type	kt	Contribution to recovery rate (%)
Material recovery	4,050	95%
Energy recovery	194	5%
Total (resource recovery)	**4,244**	-



Imports

The survey covered reporting of waste and recovered materials imported from interstate or overseas for information purposes but these do not count towards SA's recycling performance. Reported imports of waste and recovered materials into SA in 2022-23 are shown in Table 9.

Table 9 Materials reported as imported to SA for resource recovery in 2022-23, kt

Material category	Imported tonnes									
	ACT	NSW	NT	Qld	Tas	Vic	WA	Overseas	Several interstate locations	Total
Masonry	0	0	0	0	0	0	0	0	0	0
Metals	0	0	<1	0	0	0	0	0	4	4
Organics	0	0	0	0	0	67	0	0	75	142
Cardboard and paper	0	0	0	0	0	0	0	0	0	0
Plastics	0	0	0	0	0	<1	0	0	31	31
Glass	0	0	0	0	0	0	0	0	46	46
Other materials	0	0	0	0	0	0	0	0	0	0
Total	**0**	**0**	**<1**	**0**	**0**	**67**	**0**	**0**	**156**	**223**

Overall reported imports from other states and territories were similar in 2022-23 to the previous year, although the material types imported varied. Approximately 46 kt of glass was imported from interstate, compared to none in the previous year. Information about the source location of material was not well reported this year. Comments in the survey forms indicated material was imported also from WA, NT and NSW but the amounts from each were not always specified and are recorded in Table 9 under 'several interstate locations'.

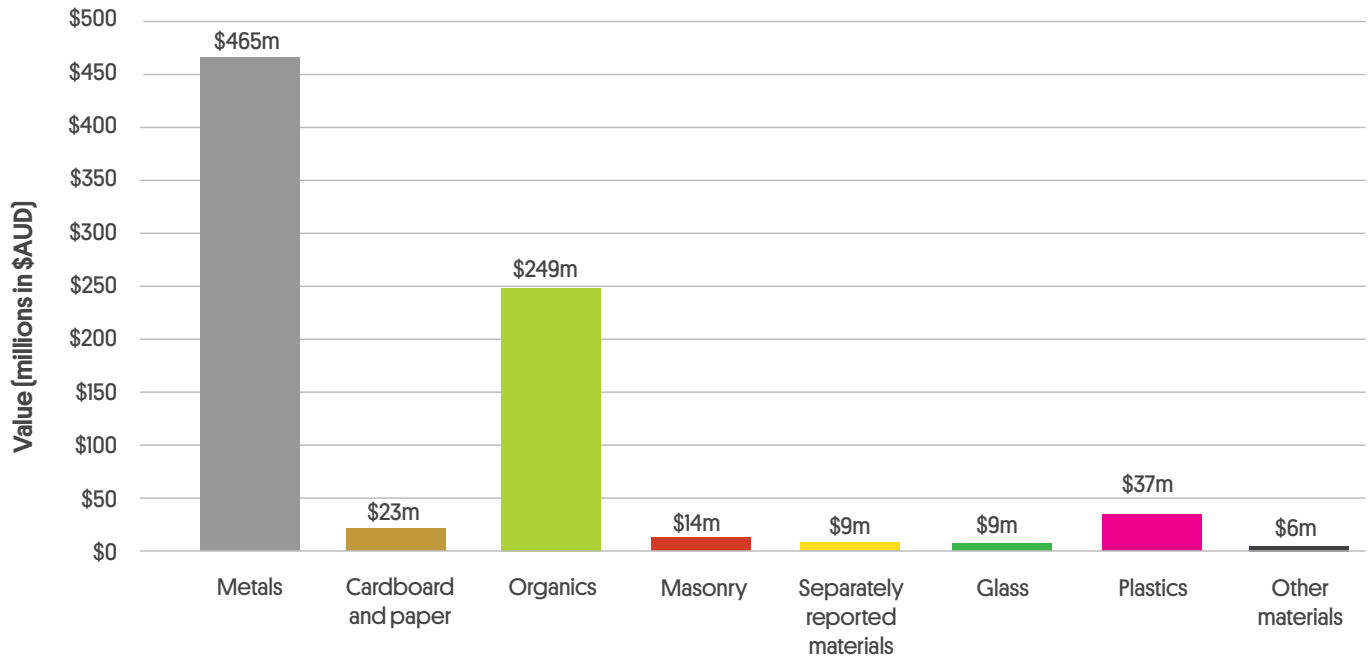
Market value of resource recovery

Survey participants were asked to estimate the average value for their products, and these were used to estimate the total market value of resource recovery in SA. Table 10 lists the estimated on-sale price per tonne for different recovered materials based on industry responses to the survey. The values in Table 10, coupled with recovered tonnes, were used to estimate the total market value of resource recovered materials seen in Figure 11. A more detailed breakdown of the value of resource recovery in SA is provided in Section 7.

Table 10 Assumed values for recovered materials in SA in 2022-23 based on survey responses

Material category or type	Estimated on-sale price ($/t)
Masonry	11
Metals – steel	558
Metals – non-ferrous including aluminium	3,033
Organics – meat rendering	2,000
Organics – garden organics, food organics and timber	*59*
Organics – other	Variable
Cardboard and paper	107
Plastics	1,110
Glass	116
Other materials (including tyres and other rubber, leather and textiles and foundry sands)	237
Separately reported materials and clean fill	8

Figure 11 Estimated market value of resource recovered material in SA during 2022-23



Scrap metals represent the largest share of the market value amongst recovered materials in 2022-23 at $465 million. This was driven by a high value per tonne for steel (estimated average of $558 per tonne, up from $390 per tonne in 2021-22), and non-ferrous metals ($3,033 per tonne, more than twice the value in 2021-22 of approximately $1,245).

Recovered organics, particularly meat rendering products such as tallow, have a high value per tonne and accounted for $249 million in 2022-23.

Scrap plastics had the next highest market share at $37 million, with the value per tonne reportedly $1,110 compared to $625 reported in 2021-22.

Scrap cardboard and paper value contributed $23 million, which is a fall from its value of $44 million in the previous year. There is some variation in value of each material type based on the survey responses. Newsprint and magazines had the highest reported value of between $180 and $200 per tonne compared to mixed paper and cardboard valued less than $100 per tonne.

Recovered masonry materials contributed about $14 million in 2022-23, a decrease from 2021-22 in which the estimate was $15 million. In 2022-23 the $ per tonne value varied between $5 and $25 per tonnes with an average of $11 per tonne; in comparison, reported values for masonry materials averaged $11 per tonne in 2021-22 and $23 per tonne in 2020-21.

Of the remaining material categories, glass recovery and separately reported materials (clay, fines, rubble and soil) were estimated to each contribute $9 million of value in SA in 2022-23, and 'other' materials (including foundry sands, leather and textiles, and tyres and other rubber) contributed $6 million.

In total, the estimated value of SA's resource recovery in 2022-23 was $811 million. This is significantly higher than 2021-22 when the total value was approximately $649 million. The increase is mostly due the high value of scrap metals in 2022-23.

Disaster waste

The State Government waived the landfill levy for about 5,400 tonnes sent to landfill in 2022-23. This was to assist communities with the cost of waste disposal after natural disasters and severe weather. In 2021-22, about 4,290 tonnes were reported as disaster waste, all from bushfires.

2.2 Performance against state targets

In 2020, Green Industries SA released *South Australia's Waste Strategy 2020-25*. The strategy defines waste diversion and reduction targets to 2025, which are guided by an overall target of zero avoidable waste to landfill by 2030.[5] This section details SA's progress in achieving these targets.

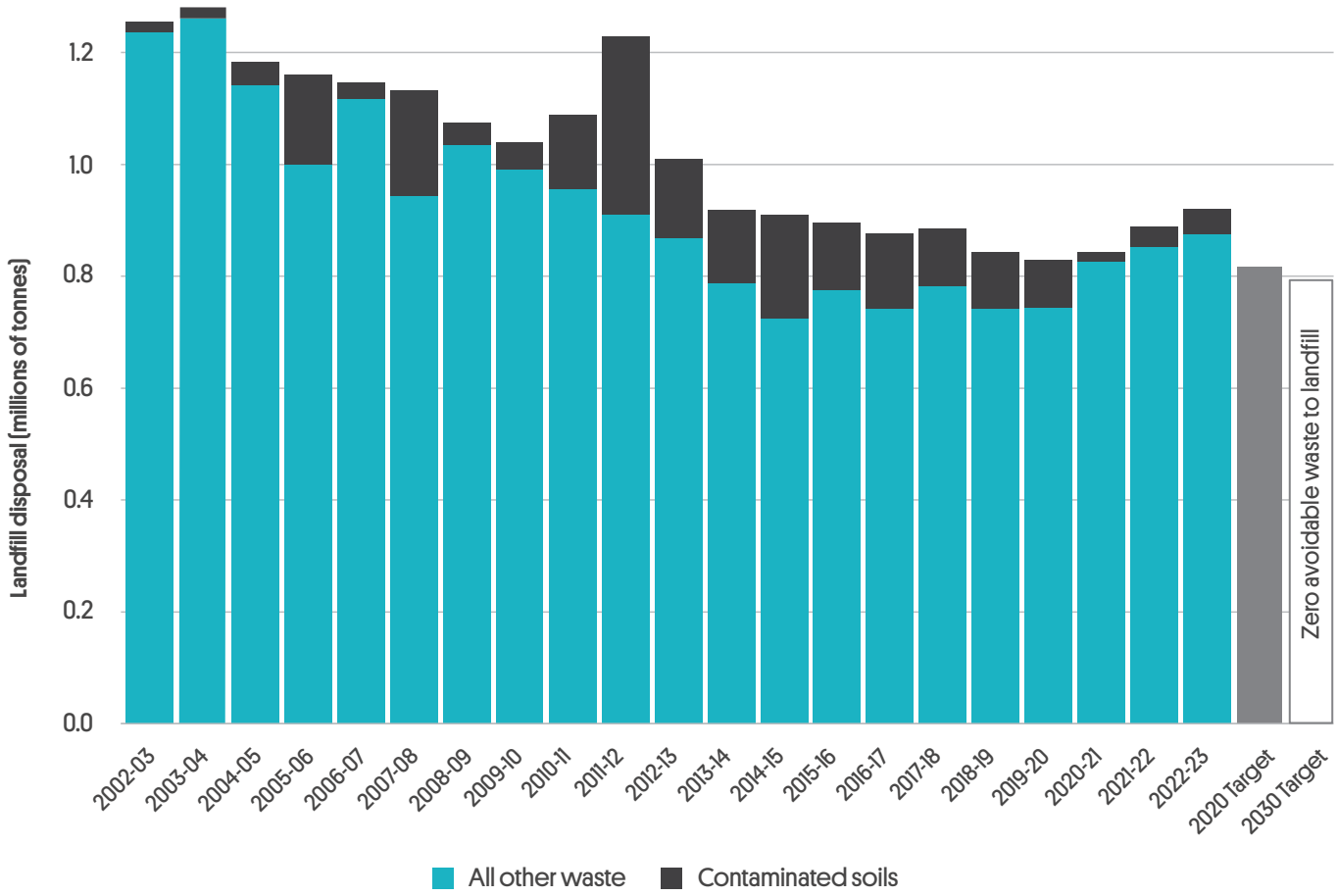
Landfill diversion target

South Australia's Waste Strategy 2020-25 sets out a goal for zero avoidable waste to landfill by 2030[5]. The State disposed of about 914 kt of waste to landfill in 2022-23, an increase from 885 kt in 2021-22, 840 kt in 2020-21 and 827 kt in 2019 20. A range of actions will need to be implemented to achieve SA's ambitious landfill target for 2030.

Figure 12 shows SA's landfill disposal trend since 2002-03.

SA had a 2020 target for reducing waste to landfill by 35% from a 2002-03 baseline. The landfill quantities in 2022-23 are equivalent to a reduction of 27% against the 2002-03 levels.

Figure 12 Landfill disposal trend since 2002-03, including state targets for 2020 and 2030



5 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.

Waste generation target

South Australia's Waste Strategy 2020-25 sets a 5% reduction in waste generation per capita from a 2019-20 baseline. Table 11 summarises a five-year trend in waste generation per capita for all reported materials. Waste generation per capita rose by 106 kilograms (4%) in 2022-23 compared to 2021-22 and declined by 0.5% since 2019-20.

Table 11 Waste generation per capita since 2017-18, including the state target for 2025

Recovery type	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	Change (%) 21-22 to 22-23	Target 2025
Waste generation per capita (kg/person/yr)	3,090	2,960	2,800	2,844	2,679	2,785	4.0%	5% reduction from 2020 baseline

Metropolitan diversion target

SA has established targets for waste diversion from landfill from its metropolitan region by source stream. The Metropolitan Adelaide goal for 2023 is 65% diversion for MSW, 85% diversion for C&I, and 90% diversion for C&D. Table 12 presents the diversion rate achieved in metropolitan SA in 2022-23, together with State targets for 2023 and 2025.

In 2022-23, the metropolitan area C&D recovery rate was 97.4%, C&I source stream recovery rate was 75.6%, and the MSW recovery rate was 61.7%. In contrast, in 2021-22, the C&I recovery rate was 88.2%, the C&D recovery rate was 87.2%, and the MSW recovery rate was 55.9%. The significant variation between 2022-23 and 2021-22 is primarily due to a change in the way the source streams of waste to landfill were assessed. A new model based on an audit conducted at several C&I transfer stations in 2022 where materials were weighed to determine waste composition and tonnages was combined with SA EPA mass balance reporting data. The new method is more accurate than the previous model, which was based on a much older landfill audit that relied on volumetric estimates and assumed densities.

Table 12 Metropolitan diversion rate for SA in 2022-23, including state targets to 2025

Source sector	2022-23 diversion rate	Metropolitan diversion target 2023	2025
MSW	61.7%	65%	75%
C&I	75.6%	85%	90%
C&D	97.4%	90%	95%

2.3 Local government recovery

Local governments data on materials collected in household bins at kerbside for disposal or recycling are presented and discussed in this section. The data represent a subset of the MSW tonnes discussed elsewhere in this report, which also include non-kerbside municipal waste such as hard waste, street sweepings and domestic materials dropped off at transfer stations.

Overall kerbside collections

Table 13 shows data on materials collected in household residual, recycling and organics bins at kerbside in SA in 2022-23. About 697 kt of kerbside materials were collected, of which 535 kt were from the metro region and 162 kt were from regional areas. This was very similar to last year. Most kerbside waste was collected in residual bins (340 kt), followed by organics bins (228 kt), and recycling bins (129 kt).

SA's recovery rate for kerbside waste in 2022-23 was an estimated 51.2%, an increase from the previous year's rate of 48.8%. Recovery was higher for metropolitan councils (53.6%) than regional councils (43.6%), both of which were higher than in 2021-22.

Table 13 Materials collected from households at kerbside in SA in 2022-23

Region	Collected at kerbside (kt)				Recovery rate (%)
	Residual	Recycling	Organics	Total	
Metro	248	100	187	535	53.6%
Regional	91	30	41	162	43.6%
SA	340	129	228	697	51.2%

The household hazardous waste collection program offers free drop-off for hazardous waste items in SA. This prevents hazardous substances from ending up in landfill. Table 14 summarises the material collected through the program.

Table 14 Household hazardous waste collection, 2022-23

Hazardous waste	Tonnes
Aerosol cans	4.6
Batteries	7.6
Corrosives	2.9
Fertilisers	1.4
Fire extinguishers	6.5
Flammables	31.3
Fumigants	<0.1
Gas bottles	27.1
Heavy metals and compounds	<0.1
Inert liquids	62.2
Isocyanates	<0.1
Lead based compound	<0.1
Light tubes	4.6
Oils	81.0
Oxidisers	1.2
Paint	4.1
Pesticides	2.6
Pharmaceuticals	<0.1
Poisons	<0.1
Preservatives	9.7
Smoke detectors	0.1

Recovery by region

Table 15 shows population and kerbside data for 2022-23 at the sub-region level, including kilograms of kerbside waste per capita. Within metropolitan SA, the Central Eastern sub-region achieved the highest overall recovery rate (56%) followed closely by Southern (55%), Western (54%) and then Northern (50%) sub-regions. The Western region generated the least waste per capita (378 kg per person) followed by the Central Eastern region and then the Northern region. Regional SA generated less waste per capita than any of the metro regions at 355 kg but also had the lowest recovery rate at 44%.

Table 15 Population and kerbside data statistics by region

Region or sub-region	Population	Kerbside waste collected (kt)	Kerbside waste per capita (kg/capita)	Recovery rate
Metro	1,363,762	535	392	54%
Central Eastern	278,283	107	384	56%
Northern	380,086	148	390	50%
Southern	343,572	143	416	55%
Western	361,821	137	378	54%
Regional	456,768	162	355	44%
All SA	**1,820,530**	**697**	**383**	**51%**

Coverage

Nearly all households in SA are provided a kerbside service. About 99% of households live in a council area providing a residual waste service, 97% have a recycling service and 91% have an organics service. In metropolitan Adelaide, about 94% of households have a 3-bin system.

2.4 Comparative performance with other jurisdictions

SA has led recycling and resource recovery performance in Australia for many years.

The methods used by states and territories to measure and report waste vary. *The National Waste Report 2022* (Blue Environment 2022), released by the Department of Climate Change, Energy, the Environment and Water, adjusts these methods to present a consistent as possible comparison of recovery rates across states and territories.

Figure 13 is taken from the National Waste Report 2022 and shows recycling, waste reuse and energy recovery and overall recovery rates for each Australian jurisdiction in 2020-21. SA had the highest recovery rate of 80%.[6] The next highest rate was ACT at 69% and NSW and Vic at 67%. Overall, Australia achieved a recovery rate of 63% in 2020-21.

Figure 13 Resource recovery and recycling rates by jurisdiction, 2020-21

Source: National Waste Report 2022 (Blue Environment 2022)

6 This differs from the value reported in the CERRR 2020-21 due to differences in method.

2.5 Employment in the SA resource recovery sector

SA's resource recovery sector employs thousands of people across a wide range of jobs. The survey asked SA recyclers about their workforce and employment details, and Table 16 and Table 17 summarise the results. The data represents a sub-set of total employment in SA's waste and resource recovery industry, which includes a wider range of positions (e.g. landfill operators).

Table 16 shows the number of reported full-time equivalent employees in SA's resource recovery sector over the last few years. In 2022-23, 1,701 equivalent full-time employees were reported. While the numbers appear to be declining, companies and organisations that reported employee numbers in 2022-23 made up only 45% of the year's total recovered tonnes, suggesting the true number may be significantly higher. Some companies making large contributions to resource recovery in SA did not respond to this question.

Table 16 Reported full-time equivalent employees in SA's resource recovery sector based on survey results

Employment category	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Total full time equivalent employees	1,831	1,850	2,098	2,108	1,957	1,701

The survey asked respondents to breakdown their reported workforce by employment classification. The results are shown in Table 17 with results of previous years. Machinery operators were the most reported employee classification, followed by employees engaged in sorting, then drivers and administrators. There has been little variation in the proportions since 2019-20.

Table 17 Full time equivalent employees in SA's resource recovery sector by employee type

Employment type	2019-20	2020-21	2021-22	2022-23
Unskilled	17%	9%	4%	3%
Administration	15%	13%	14%	13%
Construction /design	0.5%	0.2%	0.0%	0%
Driver	17%	18%	14%	13%
Machinery operator	26%	31%	37%	28%
Sorting	4%	3%	8%	14%
Technical support	4%	8%	11%	9%
Sales/ marketing	4%	5%	3%	5%
Supervisor	5%	7%	5%	5%
Other	7%	6%	3%	11%
Total	**100%**	**100%**	**100%**	**100%**

2.6 Reuse and the circular economy

Reuse

Reuse can be defined as the reallocation of products or materials to a new owner or purpose without reprocessing or remanufacture (but potentially with some repair). The practice promotes the cycling of material without the need to consume new resources. Australia has a longstanding reuse network that includes its charities, non-government organisations (e.g. food rescue organisations), community groups and online trading platforms (e.g. Gumtree). Items and products commonly recirculated via the Australia's reuse economy include clothing, food, home furniture, whitegoods, vehicles and electronics.

MRA (2021) found that each year, Australians divert about 310 kt of clothing for reuse to charitable organisations nationally. Almost 10% of this is attributed to South Australians. According to the study, reusing clothes instead of landfilling them reduces carbon emissions by 66%, water consumption by 57% and energy use by 59%. Reused clothing also generates an estimated revenue of $1,700 per tonne. Nationally, the charitable recovered clothing industry provides 5,300 jobs and volunteer places for 35,000 people again promoting the economic value in reuse practices.

The CERRR survey targeted key players in SA's charitable network and reuse economy. Reported quantities from 2022-23 are shown in Table 18, together with estimated values for the reuse materials. Table 18 is expected to represent only a portion of reuse in SA. Some items excluded from Table 18 would contribute significant volumes to overall reuse in SA but are difficult to measure, such as items traded via community platforms (e.g. Facebook Marketplace, Gumtree, etc.). Still, the quantities and estimated values in Table 18 highlight the importance of the reuse economy from both an environmental and economic standpoint. The detail of the reuse section in future reports will improve as better data become available.

Table 18 Reuse in SA in 2022-23 based on survey results

Reuse material	Tonnes	Estimated value of reuse material ($/tonne)	Estimated value of reuse materials in SA ($m/yr)
Food rescue	3,900	$6,000	$23.6
Clothing	3,100	$1,700	$5.3
Home furnishings and goods	1,900	$15,000	$28.7
Books	500	$1,000	$0.5
Electrical goods	200	$11,800	$2.0

Industry engagement with the circular economy concept

Our survey asked companies and organisations to nominate which factors were of the highest priority, in a circular economy, for selecting the end destination of the materials they receive. The results to this question are shown in Table 19. Not all survey participants provided a response to this question, but based on available data, the desire to recover materials was as important as financial reasons.

Table 19 Responses to the question "which of the following factors is your highest priority when identifying the reprocessing destination for sourced goods and materials in a circular economy?"

Circular economy factor	Number of responses
Financial	14
Avoiding landfill	6
Goods or material can be recycled	7
Goods or material can be repaired or reused	2
Other	14

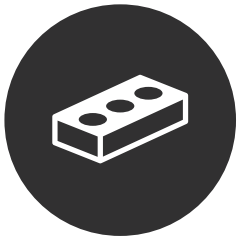

27
FOODBANK
CROWN
CG18S
CROWN
VISOBIN
VISY


VEOLIA
ENVIRONMENTAL
SERVICES

3 Material resource recovery reports

This section presents the key findings from analysis of 2022-23 survey data by material category and type. The materials covered in this section are:

- masonry – asphalt, bricks, concrete, plasterboard, and clay, fines, rubble and soil
- metals – iron and steel, aluminium, and non-ferrous metals
- organics – food organics, garden organics, timber, and other organics
- cardboard and paper – cardboard and waxed cardboard, liquid paperboard, magazines and newsprint, and printing and writing paper
- plastics – polyethylene terephthalate (PET), high density polyethylene (HDPE), polyvinyl chloride (PVC), low density polyethylene (LDPE), polypropylene (PP), polystyrene (PS), mixed and/or other plastics
- glass – glass from food and beverage containers, and other glass
- other materials – fly ash, foundry sands, leather and textiles, and tyres and other rubber.



3.1 Masonry

About 2.29 million tonnes of masonry was recovered in SA in 2022-23 which is an increase from 2021-22 (2.03 million tonnes) but still not as high as previous years such as 2020-21 (2.40 million tonnes). The masonry recovery figures are significantly affected by a small number of recycler returns with data quality issues, therefore there may be some variation between calculated recovery and actual recovery, especially for bricks.

Clay, fines, rubble and soil contributed the greatest proportion of reported masonry materials (46%) and made up a larger share of the total masonry recovered than in 2021-22 when it was about 30%.

Concrete was the next largest contributor (44%), followed by asphalt (9%), bricks (1%) and plasterboard (<1%). The quantity of bricks reported recovered was significantly lower than what was reported in 2021-22.

Table 20 summarises masonry recovery in 2022-23.

Table 20 Masonry recovered, SA, 2022-23

Material type	Net recovery (kt)
Asphalt	208
Bricks	16
Concrete	1,005
Plasterboard	2
Clay, fines, rubble and soil – clean fill	1,050
Clay, fines, rubble and soil – intermediate waste soil	14
Total	**2,294**

Figure 14 and Figure 15 show trends in masonry materials types over time, while Figure 16 compares the reported composition of masonry materials in 2021-22 and 2022-23.

Figure 14 Masonry recovered since 2003-04 – concrete and clay, fines, rubble and soil

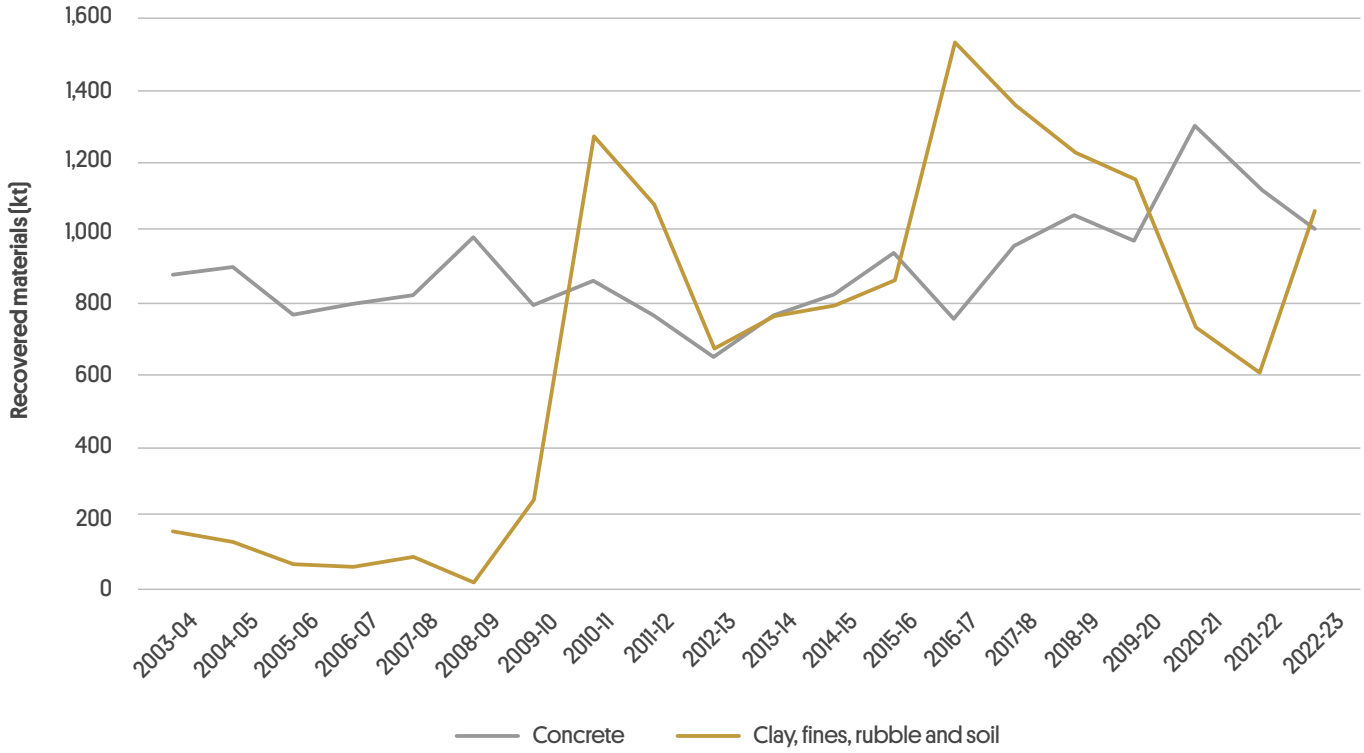


Figure 15 Masonry recovered since 2003-04 – asphalt, bricks and plasterboard

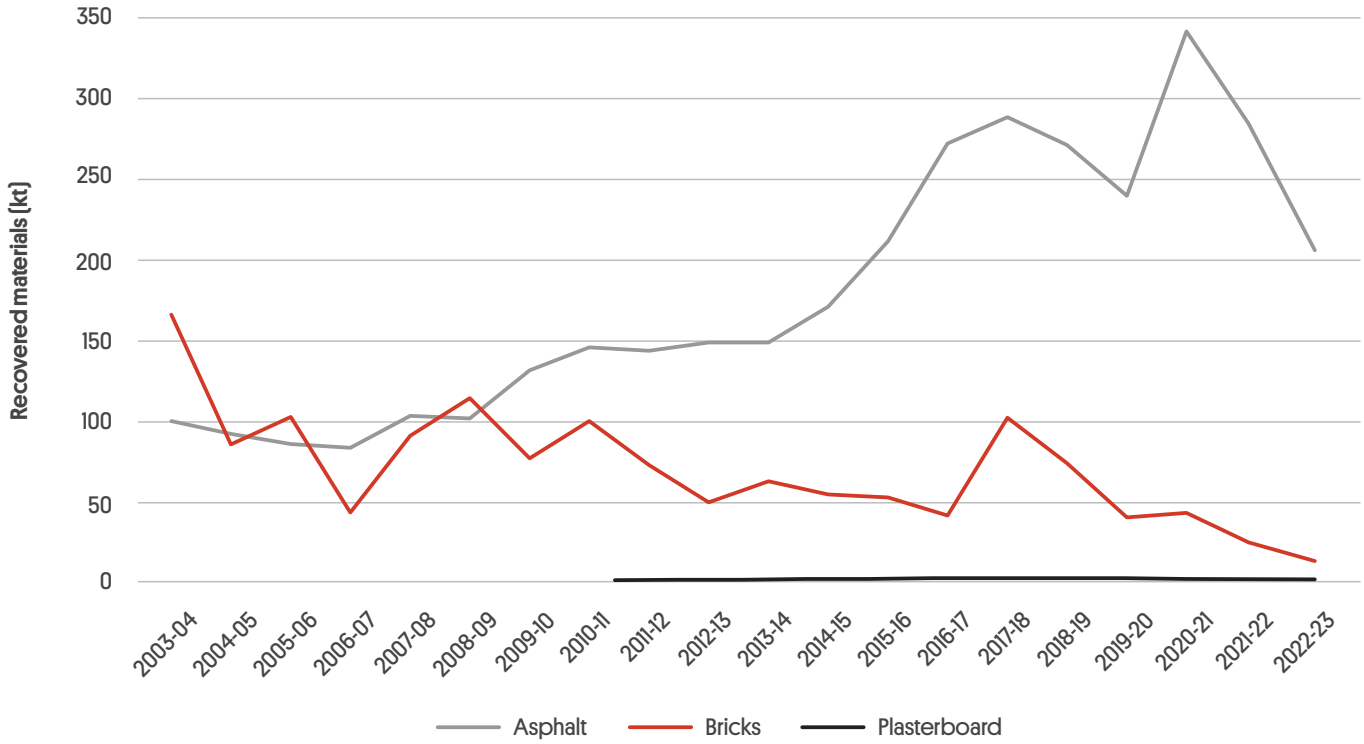


Figure 16 Reported percent composition of masonry recovered in 2021-22 and 2022-23

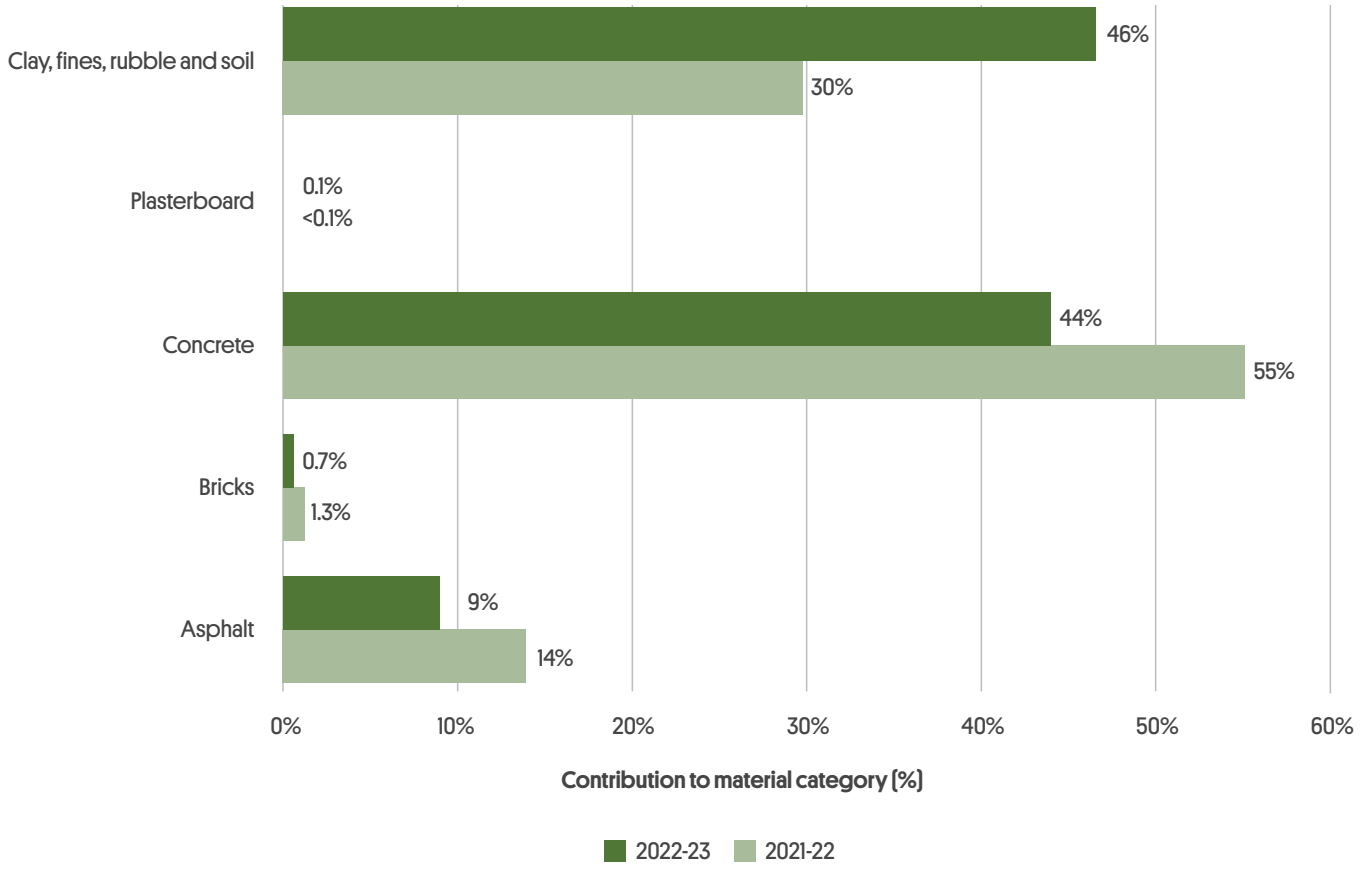


Table 21 presents the source stream, geographical origin and reprocessing location for recovered masonry materials in SA in 2022-23. Masonry is mostly from infrastructure projects in the metropolitan region, and all recovered masonry is reprocessed locally in the State.

Table 21 Masonry recovered in 2022-23 by source stream, geographical origin and reprocessing location

	Source stream (%)			Geographical origin (%)		Reprocessing location (%)		
Material type	**MSW**	**C&I**	**C&D**	**Metro**	**Regional**	**SA**	**Interstate**	**Overseas**
Asphalt	0%	0%	100%	91%	9%	100%	0%	0%
Bricks	0%	0%	100%	61%	39%	100%	0%	0%
Concrete	0%	0%	100%	88%	12%	100%	0%	0%
Plasterboard	0%	78%	22%	100%	0%	100%	0%	0%
Clay, fines, rubble and soil – clean fill	0%	8%	92%	83%	17%	100%	0%	0%
Clay, fines, rubble and soil – intermediate waste soil	0%	53%	47%	97%	3%	100%	0%	0%
Total	**0%**	**4%**	**96%**	**86%**	**14%**	**100%**	**0%**	**0%**

3.2 Metals

Recovery of scrap metals increased in the 2022-23 financial year to about 507 kt, compared to the previous year's 329 kt. Recovered metals were mostly iron and steel (433 kt), followed by aluminium (41 kt), non-ferrous metals (excluding aluminium and copper) (18 kt), copper (15 kt) and mixed metals (<1 kt). Table 22 summarises metals recovery in SA in 2022-23.

Table 22 Metals recovered, SA, 2022-23

Material type	Net recovery (kt)
Iron and steel	433
Aluminium	41
Copper	15
Non-ferrous metals (excl. aluminium and copper)	18
Mixed metals	<1
Total	**507**

Figure 17 and Figure 18 show metals recovery trends since 2003-04. The percent composition that iron and steel, aluminium and other non-ferrous metals contribute to overall metals recovery is presented in Figure 19.

Figure 17 Metals recovered since 2003-04 – iron and steel

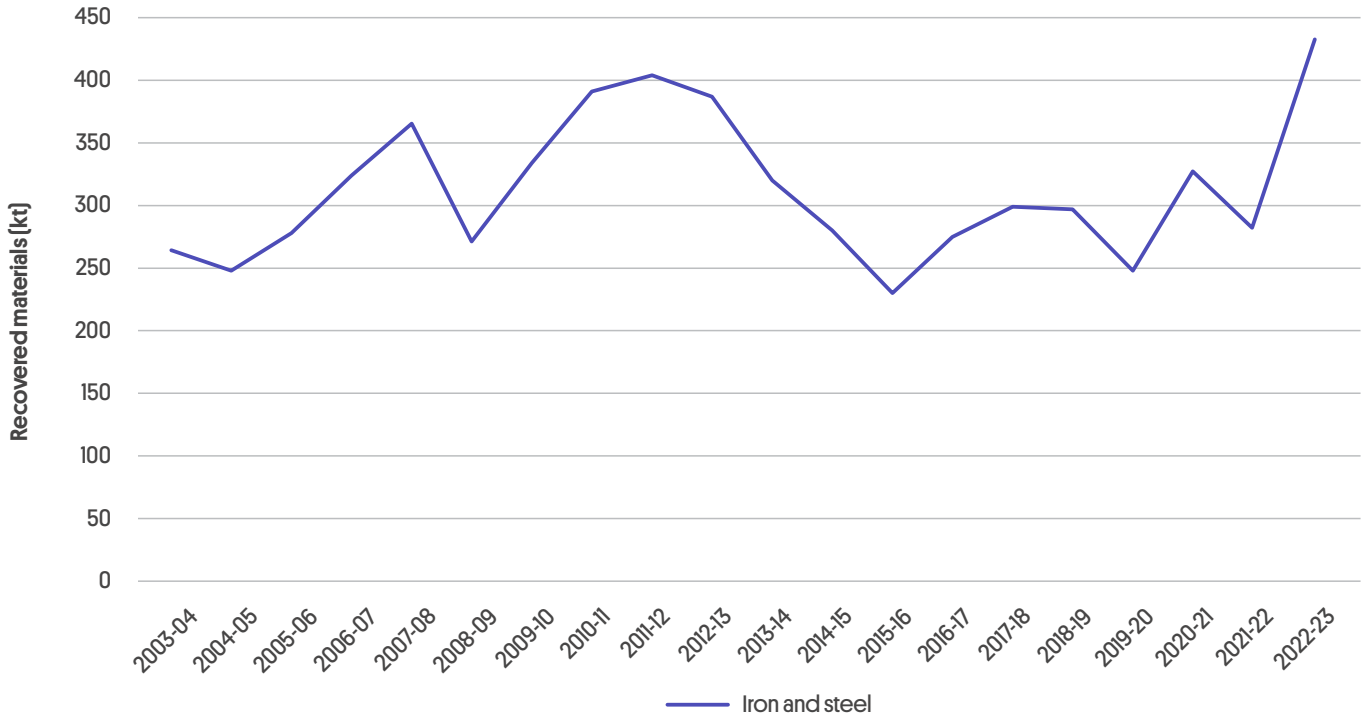


Figure 18 Metals recovered since 2003-04 – aluminium and other non-ferrous metals

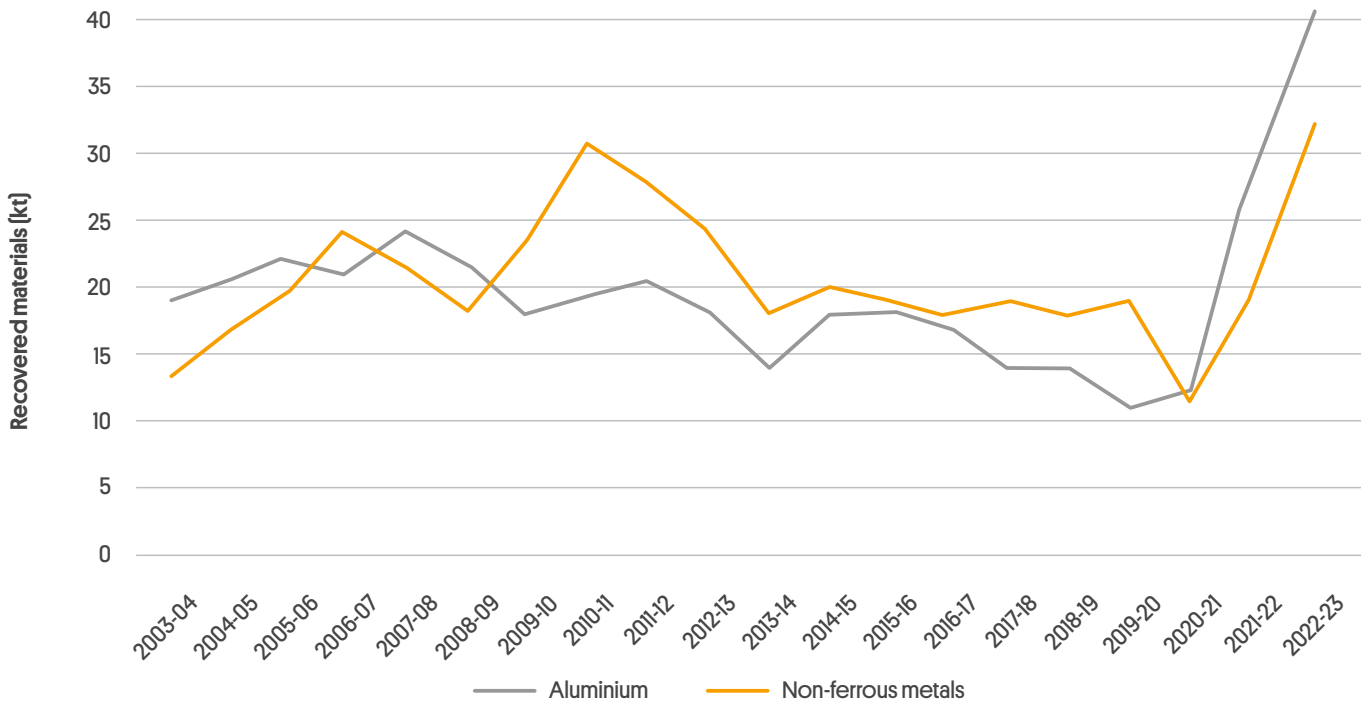


Figure 19 Reported percent composition of metals recovered in 2021-22 and 2022-23

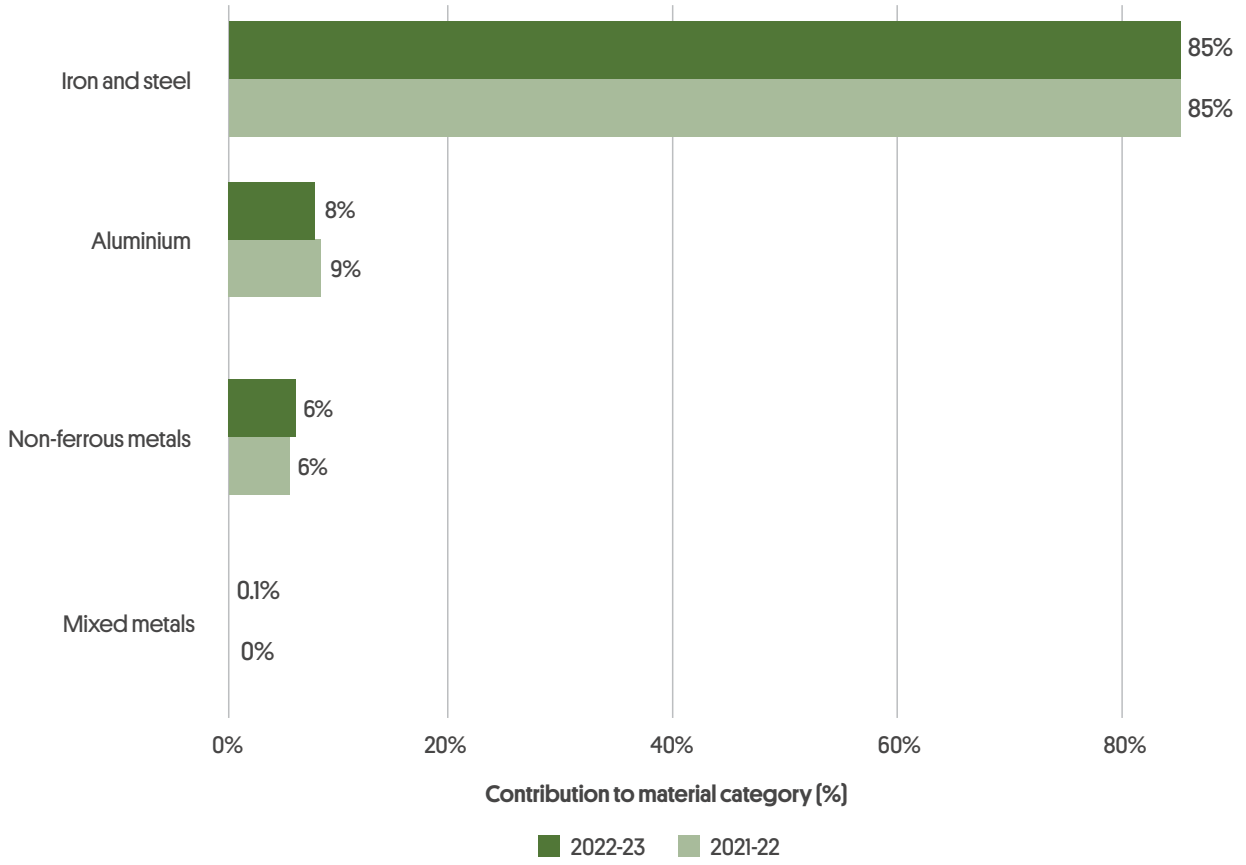


Table 23 shows metals recovered by type, source stream, geographical origin and reprocessing location. Recovered metals were mostly from C&I sources but C&D contributed 10% and MSW 4%.

Table 23 Metals recovered in 2022-23 by source stream, geographical origin and reprocessing location

	Source stream (%)			Geographical origin (%)		Reprocessing location (%)		
Material type	**MSW**	**C&I**	**C&D**	**Metro**	**Regional**	**SA**	**Interstate**	**Overseas**
Iron and steel	5%	85%	10%	75%	25%	74%	5%	21%
Aluminium	3%	92%	5%	83%	17%	31%	0%	69%
Copper	0%	80%	20%	78%	22%	17%	0%	83%
Non-ferrous metals (excl. aluminium and copper)	0%	84%	15%	88%	12%	75%	7%	18%
Mixed metals	0%	87%	13%	0%	100%	100%	0%	0%
Total	**4.5%**	**85.4%**	**10.1%**	**76%**	**24%**	**69%**	**5%**	**26%**

Note: Some values are presented to one decimal place to avoid misrepresentation due to rounding

3.3 Organics

Organics recovery remained strong in 2022-23, with almost 1.1 million tonnes of organic materials recovered. Table 24 summarises the recovery of food organics, garden organics, timber and other organics in SA in 2022-23.

As in previous years, the group of 'other' organics, which includes meat rendering, waste grease and fat, waste sludge and biosolids and miscellaneous organics, contributed the most to overall organics recovery, at 59%, accounting for 651 kt recovered.

About 332 kt of garden organics were recovered in SA in 2022-23, contributing about 30% towards overall organics recovery. Reported timber recovery declined strongly in 2022-23 to 68 kt compared to 238 kt in 2021-22. Timber comprised 6% of total organics recovery in 2022-23. Food organics recovery in 2022-23 tripled to 47 kt but remained the lowest contributor to organics recovery at 4% of the total organics recovered.

About 204 kt of food organics and garden organics were reported as 'mixed food organics and garden organics' or 'FOGO' in the survey and other data sources. This reflects the growing number of councils in both metropolitan and regional SA offering kerbside FOGO trials and services. FOGO is included in the food organics and garden organics in Table 24 having been split into the components using the assumed ratio 19% food organics and 81% garden organics (based on audit data).

Table 24 Organics recovered, SA, 2022-23

Material type	Net recovery (kt)
Food organics	47
Garden organics	332
Timber	68
Other organics	651
Meat rendering	221
Waste grease and fat	82
Waste sludge and biosolids	132
Organics – other	216
Total	**1,097**

Figure 20 Organics recovered since 2003-04

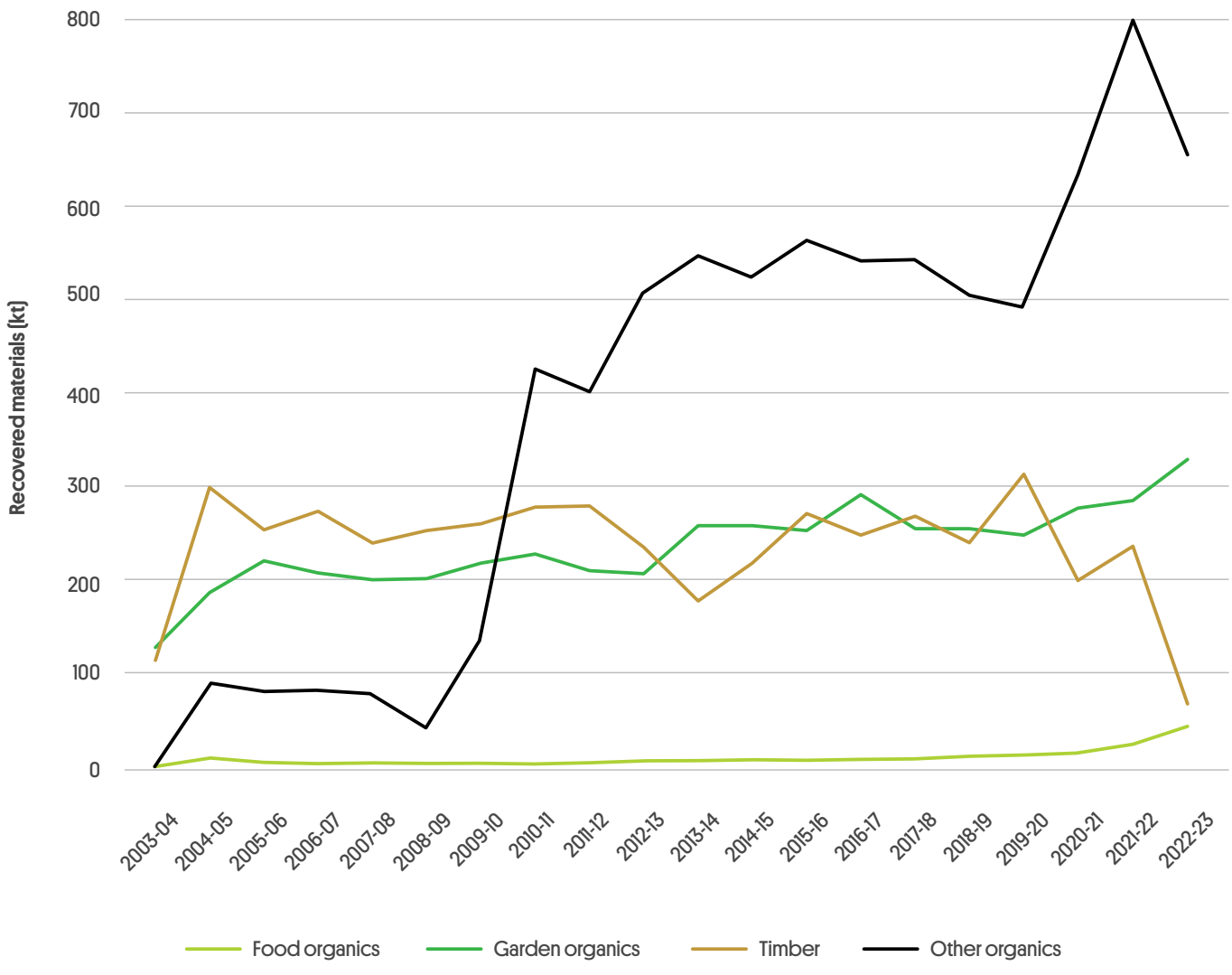


Figure 21 Other organics recovered since 2009-10

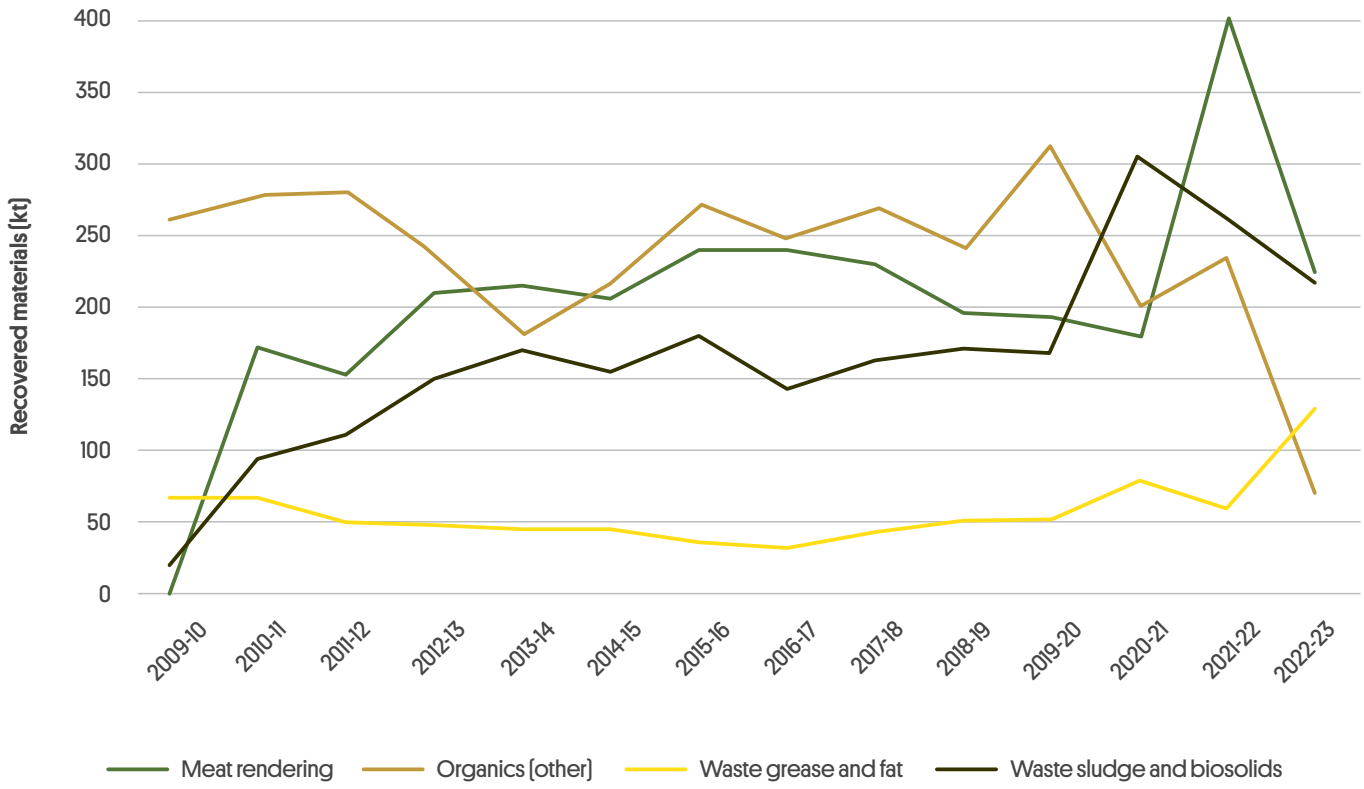


Figure 22 Reported percent composition of organics recovered in 2021-22 and 2022-23

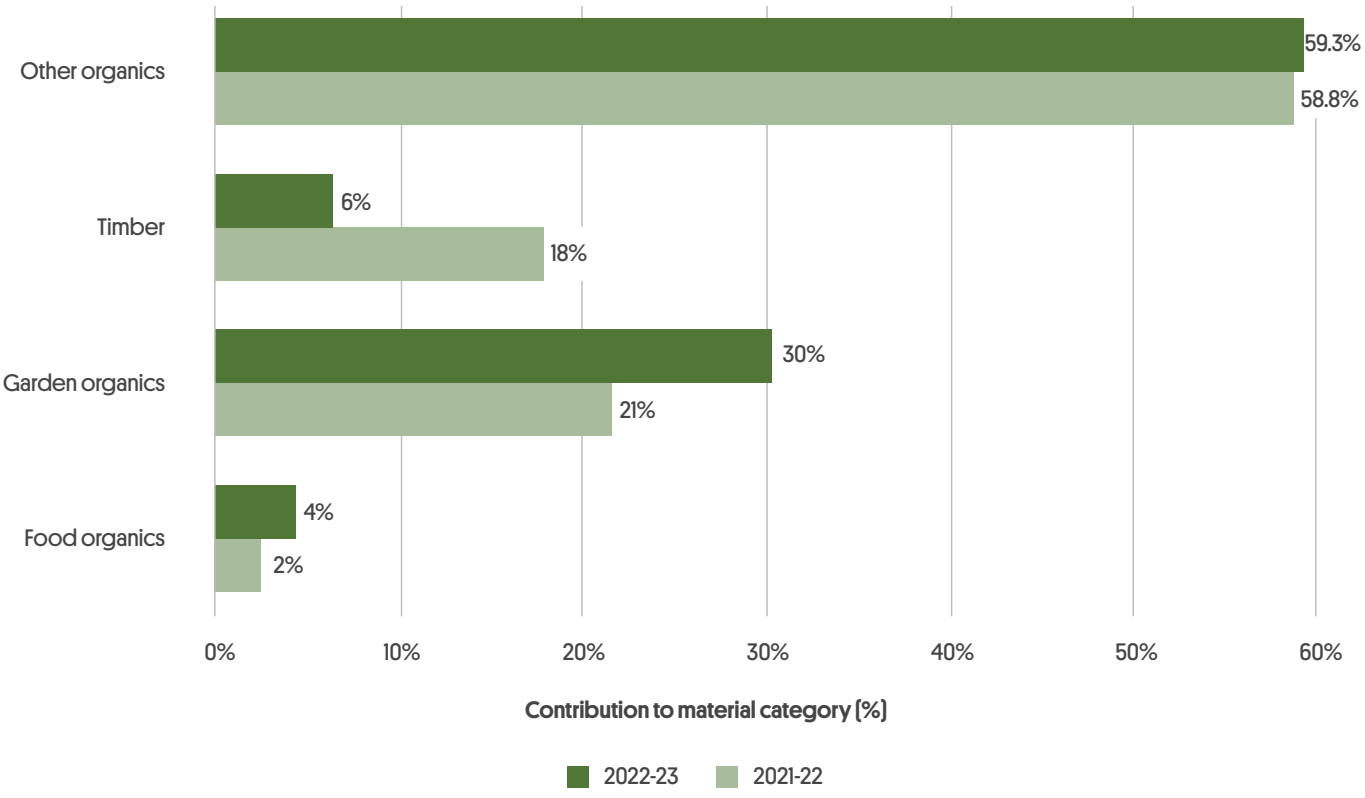


Table 25 provides detail of organics recovery in SA in 2022-23, including information of source stream, geographical origin and reprocessing location. Most organics came from SA's C&I stream (65%), followed by the MSW stream (30%), with a small proportion being C&D waste (4%). Almost all organics generated in SA were recycled in SA (97%). Metropolitan SA generated more organics (69%) than regional SA.

Table 25 Organics recovered in 2022-23 by source stream, geographical origin and reprocessing location

	Source stream (%)			Geographical origin (%)		Reprocessing location (%)		
Material type	**MSW**	**C&I**	**C&D**	**Metro**	**Regional**	**SA**	**Interstate**	**Overseas**
Food organics	37%	63%	0%	93%	7%	100%	0%	0%
Garden organics	65%	29%	5%	82%	18%	100%	0%	0%
Timber	5%	49%	46%	82%	18%	100%	0%	0%
Other organics	14%	86%	0%	60%	40%	95%	5%	0%
Total	**30.1%**	**65.5%**	**4.4%**	**69%**	**31%**	**97%**	**3%**	**0%**

Note: Some values are presented to one decimal place to avoid misrepresentation due to rounding

3.4 Cardboard and paper

Recovery of scrap cardboard and paper rose slightly in 2022-23 with about 216 kt of cardboard and paper recovered in SA, up from 164 kt in 2021-22. Cardboard and waxed cardboard was the largest portion of the category with 106 kt reported as recovered in 2022-23. Recovery of magazines and newsprint accounted for 75 kt and printing and writing paper totalled 35 kt. A small amount of liquid paperboard was recovered (486 tonnes). Reported mixed paper and cardboard were apportioned into the sub-categories of magazines and newsprint and printing and writing paper.

Table 26 Cardboard and paper recovered, SA, 2022-23

Material type	Net recovery (kt)
Cardboard and waxed cardboard	106
Liquid paperboard	<1
Magazines and newsprint	75
Printing and writing paper	35
Total	**216**

Figure 23 and Figure 24 show trends in cardboard and paper recovery over time with mixed paper and carboard apportioned into other material types, while Figure 25 compares the percent composition for different cardboard and paper types in 2022-23 and 2021-22. Consumption of paper and cardboard – and particularly newsprint and magazines – continues to decline due to digitisation.

Figure 23 Cardboard and paper recovered since 2003-04 – cardboard and waxed cardboard, magazines and newsprint and printing and writing paper

Figure 24 Cardboard and paper recovered since 2003-04 – liquid paperboard

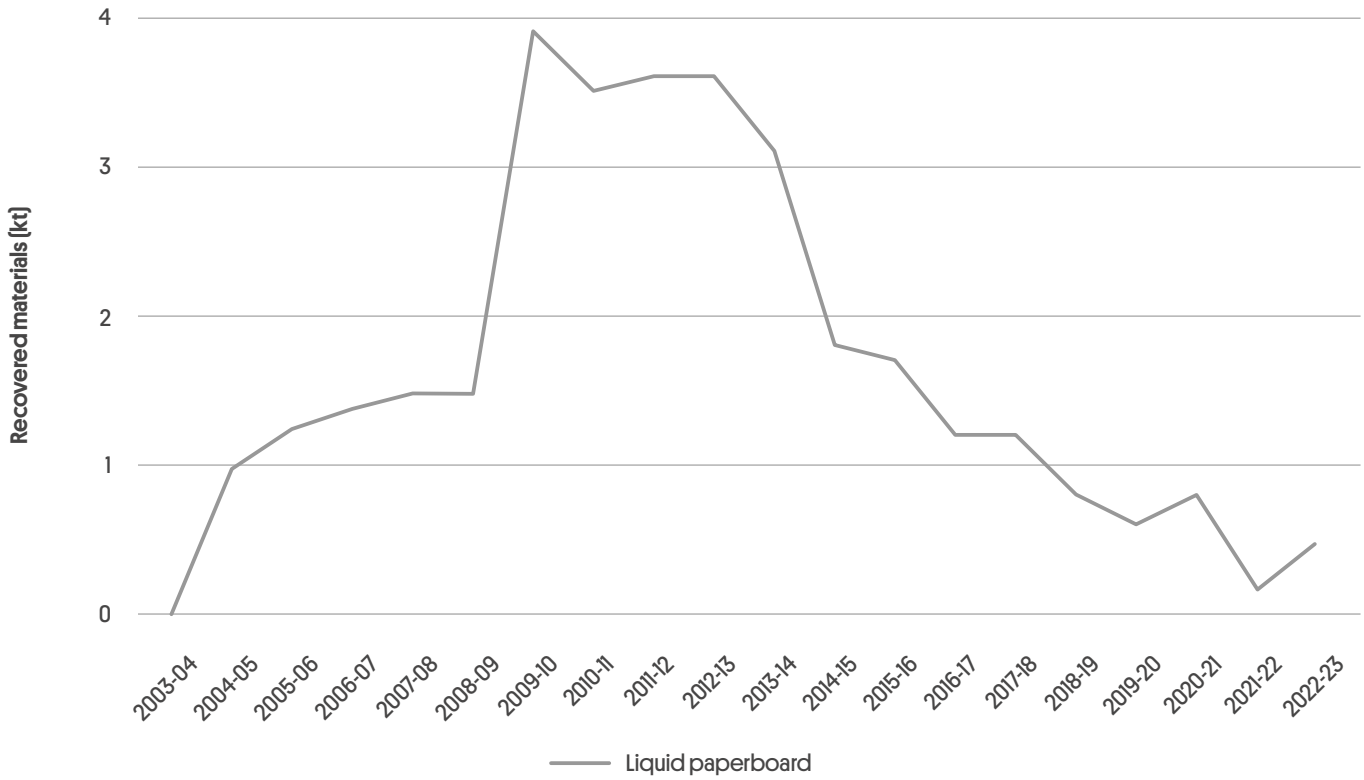


Figure 25 Reported percent composition of cardboard and paper recovered in 2021-22 and 2022-23

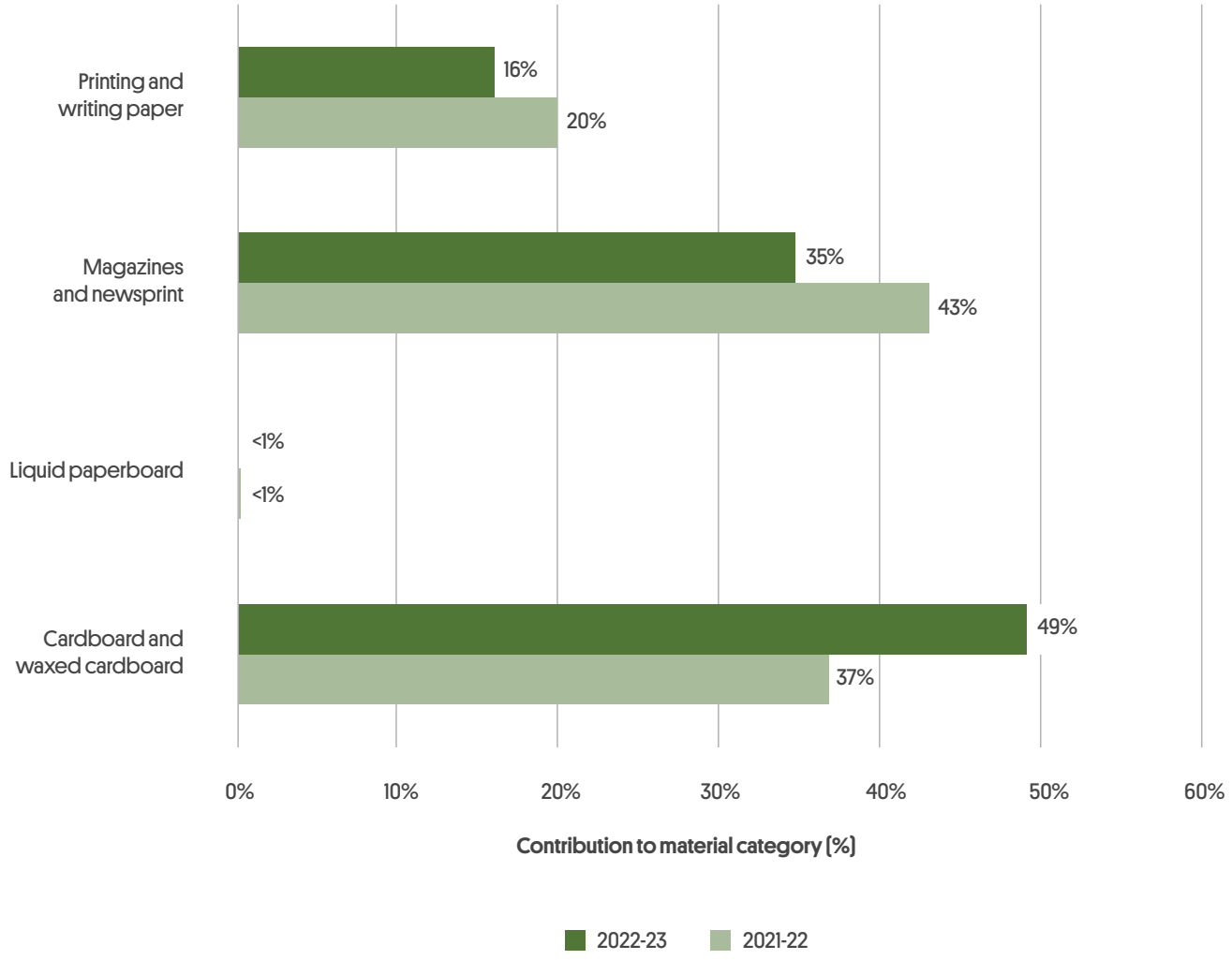


Table 27 presents the source stream, geographical origin and reprocessing location for recovered cardboard and paper in SA in 2022-23. Cardboard and paper were mostly recovered from the C&I stream and reprocessing was mostly undertaken overseas.

Table 27 Cardboard and paper recovered in 2022-23 by source stream, geographical origin and reprocessing location

	Source stream (%)			Geographical origin (%)		Reprocessing location (%)		
Material type	**MSW**	**C&I**	**C&D**	**Metro**	**Regional**	**SA**	**Interstate**	**Overseas**
Cardboard and waxed cardboard	1%	99%	0%	98%	2%	76%	7%	18%
Liquid paperboard	4%	96%	0%	98%	2%	100%	0%	0%
Magazines and newsprint	72%	28%	0%	79%	21%	45%	0%	55%
Printing and writing paper	0%	100%	0%	97%	3%	100%	0%	0%
Total	**36%**	**64%**	**0%**	**88%**	**12%**	**51%**	**25%**	**24%**

3.5 Plastics

SA recovered 30 kt of plastics in 2022-23, a slight drop from the 33 kt recovered in 2021-22. Table 28 summarises 2022-23 plastics recovery and Figure 26, Figure 27 and Figure 28 show plastics recovery trends since 2003-04.

Mixed plastics recovery was about 1 kt in 2022-23 which is an increase from 2021-22. Recovery of individual polymer types was similar to 2021-22. The Australian Government's ban on the export of mixed plastics was implemented in July 2021. Recovered plastics in 2022-23 were mostly HDPE (39%), PET (29%) and PP (16%).

Table 28 Plastics recovered, including energy recovery, SA, 2022-23

Material type	Net recovery (kt)
Polyethylene terephthalate	9
High density polyethylene	12
Polyvinyl chloride	<1
Low density polyethylene	2
Polypropylene	5
Polystyrene	1
Mixed and/or other plastics	1
Total	**30**

Figure 26 Plastics recovered since 2003-04 – PET, HDPE, LDPE, PP and mixed and/or other plastics

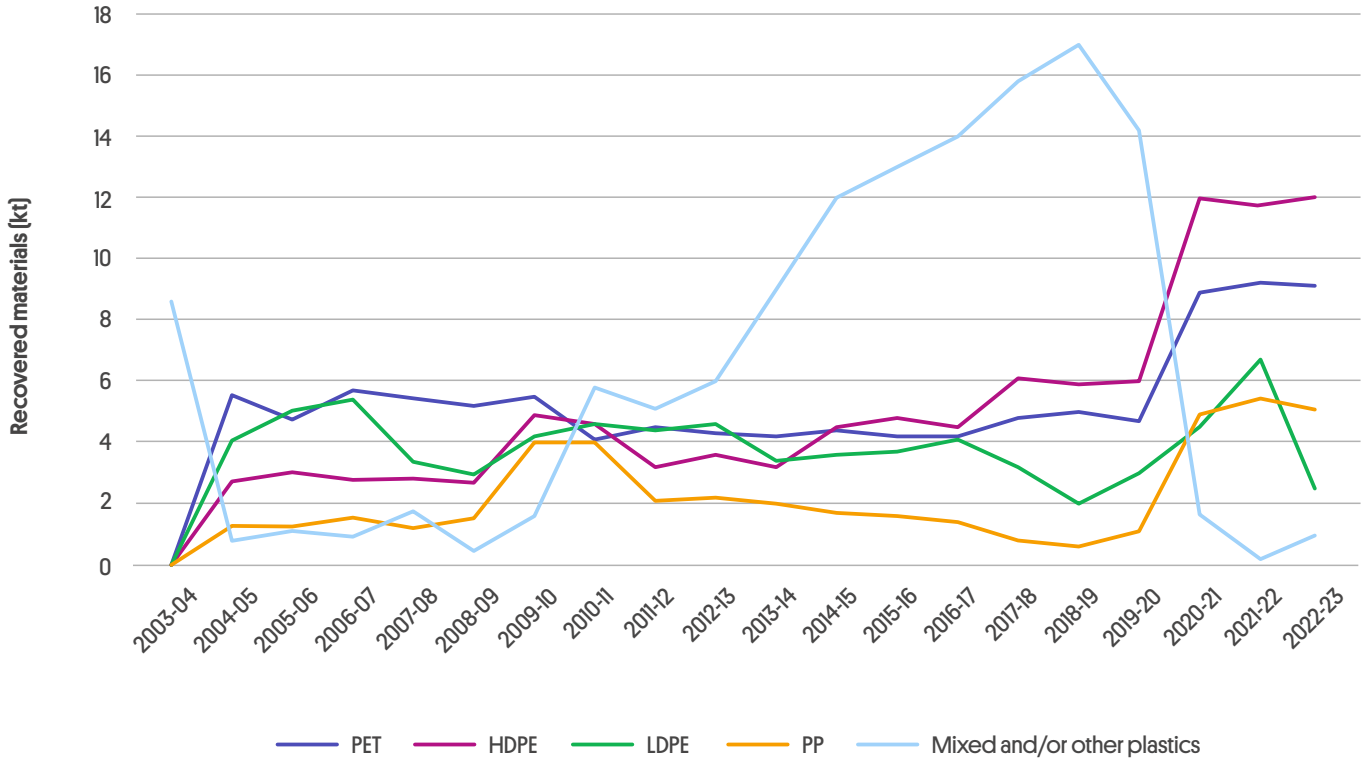


Figure 27 Plastics recovered since 2003-04 – PVC and PS

Figure 28 Plastics recovered since 2003-04 – all plastics

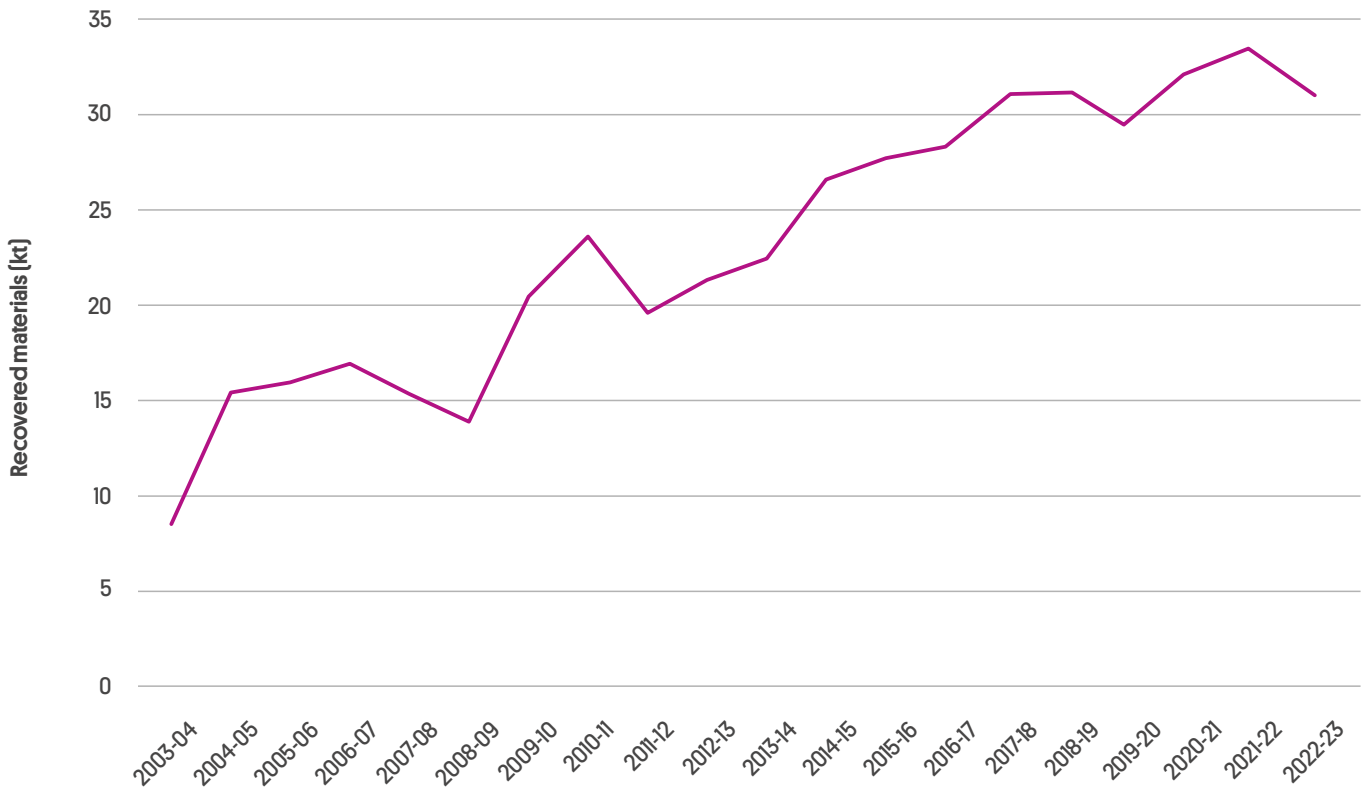
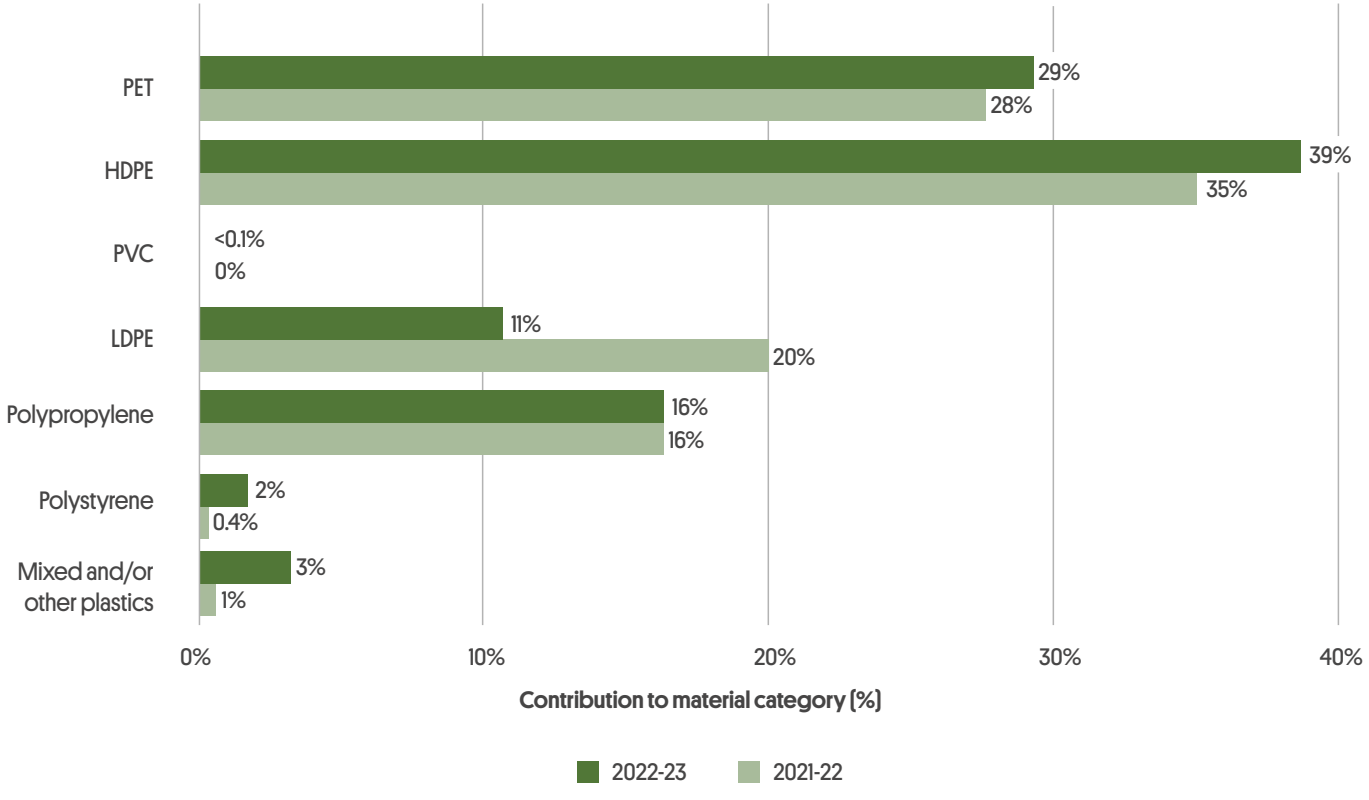


Figure 29 Reported percent composition of plastics recovered in 2021-22 and 2022-23



Plastics recovery in 2022-23 by plastics type, source stream, geographical origin and reprocessing location is shown in Table 29. About 80% of recovered plastics were reported as coming from the C&I stream, with most of the remainder from MSW sources. A comparatively very small amount of expanded polystyrene was recovered from the C&D stream, this is mostly waffle pod products.

About 85% of total recovered plastics were reprocessed locally, an increase compared to previous years. Only 3% plastics were exported. Under the new export restrictions, since 1 July 2022, organisations must have a licence to export waste plastics that have been sorted and processed so as to be ready for remanufacture without further processing in accordance with DCCEEW specifications. 'Processed' generally refers to plastics that have been sorted, washed, cleaned and transformed, for example, into hot washed flakes or single resin pellets. It does not refer to plastic that is simply shredded.

Table 29 Plastics recovered in 2022-23 by source stream, geographical origin and reprocessing location

	Source stream (%)			Geographical origin (%)		Reprocessing location (%)		
Material type	**MSW**	**C&I**	**C&D**	**Metro**	**Regional**	**SA**	**Interstate**	**Overseas**
Polyethylene terephthalate	12%	88%	0%	88%	12%	62%	38%	0%
High density polyethylene	22%	78%	0%	81%	19%	98%	2%	0%
Polyvinyl chloride	0%	100%	0%	100%	0%	100%	0%	0%
Low density polyethylene	0%	100%	0%	99%	1%	73%	0%	27%
Polypropylene	36%	64%	0%	94%	6%	100%	0%	0%
Polystyrene	0%	97%	3%	91%	9%	91%	0%	9%
Mixed and/or other plastics	29%	71%	0%	71%	29%	100%	0%	0%
Total	**19.5%**	**80.3%**	**0.3%**	**86%**	**14%**	**85%**	**12%**	**3%**

3.6 Glass

SA recovered about 74 kt of scrap glass in 2022-23, up from 54 kt in 2021-22. Orora's new glass beneficiation plant commenced operation in October 2022 contributing to higher glass recovery capacity in South Australia.

Recovered glass was mostly containers; 82% of overall volumes in 2022-23 was glass from food and beverage containers and 18% other glass.

Table 30 Glass recovered, SA, 2022-23

Material type	Net recovery (kt)
Glass from food and beverage containers	60
Other glass	13
Total	**74**

Glass recovery trends since 2003-04 are shown in Figure 30. The proportions of glass from food and beverage containers and other glass recovered in 2022-23 are shown in Figure 31.

Figure 30 Glass recovered since 2003-04

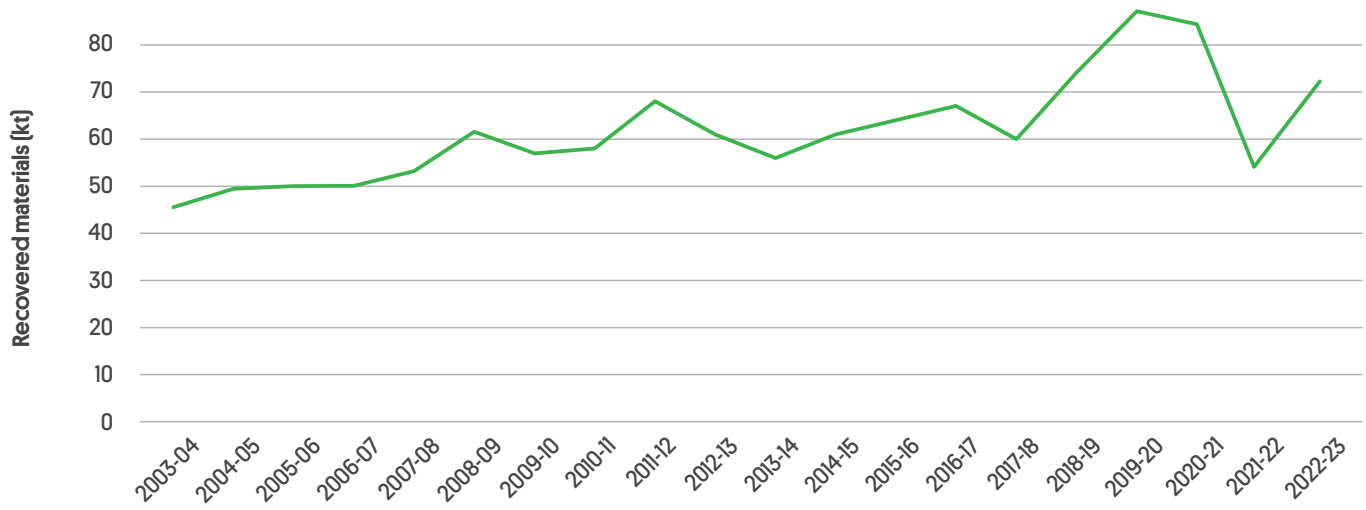


Figure 31 Reported percent composition of glass recovered in 2022-23

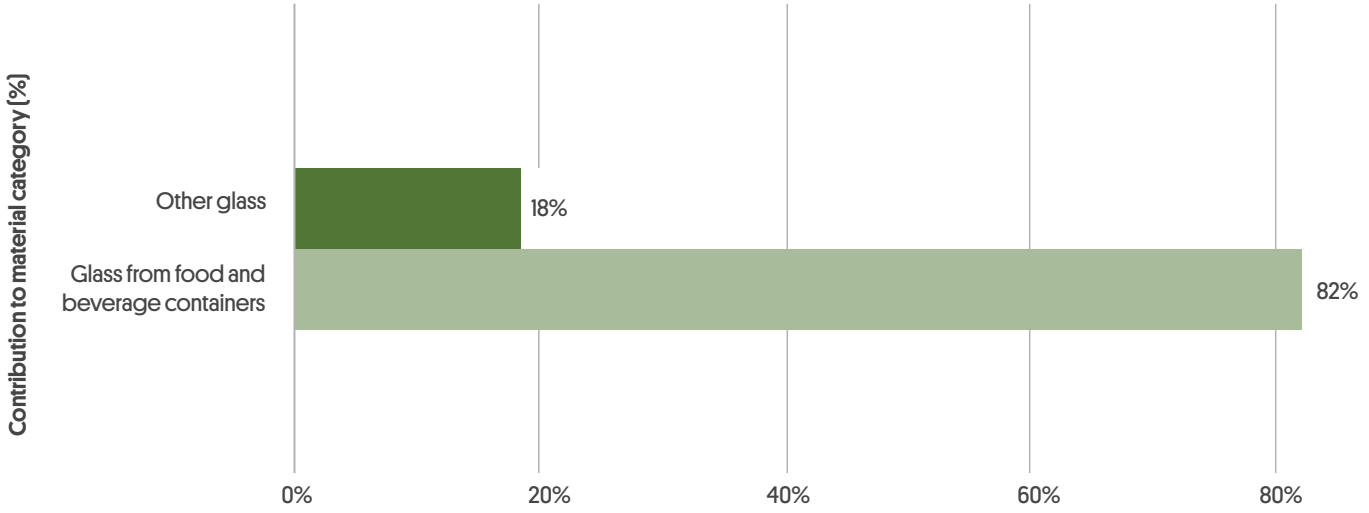


Table 31 presents the source stream, geographical origin and reprocessing location for recovered glass in SA in 2022-23. The C&I stream generated the most glass, accounting for 64% of the total volume, followed by MSW (26%) and C&D. The C&I and MSW streams were mostly food and beverage containers. Most glass was from the metropolitan region (96%), and almost all reprocessing occurred in SA (97%).

Table 31 Glass recovered in 2022-23 by source stream, geographical origin and reprocessing location

	Source stream (%)			Geographical origin (%)		Reprocessing location (%)		
Material type	MSW	C&I	C&D	Metro	Regional	SA	Interstate	Overseas
Glass	26%	64%	10%	96%	4%	97%	3%	0%

3.7 Other materials

The 'other materials' category includes fly ash, foundry sands, leather and textiles, and tyres and other rubber. The combined recovery of these materials in 2022-23 was about 26 kt. This was slightly less than the 34 kt recovered in 2021-22. Minimal quantities of foundry sands have been recovered since 2019-20 and SA has not recovered any fly ash since the closure of the Port Augusta Power Station. Tyres and other rubber contributed the most to overall recovery in this category (80%). Leather and textiles fell from 5 kt 2021-22 to 3 kt in 2022-23.

Table 32 Other materials recovered, SA, 2022-23

Material type	Net recovery (kt)
Fly ash	0
Foundry sands	2
Leather and textiles	3
Tyres and other rubber	21
Total	**26**

Figure 32 and Figure 33 show trends in the recovery of other materials by type. Figure 33 compares the contribution for different other material types toward total recovery from 2022-23 and 2021-22.

Figure 32 Other materials recovered since 2003-04 – foundry sands, leather and textiles and tyres and other rubber

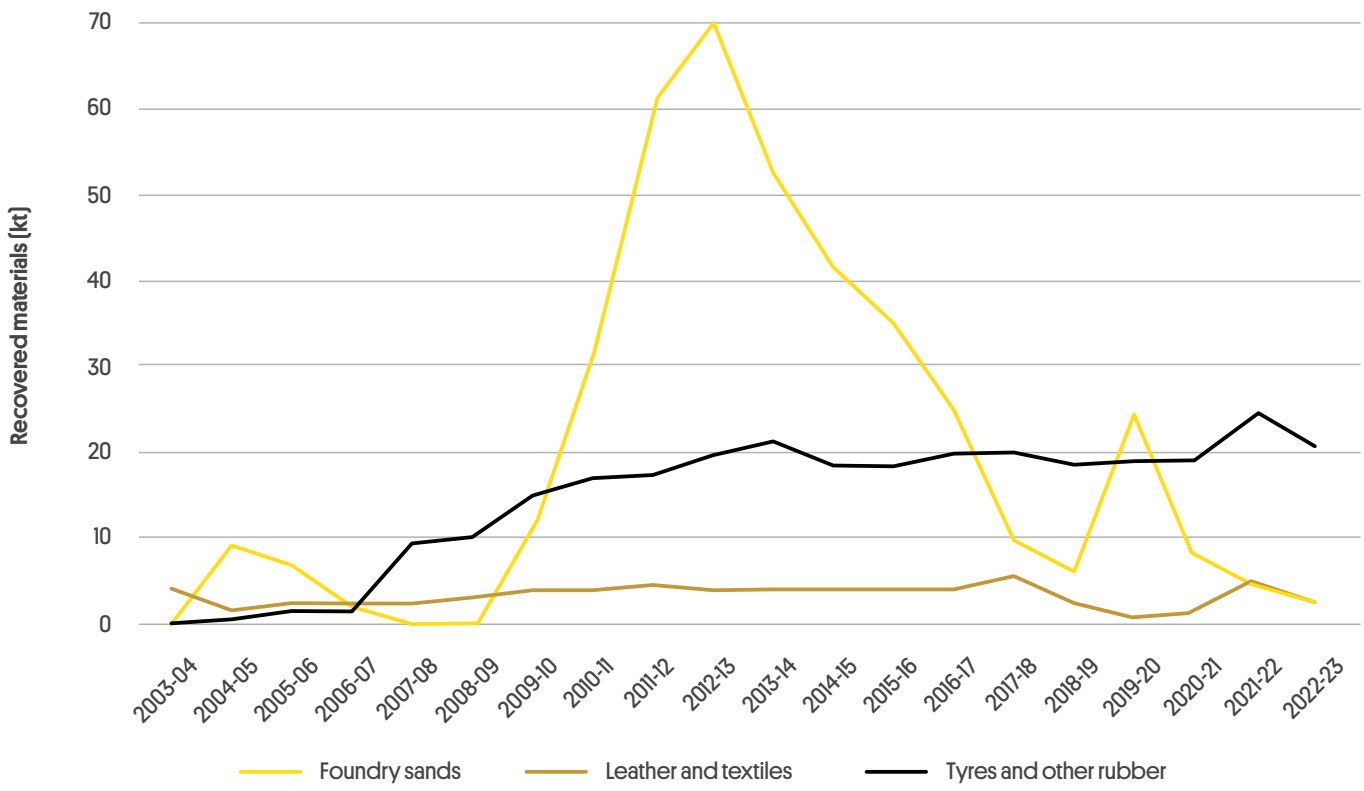


Figure 33 Reported percent composition of other materials recovered in 2021-22 and 2022-23

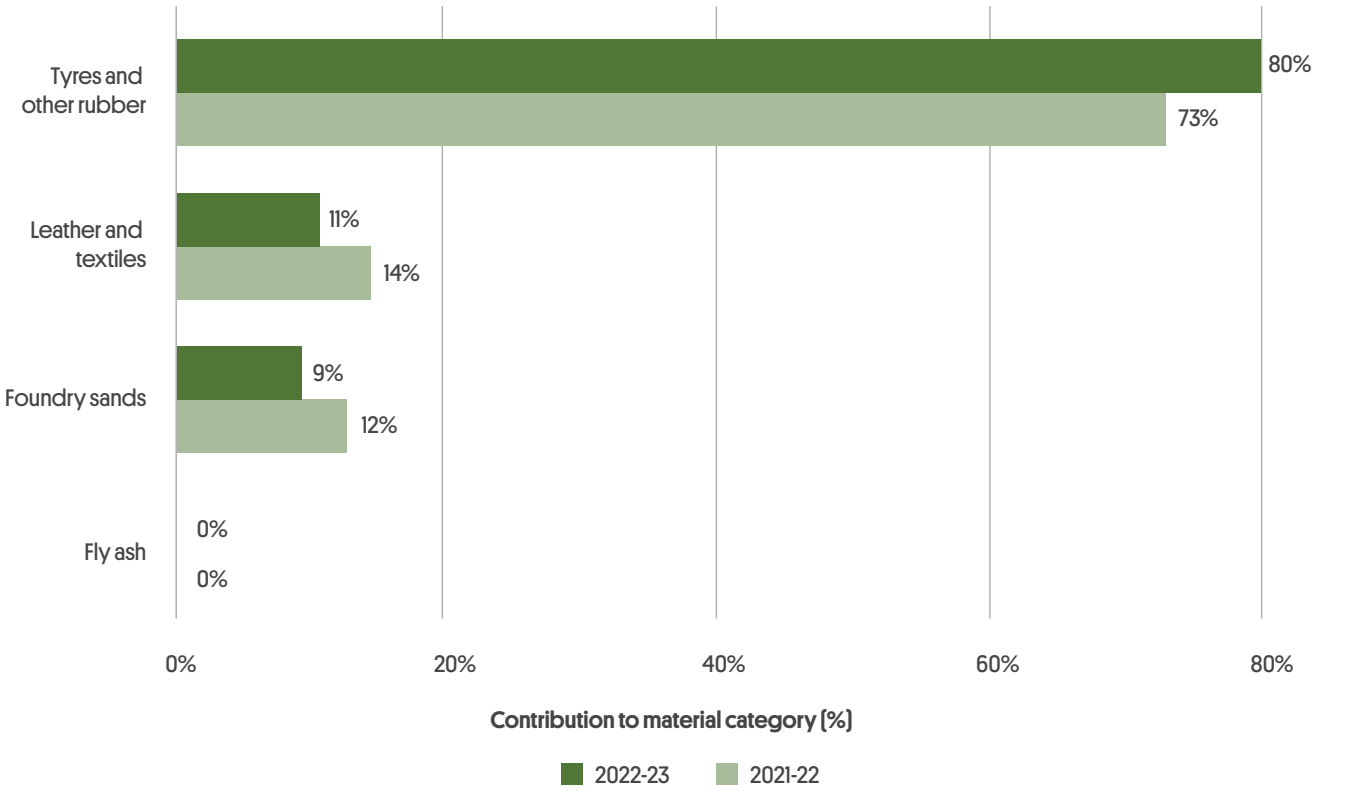


Table 33 presents the source stream, geographical origin and reprocessing destination for material types within the other materials category. All materials in this category were from C&I sources except some textiles which were MSW. About 76% of were from metropolitan SA which is consistent with last year. Most other materials were reprocessed locally (55%), while 30% was exported and the remainder was sent interstate.

Table 33 Other materials recovered in 2022-23 by source stream, geographical origin and reprocessing location

	Source stream (%)			Geographical origin (%)		Reprocessing location (%)		
Material type	MSW	C&I	C&D	Metro	Regional	SA	Interstate	Overseas
Fly ash	0%	0%	0%	0%	0%	0%	0%	0%
Foundry sands	0%	100%	0%	100%	0%	100%	0%	0%
Leather and textiles	49%	51%	0%	95%	5%	7%	0%	93%
Tyres and other rubber	0%	100%	0%	70%	30%	57%	18%	25%
Total	**5%**	**95%**	**0%**	**76%**	**24%**	**55%**	**15%**	**30%**

4 Material flow analyses

This section presents the results of material flow analyses (MFAs) of SA materials in the 2022-23 financial year. The materials covered in this section are:

- metals – iron and steel, aluminium, and non-ferrous metals
- cardboard and paper – cardboard and waxed cardboard, liquid paperboard, magazines and newsprint, and printing and writing paper
- plastics – PET, HDPE, PVC, LDPE, PP, PS, mixed and/or other plastics
- glass – glass from food and beverage containers, and other glass
- textiles
- tyres.

4.1 Introduction to material flow analysis

A general definition of MFA is provided by the UN Environment Programme International Resource Panel (UNEP 2020):

> *Material flow analysis (MFA) comprises a group of methods to analyse the physical flows of materials into, through and out of a given system. It can be applied at different levels of scale, i.e. products, firms, sectors, regions, and whole economies. The analysis may be targeted to individual substance or material flows, or to aggregated flows, e.g. of resource groups (fossil fuels, metals, minerals).*

They follow the principle of conservation of mass, tracing material flows by balancing inputs and outputs and drawing on the following concepts of:

- a *system* of processes, flows and stocks
- *processes* that transform, transport or store materials
- *flows* between connected processes
- *transfer coefficients* that apportion outgoing flows from a process to downstream processes
- *stocks* resulting from a portion of the flow remaining as an 'accumulation', going back 100 years (e.g. accumulated materials in use, stockpiling of wastes or landfill).

MFA and the scientific field developing around it support the analysis of anthropogenic (and natural) material flows through manufacturing, use, disposal and recovery. This is useful for measuring and monitoring the transition to a circular economy, identifying opportunities for maximising recovery, and improving environmental outcomes generally.

The MFAs assess materials flowing to and from processes within a system. A list of these processes is provided in Table 34.

Table 34 Material flow analysis processes

Process	Definition
Atmosphere	Dispersal to the atmosphere.
Energy recovery	The process of recovering energy that is embodied in solid waste.
Environment	Dispersal to the open environment, and could also be termed 'leakage'. Examples include tyre dust from tyres and other microplastics dispersed directly to the open environment. Subsequent clean-up may occur for larger objects, e.g. litter, which would then typically be disposed to landfill. From the perspective of the MFA modelling, materials dispersed to the open environment, which are subsequently cleaned up, will be modelled as going directly to another fate, such as landfill or sorting, and not via the 'Environment' process.
Export	The downstream process of post-consumption materials going to export.
Import primary	The upstream process of incoming system materials from imported primary sources.
Import recycled	The upstream process of incoming system materials from imported recycled sources.
Landfill	Disposal of all materials to landfill. Includes onsite disposal.
Local primary	The upstream process of incoming system materials from local primary sources.
Manufacturing	All processes that transform materials into saleable products.
Open loop	The downstream process of materials going to other local material systems. From a reprocessing standpoint, this could be considered manufacture of new products different to those from which the recovered material was derived.
Reprocessing	All post-sorting processes that physically transform (i.e. reprocess) materials and products that are then (typically) input ready for the manufacture of new products.
Sorting	All post-use processes that sort/separate products into discrete material streams prior to processes that physically transform (i.e. reprocess) materials and products that are then (typically) input ready for the manufacture of new products.
Use	Use phase of the products containing the materials. Includes stocks of materials that are in use.

MFAs can help to measure material circularity and assess the performance of the waste and resource recovery sector at different stages of recovery. A set of circular economy indicators were selected for this work:

- **Recycled content**: Performance of the manufacturing system in utilising recycled materials.
- **Collection efficiency**: Performance of the collection system. Low efficiency means a high proportion of material isn't separated from material flows at the household or business and is directed to landfill, e.g., owing to limited source separation and/or poor disposal practices.
- **Sorting efficiency**: Performance of the system to sort materials designated for specific recovery pathways. Low sorting efficiency highlights opportunities to reduce contamination of collected materials received and/or improve sorting processes at the sorting facilities.
- **Reprocessing efficiency**: Performance of the system to reprocess materials to be ready for specific remanufacturing or energy recovery pathways. Low reprocessing efficiency highlights opportunities to reduce contamination of sorted materials received, improve product design, and/or improve reprocessing processes at the reprocessing facilities.
- **Recycling rate**: Performance of the system in recycling end-of-life materials.
- **Energy recovery rate**: Performance of the system in diverting end-of-life materials to energy recovery.
- **Recovery rate**: Performance of the system in diverting end-of-life materials to recycling and energy recovery.
- **Local material utilisation rate**: Performance of the system in on-shore remanufacturing, relative to the amount of material that is potentially available.

A description on how these indicators were derived is provided in a more detailed MFA method in Appendix A.

4.2 Material flow analyses results

The results of the MFA modelling are summarised in the following section, covering one material category (metals, cardboard and paper, plastics and glass) or material type (textiles and tyres) per page.

The results include a table for each material that summarise flows for SA in 2022-23, covering list quantities for consumption, waste generation and recovery and the calculated MFA indicators. They also include a Sankey chart, in which material flows are represented using arrows proportional to the scale of the calculated material flow.

Note that the recovery quantities calculated via MFA may differ slightly from those presented in Section 2 and 3 above because they draw on estimates of material consumption and lifespans. Additionally, waste generation and waste to landfill at the material level are not measured in this report, meaning there is uncertainty associated with the recovery rates presented in this section.

The MFAs estimate landfill gas capture and recovery but quantities do not contribute towards overall recovery.

Metals

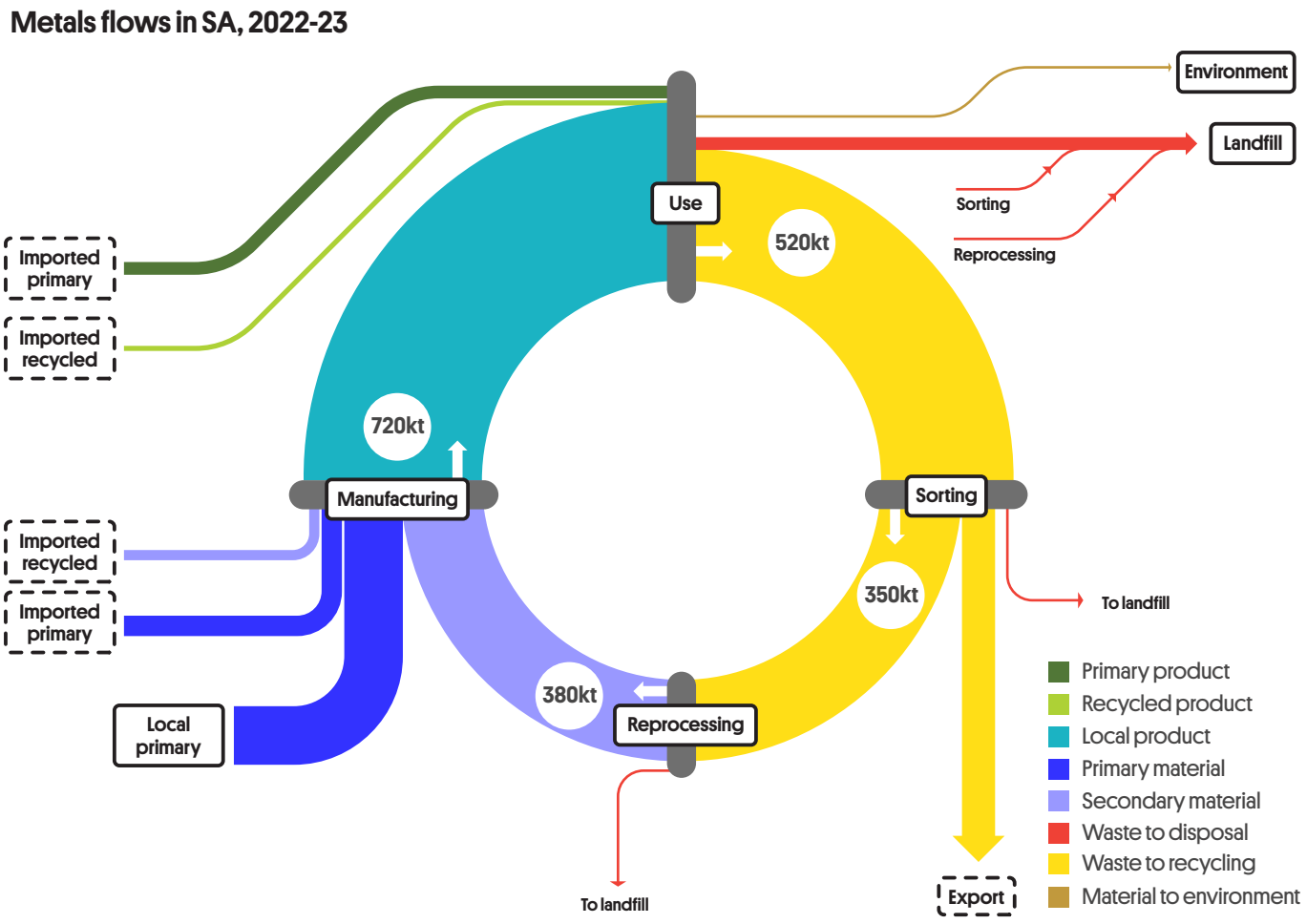
Estimated metal flows in SA in 2022-23 are shown in Table 35 and Figure 34. Metals are valuable and have well-established recycling systems, leading to correspondingly high recovery rates across Australia. SA's metals recovery rate in 2022-23 was estimated at 88%.

Metals recovery is supported by strong export markets and minor losses at sorting facilities and smelters. Metals had the highest estimated recycled content rate out of the modelled materials at about 56%.

Table 35 MFA modelled indicators for metals in SA, 2022-23

Indicator	Unit	Value
Consumption	kt	797
Waste generation	kt	575
Recovery	kt	505
Recycled content	%	56%
Collection efficiency	%	90%
Sorting efficiency	%	92%
Reprocessing efficiency	%	100%
Recycling rate	%	88%
Energy recovery rate	%	0%
Recovery rate	%	88%
Local material utilisation rate	%	66%

Figure 34 Metals flows in SA, 2022-23



Paper and cardboard

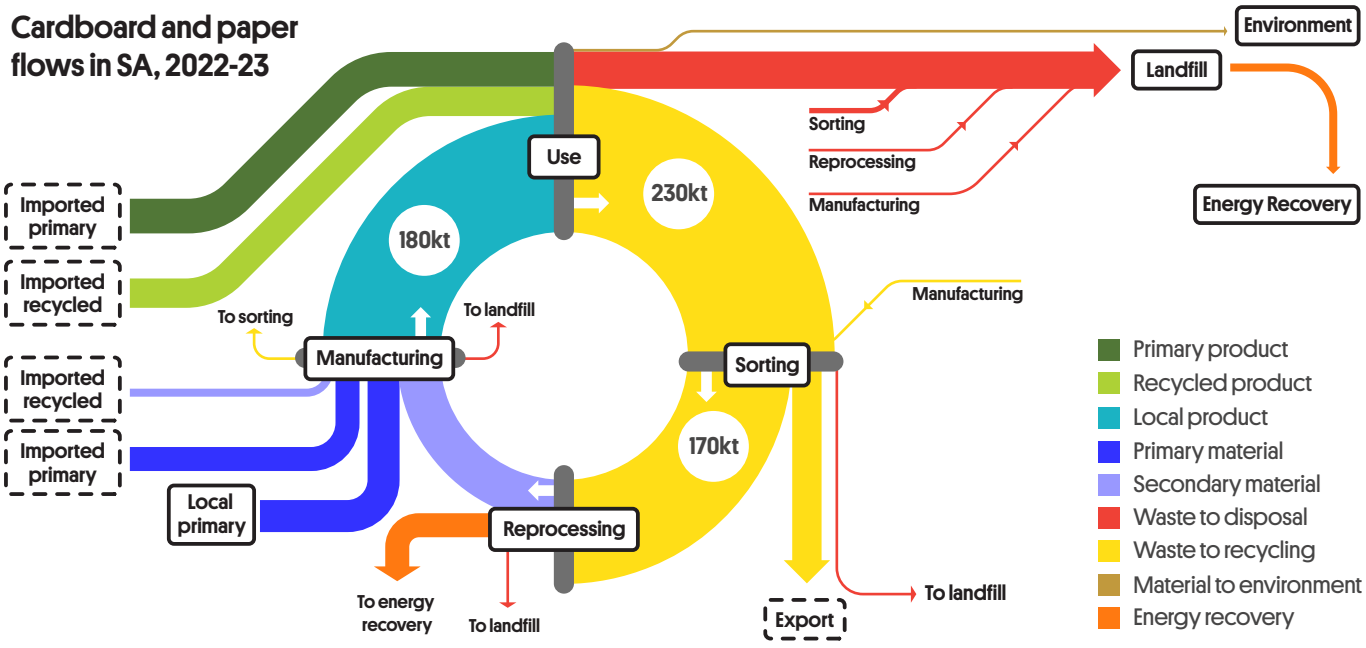
Table 36 summarises key MFA quantities and indicators for cardboard and paper. Figure 35 shows cardboard and paper flows in SA in 2022-23. It is estimated that about 294 kt of cardboard and paper waste was generated in 2022-23, of which about 216 kt, or 74%, was recovered. Recycling and energy recovery contributed similar proportions towards overall recovery.

Significant quantities (over 50 kt) of cardboard and paper were exported from SA for recovery in 2022-23. This may decrease in the next iteration of this report following the impact of the forthcoming export restrictions.

Table 36 MFA modelled indicators for cardboard and paper in SA, 2022-23

Indicator	Unit	Value
Consumption	kt	294
Waste generation	kt	294
Recovery	kt	216
Recycled content	%	40%
Collection efficiency	%	78%
Sorting efficiency	%	96%
Reprocessing efficiency	%	98%
Recycling rate	%	38%
Energy recovery rate	%	35%
Recovery rate	%	74%
Local material utilisation rate	%	21%

Figure 35 Cardboard and paper flows in SA, 2022-23



Plastics

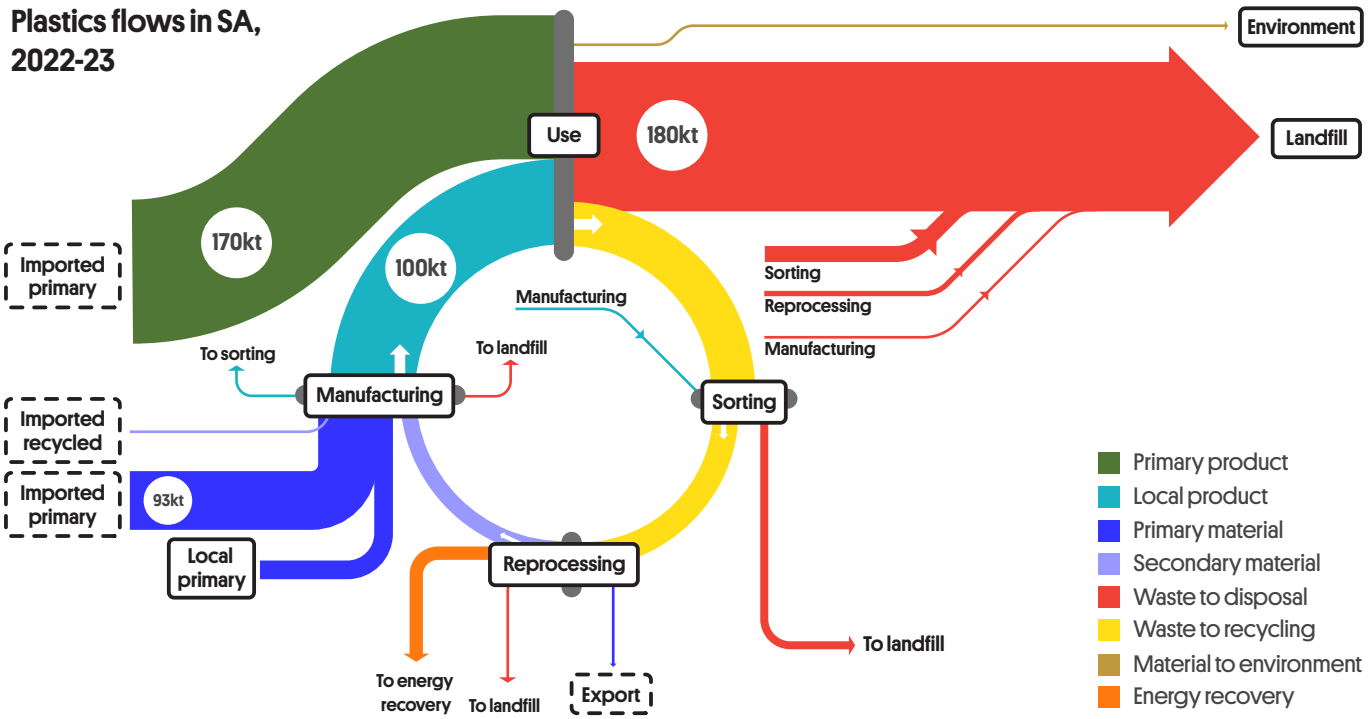
Estimated plastics flows in SA in 2022-23 are summarised in Table 37 and Figure 36. About 30 kt of plastics were recovered in 2022-23, comprising about 16 kt energy recovery and 14 kt recycling.

The MFA shows that most plastic losses to landfill occur after the use stage. A high proportion of material goes from households or businesses to landfill. Losses also occur at sorting facilities.

Table 37 MFA modelled indicators for plastics in SA, 2022-23

Indicator	Unit	Value
Consumption	kt	275
Waste generation	kt	221
Recovery	kt	30
Recycled content	%	5%
Collection efficiency	%	20%
Sorting efficiency	%	74%
Reprocessing efficiency	%	93%
Recycling rate	%	6%
Energy recovery rate	%	7%
Recovery rate	%	13%
Local material utilisation rate	%	6%

Figure 36 Plastics flows in SA, 2022-23



Glass

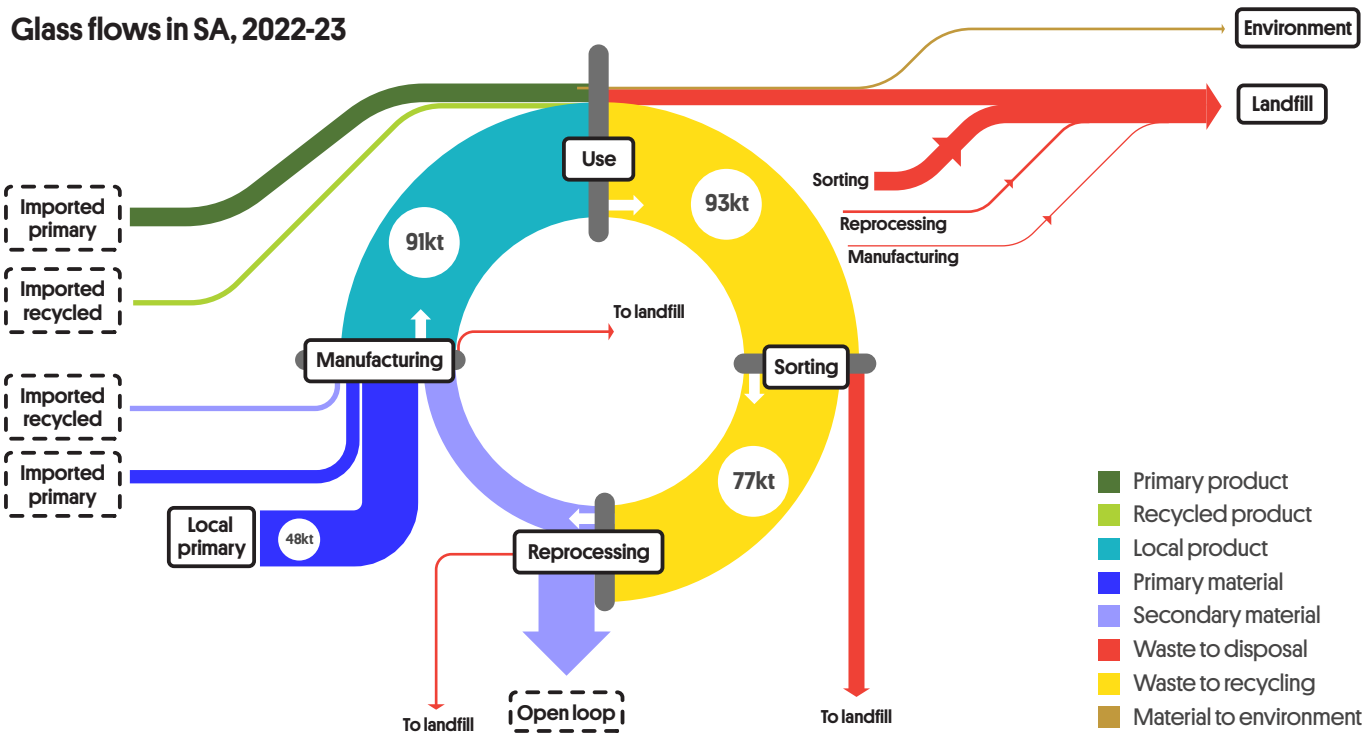
Table 38 and Figure 37 summarise glass flows in SA in 2022-23. About 109 kt of glass waste was generated in SA in 2022-23, of which about 74 kt, or 68%, was recovered. Glass recovery is supported by strong kerbside collection systems, container deposits and local container-to-container manufacturing. Glass breakages during sorting are a key contributor to landfilled quantities.

Glass waste exports across Australia effectively ceasing since restrictions came into effect in 2021.

Table 38 MFA modelled indicators for glass in SA, 2022-23

Indicator	Unit	Value
Consumption	kt	112
Waste generation	kt	109
Recovery	kt	74
Recycled content	%	33%
Collection efficiency	%	86%
Sorting efficiency	%	83%
Reprocessing efficiency	%	96%
Recycling rate	%	68%
Energy recovery rate	%	0%
Recovery rate	%	68%
Local material utilisation rate	%	68%

Figure 37 Glass flows in SA, 2022-23



Textiles

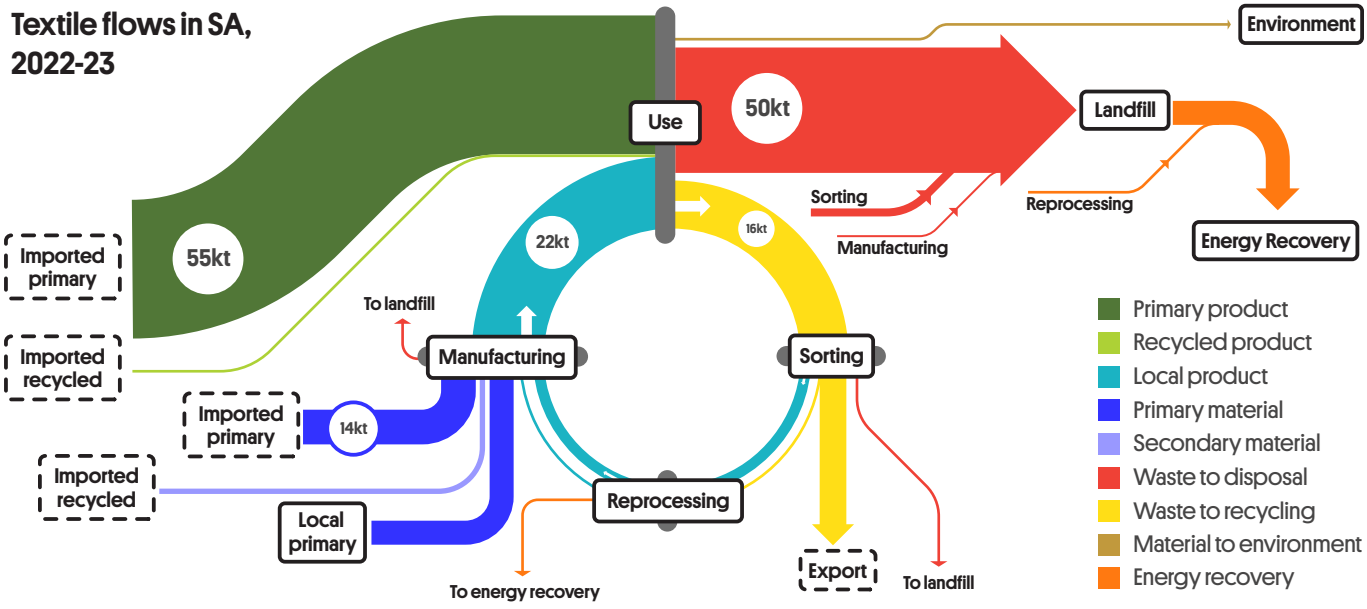
Textiles flows in SA in 2022-23 are shown in Table 39 and Figure 38. About 64 kt of textiles waste was generated in SA in 2022-23 and about 10 kt of textiles was modelled as recovered. This is higher than recovery reported in Sections 2.6 and 3.7 as the MFA estimates for some local and international reuse of clothing and other textiles that may not have been captured via the survey or in exports data. Most recovered textiles were sent overseas for reuse or recycling. Less than 100 t was recycled locally in 2022-23.

Unlike the other Sankey diagrams, Figure 38 shows a local reuse flow from 'sorting' to 'use', which suggests about 3.4 kt of clothing and textiles were recirculated and reused in SA in 2022-23.

Table 39 MFA modelled indicators for textiles in SA, 2022-23

Indicator	Unit	Value
Consumption	kt	68
Waste generation	kt	64
Recovery	kt	10
Recycled content	%	1%
Collection efficiency	%	25%
Sorting efficiency	%	84%
Reprocessing efficiency	%	100%
Recycling rate	%	4%
Energy recovery rate	%	<1%
Recovery rate	%	16%
Local material utilisation rate	%	<1%

Figure 38 Textiles flows in SA, 2022-23



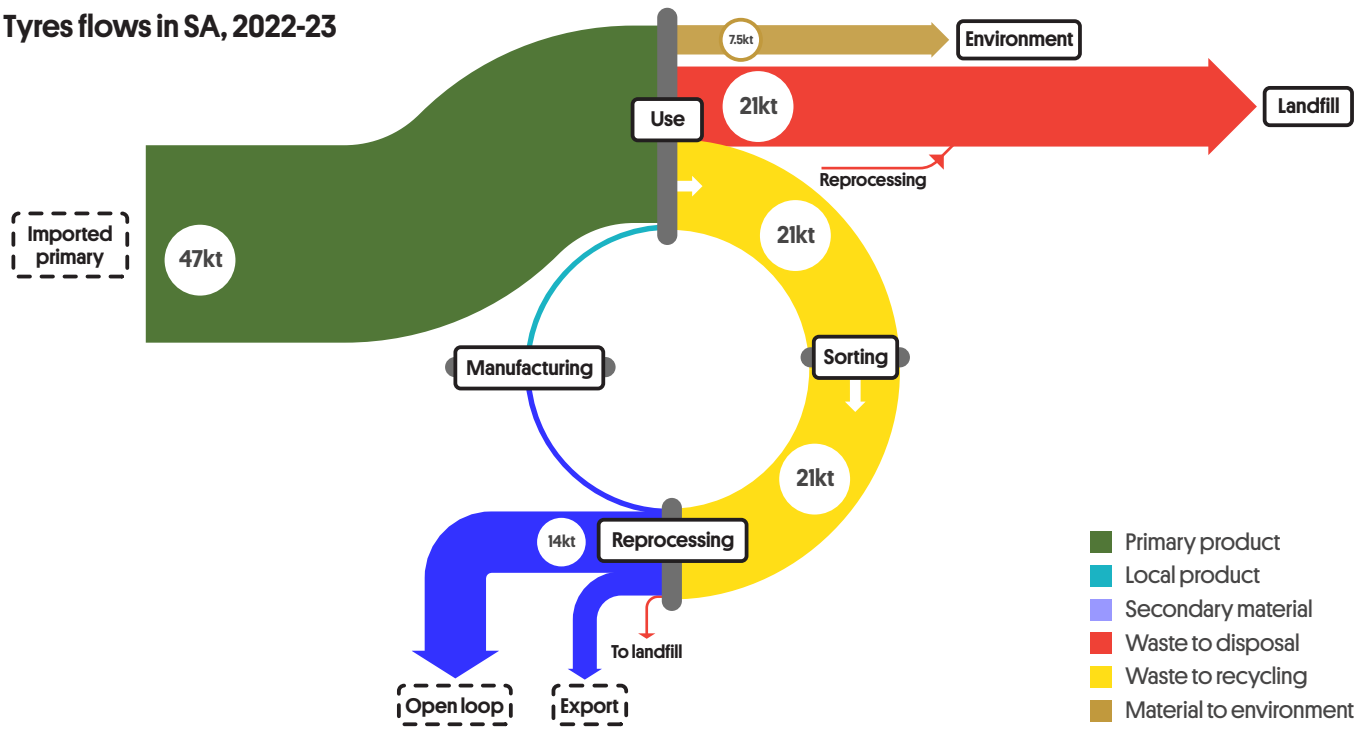
Tyres

Table 40 and Figure 39 summarise estimated flows of waste tyres in SA in 2022-23. About 46 kt of tyres reached end of life, of which 21 kt, or 45%, were recovered[7]. Tyres wear during use, producing a tyre dust flow from 'use' to 'environment'. About 25% of estimated tyre recovery was overseas.

Table 40 MFA modelled indicators for tyres in SA, 2022-23

Indicator	Unit	Value
Consumption	kt	48
Waste generation	kt	46
Recovery	kt	21
Recycled content	%	3%
Collection efficiency	%	45%
Sorting efficiency	%	100%
Reprocessing efficiency	%	100%
Recycling rate	%	45%
Energy recovery rate	%	0%
Recovery rate	%	45%
Local material utilisation rate	%	34%

Figure 39 Tyres flows in SA, 2022-23



7 Tyre recovery is underestimated because the ABS exports data excludes low value exports and some exporters use incorrect codes. The inclusion of tyre dust losses to the environment also reduces the recovery rate.


HyFlex

5 Electrical and electronic waste

- Electrical and electronic waste (e-waste) is a globally growing waste stream, and reported tonnes continued to rise in 2022-23.
- Reported e-waste recovery in SA increased by 40% from 2021-22 to 2022-23, from about 5.3 kt to about 8.2 kt. This was impacted by new insights into the collection process of some products in SA.

Electronic waste (e-waste) can be defined as anything with a plug or battery that is no longer wanted, and includes a wide range of items such as computers, televisions and white goods. The results are provided in this section. The data discussed below represent a subset of the materials recovery data presented in Section 3.

Reported e-waste recovery in SA increased 40% from 2021-22 to 2022-23, from 5.3 kt to 8.2 kt. The quantity of batteries reported recovered greatly increased in 2022-23. The huge apparent change in the volume of printer cartridges recovered was due to new insights into the collection process of printer cartridges for recycling in SA from a major processor. The % change recorded does not necessarily reflect an increase in actual recovery but rather increased visibility. No recovery of compact fluorescent was reported in 2022-23. Table 41 summarises e-waste recovery in SA in 2019-20, 2020-21, 2021-22 and 2022-23.

Table 41 Reported tonnes of e-waste, SA, 2022-23, 2021-22, 2020-21 and 2019-20

E-waste type	2019-20 (tonnes)	2020-21 (tonnes)	2021-22 (tonnes)	2022-23 (tonnes)	Change (%) 21-22 to 22-23
Printer cartridges	170	150	20	980	4,790%
Compact fluorescent lamps	120	120	120	0	-100%
Batteries	50	90	2,270	3,490	54%
Computers	2,600	1,660	860	1,590	85%
Televisions/monitors	1,700	2,930	1,140	1,830	60%
Mobile phones	6.0	5.7	4.8	3.6	-26%
Other e-waste	740	920	860	330	-62%
Total	**5,390**	**5,870**	**5,270**	**8,220**	**40%**

Table 42 lists the proportion of total e-waste recovered from different source streams, geographical origins and reprocessing locations. E-waste is split between C&I sources (63%) and MSW (37%). Table 42 shows that e-waste is mostly recovered in SA (61%) or interstate (36%) with a small amount sent overseas. Analysis of ABS exports of materials likely containing e-waste show that 67 tonnes of e-waste machinery and 210 tonnes of batteries were sent overseas for reprocessing in 2022-23. Materials from e-waste products were also sent overseas for reprocessing after dismantlement and sorting in SA but the exported figures are captured in exports of plastics, metals and other materials.

Table 42 E-waste recovered in 2022-23 by source stream, geographical origin and reprocessing location

	Source stream (%)			Geographical origin (%)		Reprocessing location (%)		
Material type	MSW	C&I	C&D	Metro	Regional	SA	Interstate	Overseas
E-waste	37%	63%	0%	91%	9%	61%	36%	3%

Figure 40 and Figure 41 show e-waste trends since 2009-10, while Figure 42 shows a comparison of 2021-22 and 2022-23 data.

Figure 40 Reported e-waste recovered since 2009-10 (batteries, televisions and monitors, computers and other e-waste)

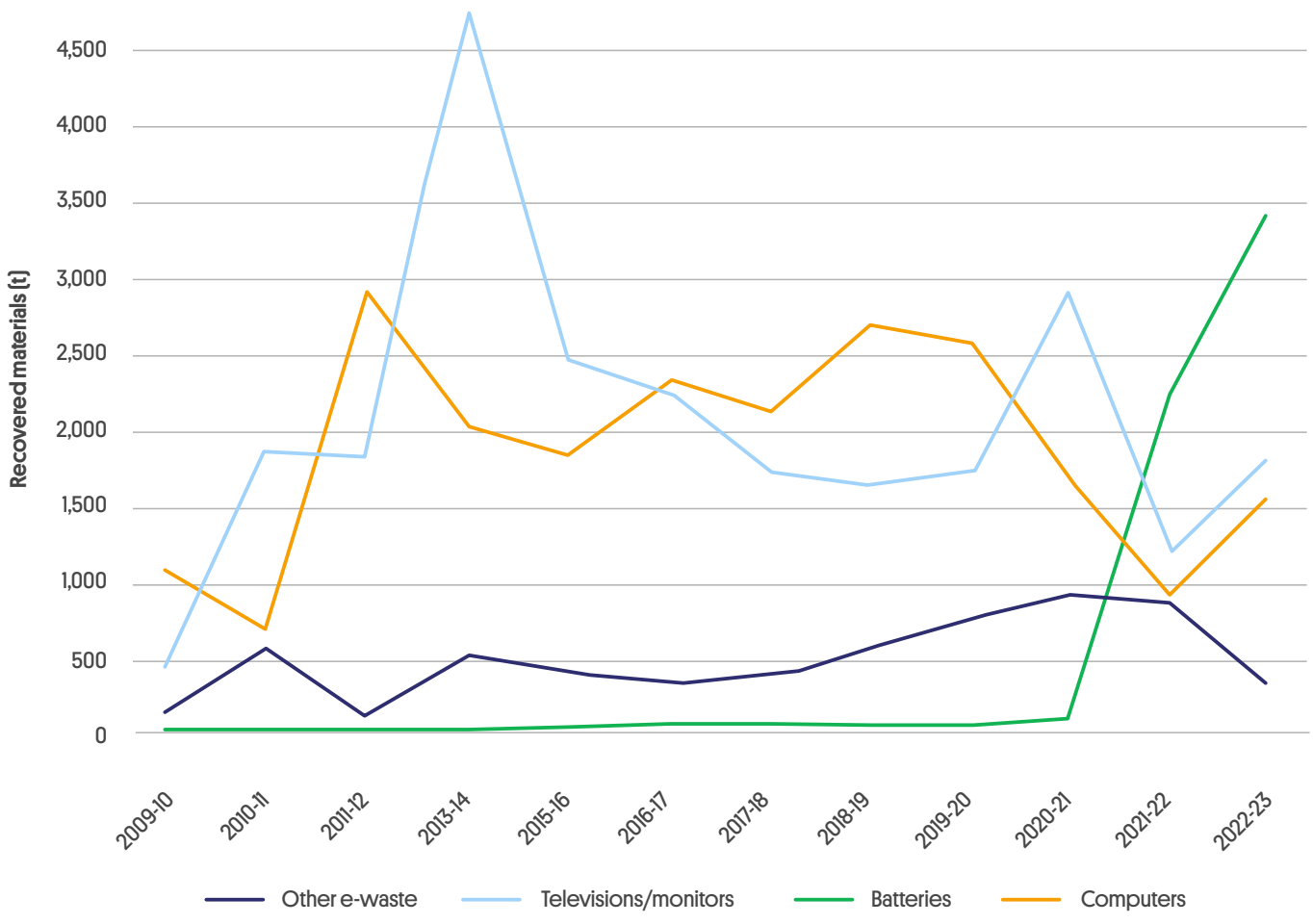


Figure 41 Reported e-waste recovered since 2009-10 (compact fluorescent lamps, printer cartridges and mobile phones)

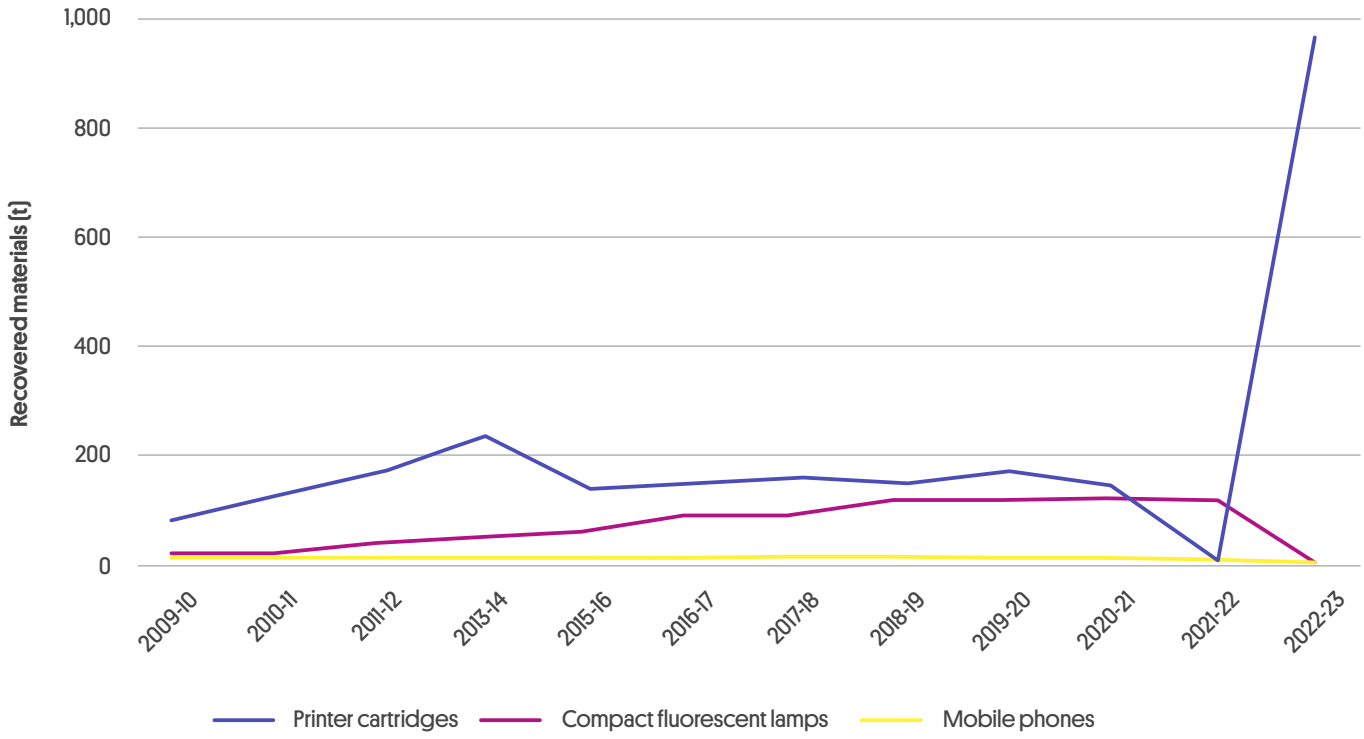
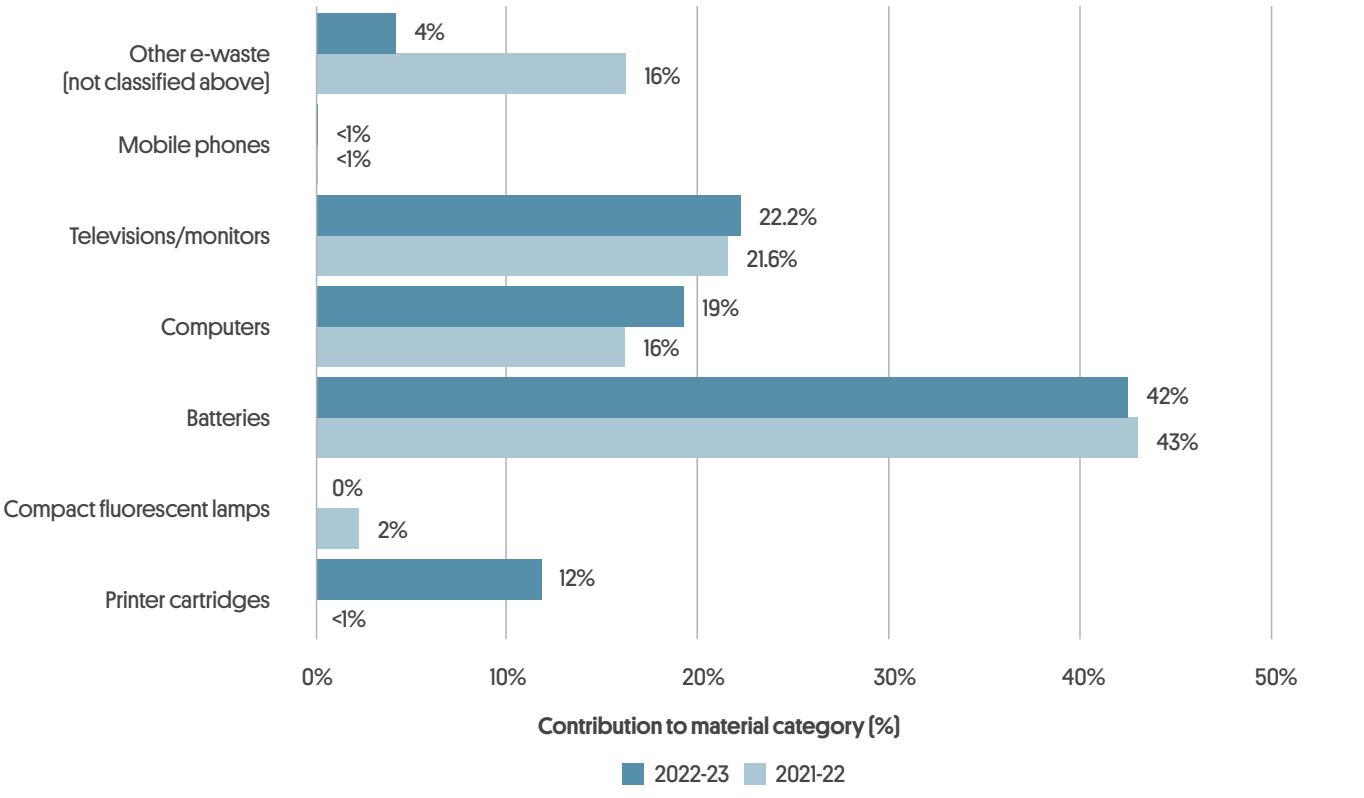
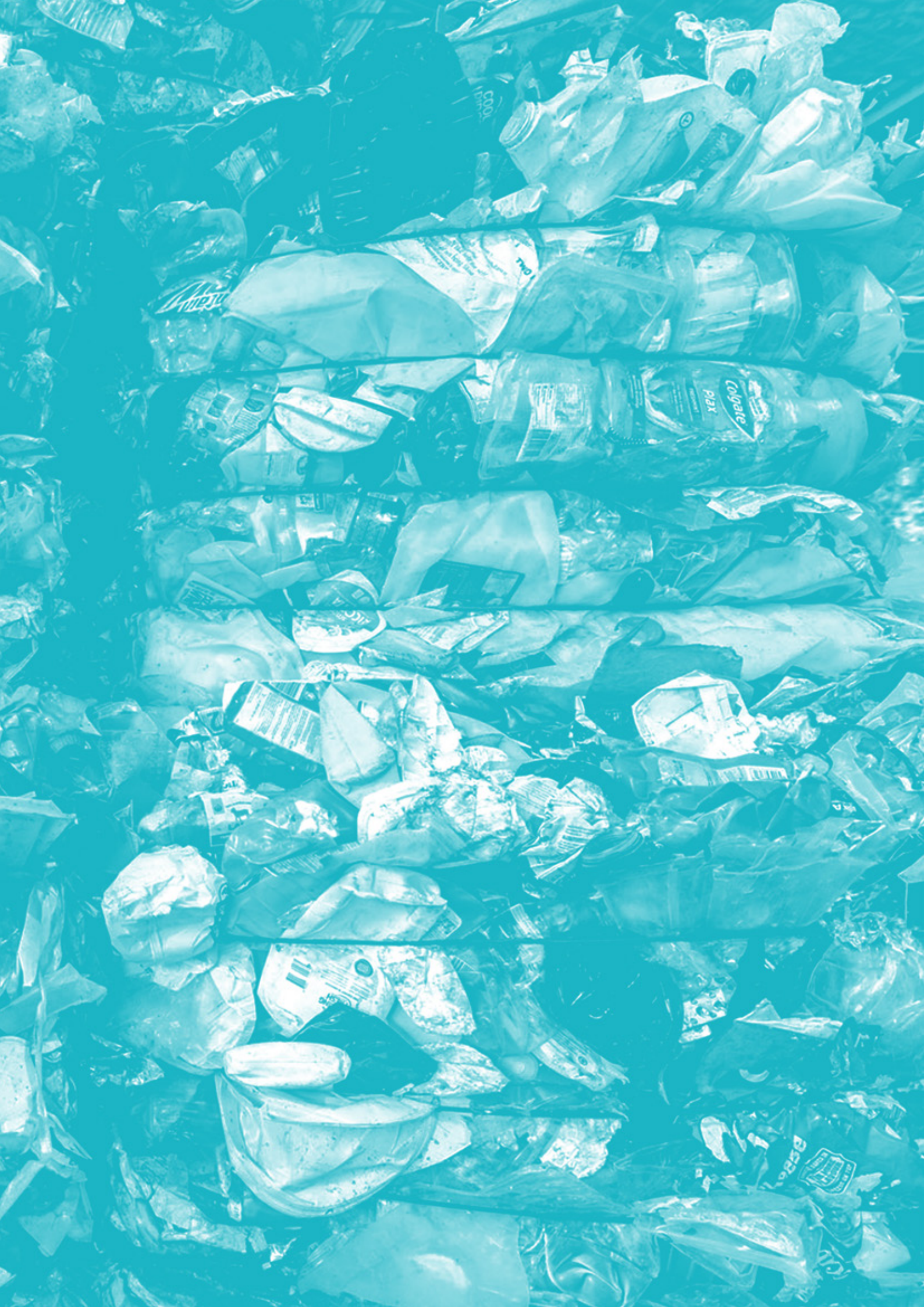


Figure 42 Reported percent composition of e-waste recovered in 2021-22 and 2022-23




Colgate
Plax

6 Packaging

Australia has established targets for the management of packaging waste by 2025, as follows (DCCEEW 2022):

- 100% of packaging being reusable, recyclable or compostable by 2025
- 70% of plastic packaging being recycled or composted by 2025
- 50% of average recycled content included in packaging by 2025
- the phase out of problematic and unnecessary single-use plastic packaging by 2025.

It is now widely accepted that these targets will not be met. However, the recovery of packaging waste remains an important part of sustainable waste management in Australia. Packaging data is requested in the survey and the results are detailed in this section. The data presented are a subset of the data in Section 3.

Overview

Data in this section includes container deposit legislation (CDL) materials, as well as any other packaging collected from kerbside collections and businesses. Overall, SA recovered about 387 kt of packaging materials in 2022-23, comprising about 38 kt (10%) CDL materials and 348 kt (90%) non CDL materials.

Table 43 summarises estimated packaging recovery in SA in 2022-23. Broadly, compared to the previous year, quantities of recovered:

- aluminium cans showed little change from 2021-22.
- cardboard and most plastics packaging increased somewhat on 2021-22.
- glass bottles and jars, LDPE packaging and steel cans had significant growth since 2021-22, increasing by 142%, 239% and 137% respectively.

Table 43 Estimated packaging recovered in SA in 2022-23 (kt)

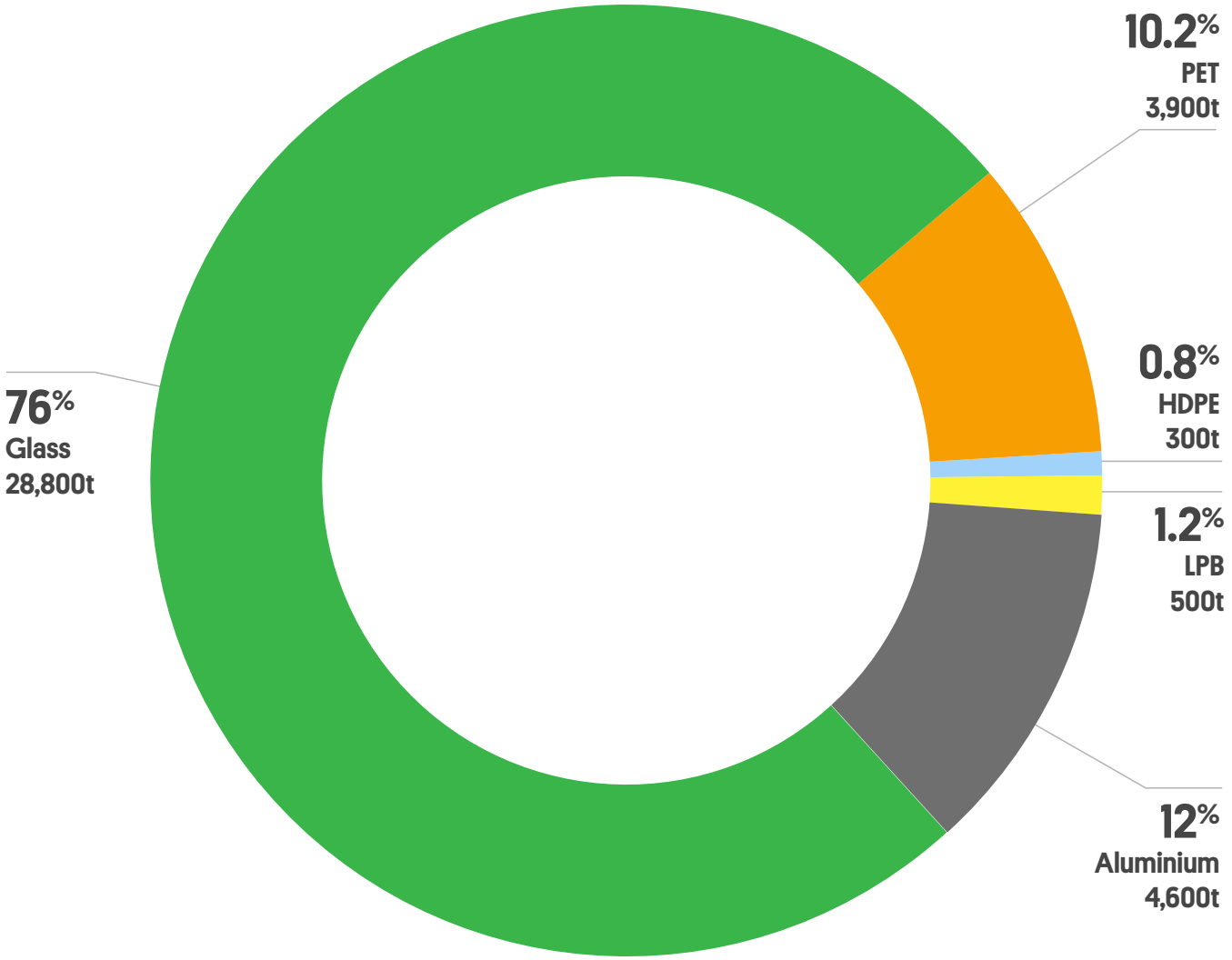
Packaging type	Recovered (kt)			Packaging as a proportion of total recovery
	CDL	Other	Total	
Aluminium cans	4.6	0.1	4.7	1%
Cardboard packaging	0.0	160.3	160.3	41%
Glass bottles and jars	28.8	128.1	156.9	41%
HDPE packaging	0.3	21.2	21.5	6%
LDPE packaging	0.0	5.1	5.1	1%
Liquid paperboard cartons	0.5	0.9	1.4	<1%
Other plastics packaging	0.0	0.0	0.0	0%
PET packaging	3.9	12.7	16.6	4%
Polypropylene packaging	0.0	14.2	14.2	4%
Polystyrene packaging	0.0	0.4	0.4	<1%
PVC packaging	0.0	0.0	0.0	0%
Steel cans	0.0	5.4	5.4	1%
Total	**38.1**	**348.4**	**386.5**	-

6.1 Container deposit legislation

SA has the longest established CDL in Australia, having introduced its container deposit scheme in 1977. The next jurisdiction after SA to implement CDL was the NT in 2012. Today, all states and territories have implemented a CDL.

In total, South Australians returned about 38 kt of containers to CDL locations across the State in 2022-23. The bulk of these materials were glass containers, which made up about 28.8 kt (76% by weight) of total CDL materials in 2022-23. About 4.6 kt of aluminium cans, 3.9 kt of PET, 500 tonnes of liquid paperboard and 300 tonnes of HDPE packaging was returned.

Figure 43 Relative proportions of returned container deposit legislation materials by weight, SA, 2022-23



The return rates for CDL materials are provided in Table 44 below. Return rates were high for glass and aluminium at over 80%, while plastics packaging and liquid paperboard exhibited more moderate return rates. The return rates for aluminium, glass, PET and HDPE remained steady compared to return rates in 2021-22.

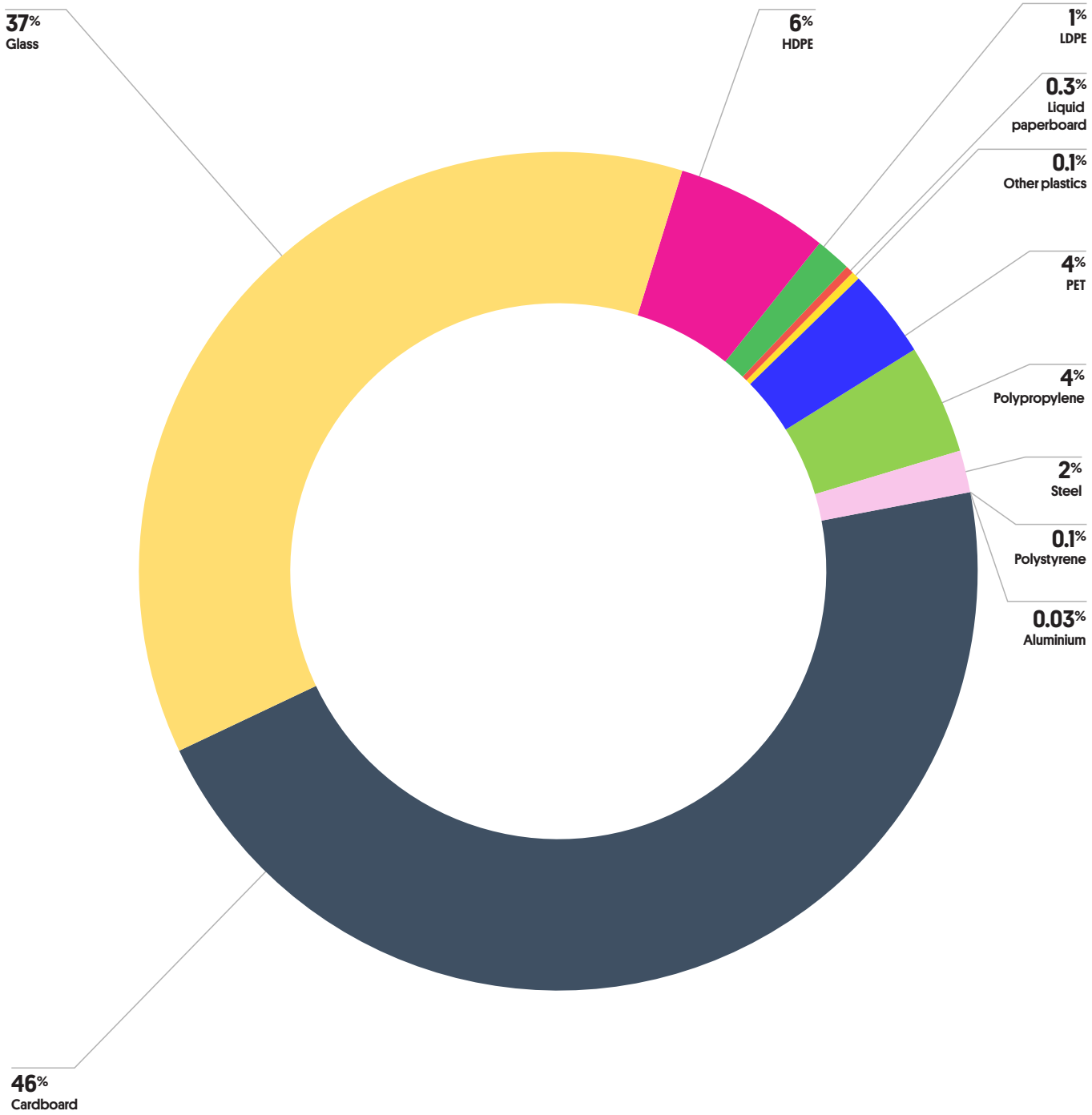
Table 44 Return rates for SA's container deposit legislation materials in 2022-23

Packaging material	kt	Return rate (%)
Glass	29	86%
Aluminium	4.6	81%
PET	3.9	67%
Liquid paperboard	0.5	51%
HDPE	0.3	63%

6.2 Other packaging materials

Figure 44 presents the tonnes and proportions of non-CDL recovered packaging material from 2022-23. Cardboard packaging remained the highest contributor (46%), which was lower than 2021-22 (61%). The second highest proportion was glass bottles and jars (37%), which was higher than 2021-22 (19%). Other non-CDL packaging materials comprise plastics (in total about 15%), with metals and liquid paperboard each contributing less than 2% to the total. This was overall quite similar to 2021-22.

Figure 44 Relative proportions of other (non-CDL) packaging materials, SA, 2022-23




kids
Lactose Free
10

7 Resource recovery value

- The total value of resource recovery in SA in 2022-23 is estimated at about $811 million.
- Overall, metal was the category contributing the most to the resource recovery value in 2022-23, followed by organics, plastics, cardboard and paper, masonry and glass, and other materials.

Surveyed companies and organisations were asked to provide the value per tonne for each of the materials they recycled. These were used to estimate the market value of resource recovery in SA, noting that not all respondents provided this information.

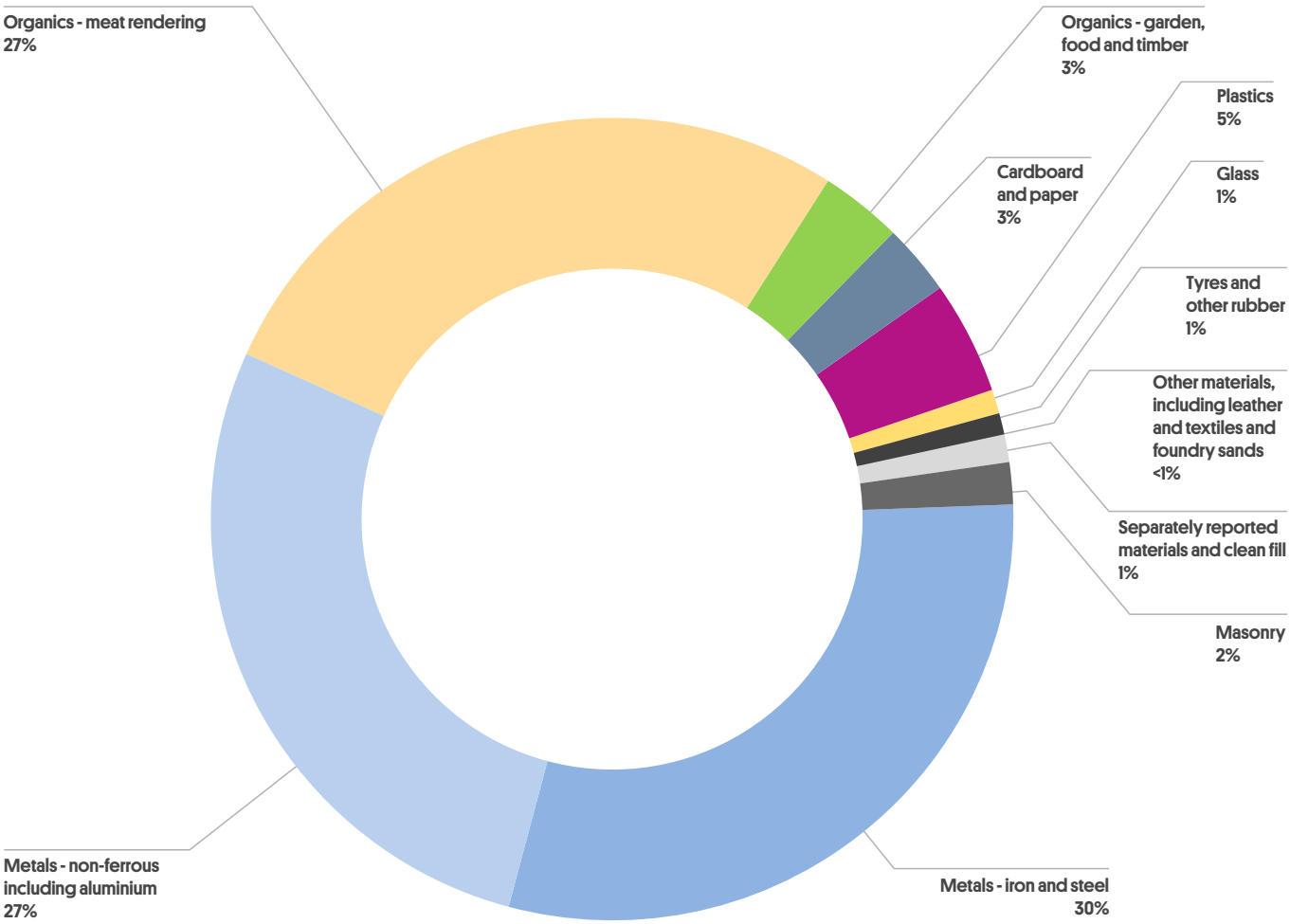
Table 45 summarises the estimated value of recovery in SA in 2022-23, including recovered tonnes by material, estimated on-sale values per tonne and estimated overall value per material. The total value of recovery in SA in 2022-23 is estimated at about $811 million, an increase from the estimated 2021-22 value of $649 million. The increase is mostly due to the high reported value of scrap metal in 2022-23.

Overall, metals recovery ($465m) was the greatest contributor to total resource recovery value in 2022-23, followed by organics ($249m), plastics ($37m), cardboard and paper ($23m), masonry ($14m), glass ($9m) and finally other materials ($6m) recovery.

Table 45 Estimated resource value for recovered materials in SA in 2022-23

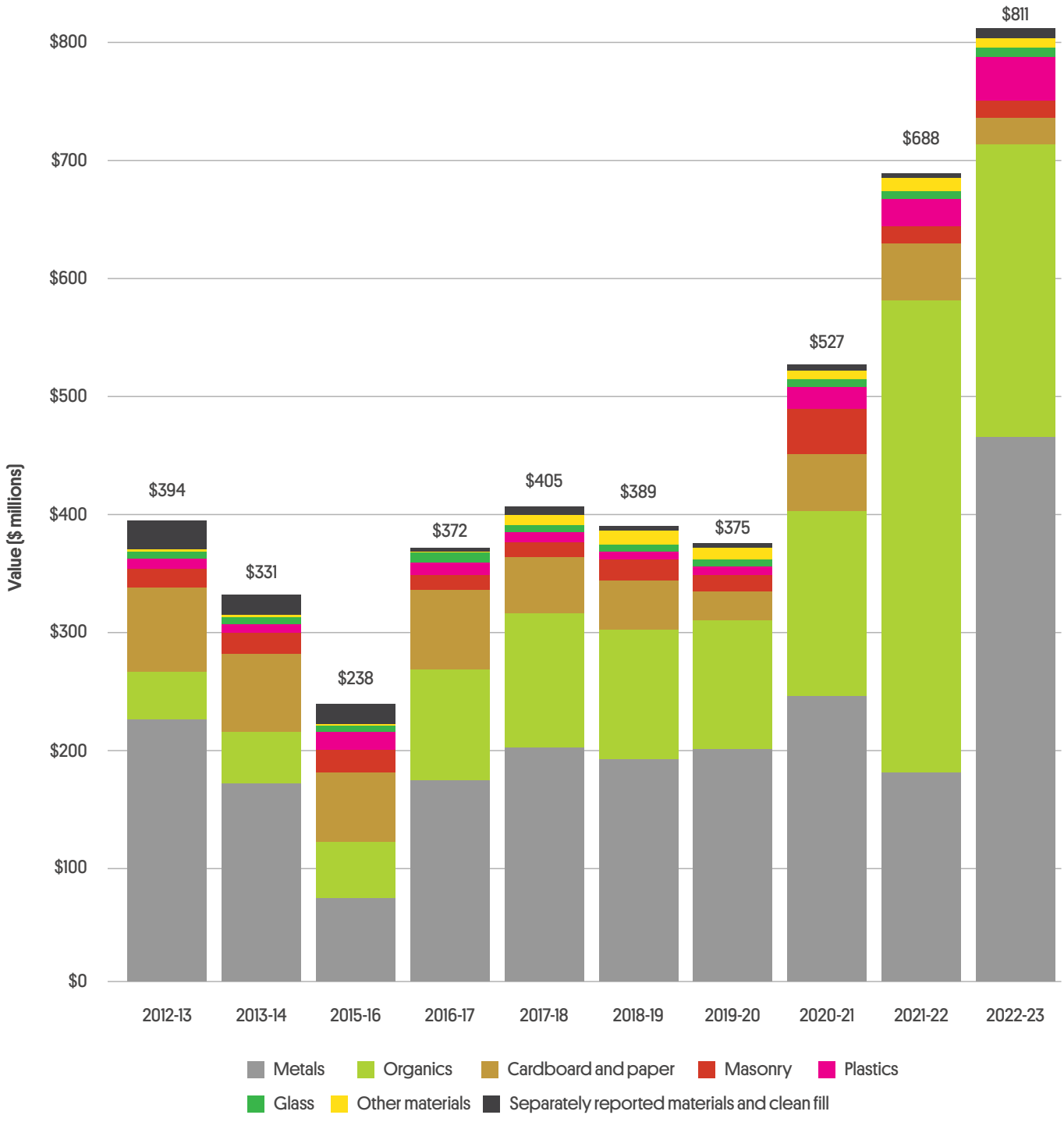
Material category or type	Quantity recovered (kt)	Estimated on-sale price ($/tonne)	Estimated value ($ millions)
Masonry	1,230	$11	$14
Metals – iron and steel	433	$558	$242
Metals – non-ferrous including aluminium	74	$3,033	$224
Organics – meat rendering	111	$2,000	$221
Organics – garden, food and timber	447	$61	$27
Organics – other	429	Variable	Not calculated
Cardboard and paper	216	$107	$23
Plastics	30	$1,229	$37
Glass	74	$116	$9
Other materials (including tyres and other rubber, leather and textiles and foundry sands)	26	$237	$6
Separately reported materials and clean fill	1,064	$8	$9

Figure 45 Estimated market value of resource recovered materials, SA, 2022-23



The trend for estimated market value of resource recovery in SA is shown in Figure 46. The value in 2022-23 is high compared to previous years, mostly due to the high value of metals this year in contrast with the low value and quantity of metals seen in 2021-22. Plastics contributed more to the value of resource recovery than previous years, possibly due to increased sorting by polymer type as highlighted by the decline of mixed plastics discussed previously in this report.

Figure 46 Estimated market value of resource recovered materials in SA, 2012-13 to 2022-23[8]



8 Historical values have been adjusted to account for inflation.

8 Environmental benefits of recycling

Resource recovery in SA in 2022-23 was estimated to achieve the following environmental benefits:

- greenhouse gas emissions savings about 1.67 million tonnes of carbon dioxide equivalent (Mt CO_2-e)
- energy savings of about 19,400 terajoules (TJ).
- water savings of about 6,400 megalitres (ML).

The production and consumption of materials requires the use of energy and water and emits greenhouse gases. When a recoverable material is landfilled, the resource and the energy 'embodied' within it (that is, the energy used to make it) are wasted. Additionally, when materials prone to biological decay (organics, paper and cardboard or textiles.) are landfilled, they generate and release the potent greenhouse gas, methane.

This section details the environmental benefits of SA's resource recovery sector, including the estimated emissions, energy and water savings the sector achieved in 2022-23. This assumes the recovered materials substitute for virgin materials so the relative savings can be estimated from life cycle assessments and other information sources as given in Appendix B. The results are summarised below in Table 46.

Table 46 Estimated environmental benefits of recycling in SA in 2022-23

Material type	Recycling kt	Emissions avoided kt CO_2-e	Energy saved TJ LHV	Water saved ML
Masonry				
Asphalt	208	6	494	183
Bricks	16	0	4	20
Concrete	1,005	20	352	1,286
Plasterboard	2	0	1	0
Clay, fines, rubble and soil	1,064	94	1,512	468
Metals				
Iron and steel	433	191	3,244	-1,022
Aluminium	41	680	8,427	1,196
Non-ferrous metals	33	29	1,190	197
Organics				
Food organics	47	27	8	21
Garden organics	332	222	103	1,854
Timber	30	5	325	-1
Organics – other	651	313	1,409	150
Cardboard and paper				
Cardboard and waxed cardboard	27	5	12	297
Liquid paperboard	<1	<1	<1	<1
Magazines and newspaper	<1	<1	<1	5
Printing and writing paper	4	5	-3	44

Material type	Recycling kt	Emissions avoided kt CO_2-e	Energy saved TJ LHV	Water saved ML
Plastics				
Polyethylene terephthalate	4	5	245	306
High density polyethylene	6	5	288	131
Polyvinyl chloride	0	0	0	0
Low density polyethylene	<1	<1	2	1
Polypropylene	3	1	75	66
Polystyrene	<1	<1	10	9
Mixed and/or other plastics	1	<1	21	18
Glass				
Glass	74	39	327	68
Other materials				
Fly ash	0	0	0	0
Foundry sands	2	0	0	0
Leather and textiles	3	0	0	0
Tyres and other rubber	21	22	1,314	1,072
Total	**4,010**	**1,670**	**19,400**	**6,400**

8.1 Greenhouse gas emission savings

It is estimated that SA saved about 1.67 million tonnes of carbon dioxide equivalent (CO_2-e) through recycling its materials in 2022-23. This is an increase from the estimated emissions savings reported in the previous year (1.52 million tonnes CO_2-e).

Metals recycling contributed the greatest proportion of greenhouse gas emissions savings at about 900 kt CO_2-e or 54% of total estimated emissions savings. This benefit is from avoided emissions from manufacture of metals from virgin materials, which is more emissions intensive than recycling.

The next greatest contribution was from recycling organics, which contributed 570 kt CO_2-about 34% of total emission savings. This is due to avoided landfill emissions.

Recycling of masonry contributed about 7%, glass about 2% and cardboard and paper, plastics, and other materials all contributed about 1%.

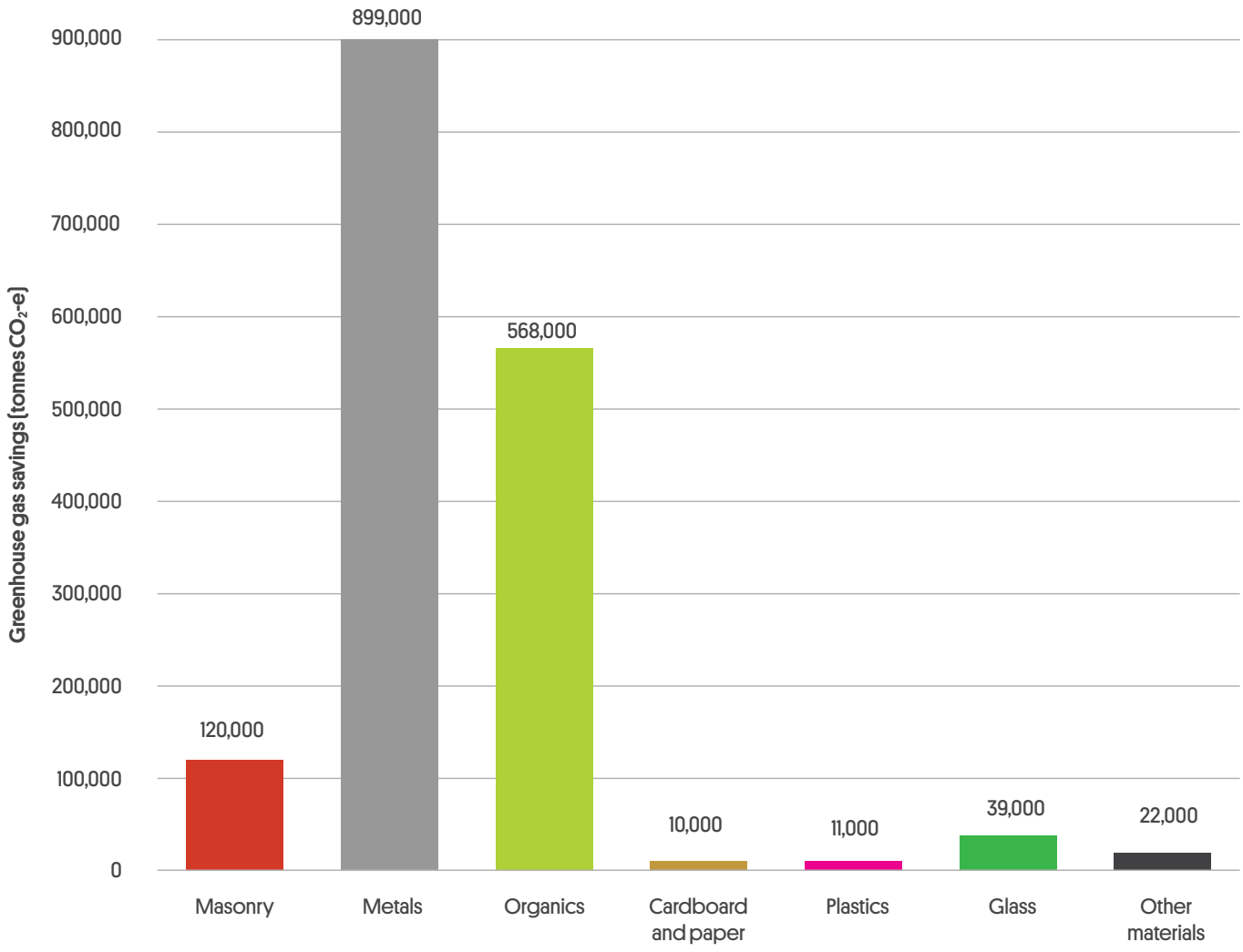
Table 47 and Figure 47 provide detail on estimated greenhouse gas emissions savings due to recycling in 2022-23. It is estimated that emissions saved due to recycling in 2022-23 is approximately equivalent to:

- the CO_2 absorbed by 2.5 million trees
- the annual emissions from 334,000 cars.

Table 47 Estimated greenhouse gas emissions savings due to recycling in SA in 2022-23

Material category	Emissions saved kt CO_2-e	Equivalent trees planted required for carbon absorption	Equivalent cars off the road in one year
Masonry	120	179,000	24,000
Metals	900	1,340,000	180,000
Organics	570	846,000	114,000
Cardboard and paper	10	15,000	2,000
Plastics	10	17,000	2,000
Glass	40	58,000	8,000
Other materials	20	33,000	4,000
Total	**1,670**	**2,487,000**	**334,000**

Figure 47 Estimated greenhouse gas emissions savings due to recycling, SA, 2022-23



8.2 Energy savings

Energy savings from recycling in SA during 2022-23 were estimated at 19,400 terajoules (TJ). This is higher than the 2021-22 estimate of 18,500 TJ. Some of this is due to high quantities of aluminium and other non-ferrous metals reported as recovered, which have high energy consumption.

The top three contributors to total energy savings in 2022-23 were metals (66%), followed by masonry at 12% and then organics at 10%.

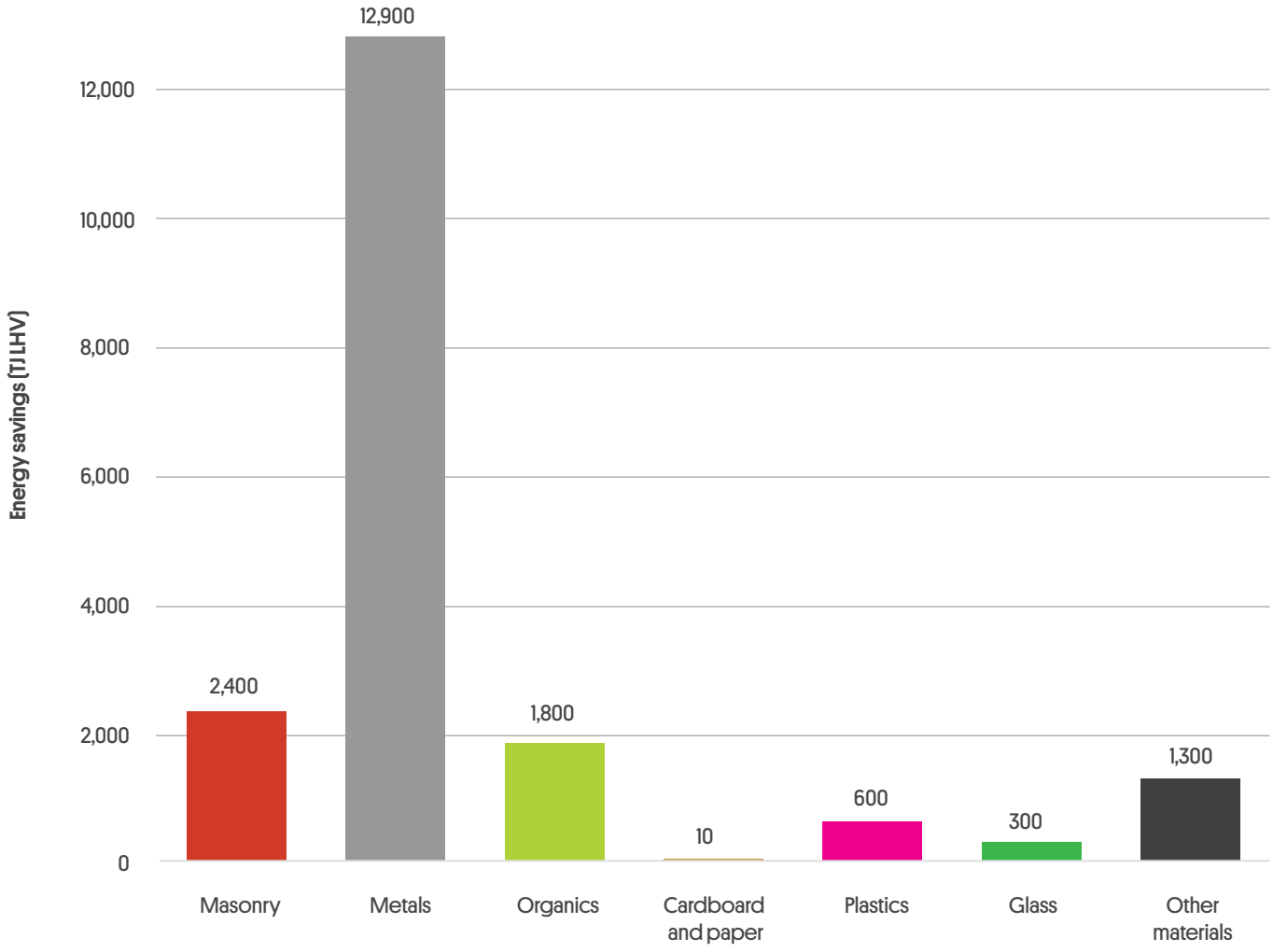
It is estimated that energy savings due to the recycling of SA materials in 2022-23 are equivalent to:

- energy use from 380,000 households in one year
- the energy supplied by 3.2 million barrels of oil.

Table 48 Estimated energy savings due to recycling in SA in 2022-23

Material category	Energy saved (TJ LHV)	Equivalent energy use from households in one year	Barrel of oil equivalents
Masonry	2,400	46,000	387,000
Metals	12,900	252,000	2,108,000
Organics	1,800	36,000	302,000
Cardboard and paper	10	190	1,600
Plastics	600	13,000	105,000
Glass	300	6,000	54,000
Other materials	1,300	26,000	215,000
Total	**19,400**	**380,000**	**3,174,000**

Figure 48 Estimated energy savings due to recycling, SA, 2022-23



8.3 Water savings

The total estimated water savings from recycling SA materials in 2022-23 were 6,400 megalitres (ML), this is a decrease from the 8,400 ML estimated in 2021-22. This is partly due to less cardboard and paper products recovered, which save water when recycled material is used rather than virgin pulp, and higher amounts of iron and steel recovered which require more water to reprocess than to use virgin material.

Organics and masonry contributed to highest proportions towards these savings at 32% and 31% respectively, followed 'other' materials (17%), plastics (8%), metals (6%) cardboard and paper (5%), and glass (1%).

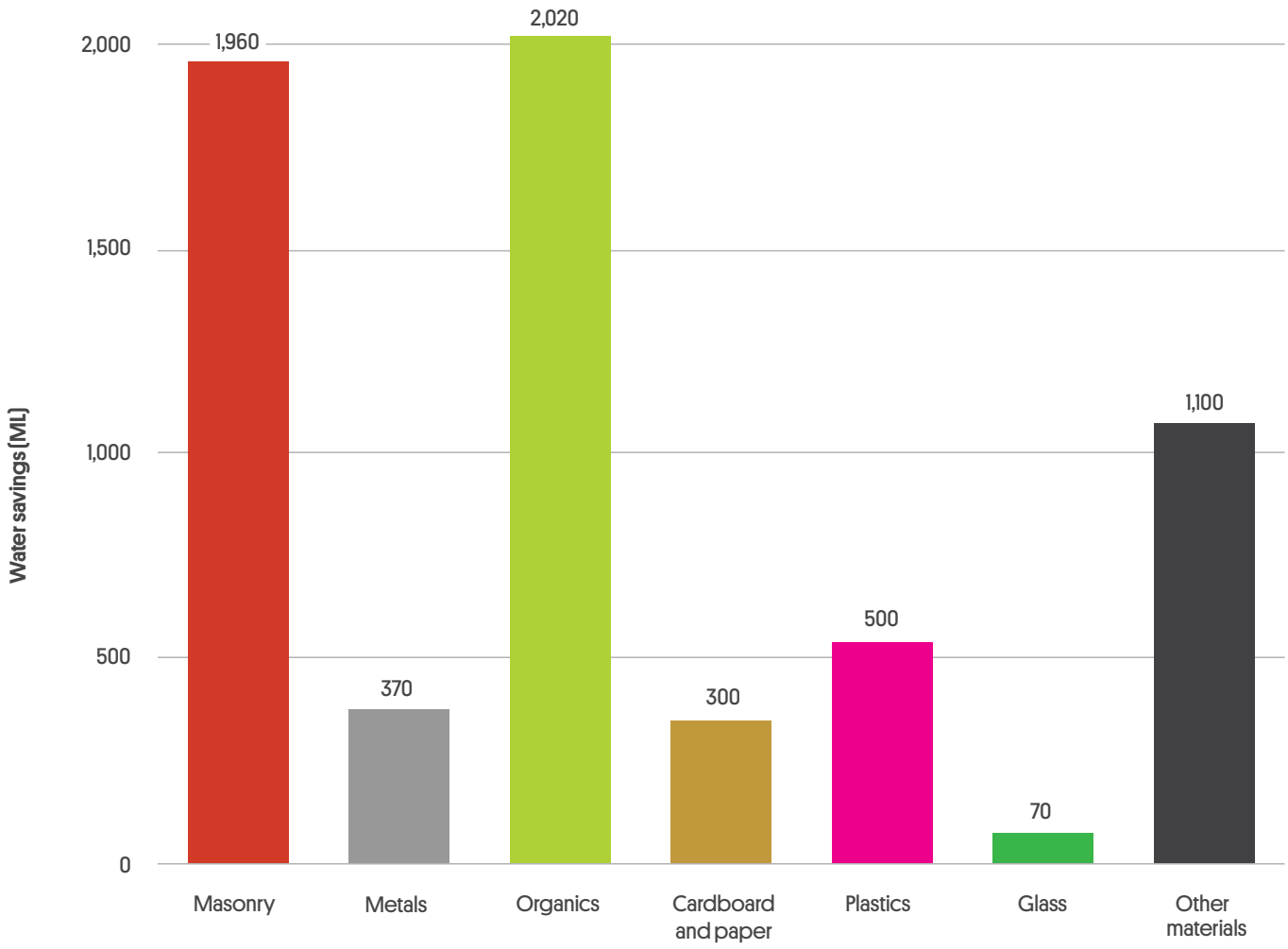
Water savings from recycling in SA in 2022-23 are estimated to be approximately equivalent to:

- annual water use from 39,000 households
- the water contained in 2,500 Olympic sized swimming pools.

Table 49 Estimated water savings due to recycling in SA in 2022-23

Material category	Water saved (ML)	Equivalent household water use in one year	Equivalent Olympic swimming pools
Masonry	2,000	12,000	800
Metals	400	2,000	100
Organics	2,000	12,000	800
Cardboard and paper	300	2,000	100
Plastics	500	3,000	200
Glass	70	400	30
Other materials	1,100	6,500	400
Total	**6,400**	**39,000**	**2,500**

Figure 49 Estimated water savings due to recycling, SA, 2022-23



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Appendices

Appendix A Technical method

A1 Overview

Green Industries SA commissioned Blue Environment to undertake a survey on SA's recycling and energy recovery industries for the 2022-23 financial year. This section outlines the approach for conducting the survey and analysing the collected data.

A2 The survey

A2.1 Design

The survey was based on the survey from used in CERRR 2020-21 with some minor changes to facilitate information gathering. The survey remained consistent with the Commonwealth Government's *Australian standard for waste and resource recovery data and reporting*. The changes were:

- separating input spaces for material coming to the organisation for recovery and recovered material leaving the organisation
- requesting information on fate of incoming material, i.e. reuse, recycling or energy recovery
- requesting information on waste to landfill as an overall figure for the organisation as requesting by material type in 2020-21 did not have a strong response
- simplifying the information request on geographical source
- allowing respondents to elect units for reporting (tonnes, % or volumetric).

The survey questionnaire was developed in consultation with Green Industries SA and can be seen in Appendix C.

A2.2 Participants

Using the Circular Economy Resource Recovery Survey 2020-21 respondents as a foundation, a list of companies and organisations involved with recycling, reuse and energy recovery in SA was developed. This covered recovery facilities, reprocessors, industry bodies, local government waste management authorities and reuse organisations. The final list, developed in consultation with Green Industries SA, comprised 127 companies and organisations. This did not include all composters, only those that received other material in addition to composting. Composters received a separate survey from Green Industries SA, the data from which were received and applied in this report.

A2.3 Delivery

The survey was deployed to participants in October 2022 via email. The survey form, an introduction letter from GISA and a confidentiality deed from the consultant team were attached to the email.

Participants were offered an opportunity to go through the survey with a member of the consultant team or fill out the form in their own time. Participants were sent follow-up reminders on the survey via email and/or phone multiple times to encourage submission. The surveying period lasted several weeks and closed in December 2023, although some data was received in early 2024.

A selection of key SA recyclers nominated by GISA were approached for a site visit and face-to-face survey interview. Nine site visits were conducted, where members of the consultant team and a representative from GISA filled out the survey questionnaire in-person alongside the survey respondent. An additional interview was conducted via videoconference. These face-to-face consultations provided additional detail and industry insights that guided the interpretation of data and the report.

The survey was voluntary and not all approached companies and organisations provided a response, despite the consultant team's best efforts. In instances of non-response, data were filled where possible using previous years' data, mass balance reporting data from SA EPA or the ABS exports data.

A3 Data analysis

A3.1 Survey data analysis

Data collected via the survey were collated into a Microsoft Excel database. The data were cleaned and verified, and then analysed to determine the following for each material type:

- **Net recovery**: the quantity of SA materials recovered, net of residuals and accounting for known and assumed double-counts.
- **Source stream**: the source stream from which the SA materials came from, including MSW, C&I and C&D.
- **Geographical origin**: the geographical origin within SA from which the material came from.
- **Destination**: where the material was sent for recycling, including in SA, interstate or overseas.

The following principles were applied when analysing survey data to generate reported figures:

- The scope of the survey was for materials generated in SA only. Therefore, any materials imported into SA from interstate or overseas for recycling were excluded.
- The proportion of received materials that were residual waste sent to landfill was excluded from reported quantities.
- Care was taken to avoid double-counts of materials, which can arise when material flows through more than one facility and is subsequently reported by more than one survey participant. Double-counts were mostly addressed via a survey question regarding where materials were sent offsite to for further processing.
- Some companies did not provide the requested survey data. Where available, SA EPA provided mass balance data to GISA for aggregated use in this report. Mass balance data is compulsorily reported under Environment Protection Act 1993 by companies handling more than 20 kt/year of waste. Mass balance data was used in the data set where available, although there were difficulties in mapping the data by waste type. Where mass balance data was not available, previously reported survey data was applied.
- Some respondents were only able to provide an estimate of the quantity of material processed at their site. Factors such as rainfall and seasonality had major impacts on the quantity of material recovered and therefore some survey responses had large margins of error. This issue particularly affects the accuracy of organics recovery reported.

A3.2 Reuse and the circular economy

The survey sought data on reuse and the circular economy, building on the progress of the CERRR 2020-21 and CERRR 2021-22. This involved engaging major South Australian reuse organisations about reuse flows through their operations in the 2022-23 financial year, as well asking all survey participants about their motivations within a circular economy context. The approach will continue to be refined and improved in future surveys.

Reported reuse quantities are not exhaustive and exclude some major reuse items, such as vehicles and anything traded via online community platforms. Again, the survey will capture more comprehensive data in the future as the data collection method is refined.

A3.3 Per capita analysis

Metrics for per capita statistics were calculated using population and demographic data from the Australian Bureau of Statistics (ABS 2023a; ABS 2023b; ABS 2023c; ABS 2019).

A3.4 Packaging

The survey sought data on the recovery of packaging materials. These were supplemented by container deposit legislation data provided by SA EPA. For non-CDL packaging:

- **cardboard packaging** was derived from cardboard material recovery data which was adjusted to account for pre-consumer material
- **plastics packaging** was derived from industry data for plastic packaging materials recovered by Adelaide MRFs and other sources.
- **glass packaging** was determined from industry-reported glass containers recovery data.

A3.5 Environmental benefits of recycling

The method for the environmental benefits of recycling used the same approach as for previous Circular Economy Resource Recovery and *Recycling Activity Survey* reports. The scope of environmental benefits analysis included the following metrics:

- **Greenhouse gas emissions savings** (in tonnes CO_2-e): The reduction in greenhouse gas emissions achieved by replacing virgin materials with recycled materials.
- **Energy savings** (in terajoules): The amount of energy saved, including all fossil, renewable, electrical, and embodied energy, by using recycled materials.
- **Water savings** (in megalitres): The reduction in water consumption by substituting recycled materials that would otherwise be required if virgin materials had been used.

The factors used to assess the benefits of recycling materials are based on life cycle analysis techniques. These can be found in Appendix B. Sufficiently comprehensive and/or reliable factors could not be identified for foundry sands and leather and textiles. Therefore, these materials were not included in the environmental benefits analysis.

The following limitations apply to the environmental benefits analysis presented in this report:

- Many of the conversion and emission factors adopted are derived from interstate studies and were not calculated specifically for SA. This may mean estimated savings do not account for all local factors.
- SA may not necessarily accrue all total estimated environmental benefits because:
  - » some of the virgin materials that are replaced by recycling are not manufactured in SA
  - » some material recovered from SA for recycling is used to manufacture products that end up being consumed outside of the State.

Due to this limitation, the environmental benefits assessment presented in this study is a generalised estimate and should be used with caution.

A3.6 Value of resource recovery

Values for products used in this report were based on industry-responses to the survey. These were supplemented by personal consultations with industry conducted in late 2021 and early 2022, as well as publicly available information on market values of recovered materials.

A4 Material flow analysis method

An introduction for material flow analysis is provided in Section 4.1, including key definitions. This section provides more detail on the MFA method used for this report.

A4.1 Material scope

The materials in scope of the MFAs are metals, cardboard and paper, plastics, glass, textiles and tyres.

A4.2 Time boundary

The MFA time boundary is financial year 2022-23. The underlying model, however, has been set up with a time boundary of 1918-19 to 2049-50. The modelling period is wider than is minimally necessary for the material groups modelled, but this ensures good model coverage into historical stocks, particular in the built environment, and the ongoing use of some of the materials in long-lived applications, again primarily in the built environment.

A4.3 Modelling software

The modelling for the MFAs was undertaken in Microsoft Excel. Widespread use of this software supports transparency of the modelling and data manipulations and is simpler and more 'future-proof'.

A4.4 Sankey diagrams

Sankey diagrams are visual tools that can be used to show the flow of material through a system. The software used for this project was e!Sankey. In e!Sankey, the diagram is built, using boxes and arrows. The arrow width is adjusted automatically by the software so that flow quantity proportions can be accurately represented.

A4.5 Indicator selection

A potentially large number of indicators can be established from economy-wide MFAs, as undertaken for the pilot MFAs. Those selected for this work are outlined in Table 50. These different types of indicators deliver complementary information about various aspects related to material use.

Table 50 Circular economy indicators developed through MFA

Performance metric	Definition	What it measures	Numerator	Denominator
Recycled content	Secondary sourced material divided by consumption.	Performance of the manufacturing system in utilising recycled materials.	Import recycled to Manufacturing + Import recycled to Use + Reprocessing to Manufacturing	Use (input)
Collection efficiency	Discarded materials that are collected for recovery (not directed to landfill), divided by total materials entering the waste system.	Performance of the collection system. Low efficiency means a high proportion of material isn't separated from material flows at the household or business and is directed to landfill, e.g., owing to limited source separation and/or poor disposal practices.	Manufacturing to Sorting + Use to Sorting	Use (output) + Manufacturing to Sorting + Manufacturing to Landfill - Sorting to Use
Sorting efficiency	Materials recovered out of sorting divided by materials sent to sorting.	Performance of the system to sort materials designated for specific recovery pathways. Low sorting efficiency highlights opportunities to reduce contamination of collected materials received and/or improve sorting processes at the sorting facilities.	Sorting to Reprocessing + Sorting to Export	Sorting (input)
Reprocessing efficiency	Materials recovered out of reprocessing divided by materials sent to reprocessing.	Performance of the system to reprocess materials to be ready for specific remanufacturing or energy recovery pathways. Low reprocessing efficiency highlights opportunities to reduce contamination of sorted materials received, improve product design, and/or improve reprocessing processes at the reprocessing facilities.	Reprocessing to Manufacturing + Reprocessing to Export + Reprocessing to Energy recovery + Reprocessing to Open loop	Reprocessing (input)
Recycling rate	Materials recycled back to local or overseas manufacturing divided by material entering the waste system.	Performance of the system in recycling end-of-life materials.	Sorting to Export + Reprocessing to Manufacturing + Reprocessing to Export + Reprocessing to Open loop	Use (output) + Manufacturing to Sorting + Manufacturing to Landfill - Sorting to Use
Energy recovery rate	Post-consumer materials recovered back to local or overseas energy recovery (excluding residuals from energy recovery) divided by post-consumer material entering the waste system.	Performance of the system in diverting end-of-life materials to energy recovery.	Reprocessing to Energy recovery	Use (output) + Manufacturing to Sorting + Manufacturing to Landfill - Sorting to Use
Recovery rate	Materials recovered back to local or overseas manufacturing, and to energy recovery (excluding residuals), divided by material entering the waste system.	Performance of the system in diverting end-of-life materials to reuse, recycling and energy recovery.	Sorting to Export + Reprocessing to Manufacturing + Reprocessing to Export + Reprocessing to Energy recovery + Reprocessing to Open loop	Use (output) + Manufacturing to Sorting + Manufacturing to Landfill - Sorting to Use
Local material utilisation rate	Secondary material used locally for manufacturing, divided by total material potentially available for local manufacturing.	Performance of the system in on-shore remanufacturing, relative to the amount of material that is potentially available.	Reprocessing to Manufacturing + Reprocessing to Open loop	Use (output) + Manufacturing to Sorting + Manufacturing to Landfill - Sorting to Use


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Appendix B Environmental benefits factors, 2022-23

The table below lists a set of factors used to estimate the environmental benefits of recycling SA materials in 2022-23. They are based on a study commissioned by Green Industries SA by Trellis Technologies (2019) and the greenhouse gas emissions factors updated in 2021-22 for food organics, garden organics and timber.

		GHG emissions saved	Energy saved	Water saved
Category	**Type**	**Emissions factor (t CO_2-e/t)**	**Conversion factor (GJ LHV/t)**	**Conversion factor (kL/t)**
Masonry	Asphalt	0.030	2.380	0.880
	Bricks	0.020	0.280	1.260
	Concrete	0.020	0.350	1.280
	Plasterboard	0.030	0.550	-0.030
	Clay, fines, rubble and soil	0.088	1.420	0.440
Metals	Iron and steel	0.440	7.490	-2.360
	Aluminium	16.667	206.667	29.333
	Non-ferrous metals	0.880	36.090	5.970
Organics	Food organics	0.980	0.180	0.440
	Garden organics	0.670	0.309	5.592
	Timber	0.180	10.730	-0.040
	Organics – other	0.481	2.165	0.230
Cardboard and paper	Cardboard and waxed cardboard	0.169	0.467	11.111
	Liquid paperboard	0.169	0.467	11.111
	Magazines	0.455	0.364	10.909
	Newsprint	0.455	0.364	10.909
	Phonebooks	0.455	0.364	10.909
	Printing and writing paper	1.300	-0.680	11.000

		GHG emissions saved	Energy saved	Water saved
Category	**Type**	**Emissions factor (t CO_2-e/t)**	**Conversion factor (GJ LHV/t)**	**Conversion factor (kL/t)**
Plastics	Polyethylene terephthalate	1.200	55.000	68.750
	High density polyethylene	0.825	50.000	22.750
	Polyvinyl chloride	0.313	30.000	26.250
	Low density polyethylene	0.825	50.000	22.750
	Polypropylene	0.313	30.000	26.250
	Polystyrene	0.313	30.000	26.250
	Mixed and/or other plastics	0.313	30.000	26.250
Glass	Glass	0.528	4.444	0.931
Other materials	Fly ash	0.029	0.552	1.260
	Foundry sands	Not specified as insufficient reference data identified		
	Leather and textiles			
	Tyres and other rubber	1.070	64.080	52.250

The emissions factors for food organics, garden organics and timber were calculated by Blue Environment based on *National Greenhouse and Energy Reporting (Measurement) Determination 2008* methods. The calculations compared emissions from landfilling these organics types (assuming a landfill gas recovery rate of 43%) compared with emissions from composting them.

Appendix C Circular Economy Resource Recovery Survey 2022-23

SA Circular Economy and Resource Recovery Survey 2022-23						
Please enter information in white cells in this worksheet.						
1. Please provide details of the person filling out this survey.						
Name						
Position						
Phone						
Email						
2. Please provide your company or organisation's contact address and details. Please also include the address of your main facility(ies) for reprocessing or handling of materials.						
Company/organisation name						
ABN						
Contact address						
	Facility 1	**Facility 2**	**Facility 3**	**Facility 4**	**Facility 5**	
Address of your main facility(ies) for reprocessing or handling of materials						
Primary waste and resource recovery facility classification						
Annual throughput capacity (without significant capital expenditure or new approvals) in tonnes per year						
3. Are you happy for your company to be recognised in the report as participating in the 2022-23 Circular Economy and Resource Recovery Survey?						
4. Please fill in Table 1 for each relevant material you received for recycling, reuse or energy recovery. This is the critical information required for the survey. All data will be kept confidential and anonymised for reporting purposes.						

GOODS AND MATERIAL TYPE	GOODS AND MATERIAL SOURCE/INPUT						
	Total quantity of goods and material received for reuse, recycling or energy recovery in 2022-23	Main fate of this material	Proportion of material derived from post-consumer packaging[1]	Quantity of material received from these regions			
				From SA - Metro	From SA - Regional	From interstate	Source jurisdiction
	Select unit from dropdown	*Select from list*	%	*Select unit from dropdown*			*Select from list*

Notes:

1. Excludes pre-consumer packaging manufacturing scrap
2. MSW = Municipal solid waste - domestic household sourced waste
3. C&I = Commercial and industrial - industry and business sourced waste
4. C&D = Construction and demolition - building, construction and demolition
5. If more than one productive use for this material, go to row 71
6. Commodity market price

(1 July 2022 - 30 June 2023)

Table 1: Material recovery data from the 2022-23 financial year

	Quantity of material from these source streams		
	MSW[2]	C&I[3]	C&D[4]
	%	%	%

Question 4 continued on next page

Question 4 continued

GOODS AND MATERIAL TYPE	RESIDUAL	Destination of goods and material for reprocessing				
	Proportion of material sent to landfill	Your SA facility(ies)		Material types sent offsite from your facility(ies) for further processing at a waste and resource recovery facility		
		Quantity recovered at your SA facility	Productive use type[5]	Elsewhere in SA - Metro	Elsewhere in SA - Regional	
	%	*Select unit from dropdown*	*Select from list*	*Select unit from dropdown*	*Select unit from dropdown*	

Notes:

1. Excludes pre-consumer packaging manufacturing scrap
2. MSW = Municipal solid waste - domestic household sourced waste
3. C&I = Commercial and industrial - industry and business sourced waste
4. C&D = Construction and demolition - building, construction and demolition
5. If more than one productive use for this material, go to row 71
6. Commodity market price

5.	**What is the method for measuring the data provided in Table 1?**	**Measurement method**
6.	**What is the estimated accuracy of the data provided in Table 1 (e.g. ±5%)?** *If weighbridge, a suitable accuracy may be ±1%.*	
7.	**If you receive mixed loads or product wastes and sort or separate material, what material types were sent offsite from your facility(ies) for further processing at a waste and resource recovery facility?**	

Incoming material type listed in Table 1	Outgoing material type #1	Tonnes sent for further processing #1	

Outgoing material type #3	Tonnes sent for further processing #3	Location of receiving facility #3	Name of destination SA waste and resource recovery facility #3	Outgoing material type #4	Tonnes sent for further processing #4	

						VALUE	
						Approx. average value per tonne[6]	Comments
	Name of SA receiving waste or resource recovery facility	Sent interstate		Sent overseas			
	Select unit from dropdown	*Select from list*	Jurisdiction	*Select unit from dropdown*	Country	$/tonne	

	Location of receiving facility #1	Name of destination SA waste and resource recovery facility #1	Outgoing material type #2	Tonnes sent for further processing #2	Location of receiving facility #2	Name of destination SA waste and resource recovery facility #2

	Location of receiving facility #4	Name of destination SA waste and resource recovery facility #4	Outgoing material type #5	Tonnes sent for further processing #5	Location of receiving facility #5	Name of destination SA waste and resource recovery facility #5

8. If a material type you received in Table 1 becomes multiple products, how much of the total material reprocessed at your facility were returned to each productive use?
Please treat the quantity of material recovered at your SA facility in Question 4 as your total onsite recovery

Incoming material type listed in Table 1	Productive use type #1	Tonnes sent to productive use #1	

9. If there have been any significant changes in quantities, stockpiles, sources or destinations from the 2021-22 financial year, what was the reason for this?

10. Where do you receive most of your material from (e.g. Councils, manufacturing, retail, hospitality, donations, etc.)?

11a. How many people (FTEs) are directly employed by your company/ organisation's site(s) or operations(s) associated with material collection, resource recovery and/or recycling (i.e. permanent or casual staff, individual contractors)?

11b. What are the employment classifications in your company/organisation? Please complete the following table.

Classification	No. FTE
Unskilled	
Administration	
Construction/ design	
Driver	
Machinery operator	
Sorting	
Technical support	
Sales/marketing	
Supervisor	
Other	

12. What is your opinion about the market strength/prospects for the recycled goods and materials your company handles?

Material	Comments on market strength/prospects

	Productive use type #2	Tonnes sent to productive use #2	Productive use type #3	Tonnes sent to productive use #3	

13. Does your company or organisation intend to expand or contract its SA facilities or make new investments in recycling activity? If yes, what will this involve?	
14. What are the biggest problems that obstruct your recycling operations?	
15. What is your organisation's approximate annual sales revenue (turnover) from goods and material collection, resource recovery and/or recycling activities?	
16. What are the names of other recyclers in your area of the SA recycling industry? *This helps us ensure that we have captured all recyclers in the industry.*	
17. What is your highest priority when identifying the reprocessing destination for sourced goods and materials?	**Circular economy factor**
18. Would you like to be invited to an industry seminar by Green Industries SA (GISA) summarising the findings of this 2022-23 Circular Economy and Resource Recovery Survey?	
19. Do you have any feedback on this survey?	

Government
of South Australia

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