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Abbreviations and glossary

ABS	Australian Bureau of Statistics
ash	residues of coal-fired power generation
ACT	Australian Capital Territory
APCO	Australian Packaging Covenant Organisation
bagasse	fibrous waste remaining when sugarcane stalks are crushed to extract juice
biosolids	stabilised organic solids produced by wastewater treatment processes
bottom ash	ash produced by burning coal or other materials that remains in the furnace or incinerator
CAGR	compound annual growth rate
capita	person
C&D waste	construction and demolition waste – waste produced by demolition and building activities, including road and rail construction and maintenance and excavation of land associated with construction activities, consistent with Australia and New Zealand Standard Industrial Classification Division E
C&I waste	commercial and industrial waste – waste that is produced by institutions and businesses, including offices, schools, restaurants, retail and wholesale businesses, and industries such as manufacturing. Also includes waste from primary and secondary production, such as mining and minerals processing, encompasses waste from all Australia and New Zealand Standard Industrial Classification codes except Division E and Group 753
CDS	container deposit scheme
CO ₂ -e	carbon dioxide equivalent (emissions)
core waste	waste that is generally managed by the waste and resource recovery sector, comprising solid waste and liquid hazardous waste, and generated in the municipal, construction and demolition, and commercial and industrial sectors, and including biosolids. Generally excludes, to the extent they can be identified, wastes from primary production
cullet	recycled broken or waste glass used in glass-making
Department	Department of Climate Change, Energy, the Environment and Water
disaster waste	debris and other waste resulting from disaster events including floods, bushfires and cyclones
disposal	processes through which wastes are collected and processed or placed in an approved facility without deriving significant productive use. Includes deposit in landfill and incineration
EfW	energy from waste
EPA	Environment(al) Protection Authority (name varies with jurisdiction)
EPS	expanded polystyrene
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
e-waste	electrical or electronic waste, comprising any equipment, device or thing that is no longer wanted or working and was in some way dependent on, or designed for the generation, transfer or measurement of, an electric current and/or an electromagnetic field and designed for a supply voltage not exceeding 1000 volts for alternating current and 1500 volts for direct current
FY	financial year – 1 July to 30 June in the following calendar year
FOGO	food organics and garden organics
GL	gigalitres
GO	garden organics
gross domestic product	the total market value of goods and services produced in Australia within a given period after deducting the cost of goods and services used up in the process of production but before deducting allowances for the consumption of fixed capital

hazardous waste	waste that, by its characteristics, poses a threat or risk to public health, safety or to the environment and comprising, in this report, waste that cannot be imported to or exported from Australia without a permit under the <i>Hazardous Waste (Regulation of Exports and Imports) Act 1989</i> , or waste that a jurisdiction regulates as requiring particularly high levels of control
hazardous liquid waste	liquid waste defined as hazardous in the <i>Australian Hazardous Waste Data and Reporting Standard</i> . This covers most liquids not disposed directly to the sewerage system from commercial and industrial premises
headline numbers	the values used in chapters 2 to 3 and 5 to 8 for reporting progress against national targets, quantities, trends and recovery rates, comprising core waste plus ash
household liquid waste	liquid waste disposed of into household bins or household chemical collection programs.
HDPE (2)	high-density polyethylene (<i>the number in brackets is the plastics identification code</i>)
inert	a substance that has little or no chemical reactivity. Thus 'inert waste' is waste that has few or no putrescible materials
kg	kilograms
kt	kilotonnes (thousands of tonnes)
LDPE (4)	low-density polyethylene (<i>the number in brackets is the plastics identification code</i>)
long-term storage	pre-approved on-site (or near site) long-term accumulations of waste in designated areas
management method	the infrastructure used to manage waste – landfill, compost facility, alternative waste treatment facility, etc.
MBT facility	mechanical biological treatment facility – processes mixed putrescible waste and includes a biological treatment process
MRF	materials recovery facility – sorts, aggregates and bales mixed recovered materials (comprising mainly packaging) for further sorting or reprocessing. MRFs may be said to undertake primary sorting of these materials
MSW	municipal solid waste – waste produced by households or collected by, or on behalf of, a municipal council
Mt	megatonnes (millions of tonnes)
non-core waste	waste that is not core waste (see Section 1.1 for further detail)
NGER	National Greenhouse and Energy Reporting
NPI	National Pollutant Inventory
NSW	New South Wales
NT	Northern Territory
organic waste	waste that is derived from biotic processes, includes food, garden organics, wood and biosolids. Typically excludes paper and cardboard, textiles, natural latex-based rubber, leather and nappies but may include them under some circumstances (for example, when considering methane emissions from landfills). Excludes plastics and synthetic rubber
per capita	per person
percentage point	a unit of one per cent (an increase from 10% to 15% is an increase of 5 percentage points)
PET (1)	polyethylene terephthalate (<i>the number in brackets is the plastics identification code</i>)
PFAS	per- and poly-fluoroalkyl substances
PP (5)	polypropylene (<i>the number in brackets is the plastics identification code</i>)
primary production	the conversion of natural resources into primary products, usually for use as raw materials by other industries

product stewardship	a policy approach recognising that manufacturers, importers, governments and consumers have a shared responsibility for the environmental impacts of a product throughout its full life cycle
PS (6)	Polystyrene (<i>the number in brackets is the plastics identification code</i>)
PVC (3)	polyvinyl chloride (<i>the number in brackets is the plastics identification code</i>)
Qld	Queensland
recycling	<p>activities through which wastes are collected, sorted, reprocessed (including through composting), and/or converted into raw materials for use in a production system, excluding for energy.</p> <p>For data reporting purposes, the mass of material allocated to the fate ‘recycling’:</p> <ul style="list-style-type: none"> • includes all materials received by a reprocessing facility that are processed to the point of being suitable for remanufacturing or return to productive use, whether immediately used or stored for later sale or use • includes weight losses to the atmosphere during the processing of wastes (for example, moisture, carbon dioxide from organics degradation) • excludes residuals that are sent to landfill or otherwise disposed of • excludes materials received at a recycling facility but not yet processed • is reported as wet weight
recycling rate	the weight of materials allocated to the fate recycling divided by the weight of waste generated. Can be applied to specific materials, source streams, communities or industries, in which case the ‘waste generated’ component is restricted to those materials, streams, communities or industries
residual waste	waste determined by its owner to be unsuitable for recovery
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
resource recovery rate	the weight of materials allocated to the fates waste reuse, recycling or energy recovery divided by the weight of waste generated. Can be applied to specific materials, source streams, communities or industries, in which case the ‘waste generated’ component is restricted to those materials, streams, communities or industries
reuse	reallocation of products or materials to a new owner or purpose without reprocessing or remanufacture, but potentially with some repair (e.g. resale of second-hand cars or clothing re-sold via opportunity shops or the repair of wooden transport pallets for resale)
SA	South Australia
secondary materials	a term applied to recovered materials that have been processed to the point of being suitable for remanufacturing or other return to productive use
sewage	human excreta or domestic waterborne waste, whether untreated or partially treated
sewerage system	the network of pipes used to deliver both sewage and trade waste to sewage treatment plants
soft plastics	plastics that can be easily scrunched
solid waste	waste that can have an angle of repose of greater than 5 degrees above horizontal, or does not become free-flowing at or below 60 degrees Celsius or when it is transported, or is generally capable of being picked up by a spade or shovel
source stream	either municipal solid waste (MSW), commercial and industrial (C&I) waste or construction and demolition (C&D) waste
t	tonne(s)
Tas	Tasmania
trade waste	non-sewage discharges to sewer from industrial and commercial premises. Excludes hazardous liquid waste but includes non-sewage discharges from hazardous waste treatment facilities

USA	United States of America
Vic	Victoria
WA	Western Australia
waste	<p>materials or products that are unwanted, surplus, discarded, rejected, abandoned or left over, including those materials or products intended for or managed by reuse, recycling, energy recovery, treatment, storage and disposal</p> <p>waste-derived materials cease to be waste and transition to being ‘secondary materials’ when the following conditions are met:</p> <ul style="list-style-type: none"> • they are to be used for a specific purpose • a market or demand exists • they fulfil the technical requirements for the specific purposes and meet the existing legislation and standards applicable to products • their use will not lead to overall adverse environmental or human health impacts <p>The transition from waste to secondary materials is generally deemed to occur at the outgoing gate of a reprocessing facility when the outputs require no further processing prior to being returned to productive use</p>
waste-derived products	used to refer to exports of waste materials that have been sorted and sometimes additionally processed, and sold for recycling or energy recovery
waste fate	the ultimate destination of a waste, possible fates are waste reuse, recycling, energy recovery, disposal and long-term storage
waste generation	the process of producing waste, for data reporting purposes, the quantity of waste generated is the sum of the quantities of materials allocated to waste reuse, recycling, energy recovery, disposal, stockpiles and treatment
waste hierarchy	a preferential order of waste management options based on environmental benefit, often framed to include, in descending order of preference: avoid/reuse, recycle, energy recovery, then disposal
waste prevention	waste prevention includes any deliberate action taken that stops an item, component or material from entering a waste management facility or system
waste reuse	reuse of a product or material that has entered a waste management facility (e.g. the sale of goods from a landfill or transfer station ‘reuse shop’)
waste stockpile	an accumulation of waste, whether or not reprocessed and whether or not in infrastructure approved for this purpose
waste treatment	the removal, reduction or immobilisation of hazardous characteristics to enable the waste to be sent to its final fate or further treatment

At a glance

During the financial year 2020–21 Australia generated an estimated 75.8 million tonnes (Mt) of waste including 25.2 Mt of building and demolition materials, 14.4 Mt of organics, 12.0 Mt of ash, 7.4 Mt of hazardous waste (mainly contaminated soil), 5.8 Mt of paper and cardboard, 5.7 Mt of metals and 2.6 Mt of plastics. This is equivalent to 2.95 tonnes (t) per capita.

Headline numbers

	Waste generation (Mt)	Waste reuse (Mt)	Waste recycling (Mt)	Waste to energy (Mt)	Waste disposal (Mt)	Resource recovery rate	Recycling and waste reuse rate
2020–21	76	3.5	42	2.3	28	63%	60%
2018–19	74	44 ¹		2.4	27	63%	60%
2016–17	70	40 ¹		2.3	27	61%	58%

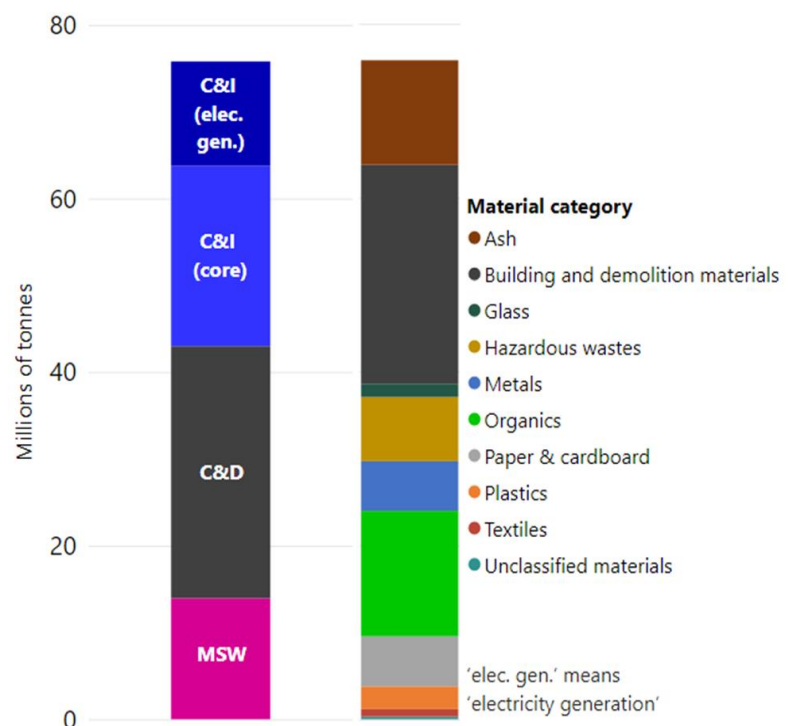
'Mt' means megatonnes (millions of tonnes)

Figure 1 shows that 2020–21 waste comprised:

- 14.0 Mt of municipal solid waste (MSW) from households and local government activities (543 kg per capita and 18% of the total)
- 32.8 Mt from the commercial and industrial (C&I) stream, including ash (43% of the total)
- 29.0 Mt from the construction and demolition (C&D) stream (38% of the total).

In 2016–17 there were 12.6 Mt of MSW; 33.7 Mt of C&I waste including ash; and 23.4 Mt of C&D waste.

Figure 1 Waste generation by material category and stream, Australia 2020–21 (core waste plus ash)



In 2020–21 there were about 63.8 Mt of 'core waste' (those wastes managed by the waste and resource recovery sector)², or 2.48 t per capita. This is up from 57.5 Mt in 2016–17.

¹ Waste reuse was not separately calculated until 2020–21, so historical values are reported with recycling and waste reuse combined.

² Headline waste includes core waste and ash. Ash is residues of coal-fired electricity generation in the C&I stream. Core waste does not include ash as this is not managed by the waste and resource recovery sector. See Section 1.1 for further detail.

Over the 15-year period for which data is available, waste generation increased by 12.8 Mt (20%). Assessed on a per capita basis, waste declined by 3.3% over this timeframe. MSW generation fell by 13% per capita and C&I waste (including ash) by 21% per capita, while C&D waste grew by 39% per capita (see Figure 2). Towards the end of the 15-year data set, C&I waste per capita dipped while MSW per capita rose strongly for the first time. This is consistent with COVID-19 lockdowns diverting waste generation from work places to homes. The increase in C&D waste is due to major development projects.

Figure 2 Trends in the generation of waste by stream in total (left) and per capita (right), Australia 2006–07 to 2020–21

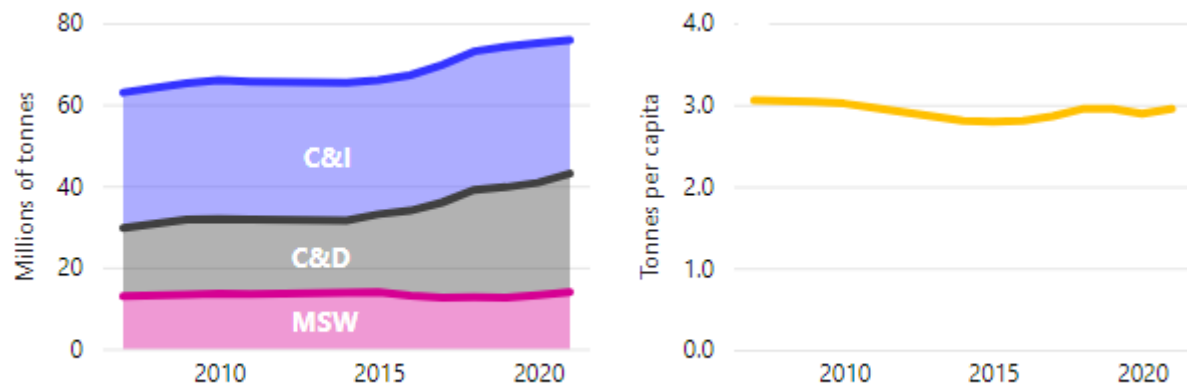
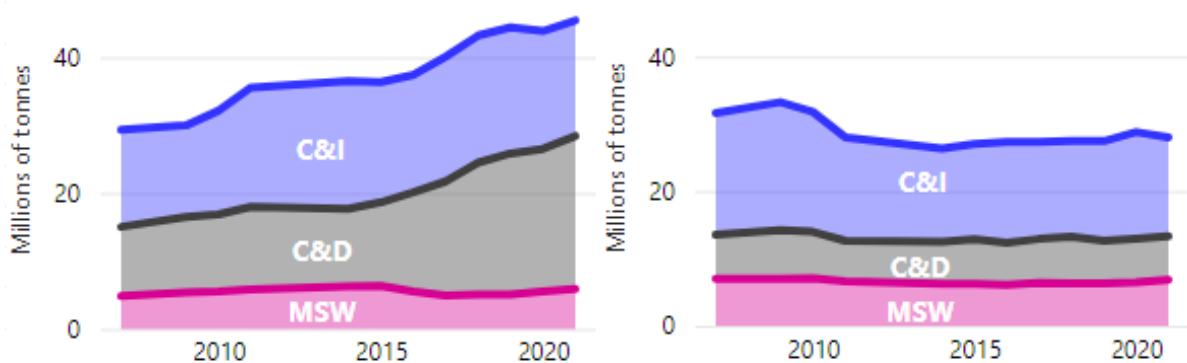


Figure 3 shows that the quantities of waste reuse and recycling have continued to increase since 2006–07, reaching about 45.4 Mt in 2020–21 (the 2016–17 value was 40.1 Mt). Over the 15-year period, waste reuse and recycling of:

- C&D waste more than doubled to 22.4 Mt.
- C&I waste levelled off and declined on a per capita basis, suggesting the easiest-to-recycle materials are dealt with and future gains in recovery will be harder to win.
- MSW fell slightly over on a per capita basis, consistent with lower sales of newsprint and declining quantities of glass and lighter weight packaging. A decline from 2014–15 to 2016–17 is associated with changes to the NSW system for collecting waste data.

Waste disposal dropped over the 15-year data period but climbed slightly from 2013–14. In 2020–21, 28.0 Mt of waste were disposed of, representing 37% of waste generated. In 2016–17, 27.3 Mt were disposed of.

Figure 3 Trends in recycling and waste reuse (left) and disposal (right) of core waste plus ash by stream, Australia 2006–07 to 2020–21



In 2020–21, Australia’s resource recovery rate (including waste reuse, recycling and energy recovery) was 63% and the recycling rate was 60% (see Figure 4). SA was the highest ranked jurisdiction, with a resource recovery rate of 80%. Following, in order and with recovery rates in brackets, were the ACT (69%), NSW and Vic (67%), WA (64%), Tas (51%), Qld (47%), and NT (19%). The national trends in recovery and recycling rates are upwards. The Australian resource recovery rate was 50% in 2006–07 and 61% in 2016–17.

Figure 4 Resource recovery rates of core waste plus ash by jurisdiction, 2020–21

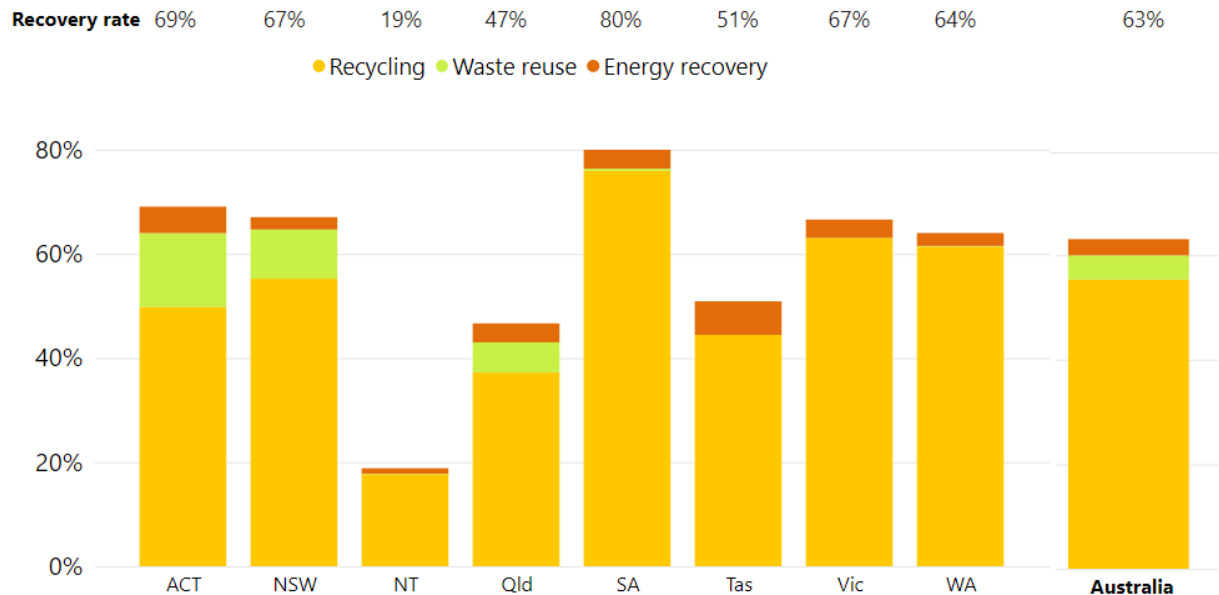
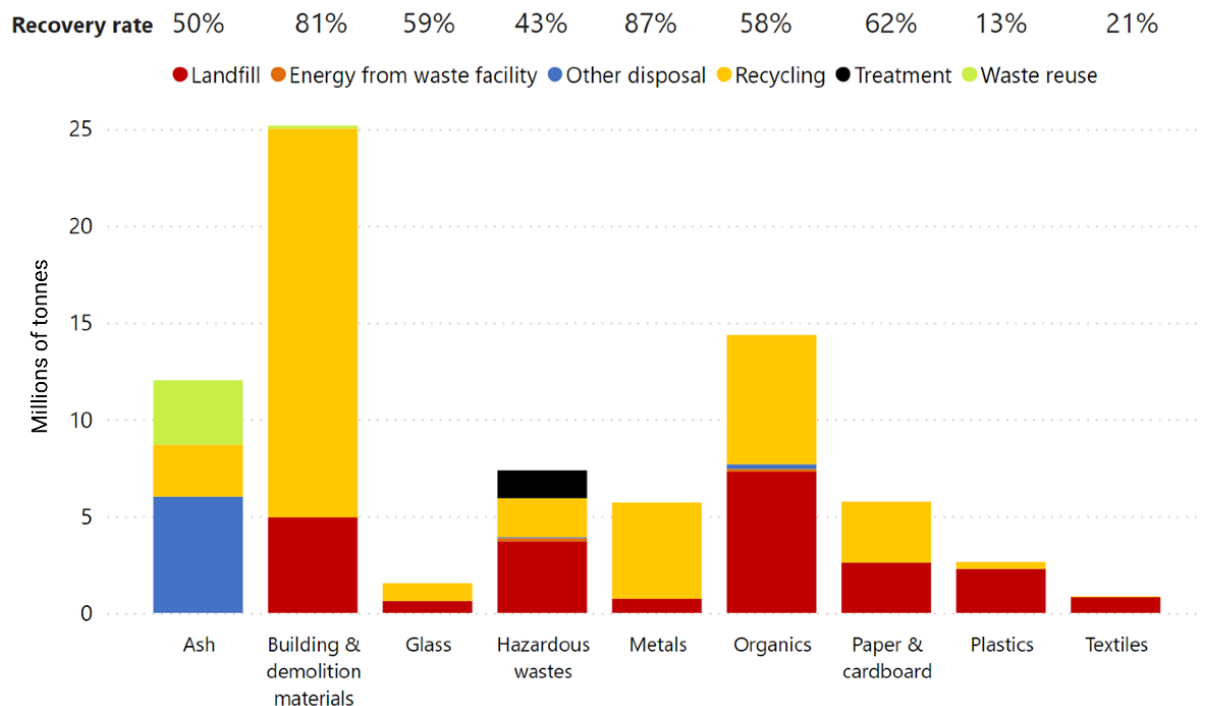


Figure 5 shows waste generation and management method by material category. The estimated resource recovery rates were highest for metals (87%) and building and demolition materials (81%). The recovery rate for plastics was the lowest at 13%.

Figure 5 Waste generation and management method by material category, Australia 2020–21



Australia has regulated its exports of glass, plastics and tyres, and will regulate paper and cardboard from July 2024. The rules generally aim to ensure that exports are ready for use as a product, and do not require further processing or cause harm to environmental or human health overseas. Combined with import controls imposed by key Asian trading partners, the rules have significantly affected the quantities of some waste-derived materials exported (see Figure 6), as well as the processing undertaken prior to export. Despite these changes, the total exports of waste and recovered materials have remained at around the 4.5 Mt/yr level since 2011–12.

Figure 6 Trend in Australian exports of waste-derived products by core material category, 2006–07 to 2021–22

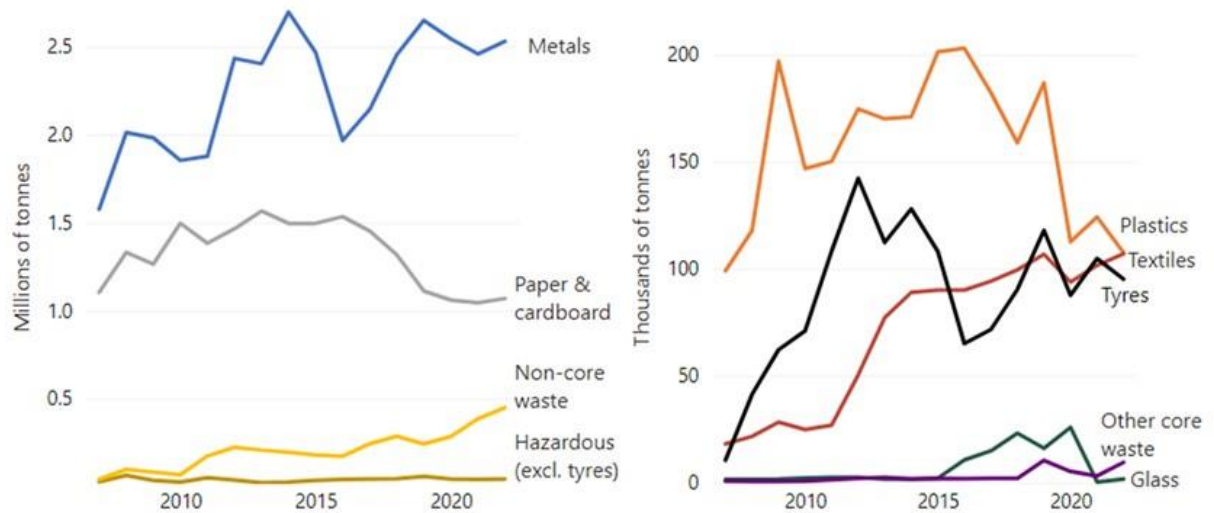
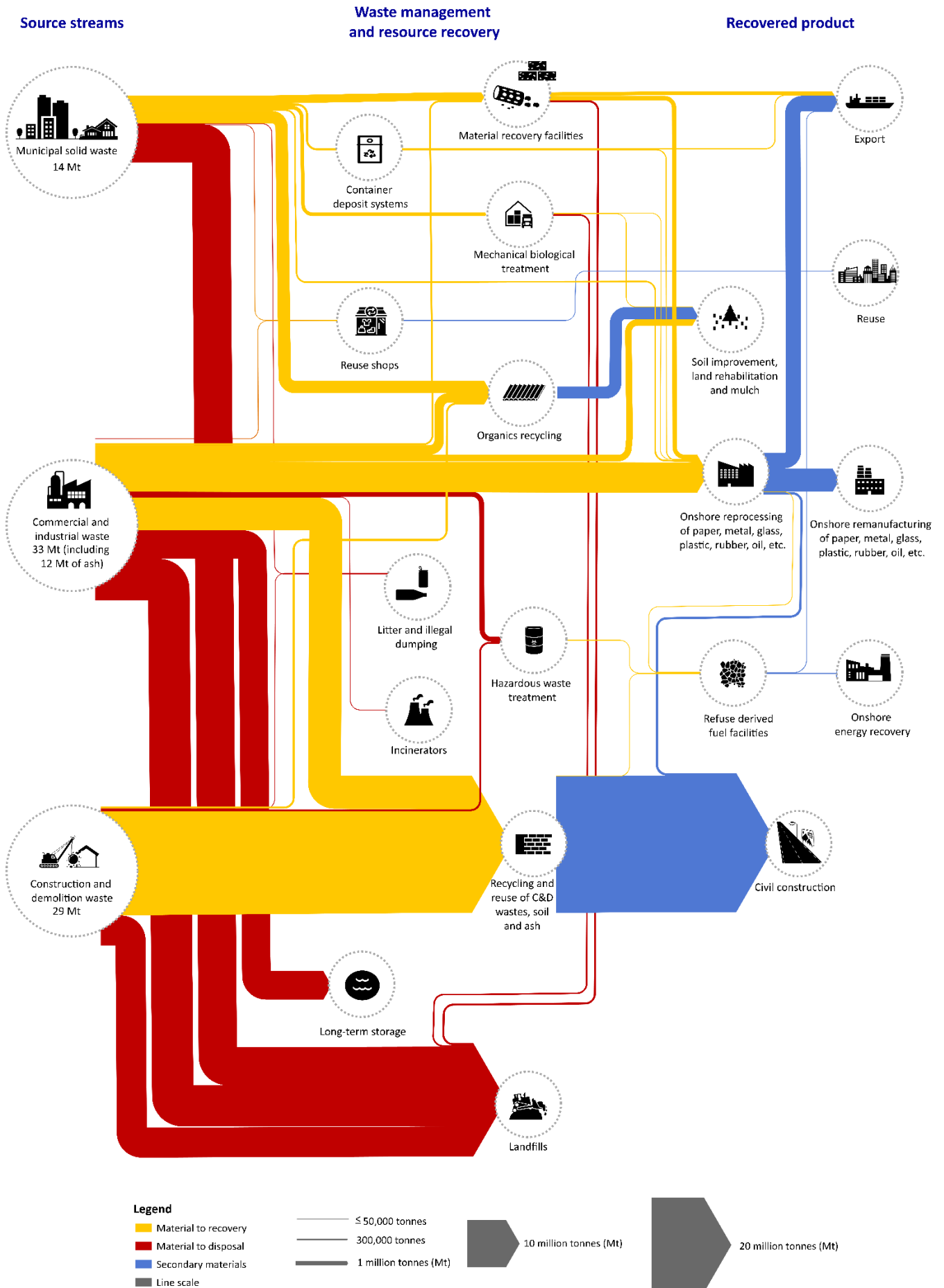


Figure 7 on page xvii is a diagram of flows of core waste plus ash in Australia in 2020–21. The arrows are proportional to the flow size measured in tonnes. The diagram provides an overview of the major material flows including source stream, waste management and destinations of recycled product.

Figure 7 Flows of core waste plus ash in Australia, 2020–21



1 Introduction

This report was prepared on commission to the Australian Government Department of Climate Change, Energy, the Environment and Water (the Department³). The Department has agreed to prepare a national waste report every two years, as recorded in the 2019 [National Waste Policy Action Plan](#). The report provides a point in time summary of waste in Australia for the financial year 2020–21 (1 July 2020 to 30 June 2021), including data on waste generation, source streams, materials and fates. Trend data is included back to 2006–07.⁴ The report is released together with:

- National Waste Reporting Tools for 2019–20 and 2020–21, containing most of the ‘raw’ data reported for those two years
- The National Waste Database 2022, containing collated data for all available years in a format that allows users to readily undertake their own data analysis. The Department has prepared a suite of visualisations so this dataset can be explored online.⁵

The management of waste is a collective responsibility for all Australians. Governments, industries, businesses, the community and individuals each need to play a part:

- The Australian Government provides national coordination and funding support. It regulates and manages exports and imports of certain waste types and engages on waste matters internationally.
- State and territory governments have primary responsibility for managing waste.
- Local governments work within their state or territory legislative framework. They interact directly with the community and have a significant role in organising waste collection and processing.
- Industry and businesses are at the front of innovation and invest in processing waste and options to reduce waste.
- The community and individuals undertake on-the-ground actions at the local level to reduce waste, find alternatives for re-use, and direct waste into the appropriate collection system.

1.1 Scope

Wastes included

The report covers waste generated in Australia. The data presented can be divided into three types:

1. The headline scope is used for reporting the headline values, trends, recovery rates and progress against national targets. The headline waste data set has two components:
 - ‘core waste’, comprising materials generally managed by the waste and resource recovery sector, including solid non-hazardous waste materials, hazardous waste⁶ including liquids, and biosolids from wastewater treatment (see the materials list in Table 1)
 - ‘ash’, comprising the residues of coal-fired power generation⁷.
2. ‘Non-core wastes’ other than ash are discussed in different parts of the report where data is available, generally for 2020–21 only. Non-core wastes include material from mining, minerals processing, agriculture and fishing.

³ This also covers predecessor organisations including the Department of Agriculture, Water and the Environment.

⁴ Refers to the financial year from 1 July 2006 to 30 June 2007. Financial years are represented similarly throughout the report.

⁵ See the waste data viewer hosted on the National waste and Resource Recovery Hub at <https://www.dcceew.gov.au/environment/protection/waste/how-we-manage-waste/data-hub/data-viewer>.

⁶ The biennial report series *Hazardous Waste in Australia* addresses hazardous waste in detail. The latest version was released in October 2021.

⁷ Included in the headline scope because it is produced in large quantities and there are opportunities for improved recovery.

3. Other waste data is presented at different parts of the report, including on local government services, product stewardship and international trade. The tonnages in these analyses are also in the headline waste data set – for example, exports of metals are also in the headline recycling data.

Table 1 Categories and types in the headline waste data set

Waste categories	Waste types included in this category
Ash	Residues of coal-fired power generation (bottom ash and fly ash).
Building and demolition materials ⁸	Asphalt; bricks, concrete and pavers; ceramics, tiles and pottery; plasterboard and cement sheeting; uncontaminated soil, sand and rock; rubble.
Glass	Glass from food and beverage containers; other glass.
Hazardous ⁹	Acids; alkalis; inorganic chemicals; reactive chemicals; paints, resins, inks and organic sludges; organic solvents; pesticides; oils; food-derived organic wastes (K100, K110 and K200); other putrescible or organic waste (K140 and K190); organic chemicals; contaminated soils; asbestos contaminated materials; other soil/sludges; clinical and pharmaceutical; tyres ⁹ ; other miscellaneous; unclassified hazardous wastes.
Metals	Iron and steel; aluminium; other non-ferrous metals.
Organics	Food, garden organics, timber, sawdust, biosolids and other organics. Excludes: <ul style="list-style-type: none"> • paper, cardboard, textiles, leather and rubber (included in separate categories) • except where specified, hazardous organic wastes (incl. as hazardous waste).
Paper and cardboard	Cardboard, polymer-coated paperboard, newsprint and magazines, office paper.
Plastics ¹⁰	PET (1), HDPE (2), PVC (3), LDPE (4), PP (5), PS (6), certified compostable plastics, other (7).
Textiles, leather and rubber (excl. tyres)	Textiles; leather and rubber (excluding tyres).
Unclassified materials	Materials that cannot be classified, usually because of uncertainty about composition

The period covered

The *National Waste Report 2022* focuses on waste generated and managed during the financial year (1 July to 30 June) 2020–21. Some more recent information is presented where available, particularly in relation to exports of waste-derived products. For the headline waste data set, trends are presented covering the period 2006–07 to 2020–21. The report includes two years of data not included in previous national waste reports – that is, for 2019–20 and 2020–21. National data covering 2007–08, 2011–12 and 2012–13 was not collected. Trends are interpolated across those years.

The geographic area covered

The report covers waste generated in Australia, including exports of waste and waste-derived products. Small amounts of imported waste are likely to be included. The report covers the Australian states and territories: Australian Capital Territory (ACT); New South Wales (NSW); Northern Territory (NT); Queensland (Qld); South Australia (SA); Tasmania (Tas); Victoria (Vic); and Western Australia (WA).¹¹

⁸ This category was previously referred to as ‘masonry materials’. During development of the *Australian Standard for Waste and Resource Recovery Data and Reporting* it was determined that this is inaccurate as some components are not masonry related. ‘Building and demolition materials’ do not include all materials that arise from the C&D stream.

⁹ Tyres are hazardous due to fire risks. In some parts of the report, tyres are addressed separately from hazardous wastes because they are a major waste material and are subject to specific export regulations.

¹⁰ The full chemical names of these types of plastic are provided in the glossary.

¹¹ May exclude data from some unincorporated areas such as aboriginal lands.

Waste sources

Waste sources are considered within three source streams: municipal solid waste (MSW) from households and council operations; commercial and industrial (C&I) waste; and construction and demolition (C&D) waste.

Waste management

Waste management processes are considered to be of two types:

1. pathways, which comprise interim steps on the way to the end destination of the material and include short-term storage¹², stockpiling¹², treatment, sorting, processing and export
2. waste fates or end destinations, which are categorised into waste reuse, recycling, energy recovery, long-term storage¹² and disposal.

The term ‘resource recovery’ is used to encompass waste reuse, recycling and energy recovery.

The term ‘management method’ is used to describe the infrastructure type used (landfill, materials recovery facility, etc.).

Most waste sent to a landfill is considered to have the fate ‘disposal’. However, many large landfills capture methane-rich landfill gas and extract its energy value, typically through combustion, to generate electricity that is sold to the grid. The tonnage of waste generating this energy is back-calculated and allocated to the fate ‘energy recovery’ (see Section 1.3).

Waste that is dissipated into the environment through litter and dumping is excluded due to lack of data.

What’s new?

This *National Waste Report 2022* includes a number of enhancements and changes from its 2020 predecessor:

- implementation of the new standard (see Feature 1) for the preparation of this report led to a number of changes, including
 - establishing ‘waste reuse’ as a fate for waste going to use without processing (see Section 5.4)
 - adopting the category name ‘building and demolition materials’ in place of ‘masonry materials’ (see Table 1)
 - inclusion of ‘soil, sand and rock not contaminated above any threshold requiring classification as contaminated soils’, where disposed of in landfill or output from a C&D recycling operation
 - clarification of which organic materials sent for composting are core waste

Feature 1 The Australian Standard for Waste and Resource Recovery Data and Reporting

The Australian Government is working with state and territory authorities to harmonise waste management data and reporting. Harmonisation of data and reporting is an important foundation for nationally consistent waste policy, a matter of great importance to the waste and resource recovery sector.

In August 2021 the Department released the [Australian Standard for Waste and Resource Recovery Data and Reporting](#) (BE 2021). Developed in consultation with the states and territories, the standard aims to establish common definitions, scope, categories and processes for use by governments and industry, with opportunistic and voluntary adoption when convenient such as when existing regulations expire. The standard also provides a common framework for describing recycling markets, categorising waste and resource recovery infrastructure, matching imports and exports to waste, estimating the material composition of mixed waste, converting volumetric data to tonnages, and other aspects of waste data and reporting.

The new standard twins with the [Australian Hazardous Waste Data and Reporting Standard](#), which was originally developed in 2015 and performs a similar function for hazardous wastes.

Revisions to the new standard are likely following this first trial of its use in preparing a national waste report.

¹² Reporting of short-term storage, stockpiling and long-term storage are limited due to data unavailability.

- specification of the fates of all known wastes, including hazardous waste sent for treatment
- a chapter on waste prevention (see Chapter 4), covering activities such as making do, borrowing, renting, sourcing second-hand, buying to last, reusing, sharing, repairing, upgrading or passing on
- detailed and comprehensive estimates on wastes from agriculture and forestry, based on data prepared for AgriFutures Australia (see Section 9.7)
- an enriched data set on textiles waste (see Section 9.10)
- exclusion of the 2020 report’s ‘Waste economics’ chapter due to lack of updated data
- enumeration of ACT biosolids, which were previously excluded as they are incinerated onsite.

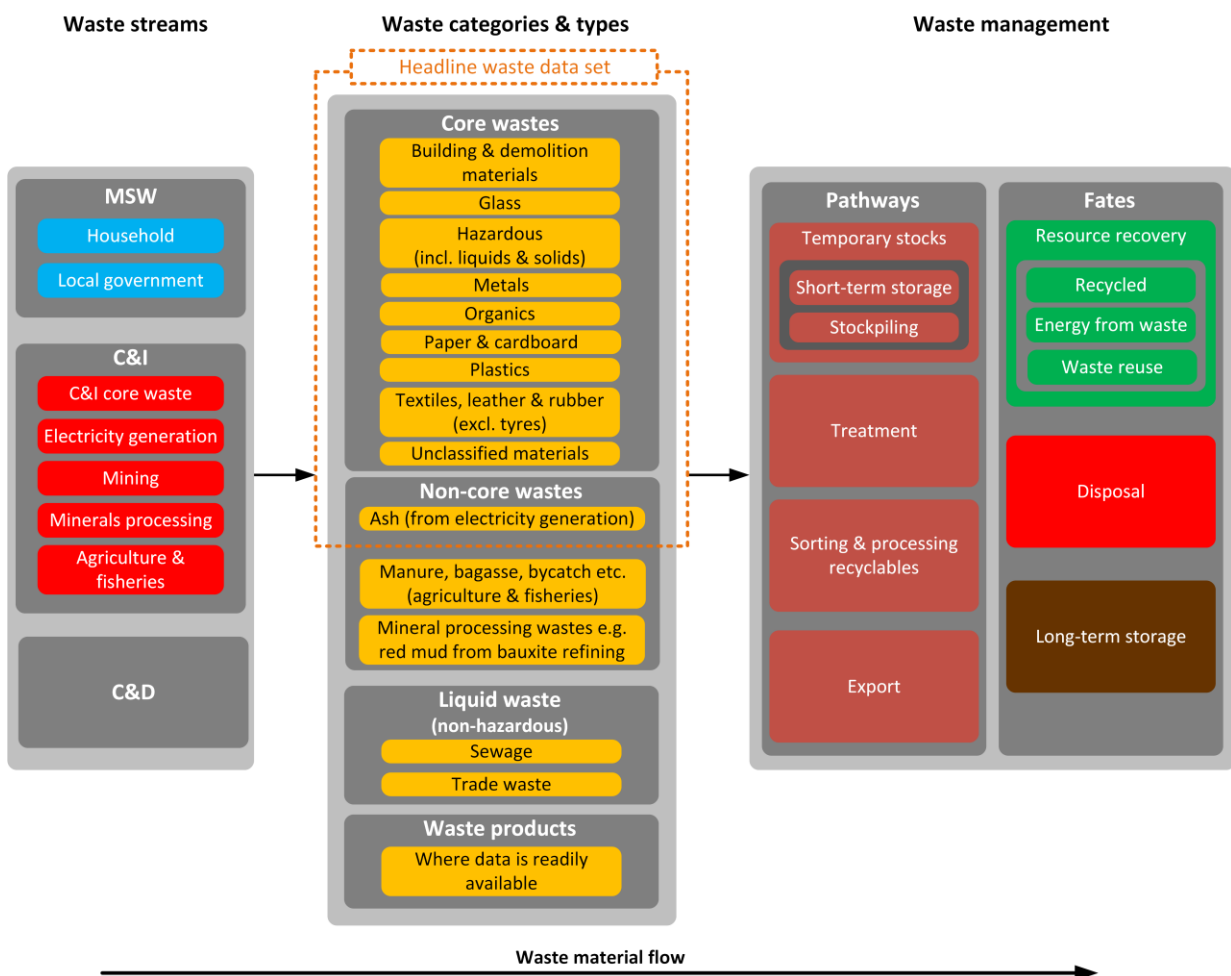
Scope difficulties

It is not straightforward to draw the boundary around the scope of wastes to be included. Sometimes it is not obvious if a material flow is actually a waste – for example, food processing residues sent for stockfeed. Some material flows are excluded for consistency despite having many characteristics of waste – for example, ‘clean fill’ used to rehabilitate quarries in Canberra. In some cases, the exclusion of agriculture, forestry and fisheries residues from the headline waste data set leads to anomalous results, such as the omission of fish processing residues applied to land in Tasmania and sawmill residues composted in Mount Gambier. The primary guide for the scope is the standard discussed in Feature 1.

Summary

Figure 8 provides a summary of the scope of reporting for this report.

Figure 8 Summary of the scope of the National Waste Report 2022



1.2 Data

Units

Quantitative data is presented by weight, in kilograms (kg), tonnes (t), thousands of tonnes (kilotonnes or kt) or millions of tonnes (megatonnes or Mt). Financial values are in Australian dollars.

Data sources

Much of the waste and resource recovery data included in this report was obtained from state and territory governments, which collect it from waste operators and local governments for their own monitoring and reporting. To provide that data to the Department, states and territories completed National Waste Reporting Tools for 2019–20 and 2020–21, which include, for each state and territory:

- tonnes of landfill waste, disaggregated by source stream where known
- the composition of waste to landfill in percentage terms, where local audits have been undertaken and are considered representative
- transfers of waste and recovered material across jurisdictional boundaries where known
- tonnes of recovered material, disaggregated by material type and source stream, sent for recycling, energy-from-waste or waste reuse
- additional data, to the extent available, on local government waste management, product waste, litter and dumping and other issues.

State and territory data is supplemented, and sometimes replaced, by national industry data or other national estimates. Significant sources are listed in Table 2. Data sources are listed in full in the bibliography and in the National Waste Reporting Tool 2020–21.

Table 2 Significant data sources additional to the states and territories

Data	Data sources
HEADLINE WASTE DATA	
Biosolids	Pollution Solutions and Designs surveys for the Australia and New Zealand Biosolids Partnership
Hazardous waste	State and territory data previously provided to the Australian Government for use in the annual report to the Basel Convention
Material flow data (glass, metals, paper and cardboard, plastics, tyres)	APCO (2019b) – data on packaging material flows IndustryEdge – data on paper and cardboard material flows TSA (2019) – data on tyre material flows
Methane recovered from landfills for energy generation by state and territory	The Department
Organic waste to landfill composition (some states and territories)	National Greenhouse and Energy (Measurement) Determination 2008 as amended
Plastics recycling	Blue Environment plastics recycling surveys
OTHER DATA	
Agricultural waste	RMCG surveys for AgriFutures Australia (unpublished)
Ash from coal-fired power	ADAA (2022)
Liquid waste	BoM (2021b)
Local government waste data	Various local government surveys and reports
Mining waste	National Pollutant Inventory; resources and energy quarterly reports from the Office of the Chief Economist; audit compliance reports developed by WA licensees in 2020, various others
Population data	ABS (2021, 2022)
Product and packaging waste	Various annual reports and personal communications from product stewardship organisations and other industry groups

Historical updates

This report supersedes previously reported data. Some of the data presented in the *National Waste Report 2020* has been revised for this report. The major changes and the reasons for them are listed in Table 3 in approximate order of significance from the perspective of total tonnes. These amendments resulted in the following changes to the headline 2018–19 data reported in the *National Waste Report 2020*, rounded to three significant figures:

- waste generation changed slightly from 74.1 Mt to 74.2 Mt
- waste recycled increased from 43.5 Mt to 44.3 Mt
- waste disposal reduced from 28.5 Mt to 27.5 Mt
- the recorded resource recovery rate is unchanged at 63%.

Table 3 Revisions to historical waste and resource recovery data for this report

Data revision	Years	Rationale and impact (where significant and readily quantifiable)
Hazardous waste	All years	Attribution of average fate proportions to hazardous waste sent for treatment, by waste type. For the 2018–19 data reported in the <i>National Waste Report 2020</i> , this adds fate data for 1.2 Mt of previously excluded from recovery rate calculations, comprising 966 kt of recycling, 70 kt of energy recovery and 412 kt of disposal.
Energy recovery from landfills (and as a corollary, disposal in landfills)	2010–11 to 2018–19	Revised data provided by the Department and the ACT Government. For the 2018–19 data reported in the <i>National Waste Report 2020</i> , this shifts 202 kt recorded as ‘disposal’ to ‘energy recovery’, mostly in Vic and WA. There were smaller changes to data for other jurisdictions and in other years.
Energy from waste tyres	All years	Inclusion of tyres to energy recovery, which were previously omitted in error. For the 2018–19 data reported in the <i>National Waste Report 2020</i> , this adds 160 kt of ‘energy recovery’.
Biosolids	All years	Addition of ACT data previously excluded as it is incinerated on-site. For the 2018–19 data reported in the <i>National Waste Report 2020</i> , this adds 23 kt of disposal. For other years, it adds an average of 32 kt of disposal.

Data quality

Significant effort has been made to ensure that the data presented in this report is reliable. In general, the quality and quantity of Australian data on waste tonnages, source streams and materials are improving. Historical data has been adjusted where possible to maintain methodological consistency over time but some discrepancies remain.¹³ Margins of error cannot be calculated because data arises from multiple sources and is aggregated in different ways by different organisations. Overall, the authors believe the data reliably supports the key messages presented here.

Data quality problems can arise due to difficulties and costs in collecting the data and the fact that state and territory data systems have evolved largely independently. Issues include the following:

¹³ For example, the WA Department of Water and Environmental Regulation advises that mandatory reporting under the Waste Avoidance and Resource Recovery Regulations 2008 commenced in 2019–20, and previously data was collected through voluntary surveys. The introduction of mandatory reporting has provided for a more complete dataset, with a significant increase in reported waste generation compared to reporting under voluntary surveys.

- Data is not always available to encompass the full scope of geography, waste categories, source streams and management methods needed. In these cases, a best estimate is made, sometimes using data from other states and territories.
- States and territories may be legally constrained from providing data about a market in which two or fewer facilities operate because commercially confidential data could be derived.
- State and territory data systems focus on material managed in their jurisdiction and are often weak in identifying material imported from or exported to other jurisdictions. This creates risks of double-counting and incorrect estimates of recovery rates.
- Waste streams are not fully separate. Municipal collections often include business waste, and commercial collections often include some high-rise residential buildings. Recycling operators cannot always report the sources of all their materials. Consequently, source stream data is not perfectly accurate.
- Data is sometimes categorised in different ways by states and territories, requiring assumptions for conversion to a common measure. Calculations performed to establish a common dataset are included in the National Waste Reporting Tool 2020–21.
- The composition of waste to landfill is estimated from periodic audits at a few landfills. These snapshots will not be perfectly representative, and may miss waste types that are deposited infrequently or seasonally.
- In some jurisdictions, data on recovered wastes is based on voluntary surveys. Some facilities may be overlooked, may decline to respond or may submit incomplete responses.
- A small proportion of the tonnage data is derived from volumetric measures or truck counts combined with density factors that may not always be reliable.
- Administrative restructuring can interfere with a data collection program.
- Reporting or calculation errors can occur.

Table 4 describes the main weaknesses in the headline waste data set of core waste plus ash, and how they were dealt with for this report. Gaps are filled with best estimates as described so the national data set is comprehensive.

The standards discussed in Feature 1 should reduce data quality problems over time.

Table 4 Main data problems and how they were dealt with

Issue	Known cases in the raw data provided	Adjustments and rationale
Data unavailable	Vic recovery data unavailable for 2020–21 due to inability to run annual survey during restructure. ¹⁴	Estimated from 2019–20 data assuming: <ul style="list-style-type: none"> MSW recycling increased at the same rate as organics and recycling aggregated from the annual local government survey C&I recycling increased at the same rate as C&I to landfill C&D recycling increased at the same rate as C&D to landfill.
Data unavailable	Data on Qld hazardous waste data incomplete for 2016–17 to 2020–21 due to a large backlog of paper waste transport certificates not yet transcribed into a digital database.	Where the reported data is <60% of the 2015–16 value, replace with the 2015–16 value multiplied by proportional increase in population.
Data unavailable	No waste data for 2007–08, 2011–12, 2012–13.	Data interpolated in trend displays.
Commercial confidentiality	The market for manufacturing fuels from waste in NSW comprises a single operator. NSW EPA has the data but was unable to provide it.	Excluded.
Misallocated jurisdiction	Interstate transfers are at risk of being included in the data from the receiving, but not the generating, jurisdiction. For example: <ul style="list-style-type: none"> NSW landfill waste sent to cheaper Qld landfills ACT, Qld and Vic landfill waste sent to levy-free landfills in rural NSW recyclables sent interstate but not identified as such. 	Corrected when identified. Qld has data on interstate imports and exports. ACT has data on exports to NSW from waste facilities (but not direct transfers). Vic landfill estimates obtained from regional waste groups. Flows of recyclate into and out of Qld were assumed to be from and to NSW. Interstate flows of hazardous waste mostly recorded and accounted for but some errors may remain. Vic recycling may include material from SA and NSW but data were not available to estimate these.
Misallocated stream	Some MSW may be included in C&I or vice-versa, e.g. transfer station waste all counted as MSW.	None.
Historical errors and method changes	Methodological changes relating to hazardous waste to treatment and ACT biosolids; data corrections regarding landfill gas to energy; error correction in relation to tyres to energy recovery.	Historical data was reviewed and updated based on new information as described in Table 3 on page 6.
Historical errors and method changes	NSW recovery data underwent a method change from 2016–17, revealing a likely over-estimate of organics recovery before that year.	No change. No data to provide a basis for this change.
Historical errors and method changes	SA ‘other organics’ prior to 2020–21 likely to include out-of-scope agricultural and forestry residues.	No change due to lack of time.

¹⁴ Final Vic recovery data will be made available in early 2023 through the Department’s [Waste and Resource Recovery Data Hub](#) to supplement the NWR 2022 data.

Issue	Known cases in the raw data provided	Adjustments and rationale
Double-counting	<p>Interstate transfers are at risk of being included in data from both generating and receiving jurisdiction, for example:</p> <ul style="list-style-type: none"> • ACT, SA and WA non-organic recyclables sent interstate • NSW recyclables sent to Qld and vice-versa. 	<ul style="list-style-type: none"> • ACT recycling quantities were deducted from NSW recycling data and estimates (all years). • Qld data on interstate flows were used to adjust NSW data. • WA data on interstate flows were used to adjust NSW, SA and Vic data. • For others, data was not identifiable and quantifiable. No adjustment made.
Double-counting	Organic hazardous waste may be included in both hazardous waste data from tracking systems and non-hazardous organics recycling data from the compost industry data.	Data checked and confirmed for all states except NSW (data not available).
Double-counting	Material delivered to a reprocessing facility is generally counted as recycled, but a portion may be subsequently sent to landfill and counted again.	None. Likely to be small, and restricted to a few waste streams in a few jurisdictions.
Double-counting	Organics recycling data – NSW experience suggests there may be significant movement of material between facilities, with risk of double-counts.	None.
Double-counting	WA and SA asbestos and contaminated soil data is likely to be included in both hazardous waste and landfill data.	Totals in hazardous waste data were deducted from SA and WA landfill data (all years).
Misallocated fate	Some tonnes allocated to recycling may in fact have gone to energy recovery, as not all states and territories distinguish well between these fates.	Careful checking undertaken and corrections made. Cannot provide NSW data due to confidentiality.
Over-reporting of recycling	Material is counted as recycled if recorded in state and territory data. However, some of this material may have been delivered but not processed, or processed but then stockpiled on- or off-site.	None. Data on these quantities is not available. NSW regulates and restricts stockpile sizes.
Over-reporting of recycling	Material is counted as recovered if it was exported for recovery. However, some of this material may have contaminants that required disposal overseas. Recent regulation on exports of glass, tyres and plastics (and paper from mid-2024) has reduced this issue.	None. Data on these quantities was unavailable.
Stockpiles inadequately reported	The reporting approach sums waste generation by year based on materials counted at waste facilities. However, some waste is produced in one year but processed in another, e.g. unprocessed materials at recycling facilities or bankrupt operators, or SA contaminated soils stored for use on subsequent major projects.	Piecemeal response. SA stored soils counted as recycled. The <i>Australian Standard for Waste and Resource Recovery Data and Reporting</i> proposes an accounting method for stockpiles but it is not yet implemented.

Data in this report may differ from state and territory data

The methods used by the Australian Government for categorising and analysing waste data are not always the same as those used by individual states and territories. Consequently, data presented here may differ from corresponding data presented in state and territory reports. Methodological approaches likely to cause differences include that:

- Some waste is generated in one state but transferred to another. States and territories typically report waste recovery and disposed within their boundaries but in this report, where data is available, transfers are reassigned to the jurisdiction where the waste was generated.
- This report covers waste that is sometimes excluded from state and territory reports, such as biosolids from sewage treatment plants, ash from power stations and hazardous waste.
- This report uses national instead of state and territory data for some waste and some jurisdictions, including for plastics recycling, ash and biosolids.
- The states and territories do not distinguish between ‘management method’ and ‘fate’ of waste, and do not count any waste to landfill as being used for energy recovery.

Data quality indicators

Indicators of higher underlying quality in the reported data include:

- reporting via compulsory, rather than voluntary, programs
- measurement via a weighbridge, rather than via volumetric measures or truck counts
- recycling collected via a comprehensive industry survey rather than partial or ad-hoc surveys
- for hazardous waste, tracking systems that require reporting of waste movements.

Table 5 shows the characteristics of the data from each state and territory against these indicators.

Table 5 Indicators of data quality in the headline 2020–21 state and territory data in this report

	RECYCLING DATA			LANDFILL DATA		HAZARDOUS WASTE DATA
	Compulsory facility reporting?	% tonnes measured via weighbridge	Comprehensive recycling survey?	Compulsory facility reporting?	% tonnes measured via weighbridge	Tracking system?
ACT	Yes	Unknown	Yes	Yes	100%	No
NSW (regulated area) ¹	Yes	Unknown	Yes	Yes	80%	Yes
NSW (other)	No	Unknown	No	Yes	80%	Yes
NT	No	Most	No	Most	80%	No
Qld	Yes	Unknown	Yes	Yes	95%	Yes ²
SA	Yes ³	77%	Yes	Yes	99%	Yes
Tas	No ⁴	80%	No	No ⁴	83%	No
Vic	No	Unknown	Yes	Yes	97%	Yes
WA (metro Perth) ⁵	Yes	34%	Yes	Yes	98%	Yes
WA (regional)	Yes	34%	Yes	Larger sites ⁶	55%	Yes

- Notes*
- 1 The regulated area covers about 86% of the NSW population comprising Sydney, Illawarra and Hunter regions, central and north coast local government areas and three other local government areas.*
 - 2 Qld has a multi-year backlog of non-transcribed paper-based hazardous waste transport records.*
 - 3 SA compulsory reporting complements a voluntary annual survey of the recovery survey.*
 - 4 Tas compulsory reporting commenced in July 2022.*
 - 5 The Perth metropolitan region represents about three quarters of the WA population.*
 - 6 Landfills accepting more than 20 kt in the reporting year.*

1.3 Method

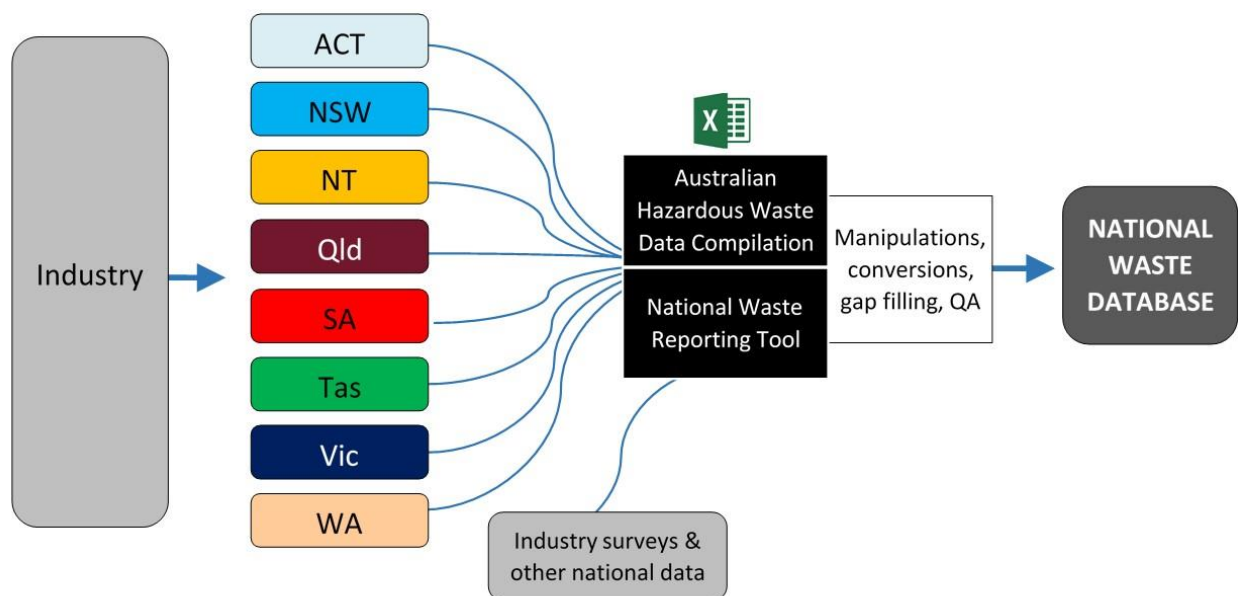
Data collation methods

To derive a national picture on waste, a common set of assumptions and categories must be applied to the collected data, based on the *Australian Standard for Waste and Resource Recovery Data and Reporting*. Some manipulation of state and territory data is required, including re-categorisation, applying assumed compositional splits and adjusting for cross-border transport.

To facilitate these manipulations, two Microsoft Excel workbooks were established that transform state and territory data into a coherent national database using a set of manipulation steps endorsed by the states and territories. These are the National Waste Reporting Tool and the Australian Hazardous Waste Data Compilation. The National Waste Reporting Tools for 2019–20 and 2020–21 are published online together with this report, and contain most of the raw data for those years.

The outputs of these tools and previous versions of them are combined into a National Waste Database 2022, which contains core and ash data back to 2006–07¹⁵ and limited non-core data for 2018–19 and 2020–21. The database is presented in ‘flat’ format so that users can easily do their own analysis. Waste data flows for the preparation of this report are illustrated in Figure 9.

Figure 9 Waste data flows and the National Waste Database



Assumptions

To present a comprehensive headline waste data set, various assumptions were needed to fill data gaps. These are described at relevant calculation or data entry points in the National Waste Reporting Tools released with this report. The methods for gap-filling often include assuming that proportions or rates in a jurisdiction, time period, area or waste stream were similar to those in another, or had particular values.

¹⁵ Except for 2007–08, 2011–12 and 2012–13, in which years national data was not collected.

A key area of uncertainty is the composition of waste to landfill. Assumptions in this area included that the composition of each non-hazardous waste stream (MSW, C&I and C&D) to landfill:

- in the ACT, SA and Vic is as determined through their own landfill and bin audits
- in NSW is as worked out in a separate workbook drawing on audits and historical breakdowns
- in NT, Qld, Tas and WA is based on national average figures calculated by assuming
 - the organic proportions are equal to those set out in the National Greenhouse and Energy (Measurement) Determination 5.11
 - the inert proportions are equal to the population-weighted average calculated from ACT, NSW, SA and Vic using 2018–19 data.

NSW reports some of its material to recycling in broad categories that required conversion to material types. Assumptions included that the compositions of recycled ‘residues and rejects’ and ‘mixed waste’ were: for MSW, as per an audit of MRF residuals to landfill (APC 2009); for C&I, as per an audit of residuals to landfill (NSW EPA 2015); for C&D, as per building and demolition waste sent for recycling.

All material exported for recovery – including contaminants within these materials – is counted as being recovered in the headline waste data set. This is due to insufficient data to characterise contaminants. Contamination levels will be much reduced due to the export regulations (see Section 10.3).

Material flow analyses

The previous *National Waste Report 2020* included materials flow analyses for five materials: glass, metals, paper and cardboard, plastics and tyres. Similar but updated analyses will be issued in a separate materials flow analysis report to be released early in 2023 and covering the same materials plus organics and textiles.

Calculating energy recovery from landfills

When organic waste decays in the anaerobic environment of a landfill, the greenhouse gas methane is formed. Many large landfills capture methane-rich landfill gas and extract or sell its energy value, commonly through combustion to generate electricity that is sold to the grid. In this report, this process is classified as a form of energy recovery. The National Waste Reporting Tool applies formulas from the National Greenhouse and Energy Reporting (NGER) system to back-calculate the quantity of waste associated with captured landfill gas and includes these under the fate ‘energy recovery’. For convenience, the method assumes instantaneous decay of waste in the landfill. The methodological steps are set out below:

1. obtain data on methane collected from landfills and used for its energy value (mostly aggregated data from the NGER system, plus data from smaller jurisdictions where the Government is constrained by commercial confidentiality)
2. convert to tonnes of recovered carbon
3. calculate the amount of carbon that actually degrades in landfill per tonne of material drawing on NGER default values
4. calculate carbon that actually degrades per tonne of waste for each jurisdiction
5. calculate the tonnes of recovered carbon attributable to each waste type by jurisdiction
6. calculate the tonnes of recovered waste types by jurisdiction, drawing on NGER default values
7. allocate the recovered waste by source stream.

1.4 Layout of the data and report

The headline waste data presentations are in Chapters 3 to 9. The primary focus is financial year 2020–21 but more recent data is included where known and relevant. Data for 2020–21 is shown mainly in static bar charts with absolute tonnages split in several ways. Trend data back to 2006–07 is presented mainly in area charts, showing absolute tonnages and, where applicable, tonnes per capita.

Most presentations in Chapters 3 to 9 are of ‘core waste plus ash’. However, data on core waste alone is also presented where applicable as this covers the materials of primary interest to the waste and resource recovery industry and the states and territories.

National targets for waste reduction and management have been established under the *National Waste Policy Action Plan* with 2016–17 as the baseline year (see Chapter 2). Accordingly, 2016–17 data values are emphasised in many parts of the report.

Technical terms and abbreviations are explained in the glossary below the tables of contents.

Three data appendices are presented:

- Appendix B contains data corresponding to the charts
- Appendix C compares data for 2016–17 (the baseline year for the *National Waste Policy Action Plan*) and 2020–21
- Appendix D presents data on waste deposited in landfill.

Data is rounded to different levels of significance for the benefit of different users, as shown in Table 6. Blue Environment recommends that users of the data reported in this document:

- express data to two significant figures only to appropriately reflect the uncertainty in the values
- undertake calculations using data in the National Waste Database 2022 (which expresses the data to the nearest tonne) or, alternatively, use the data in the appendices.

The data presentations are generated using Microsoft Power BI and are subject to that program’s limitations. Chart labels refer to financial year, so ‘2020’ means ‘financial year 2019–20’ and so on. The National Waste Database on the Department’s website enables users to do their own analyses.

Due to rounding, some data may not appear to add up perfectly and percentages may sum to more or less than 100%.

Table 6 Levels of significance of data presentations

Report elements	Level of significance
<ul style="list-style-type: none"> • Headline numbers box on first page of ‘At a glance’ • Charts • Percentage values • Values in ‘At a glance’ and Chapters 3 to 9, 14 and 15 that are <10 and part of a group in which most values are >10 	Two significant figures
<ul style="list-style-type: none"> • Most other text in ‘At a glance’ and Chapters 3 to 9, 14 and 15 	Three significant figures
<ul style="list-style-type: none"> • Appendices B, C and D 	Largest value in any table given to four significant figures. Other data rounded to same number of decimal places as that figure.
<ul style="list-style-type: none"> • Other Chapters 	Ad hoc, based on source data

2 Progress against the national waste targets

The 2018 *National Waste Policy: Less Waste, More Resources* was agreed by all Australian governments and sets a path for Australia’s waste and resource recovery to 2030 and beyond. The policy is implemented through the 2019 [National Waste Policy Action Plan](#), which guides investment and supports policy reform to better manage Australia’s waste and resource recovery. The Action Plan identifies seven targets underpinned by 80 actions, to be delivered collaboratively between governments, industry and the community. A Resource Recovery Reference Group oversees delivery of the Action Plan and advises environment ministers on progress and amendments needed to ensure the Action Plan remains ambitious and relevant. Targets in the Action Plan are measured against baselines for the 2016–17 financial year reported in National Waste Reports. Table 7 reports on progress.

Table 7 Progress against the targets in the National Waste Policy Action Plan

Target	Progress report						
1 Ban the export of waste plastic, paper, glass and tyres, commencing in the second half of 2020	Exports of these materials are regulated by the Recycling and Waste Reduction Act 2020 and subordinate rules.						
		From	Material		What waste-derived materials can be exported?		
	1 Jan 2021	Glass	Implemented	Glass processed into, for example, furnace-ready or non-furnace-ready glass cullet or fines.			
	1 July 2021	Plastics	Implemented	Plastics sorted into single resin or polymer type or processed with other materials into processed engineered fuel. ¹⁶			
	1 July 2022	Plastics	Implemented	Plastics sorted into single resin or polymer type and further processed, for example flaked or pelletised, or processed with other materials into processed engineered fuel.			
	1 Dec 2021	Tyres	Implemented	Tyres processed into shreds or crumb of not more than 150 mm for use as tyre-derived fuel; tyres for retread by an appropriate retreading facility; tyres to an appropriate importer for re-use as a second-hand tyre on a vehicle; tyres processed into shreds, crumbs (not for use as tyre-derived fuel), buffings or granules.			
	1 July 2024	Paper & cardboard		Rules under development.			
2 Reduce total waste generated in Australia by 10% per person by 2030	Estimated core waste plus ash per capita, Australia	2016–17	2017–18	2018–19	2019–20	2020–21	Estimated increase of 3% since 2016–17
		2.86 t	2.95 t	2.95 t	2.94 t	2.95 t	
3 80% average resource recovery rate from all waste streams following the waste hierarchy by 2030	Estimated resource recovery rate, Australia	2016–17	2017–18	2018–19	2019–20	2020–21	Estimated increase of 2.2 percentage points since 2016–17
		60.8%	62.4%	63.0%	62.7%	63.1%	

¹⁶ Also known as a solid recovered fuel.

Target	Progress report						
4 Significantly increase the use of recycled content by governments and industry	Material to recycling and waste reuse not exported	2016–17	2017–18	2018–19	2019–20	2020–21	Estimated increase of 15% since 2016–17
		36.1 Mt	39.0 Mt	40.1 Mt	39.9 Mt	41.6 Mt	
5 Phase out problematic and unnecessary plastics by 2025	<p>Since this commitment was made:</p> <ul style="list-style-type: none"> The National Plastics Plan was released in March 2021 Environment ministers have agreed to ban 8 problematic and unnecessary single-use plastic products (see Table 21 on page 61) The Australian Packaging Covenant Organisation (APCO) has released an Action Plan for Problematic and Unnecessary Single-Use Plastic Packaging and established the ANZPAC Plastic Pact – a collaborative approach to work towards a circular economy for plastics, operating within the Pacific Oceania region. <p>Single-use plastic bags are now banned in all states and territories. Specified additional single-use plastics are banned in ACT, NSW, Qld, SA, WA and Hobart (Tas), and will be banned in Vic in 2023 and NT by 2025.</p>						
6 Halve the amount of organic waste sent to landfill by 2030	Estimated organic waste disposed of in landfill ¹⁷	2016–17	2017–18	2018–19	2019–20	2020–21	Estimated 3% increase since 2016–17 ¹⁸
		5.73 Mt	5.59 Mt	5.60 Mt	5.51 Mt	5.89 Mt	
7 Make comprehensive, economy-wide and timely data publicly available to support better consumer, investment and policy decisions	<p>Since this commitment was made, the Department has released or developed:</p> <ul style="list-style-type: none"> National Waste Reports for 2020 and 2022 leading to an updated National Waste Database Hazardous Waste in Australia 2021; an assessment of the adequacy of hazardous waste infrastructure; and an update to the Australian Hazardous Waste Data and Reporting Standard Australian Standard for Waste and Resource Recovery Data and Reporting, providing nationally consistent definitions, concepts and classifications the new Waste and Resource Recovery Data Hub that will make comprehensive, economy-wide, and timely data publicly available to support better consumer, investment and policy decisions, which included the following interactive visualisations in its first release: <ul style="list-style-type: none"> the new National Waste Data Viewer which provides interactive visualisations of the National Waste Database the Australian (non-hazardous) waste and resource recovery infrastructure database that maps over 7,200 existing waste and resource recovery facilities The Recycling Modernisation Fund viewer, which allows users to search projects funded under the program by jurisdiction and location, filter projects by material type and facility type, and provides detailed information on investment The Waste Export data viewer that presents data on waste and recycled material exports which is collected as part of a series of Australia’s trade with other countries. 						

¹⁷ Data excludes: paper and cardboard; textiles, rubber and leather; and waste that generates methane captured at the landfill and used for energy recovery (see Section 1.3).

¹⁸ Data on the composition of waste to landfill, including the organics proportion, is poor. It is constructed from audits of bins (MSW) and landfill receipts (C&I and C&D waste). Bin audits use varying categories and are not consistently collected and collated. Landfill audits are infrequent and not well standardised.

3 Waste generation

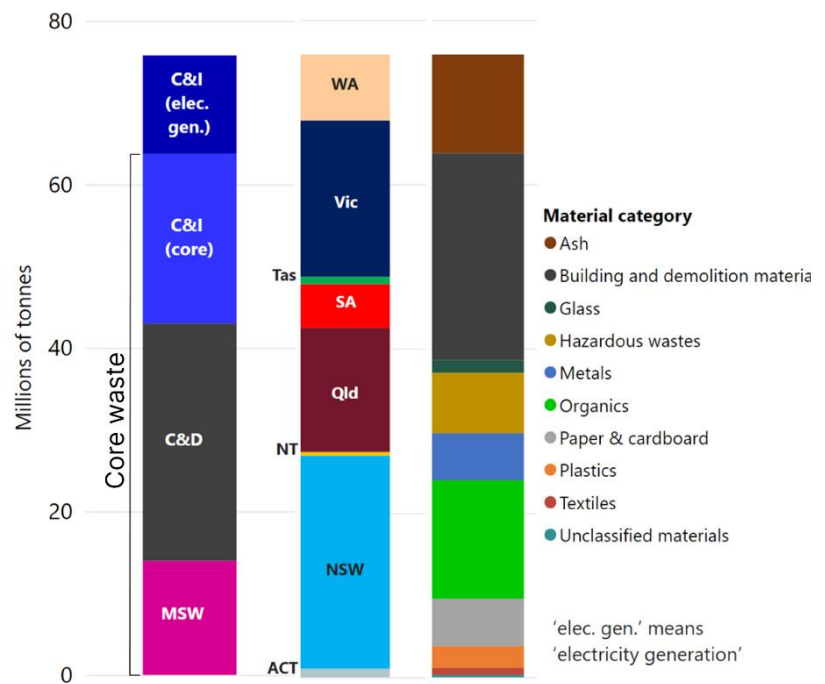
This chapter reports on waste generated in Australia in 2020–21 and the trends since 2006–07.

3.1 Waste generation in 2020–21

Waste generation in 2020–21 is illustrated in Figure 10.¹⁹ The right-hand column of the figure shows the waste by material category, encompassing core waste plus ash. In total, an estimated 75.8 Mt of waste was generated, including 25.2 Mt of building and demolition materials, 14.4 Mt of organics, 12.0 Mt of ash, 7.4 Mt of hazardous waste (mainly contaminated soil), 5.8 Mt of paper and cardboard, 5.7 Mt of metals and 2.6 Mt of plastics. This is equivalent to 2.95 t per capita. Of the 75.8 Mt generated, 10% is classified as hazardous.

There were about 63.8 Mt of core waste (2.48 t per capita). This is up from 57.5 Mt in 2016–17.

Figure 10 Waste generation by material category and stream, Australia 2020–21 (core waste plus ash)



By waste stream, in 2020–21 there was 14.0 Mt of MSW (545 kg per capita and 18% of the total), 32.8 Mt of C&I waste including ash (43% of the total) and 29.0 Mt of C&D waste (38% of the total).

In 2016–17 there were 12.6 Mt of MSW, 33.7 Mt of C&I waste including ash and 23.4 Mt of C&D waste, summing to overall waste generation of 69.7 Mt.

3.2 Primary and secondary production waste

The headline waste data set excludes many industry wastes that are managed on-site or are generated upstream in the production system. The main sources are primary production activities such as mining, agriculture and forestry, and secondary production such as mineral and agricultural processing. Data on these waste materials is less well developed than the headline waste data set.

Figure 11 presents waste generation estimates including most ‘non-core’ industry wastes generated in 2020–21 – that is, wastes from mining, some mineral processing, and agricultural, fisheries and forestry organic residues. The total quantity is 758 Mt. Mining and mineral processing wastes are discussed below. Organic primary production and processing wastes are addressed in Section 9.8.

¹⁹ Full data for all charts is given in Appendix B.

Mining wastes

The main method used for estimating quantities of mining wastes was by combining data reported via the National Pollutant Inventory (NPI) with public annual audit compliance reports from mine sites in WA. The NPI is a database of emissions and transfers of 93 toxic substances, including 38 found in mine tailings and residues. These were matched by mining sector against the waste quantities stated in the audit compliance reports to derive an average 'factor' that could be applied to national NPI data to scale up the NPI substance transfers to total waste.²⁰

Total mining waste in 2020–21 is estimated at 620 Mt excluding moisture, more than eight times the quantity of core waste plus ash, and 44 times the quantity of MSW. Typically, mining waste is a slurry of pulverised rock and water. An estimated 96% of mining waste was deposited in tailings dams, which are generally intended to facilitate separation of the solid and water fractions.²¹ Most of the remainder was used to fill mining voids. Mines are increasingly recycling more valuable materials including truck tyres but often run an on-site landfill for general site waste.

Figure 12 presents estimated waste quantities by the mining sector. Gold mining produced the most waste; iron ore mining was second.

Mineral processing wastes

The two main mineral processing wastes identified and quantified are:

- an estimated 27 Mt of red mud, an alkaline by-product of bauxite refining that was deposited at sites in WA and Qld (about 900 Mt of red mud has been deposited in Australia over the last 50 years)
- an estimated 2.4 Mt of coal-seam gas brine, a residue of the desalination of extraction waters that were deposited in much higher volumes in ponds mainly in south-east Qld.

Figure 11 Waste generation (all measured materials) by stream, Australia 2020–21

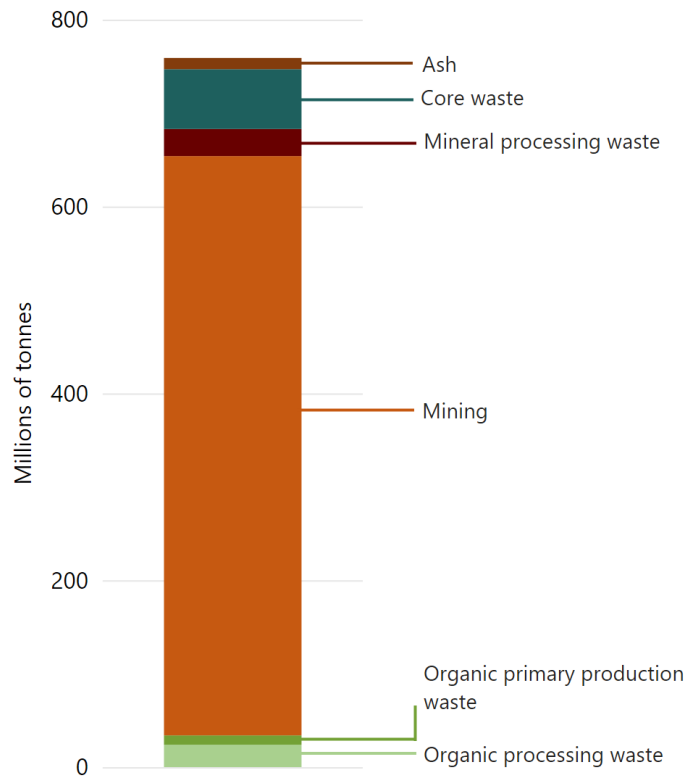
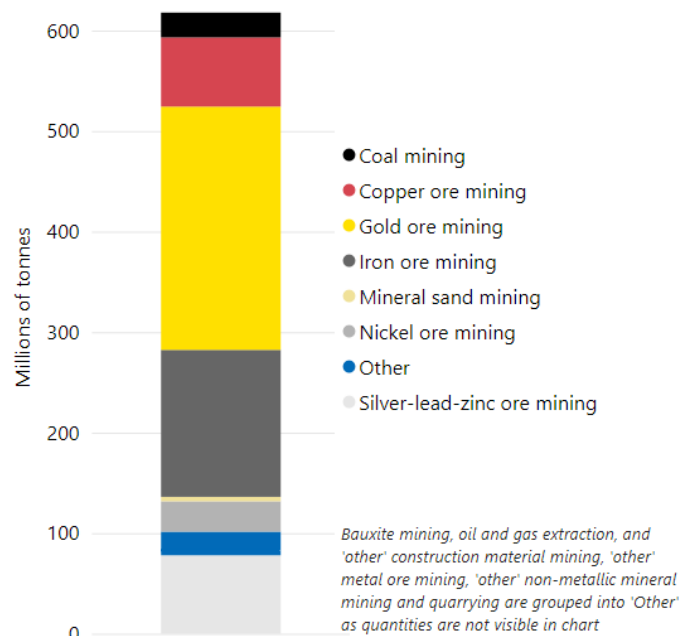


Figure 12 Estimated mining waste by commodity, Australia 2020–21



²⁰ The authors thank Cara Francis and the WA Department of Water and Environmental Regulation for help with this process.

²¹ Tailings estimates exclude water. The *National Waste Report 2020* inadvertently included water in the data on oil and gas extraction waste injected underground. This is corrected in the revised National Waste Database.

3.3 Trends in waste generation

Figure 13 shows the trend in the generation of core waste plus ash between 2006–07 and 2021–21 by source stream. The charts on the left are total tonnes and those on the right are tonnes per capita. Over the 15-year data period, waste generation increased by 12.8 Mt (20%) or by 15.2 Mt (31%) when ash is excluded. During the same period, Australia’s population grew by about 25% and its gross domestic product by 38%.

By stream, MSW grew by 1.1 Mt (8.5%), C&I waste including ash shrank by 0.5 Mt (-1.4%), C&I waste excluding ash grew by 1.8 Mt (10%) and C&D waste grew by 12.3 Mt (73%). Full data is given in Appendix B.

Table 8 presents the 15-year changes on a per capita basis by waste stream, and shows that both MSW and C&I waste per capita fell. The phenomenon of declining waste per capita has been observed in other developed nations, including Japan (MoE 2014), Singapore (NEAS 2020), Germany (FMENCN 2018) and the USA (US EPA 2020). The concept of ‘peak waste’ has been formulated from this observation. Probable causes include reduced printed material due to digitisation and advances in material science and technology making products smaller, lighter and more resource efficient (Hornweg et al. 2013). It may also reflect relative increases in the marginal cost of extracting mineral resources (Badia et al. 2014). Declining weights do not necessarily correspond to declining volumes.

Table 8 Changes in the quantity of waste generated per capita, Australia 2006–07 to 2020–21

	Core waste plus ash	Core waste	MSW	C&I incl. ash	C&I excl. ash	C&D
15-year change	-3.3%	+5.4%	-13%	-21%	-12%	+39%

The data for MSW and C&I waste generation over the past two years illustrate the impact of COVID-19. This is best seen in the per capita charts at the right of the figure: towards the end of the 15-year data set C&I waste per capita dipped while MSW per capita rose strongly for the first time. This is consistent with COVID-19 lockdowns diverting waste generation from work places to homes.

Quantities of C&D wastes are strongly affected by major projects, particularly related to transport infrastructure. Consequently, the data for C&D is less even than the other streams.

Figure 14 (p.22) shows the trend in generation of core waste plus ash by jurisdiction between 2006–07 and 2020–21. The largest recorded increases are in SA (49%), the ACT (46%) and Vic (41%). In each case, the biggest rise was in the C&D stream. The only recorded fall is in the NT (-13%).

Figure 13 Trends in the generation of core waste (plus ash where shown) by stream in total (left) and per capita (right), Australia 2006–07 to 2020–21

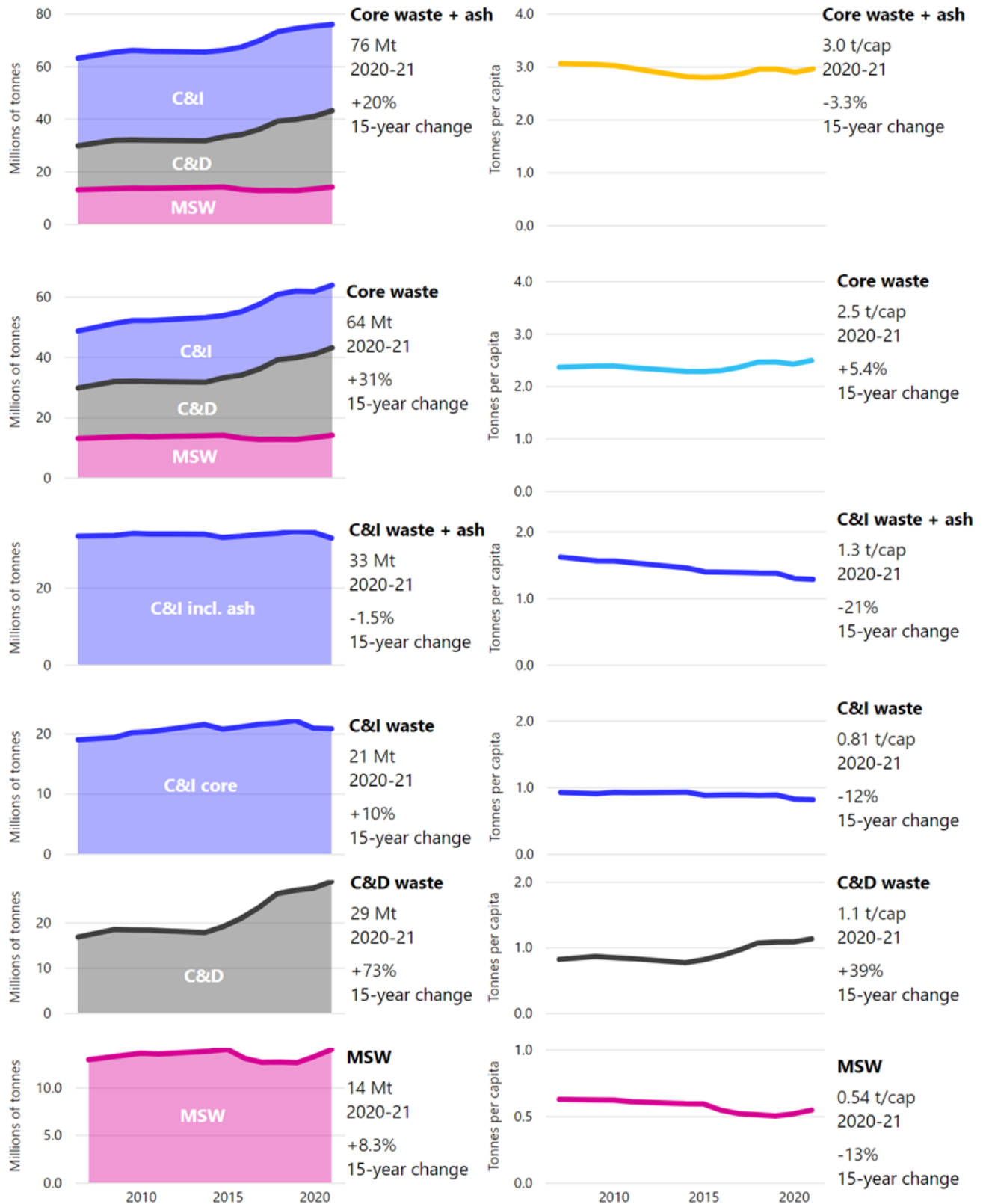
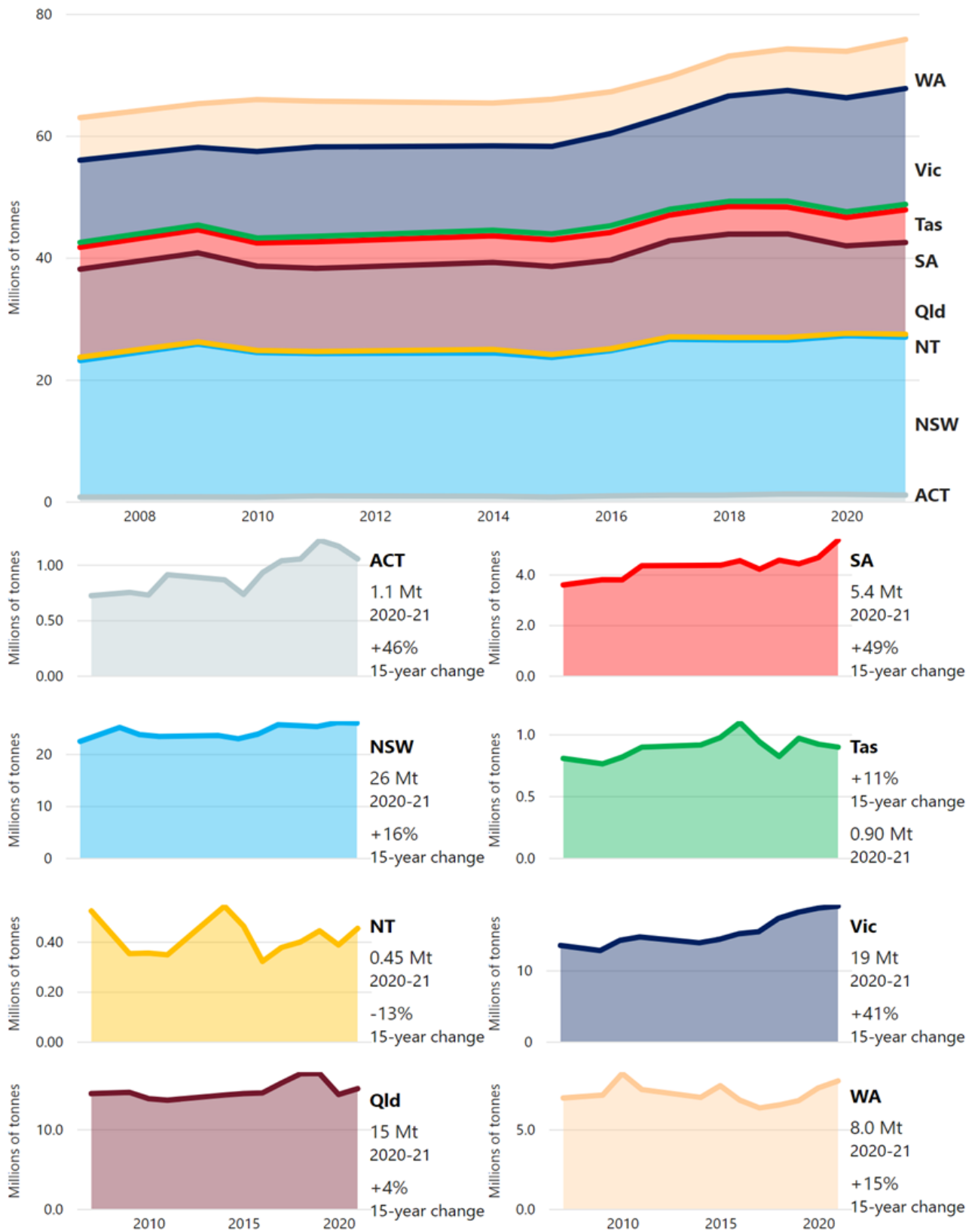


Figure 14 Trends in the generation of core waste plus ash by jurisdiction, Australia 2006–07 to 2020–21



4 Waste prevention

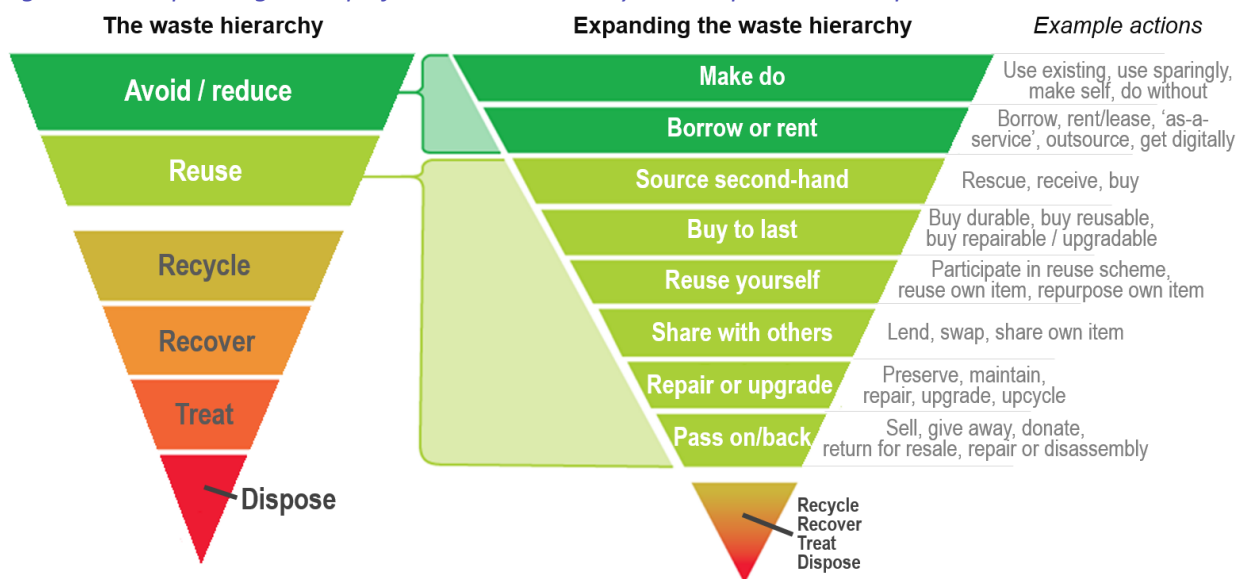
This chapter reports on efforts to prevent or avoid waste generation in Australia in 2020–21. It is the first time waste prevention has featured in its own chapter in a National Waste Report. This chapter helps provide a picture of the progress towards Australia’s commitment to reducing waste generation by 10% per person by 2030.

4.1 Definition and scope

A new, national *Framework for Understanding, Measuring and Communicating Waste Prevention* has been developed (BehaviourWorks Australia 2022a). In this framework, waste prevention includes any deliberate action taken that stops an item, component or material from entering a waste management facility or system.

The ‘waste hierarchy’ establishes a preferential order of waste management options based on environmental benefit, and has long been adopted by Australian governments to guide waste management decisions. The activities at the top of the hierarchy tend to have the highest environmental benefit. As part of the framework, an expanded version of the waste hierarchy has been developed that extends the top levels of the hierarchy to distinguish a range of distinct waste prevention activities.

Figure 15 Expanding the top of the waste hierarchy to incorporate waste prevention activities



Source: BehaviourWorks Australia (2022a)

4.2 Waste prevention initiatives

Waste prevention is not new, and there are numerous examples of established waste prevention activity in Australia. They include: lean manufacturing; product leasing that encourages extended lifetimes and reuse; repairing of vehicles and appliances; donation channels for surplus or unsold food or unwanted household goods to be passed on to others; and charity shops that on-sell donated goods.

New business models have begun to emerge that prevent waste, including: digitisation; micro rental; product-as-a-service; peer-to-peer sharing and ‘libraries of things’; and reusable alternatives to single-

use packaging or products. Government programs and civil society consumer campaigns to encourage waste prevention activity by businesses and households are increasingly common.

A range of other activities reduce waste generation by keeping materials out of the formal waste stream, including: onsite recycling or energy recovery of by-products; industrial symbiosis whereby wastes of one business become raw materials for another; diversion of food processing residues to feedlots; and home or community composts.

Household waste prevention activity

An online survey assessed behaviour in five waste prevention activities for common household goods, using a nationally balanced sample of 1,024 Australian adults. The results in Table 9 suggest that most Australians have undertaken one or more waste prevention activities in their lifetime ('ever'), with almost half performing at least one action in the last 4-week period ('recent').

Table 9 Occurrence and recency of select waste prevention activities amongst Australian adults

	Borrow	Second-hand	Buy to last	Repair	Pass on	ANY
Recent	18%	17%	8%	19%	24%	48%
Ever	46%	79%	52%	79%	84%	95%

Source: BWA (2022b)

Right to repair

The Productivity Commission (2021) recently completed an inquiry into consumers' ability to repair faulty goods and to access repair services at a competitive price. The report contains a number of recommendations to overcome barriers to repair, including enhancing consumer rights, promoting competition in the repair market, and improving product information. It highlights waste prevention by producers (e.g. by designing to last), retailers (e.g. by providing circular business models) and users (e.g. through buying to last).

National Food Waste Strategy

The *National Food Waste Strategy* (Commonwealth of Australia 2017) establishes a target of reducing food waste by half by 2030. A feasibility study estimated achievement of the recommended scenario could prevent 22.4 Mt of food waste between 2020 and 2030 compared to business-as-usual (FIAL 2021; see Table 10 below). This would mean food waste effectively eliminated from wholesale and retail operations; more than halved from production, manufacturing and hospitality; and reduced by 30% in households.

Table 10 Estimated future food waste prevented under the recommended scenario of the National Food Waste Feasibility Study (Mt)

	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
Waste generated in the business-as-usual scenario	8.2	8.3	8.5	8.6	8.7	8.9	9.0	9.1	9.2	78.5
Waste generated in the recommended scenario	8.2	8.0	7.6	6.9	6.1	5.5	4.9	4.5	4.4	56.1
Waste prevented	0.0	0.3	0.9	1.7	2.6	3.3	4.1	4.6	4.8	22.4

Source: FIAL (2021)

Single-use plastic bans

Another recent development is the extension of bans on lightweight plastic shopping bags to include a range of other single-use plastic items. All states/territories except Tasmania have legislated bans of

additional single-use plastic items, with some already implemented and others being phased in (see Table 21 on page 61). Extrapolating from modelling commissioned by the Victorian Government (DELWP 2022), the bans could see 65,000 tonnes of single-use plastic waste prevented in Australia over 10 years.

4.3 Waste prevented

Waste prevention reporting is in its infancy in Australia. The following table provides a snapshot of the limited number of initiatives for which measurement and public reporting were identified. In some cases, these are estimates of actual waste generation prevented²², while in other cases they represent the total tonnage of items/material subject to the initiative (shown with an asterisk).

Table 11 Identifiable amounts of waste prevented by initiatives, Australia 2020–21

Strategy	Initiatives	Prevented (kt)
Make do	Consumer plastic avoidance campaigns – Plastic Free July (Plastic Free Foundation: Ashton-Graham 2021)	49.5
Source-second-hand	Purchase of second-hand consumer clothing, e.g. charity shops, online peer-to-peer sales (National Clothing Product Stewardship Scheme: SRU 2022 & BWA 2022a)	27.3
	Purchase of second-hand furniture and bric-a-brac e.g. charity reuse stores (Charitable Recycling Australia: MRA 2021 & BWA 2022a)	78.1
	Consumer second-hand campaigns – Garage Sale Trail (Garage Sale Trail 2022)	0.4
Reuse yourself	Reusable business-to-business packaging, e.g. pallets, crates, drums, etc (APCO 2021)	2,815.7*
	Reusable consumer packaging products, e.g. reusable shopping bags, coffee cups (APCO 2021)	116.2*
	Reusable/refillable packaging services, e.g. coffee cups, laundry products (Responsible Cafes 2022, Dirt Company 2022, Green Cafeen 2022)	22.8*
Pass on or back	Household donation of unwanted clothing, e.g. to charity stores (National Clothing Product Stewardship Scheme: SRU 2022 & BWA 2022a)	165.9
	Household donation of unwanted furniture and bric-a-brac, e.g. to charity stores (Charitable Recycling Australia: MRA 2021 & BWA 2022a)	170.4
	Business donation of unsold goods, e.g. unsold retail product, office furniture (Good360 2022, GIVIT 2022; GreenChair: Bateup Consulting, 2022)	5.3*
	Business donation of unsold food, e.g. supermarkets and major food services (Foodbank 2022, Second Bite 2022, OzHarvest 2022, Fare Share 2022)	68.0*

* *This is the quantity of material subject to the activity. The quantity of waste prevented could be lower than this.*

The total 3.52 Mt presented in the table is likely only a fraction of all waste prevented, as there is a much larger range of activities and organisations preventing waste in Australia (BWA 2022c).

The University of Technology Sydney’s Transdisciplinary School undertook modelling to estimate aggregate waste prevention using historical waste generation data while controlling for economy-wide economic activity. The modelling excluded waste streams that are significantly influenced by factors that

²² Waste is prevented only if an activity ‘displaces’ a waste generating activity. For example, buying an item second-hand only prevents waste if the second-hand item was purchased instead of a new item. The new framework proposes ‘Displacement’ rates for household waste prevention activities such as borrowing, buying second-hand, repairing and passing on.

cannot be readily modelled, that is, building and demolition wastes (influenced by particular large-scale projects) and organics (influenced by weather and the provision of kerbside services²³).

The UTS model (unpublished at the time of writing) compares actual waste quantities with those that would have been generated had the quantity per unit of GDP of the modelled waste remained unchanged since 2016–17. The model found a difference of 13.6 Mt over the four years, with the largest differences during periods impacted most by the COVID-19 lockdowns. While it is not possible to attribute all the waste reduction to waste prevention activity, the figure indicates that substantially less waste has been generated across the economy.

²³ When new organics bins are provided, measured waste quantities tend to increase because some of the collected material was previously managed within domestic properties and not counted in earlier totals.

5 Recycling and waste reuse

This chapter reports on the quantities of waste materials reused and processed for recycling in Australia in 2020–21 and the recycling trends since 2006–07. Information on the recycling of particular waste materials is given in Chapter 9. Full data for all charts is given in Appendix B.

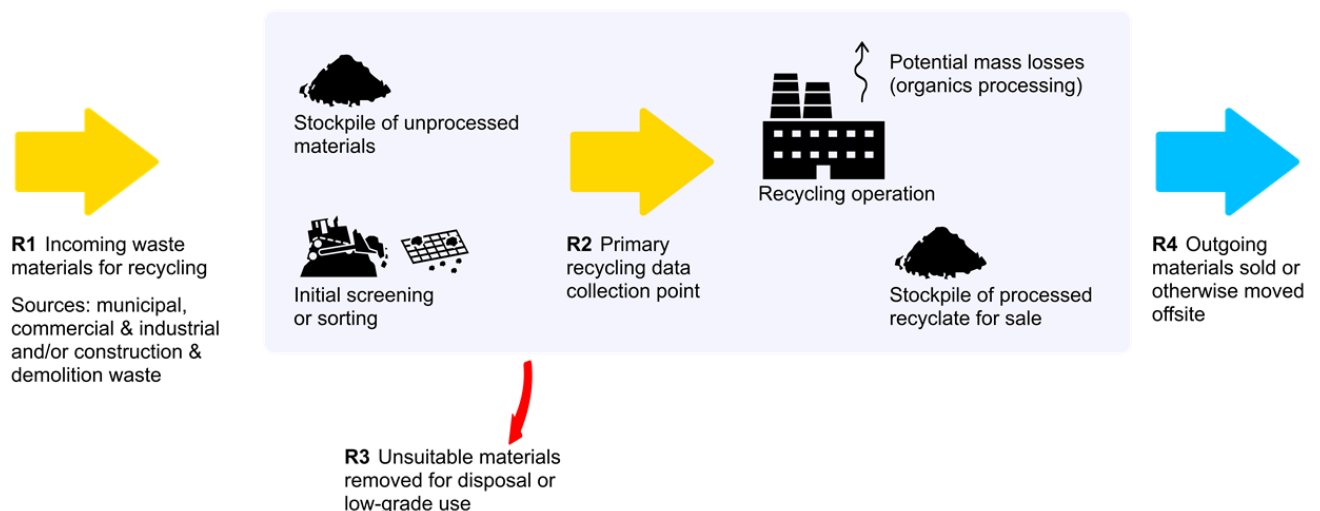
5.1 What the recycling data covers

Figure 16 illustrates material flows at a generic recycling facility. Material flows to recycling can be measured at different points, illustrated as R1 to R4. The measurement points used vary by waste type and jurisdiction. If materials are measured at point R1 there is a risk that recycling is exaggerated because stockpiles of processed or unprocessed material could be included and rejected materials (R3) could be counted twice (at the recycling depot and landfill). NSW reports at point R4, arguing that this is the true measure of actual recycling. However, this is not currently achievable by all jurisdictions and makes tracking of waste generation more difficult.

The national approach²⁴ is to measure recycling at point R2, and most states and territories are able to report against at this measurement point for most of their reported waste flows. However, some is recorded at point R1, including all material exported for use overseas. Exports include some contamination (or ‘off-spec’ material) that is likely to have been disposed of or used as a fuel, so exports data overstates recycling quantities. This contamination fraction is now reducing strongly due to the Australian restriction of exports of waste-derived materials that previously contained high levels of contamination (see Section 10.3).

The quantities reported here are indicators of recycling. In reality, recycling does not occur until the processed material is used in new products, buildings or infrastructure that is the step after R4. However, the vast bulk of material reaching R2 is so used.

Figure 16 A generic recycling process, illustrating what is included in the data presented in this section



²⁴ Set out in the [Australian Standard for Waste and Resource Recovery Data and Reporting](#). The standard encourages data and reporting to follow the return of recovered material to further productive use but comprehensive national dataset on this is unavailable to date.

5.2 Recycling and waste reuse in 2020–21

Recycling and waste reuse of core wastes and ash in Australia in 2020–21 are illustrated in Figure 17. About 45.4 Mt of materials were received or processed, up from 40.1 Mt in 2016–17. The increase was mostly building and demolition waste. The four largest fractions of recycling, making up 84% of the total, were building and demolition materials (20.2 Mt), organics (6.8 Mt), ash (6.0 Mt), and metals (5.0 Mt). C&D represented the largest source stream (50%) followed by C&I including ash (38%) and MSW (13%). The equivalent values in 2016–17 were 42%, 46% and 12% respectively.

Figure 17 Recycling and waste reuse of core waste plus ash by category, jurisdiction and stream, Australia 2020–21

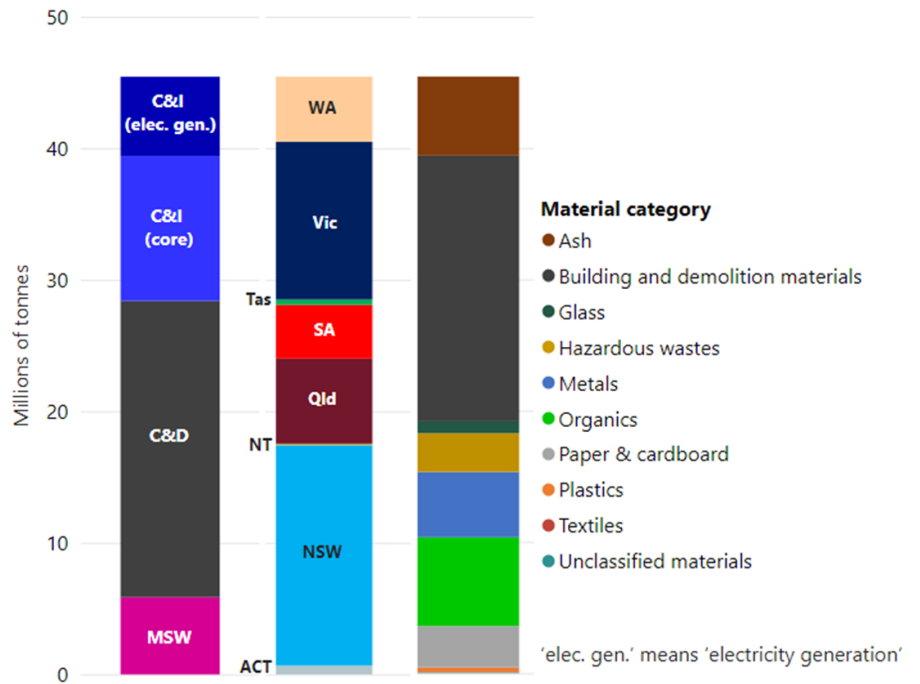
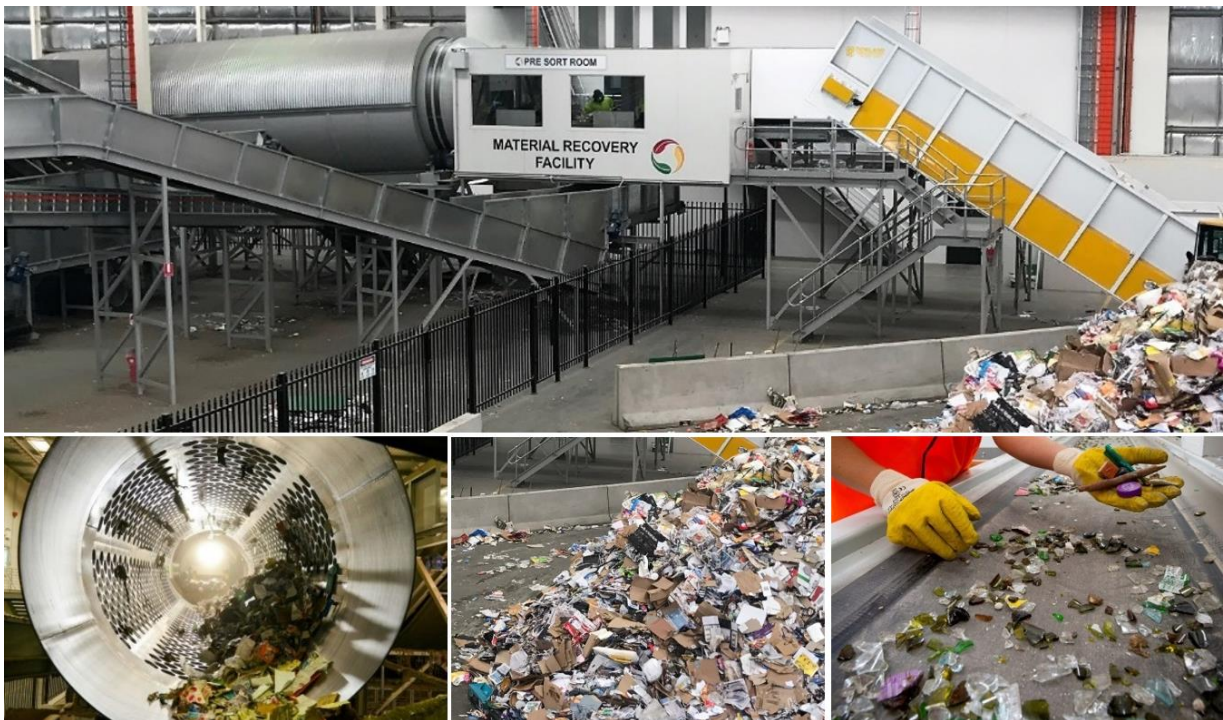


Photo 1 Materials recovery facilities (MRFs) sort domestic recyclables into product lines using mechanical and manual processes



NAWMA's Adelaide MRF processes about 60 kt/yr of domestic recyclables. Clockwise from top: the start of the sorting process; manual separation of glass contaminants; unprocessed recyclables; a rotating trommel that allows small items to fall through the holes while larger items fall from the open end. Photos kindly provided by NAWMA.

5.3 Sorting

The data presented above covers materials processed by or delivered to recycling operations. Depending on the source and material, materials often need to be sorted before delivery to these facilities. Sorting of homogenous, commercially-sourced material streams such as cardboard or glass can be a simple manual process, but mixed material streams need sophisticated sorting.

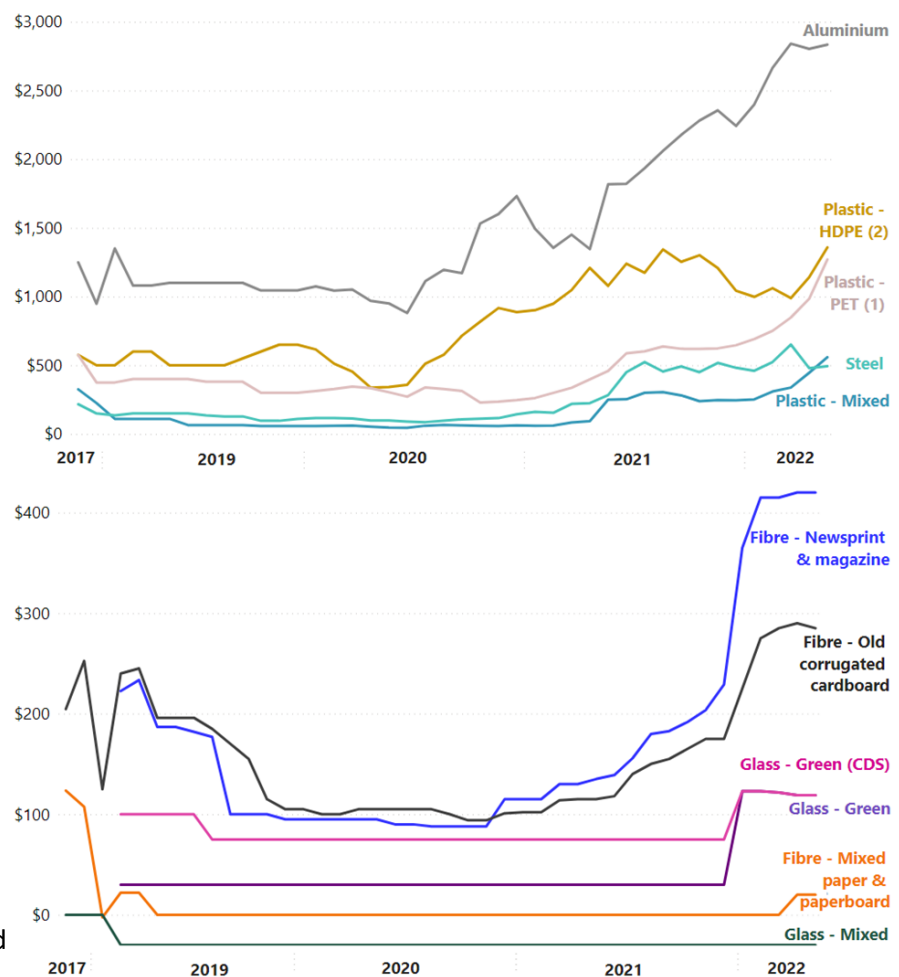
The most complex sorting processes are at material recovery facilities (MRFs, see Photo 1) receiving mixed domestic materials. In 2020–21, MRFs received about 2.23 Mt of materials, comprising about 1.83 Mt from households and 0.40 Mt from commercial sources. About 20% was sent to landfill. Typically, this is because the material was not recyclable, was improperly presented (e.g. inside a plastic bag), was too small (e.g. container caps) or was damaged by the recycling process (e.g. small pieces of broken glass). MRFs separate materials using a mix of manual and automated sorting methods. Machinery may include trommels, air separators, magnets, eddy currents, optical sorting devices and, increasingly, units controlled through artificial intelligence. MRF outputs include high value products such as baled aluminium cans and low value materials such as mixed paper.

Between 2006–07 and 2016–17, demand for low-grade mixed products was high, mainly from Chinese buyers. This tended to promote high speed and low cost MRF operation, producing low-grade product that was finished cheaply in Asia. From late 2017, import restrictions from China, followed by other Asian countries, disrupted this approach across the globe.

Figure 18 shows longitudinal data on indicative scrap commodity prices since June 2017. Prices for mixed materials all tumbled during 2018 and 2019 due to the export market disruptions. The value of most sorted materials was not significantly affected and over the past year or two has increased strongly.

Data on export quantities and trends is given in Section 10.3.

Figure 18 Indicative scrap commodity prices (\$ per tonne, product leaving a material recovery facility)



Sources: Blue Environment and Envisage Works research and consultation

5.4 Waste reuse

'Waste reuse' is a new management category in the scope of national waste reporting, established by the 2021 release of the *Australian Standard for Waste and Resource Recovery Data and Reporting*. Waste reuse encompasses the recovery of materials that have been part of the waste stream without any reprocessing but potentially with some repair. In this report, it covers goods and products 'rescued' from the waste stream in reuse shops (sometimes called 'tip shops') and contaminated soils and ash put to some beneficial use without any reprocessing.

Australia's estimated 130 reuse shops play an important role, contributing to a reduction in waste to landfill, producing low-cost goods, and often providing employment for disadvantaged people (see Photo 2). In 2020–21, reuse shops in the ACT, NT, Qld and WA reported sales of about 27.1 kt of goods.²⁵

The other contribution to waste reuse is from ash and low-level contaminated soils reused without processing void rehabilitation or civil construction. Approximately 3.31 Mt of ash and 149 kt of contaminated soil were reused.

Photo 2 Reuse shops recover products and materials from landfill disposal for repair and sale



AroundAgain in Mildura, Victoria, was established in 2000 as a reuse shop with an environmental and community conscience. It focuses on reducing the amount of waste to landfill and providing employment opportunities for individuals living with a disability.
Image kindly provided by AroundAgain

5.5 Trends in recycling and waste reuse

Figure 19 on page 30 shows the trends in recycling and waste reuse by source stream, in absolute tonnes on the left and per capita on the right. Recycling is the dominant component. Overall recycling and waste reuse increased strongly during the 15-year timeframe, rising by 55% on a tonnage basis and by about 24% on a per capita basis. Within this overall assessment are different stories for each stream (MSW, C&I waste and C&D waste).

²⁵ NSW, SA, Tas and Vic were unable to provide data.

C&D waste recycling and waste reuse more than doubled over the 15-year data period, rising slowly in the earlier years then sharply from 2014–15. This is mostly due to larger amounts of material generated (see Section 3.3) but also better recovery of those materials, which tend to be relatively homogenous. Demolition waste recycling is a success story in most jurisdictions, providing an alternative source of materials for road base and construction aggregates (see Section 9.4).

C&I waste recycling and waste reuse levelled off and declined slightly on a per capita basis. This suggests the easiest-to-recycle materials are dealt with and future gains in recovery may be harder to win.

MSW recycling and waste reuse dropped sharply from 2014–15 before rising again, but in 2020–21 remained below 2006–07 levels on a per capita basis. This trend seems counter-intuitive, given significant expansion of kerbside organics collection systems (see Section 12.3). It appears to be caused by:

- falling weight of domestic recyclables due to lower sales of newsprint, declining quantities of glass and lighter weight packaging
- improvements to NSW data in 2015–16 that found lower quantities of organics than previously reported due to material transfers between facilities that were not previously detected, so are double counted.²⁶

Figure 20 (on p.31) shows trends in the quantities of core waste plus ash to recycling and waste reuse by jurisdiction.²⁷ Rates increased in all jurisdictions. The steep rises towards the end of the Qld and Vic data series were mainly associated with C&D waste. The variability in the smaller jurisdictions is associated with particular large-scale projects and potentially data measurement issues. The clarifications of scope and method in the 2021 standard²⁸ resulted in some small reductions in recycling rates, including for SA.

Photo 3 Cardboard baled for recycling



Image by R-tem on Freemages.com

²⁶ This is a cautionary tale for jurisdictions that still use voluntary surveys to collect recycling data. Interestingly, WA's journey from voluntary to compulsory data reporting of recycling data identified more waste rather than less.

²⁷ Ash is not included in this chart as ash recycling rates by jurisdiction are estimates only and not relevant to ACT, NT, SA or Tas.

²⁸ [Australian Standard for Waste and Resource Recovery Data and Reporting.](#)

Figure 19 Trends in the recycling and waste reuse of core waste (plus ash where shown) by stream in total (left) and per capita (right), Australia 2006–07 to 2020–21

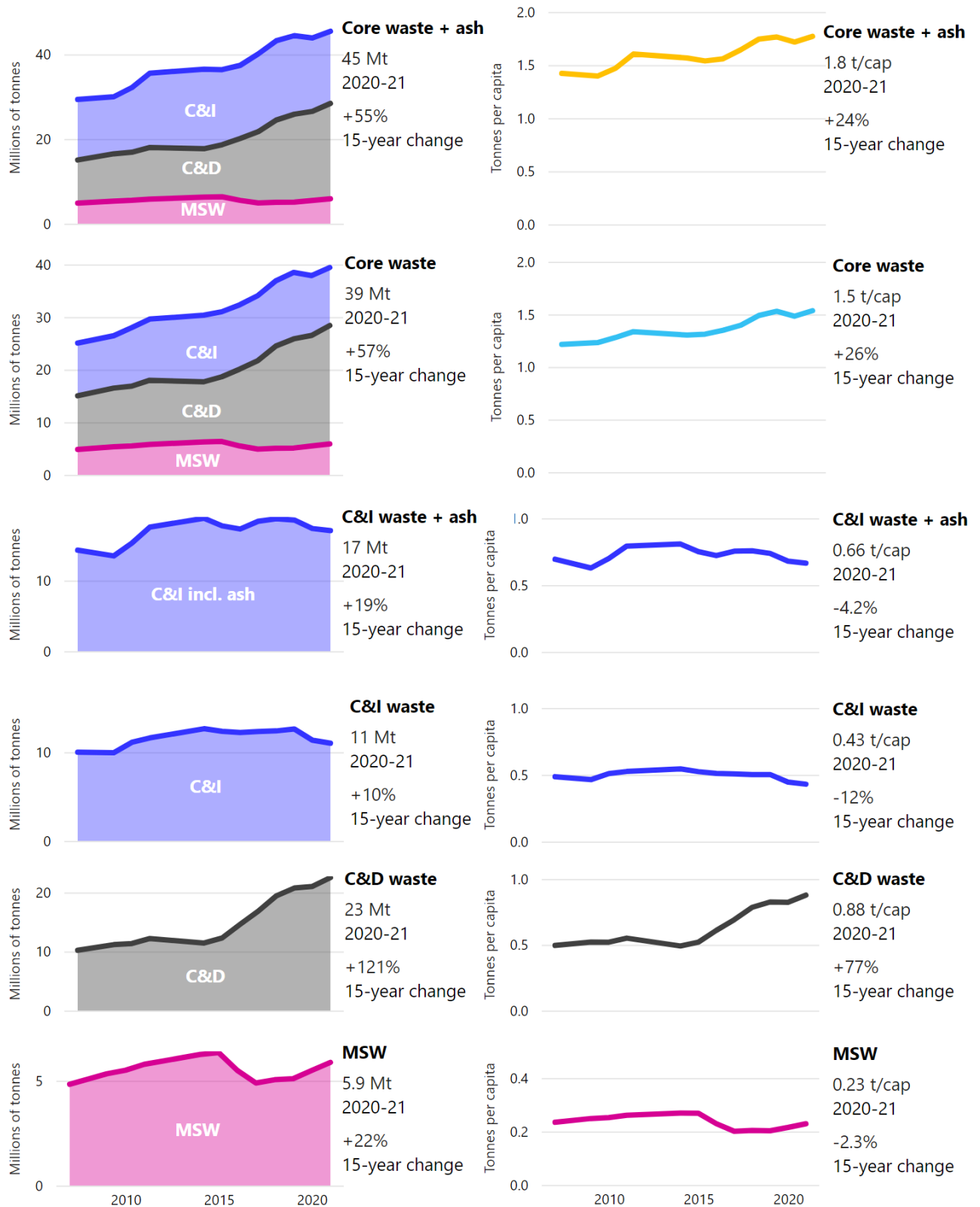
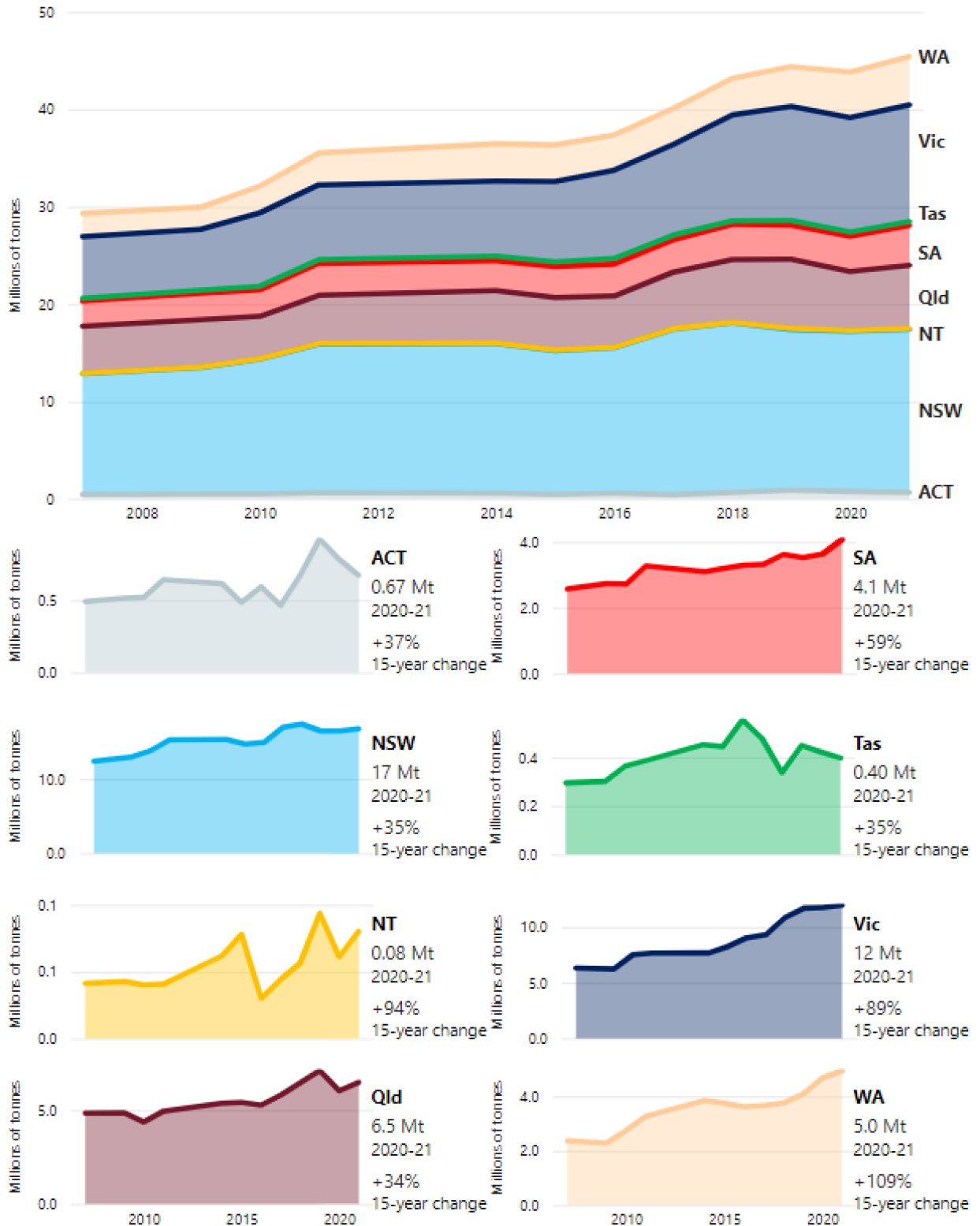


Figure 20 Trends in the recycling and waste reuse of core waste plus ash by jurisdiction, Australia 2006–07 to 2020–21 (Mt)



6 Energy recovery

This chapter reports on core waste materials used for their energy value in Australia in 2020–21.²⁹

6.1 Types of energy recovery

The main ways waste was or could be used for energy are described below, in order of quantity of energy recovered in 2020–21.

Table 12 Types of energy recovery from Australian solid waste

Method	Description
Landfill gas	Methane-rich gas is generated from anaerobic decay of organic wastes in landfills. At larger sites, including those accepting about 75% of MSW, this is collected and combusted for its energy value, usually by generating electricity for sale to the grid.
Waste-derived fuels	Waste-derived fuels are of different types: <ul style="list-style-type: none"> • ‘solid recovered fuels’ (sometimes called ‘processed engineered fuels’) are made to a specification, including a calorific value, mainly from C&D and C&I waste timber, plastics, paper, cardboard and/or textiles • ‘tyre-derived fuels’ are solid recovered fuels made from shredded waste tyres • ‘refuse-derived fuels’ are not processed to a specification, and are generally residual timber or garden organics • high calorific value liquid hazardous wastes (solvents and paints).
Anaerobic digestion ³⁰	Anaerobic digestion is similar to composting in large, oxygen-deprived tanks. This generates methane that can be used for generating electricity. Anaerobic digestion is not widely used at scale for solid waste due to its cost.
Thermal energy-from-waste facilities	No large-scale energy-from-waste facilities yet operate in Australia. ³¹ Two are under construction in WA (at Kwinana and East Rockingham – see Photo 4), with operations likely to commence in 2023. Several others are planned in other states.

6.2 Energy recovery in 2020–21

Figure 21 shows recorded energy recovery from core waste by management method, material, stream and jurisdiction. About 2.3 Mt of waste is recorded as used for energy recovery³², a minor increase of about 2.5% since 2016–17.

Landfill gas collection accounts for about 83% of the energy recovery, or 1,960 kt of waste.³³ About 47% of all landfill gas generated in Australia was captured, and over 80% of this is used for its energy value. For the six states³⁴, the National Greenhouse Gas Inventory provides estimates of the quantity of methane generated that can be compared with the quantity collected for energy recovery. In the latest inventory year 2019–20, those proportions were, ranked in order: Vic. (61%), Qld (52%), NSW (49%), Tas. (46%), SA (34%) and WA (28%). The energy derived from landfill gas was about 0.2% of the reported energy derived from natural gas (DCCEE 2022a).

²⁹ Excludes agricultural and forestry biomass (e.g. sugarcane bagasse and mill sawdust) and energy recovery from wastewater.

³⁰ Anaerobic digestion is currently classified as a form of recycling in this data set and is listed here for completeness. About 74 kt of waste was sent to anaerobic digesters in NSW, Vic and WA.

³¹ Australia has a number of incinerators processing mainly medical wastes but they do not recover energy.

³² Some data is missing from this total due to commercial confidentiality.

³³ The calculation method is set out in Section 1.3.

³⁴ Not available in the territories due to the need to protect the commercial confidentiality of the sole operator.

The remaining 390 kt of energy recovery was waste-derived fuels. Column 1 of Figure 21 classifies most of this material as ‘energy from waste’, comprising about:

- 170 kt of tyre-derived fuel for export
- a similar quantity of other solid recovered fuel³⁵ for export or use in domestic boilers or kilns
- 60 kt of refuse-derived fuel.³⁶

About 70 kt of hazardous waste other than tyres was used in cement kilns. This is classified as ‘treatment’ in column 1 of Figure 21 because it is treated first to manufacture the fuel.

Figure 21 Energy recovery from core waste by management method, material category, stream and jurisdiction, Australia 2020–21

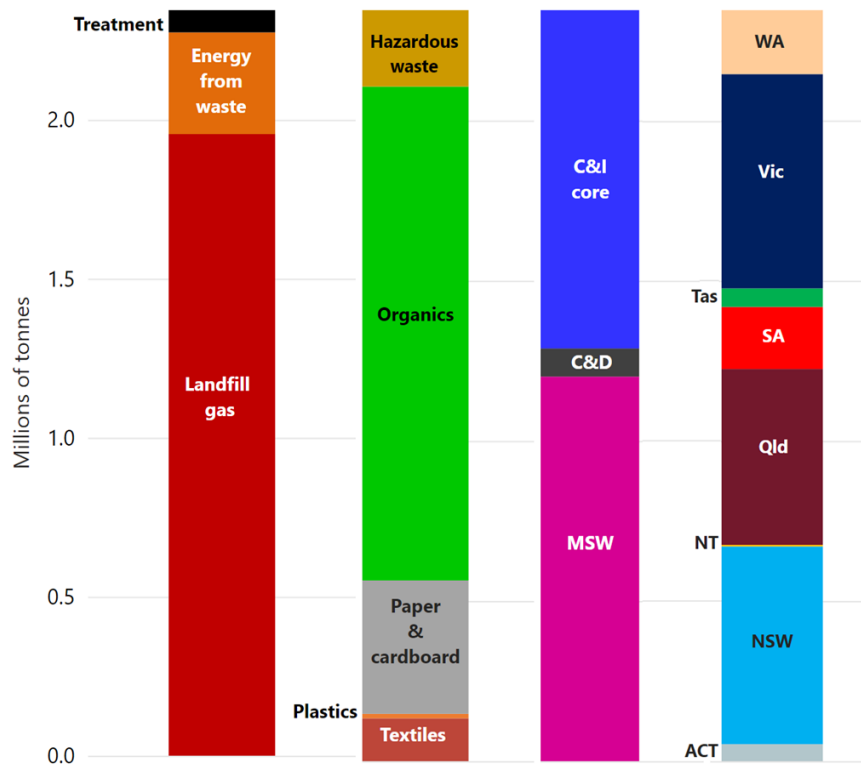


Photo 4 Artist's impression of East Rockingham Waste to Energy Facility, Western Australia



The East Rockingham facility will be Australia's first large scale thermal energy-from-waste operation, with capacity to process 300 kt of waste per year and generate 29 MW of energy. Image kindly provided by East Rockingham Waste to Energy

³⁵ Accurate data is unavailable due to commercial confidentiality.

³⁶ This covers only material redirected from the waste stream. Many industrial facilities use organics processing residues to power their operations (e.g. saw mills, sugar cane processors) but this is out of the scope of this report.

6.3 Trends in energy recovery

The trend chart in Figure 23 shows energy recovery from waste peaked in 2014–15 and has since fallen by 11%. This is mostly due to declining use of landfill gas energy, particularly in NSW. Factors that could be contributing to this declining use include:

1. reduced quantities of organics sent to landfill
2. lower rainfall reducing waste degradation rates (the data precedes the NSW floods)
3. a switch in operator focus from energy generation to flaring³⁷ (flaring increased from 15% to 20% of recovered methane between 2019–20 and 2020–21).
4. missing data due to less local government input to National Greenhouse and Energy Reporting.³⁸

Whichever of these reasons are dominant, greenhouse gas inventory data suggest the decline in landfill gas used for energy recovery is not leading to higher levels of landfill emissions – see Feature 2.

Feature 2 Solid waste management and climate change

The carbon footprint of waste management is multi-faceted.

There were direct emissions of 9.8 Mt of carbon dioxide equivalent (CO₂-e) from solid waste management (landfill, biological treatment and incineration) in 2019–20, equivalent to 2.0% of Australia’s total. Methane from landfills represented 97% of these emissions. Landfill emissions have declined substantially over 25 years (see Figure 22), primarily due to increasing methane capture and combustion.

Emissions from on-site fossil fuels or electricity can be high in some processes, especially scrap metal processing, paper recycling and MRF operation.

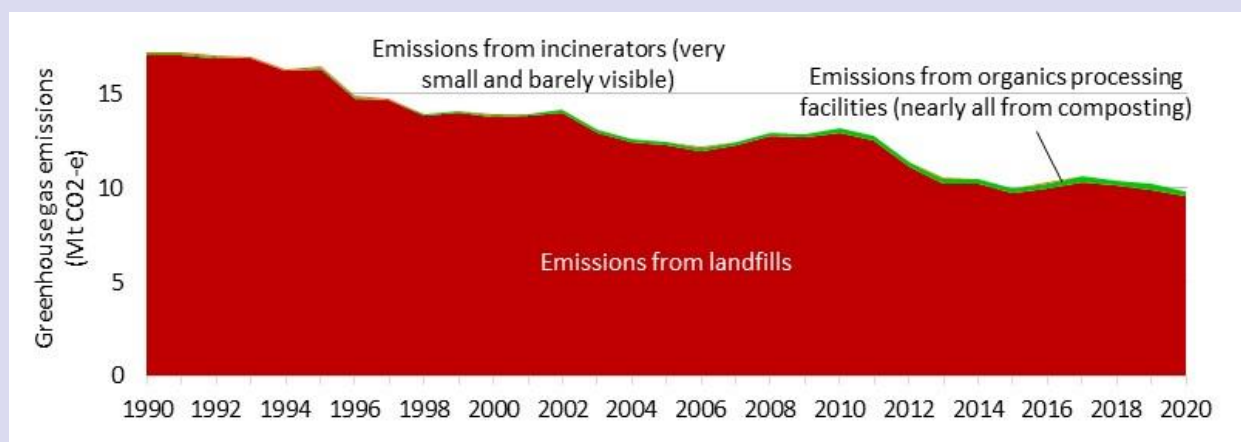
Emissions from collecting and transporting waste, on the other hand, are generally low. National accounting methods suggest that depositing a 20-tonne load of municipal waste in a landfill with no gas capture would produce more emissions than driving that load on a 14,000 km lap of the continent.

Recycling produces significant carbon benefits by substituting for emissions-intensive primary production. This effect is particularly pronounced for metals (Carre et al. 2015).

There are also significant benefits in generating low emission energy from waste, including from landfills, noting that this substitutes for fossil fuel energy.

Organic carbon stored in soils and landfills represents a greenhouse benefit by delaying emissions, potentially for long periods.

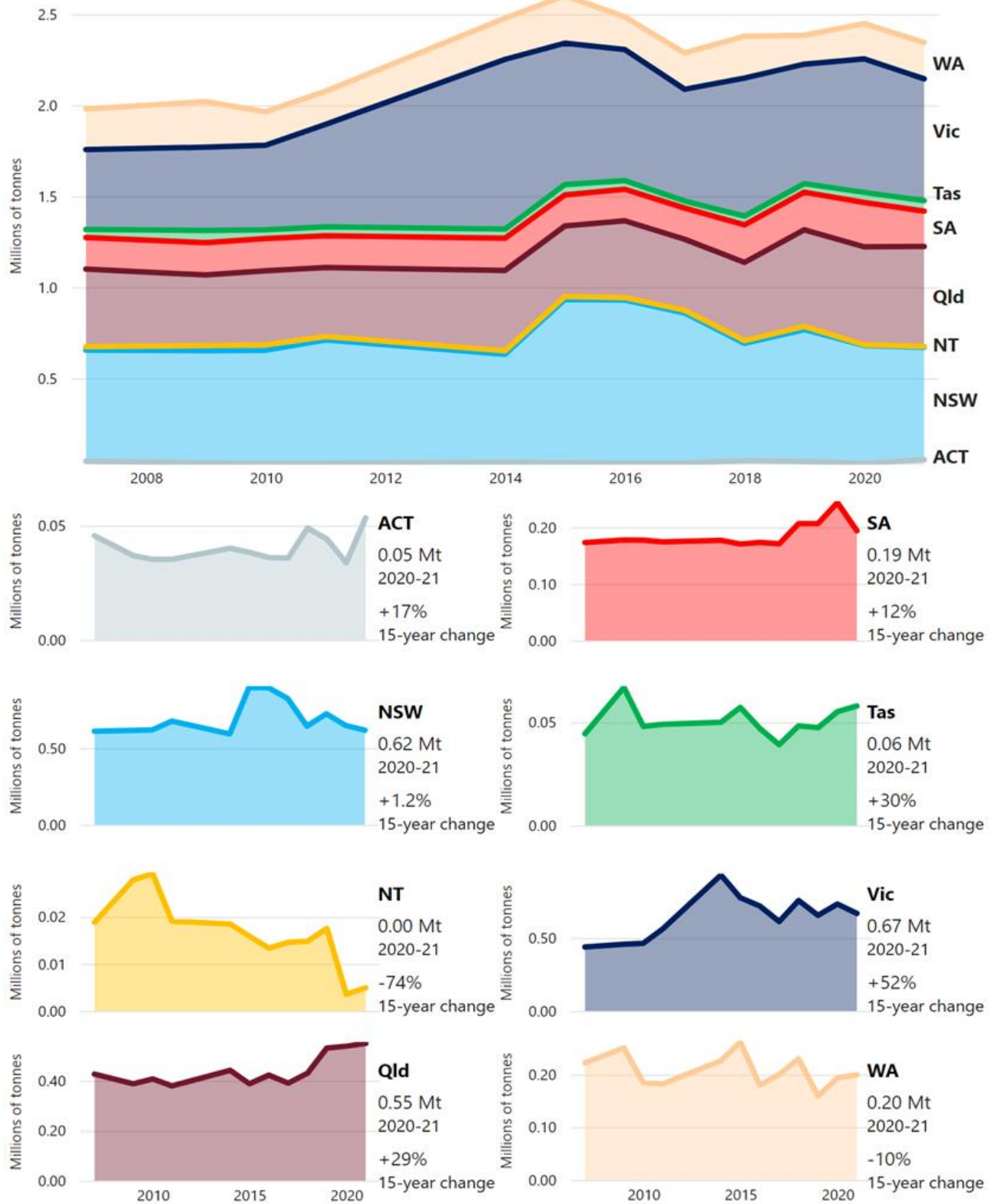
Figure 22 Greenhouse gas emissions from solid waste management, 1989–90 to 2019–20 (Mt CO₂-e)



³⁷ At landfills that are small or far from the grid, landfill methane is sometimes collected and flared. When this occurs, it is usually because it was required by the regulator to reduce odour or to generate credits under the Emissions Reduction Fund.

³⁸ Local government reporting changed from compulsory to voluntary when the *Clean Energy Act 2011* was repealed in 2014.

Figure 23 Trends in core waste to energy recovery by jurisdiction, Australia 2006–07 to 2020–21



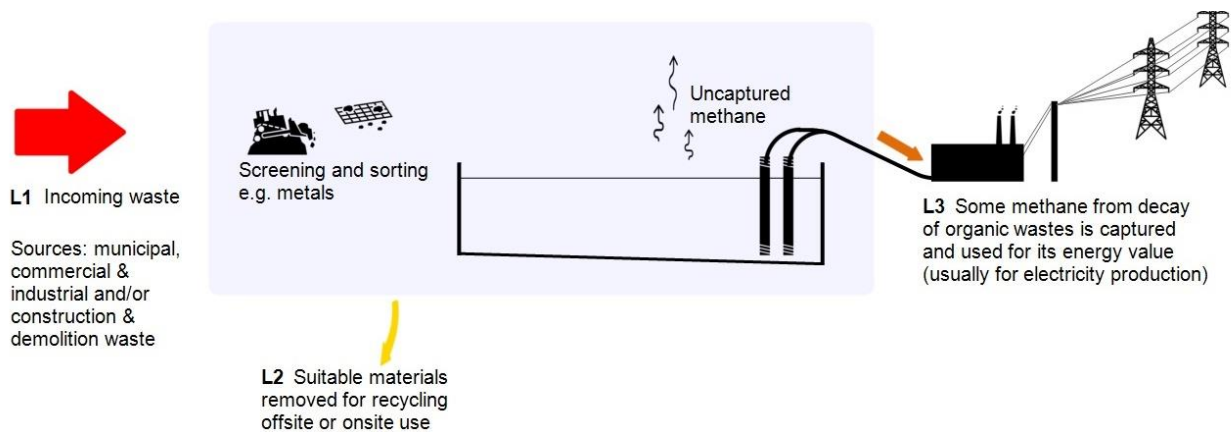
7 Disposal

This chapter reports on the quantities of core waste plus ash materials disposed of in Australia in 2020–21. Disposal means allocation to a fate in which no use is made of the waste. More than 80% of disposed material was sent to landfill (see Photo 5 on page 37). The remainder comprises ash deposited in ash dams and relatively small quantities of medical and other waste sent for thermal destruction.

7.1 What the data covers

In this report, not all waste taken to landfill is ‘disposal’. Waste to landfill that generates methane used for generating electricity is counted as ‘energy recovery’ and material used on-site or sold is counted under ‘recycling’. This is illustrated in Figure 24, which shows material flows at a generic landfill facility. Waste to landfill is equal to L1 minus L2; waste to disposal is equal to L1 minus L2 minus L3.

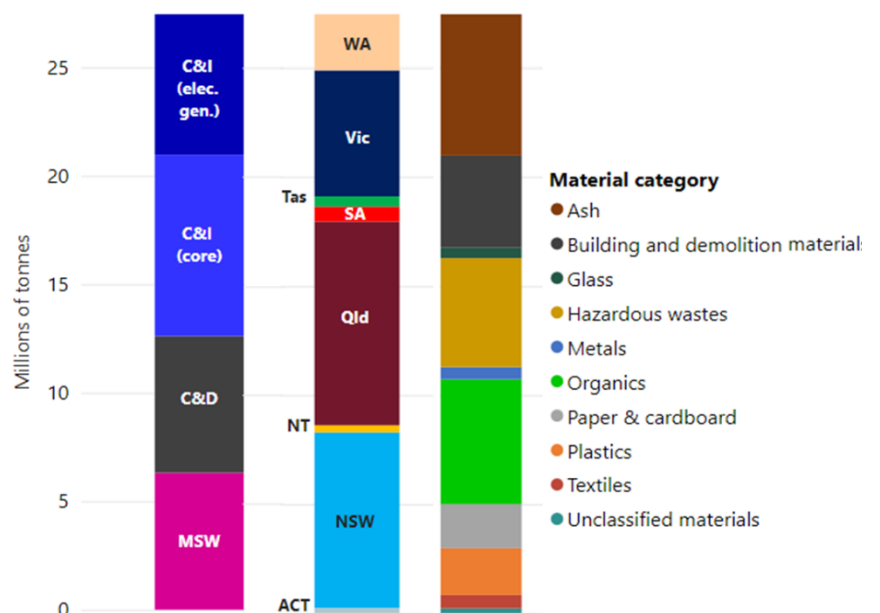
Figure 24 A generic landfill process, illustrating the data presented in this section



7.2 Waste disposal in 2020–21

Figure 25 shows disposal of core waste plus ash by material, stream and jurisdiction. About 28.0 Mt of waste were disposed of, some 37% of the 75.8 Mt generated. Disposal tonnages were 27.3 Mt in 2016–17. The biggest material fractions disposed of were organics (22%), ash (21%), building and demolition waste (18%) and hazardous waste (mainly soils contaminated with hydrocarbons, heavy metals or asbestos, 15%). The proportions of the disposal stream were: MSW 25%; C&I waste (core plus ash) 52% and C&D 23%. In 2016–17 these values were 24%, 53% and 24% respectively.

Figure 25 Disposal of core waste plus ash by stream, jurisdiction and material, Australia 2020–21



Supplementing the disposal data, Table 13 shows, for each state and territory, the quantity of waste sent to landfill (L1 minus L2 in Figure 24). About 23 Mt of waste was deposited in landfill, comprising 36% of the 64 Mt of core waste generated. The fall in ACT waste is linked to the ‘Mr Fluffy’ story (see Feature 3). The Qld fall is due to a drop in C&D waste. More detail on waste to landfill is given in Appendix D.

Table 13 Waste to landfill by jurisdiction, Australia 2020–21 (kt) and changes since 2016–17

	ACT	NSW	NT	Qld	SA	Tas	Vic	WA	Aust.
MSW	117	2,770	114	1,800	367	126	1,690	1,090	8,070
C&I waste	107	2,630	154	2,030	150	273	2,310	1,120	8,780
C&D waste	130	2,340	92	970	581	70	1,710	518	6,410
Total	354	7,740	359	4,800	1,100	468	5,710	2,730	23,260
Change since 2016–17	-25%	9%	11%	-22%	49%	3%	15%	15%	3.1%

Apart from landfill, in 2020–21 there was about 6 Mt of ash deposited in ash dams and 38.6 kt of hazardous wastes sent for thermal destruction, including 17.1 kt of clinical and pharmaceutical waste.

Photo 5 Veolia’s Woodlawn Eco-precinct and landfill



Veolia’s Woodlawn landfill is one of Australia’s largest. Sited at a former mine, the facility receives about 1 Mt per year of putrescible waste, mostly from Sydney, which is transported to the site via rail and truck. About 32 Mt of capacity remains. The landfill operates as a bioreactor, in which moisture is controlled to optimise degradation and methane production. Landfill gas is piped to a bioenergy plant that generates electricity for the grid and heat for aquaculture. The evaporation ponds to the right of the image hold stormwater and treated leachate recovered from the waste body. The Woodlawn Eco-precinct also includes 23 wind towers, a solar farm and a mechanical biological treatment facility to recover organics.

Image kindly provided by Veolia

7.3 Trends in waste disposal

Figure 26 shows trends in the disposal of core waste plus ash by source stream. Over the 15-year data set waste to disposal declined by 12% including ash but increased by 1.9% when ash is excluded (ash quantities fell strongly in the early part of the data series). With ash excluded, quantities across all three streams were relatively stable apart from a fall in C&D disposal around 2010–11 that is matched by increased recovery. On a per capita basis, disposal quantities declined across all streams. COVID-19 lockdowns appear to have caused an increase in MSW quantities per capita in 2019–20 and 2020–21.

Figure 26 Trends in the disposal of core waste (plus ash where shown) by stream in total (left) and per capita (right), Australia 2006–07 to 2020–21

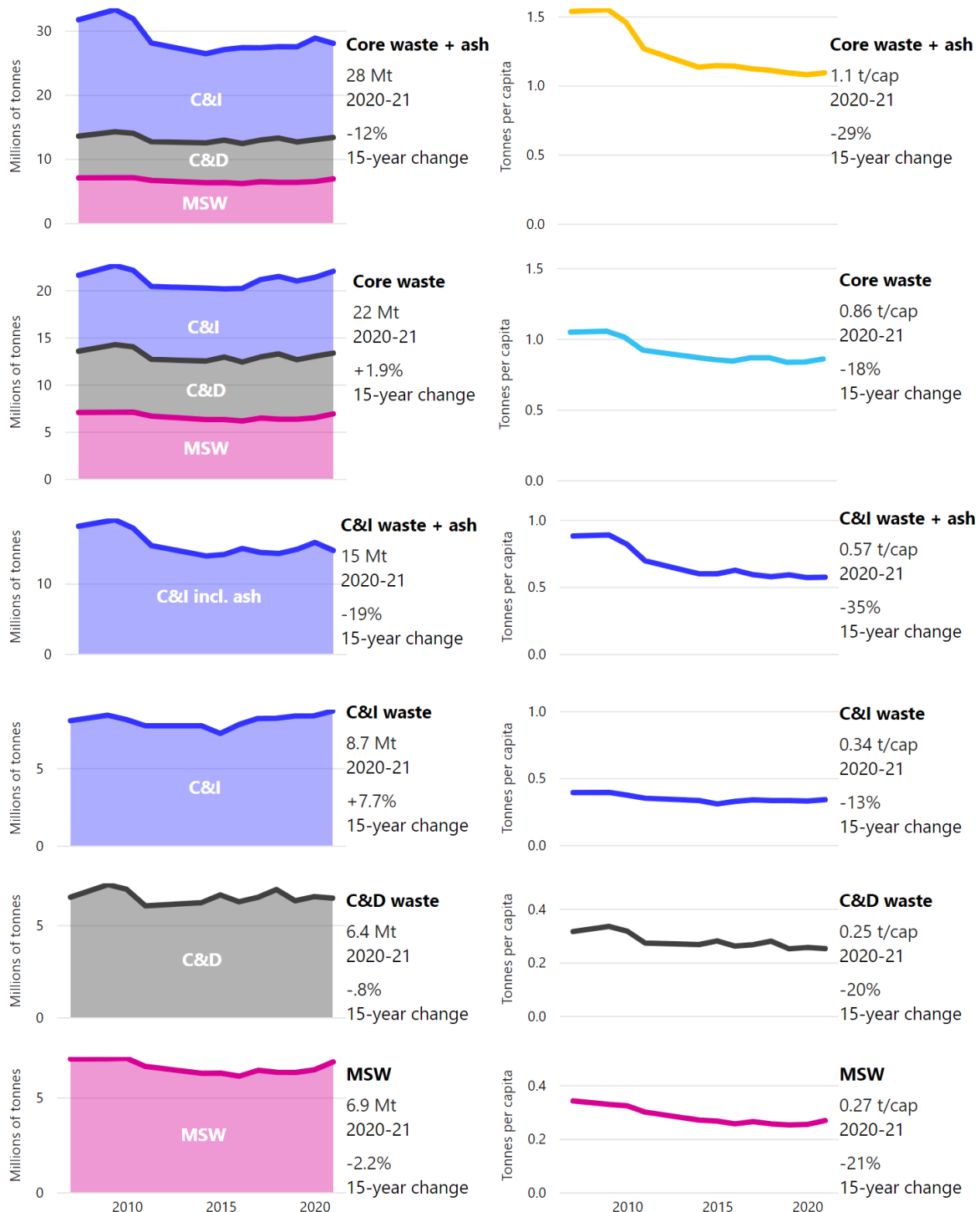
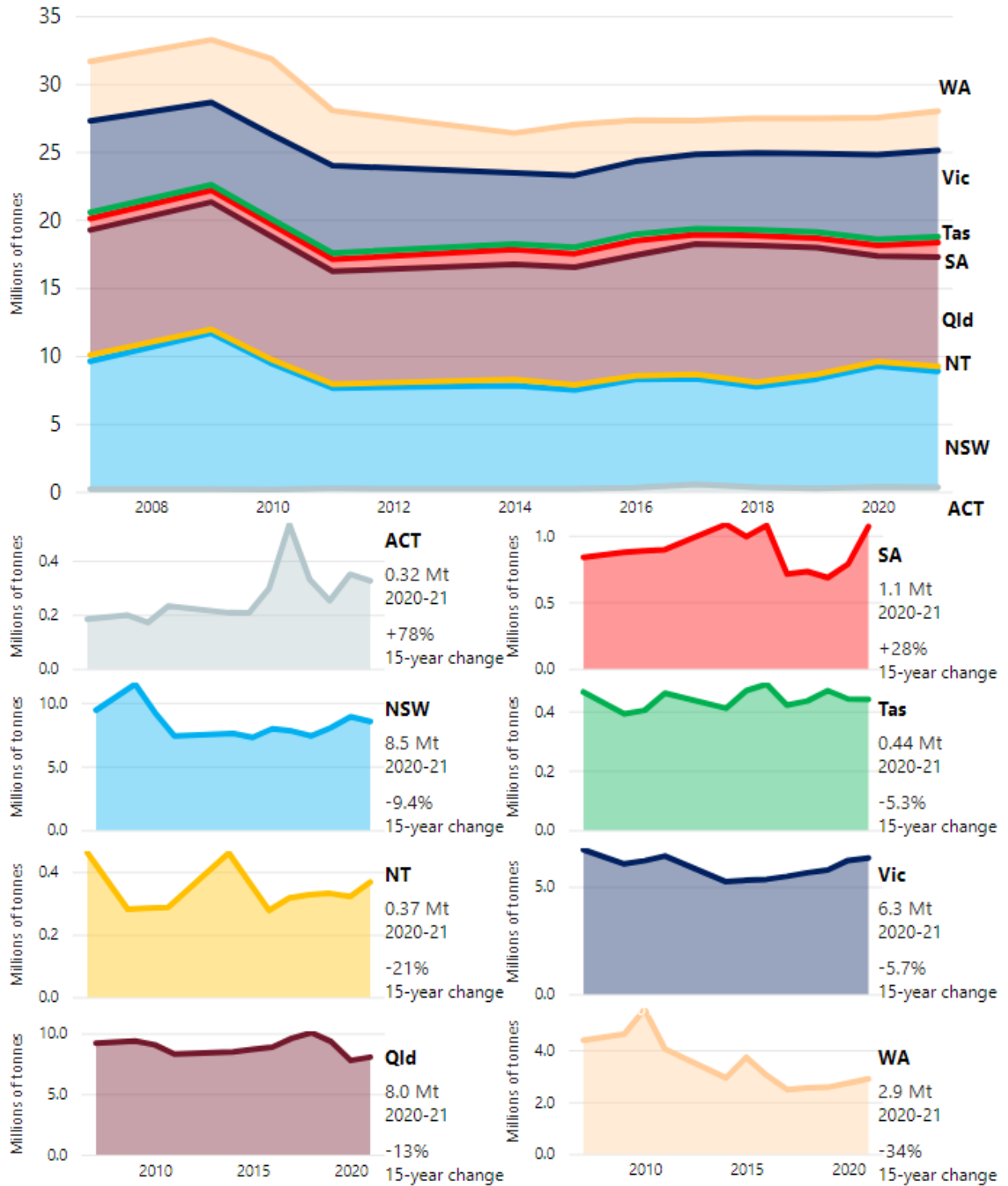


Figure 27 shows differing disposal trends by jurisdiction. The spikes in the ACT and NT data, and the recent significant growth in Vic, are associated with large development projects. A strong fall in WA disposal is matched by a similar rise in recycling. The large rise in SA's disposal in the last two data years is due to reporting uncontaminated waste soil, a new inclusion under the standard.³⁹

Figure 27 Trends in the disposal of core waste plus ash by jurisdiction, Australia 2006–07 to 2020–21



³⁹ Earlier data on this waste stream in SA is not available as it had a levy exemption and was not recorded. This remains the case in Qld, so its uncontaminated waste soils data is excluded. Like SA now, the ACT, NSW and Vic include only soils not used for landfill construction or cover purposes. WA includes all soil delivered to landfill in its data. The status in NT and Tas is uncertain.

8 Resource recovery rates

This chapter assesses and compares resource recovery rates for the states and territories⁴⁰ and the three main waste streams. For clarity, the resource recovery rate is the proportion of generated waste that is allocated to waste reuse, recycling or energy recovery.⁴¹ The scope of waste included is core waste plus ash except where stated otherwise.

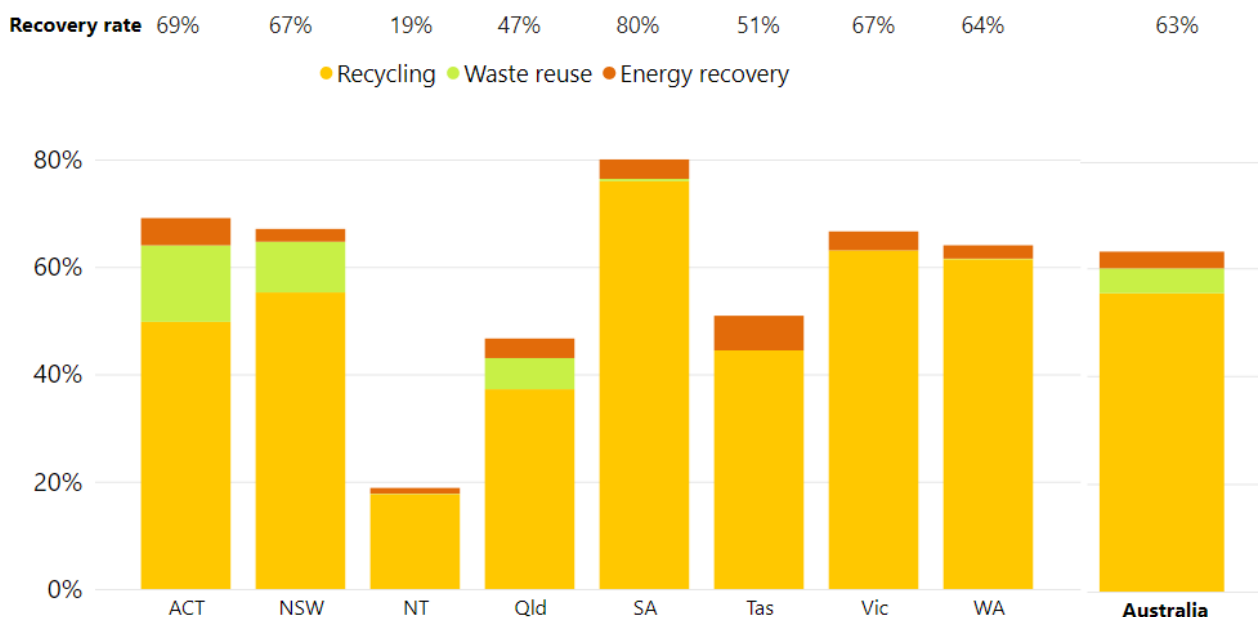
8.1 Resource recovery rates, 2020–21

The national resource recovery rate in 2020–21 was 63%, comprising 55% recycling, 5% waste reuse and 3% energy recovery rate of 3%. In 2016–17, the resource recovery rate was 61%.

Figure 28 shows the estimated resource recovery and recycling rates for each state and territory. The energy recovery component is nearly all associated with the use of landfill gas for generating electricity. Waste reuse is mainly ash and contaminated soil.

SA had the highest recovery rate at 80%. Following, in order, were the ACT (69%), NSW and Vic (67%), WA (64%), Tas (51%), Qld (47%) and NT (19%).

Figure 28 Resource recovery rates of core waste plus ash by jurisdiction, 2020–21



If ash is excluded, the resource recovery rates of the ACT, NT, SA and Tas are unchanged but the rates for NSW and WA fall to 64% and 62% respectively and those for Qld and Vic rise to 58% and 70% respectively.

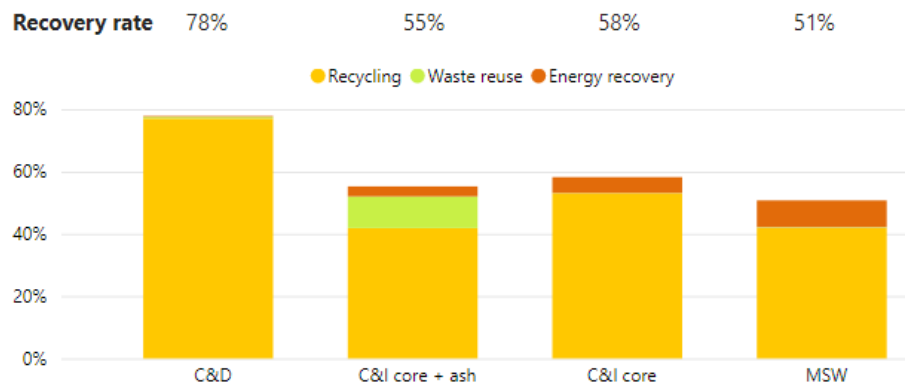
⁴⁰ The *Australian Standard for Waste and Resource Recovery Data and Reporting* goes a long way towards standardising the scope of national waste reporting. However, there may still be differences in the scope of state and territory data, for example in business-to-business recycling and organics processing. Caution should be exercised in comparing between jurisdictions.

⁴¹ In the *National Waste Report 2020*, resource recovery and recycling rate calculations ignored waste sent to treatment because the fate of these materials was not known. Treatment fates have subsequently been estimated so in this report, these measures include treatment.

Figure 29 shows resource recovery rates by source stream in 2020–21.

Recovery from the C&D waste stream was highest (78%), followed by C&I waste (shown separately with and without ash included, with rates of 55% and 58% respectively), and lastly MSW (51%).

Figure 29 Resource recovery rates by source stream, Australia 2020–21

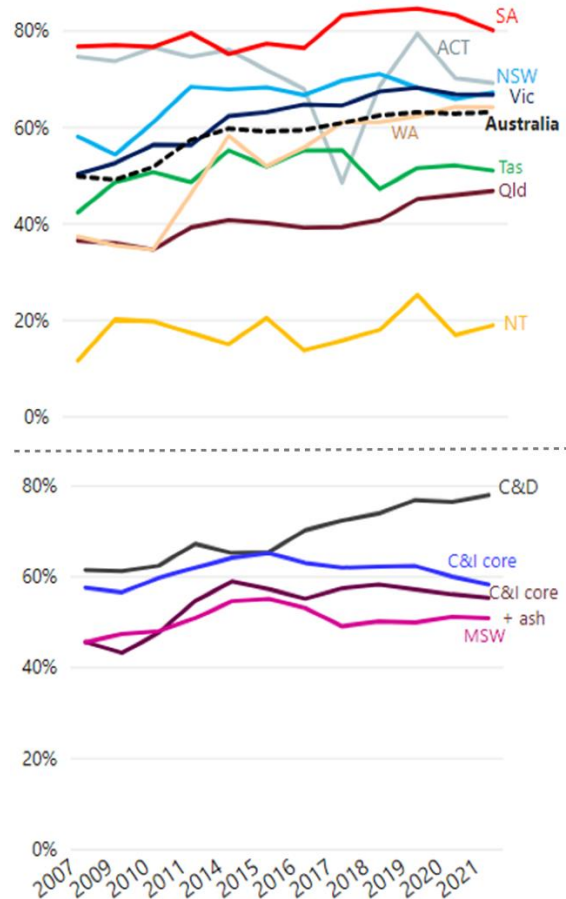


8.2 Trends in resource recovery rates

Figure 30 shows the trends in resource recovery rates by jurisdiction and by source stream over the 15 years from 2006–07 to 2020–21. The analysis includes core waste plus ash. In general, and across Australia in aggregate, recovery rates are trending upwards. Australia’s resource recovery rate rose from about 50% in 2006–07 to 61% in 2016–17 then to 63% in 2020–21.

The dip in SA’s recovery rate is due to changes in its data set in response to the *Australian Standard for Waste and Resource Recovery Data and Reporting*, which excludes some previously included recovery and added some previously excluded disposal.⁴² The sharp dip in the ACT recovery rate in 2016–17 is due to the ‘Mr Fluffy’ demolitions (see Feature 3 on page 45).

Figure 30 Resource recovery rate trends of core waste plus ash by jurisdiction (top) and stream (bottom), Australia 2006–07 to 2020–21



Examined by source (the lower part of Figure 30):

- C&D recovery rates continue to climb
- MSW recovery rates have stagnated, likely due to a mixture of lighter weight packaging, reduced quantities of printed material, and changes to the NSW data system
- C&I recovery rates including ash have declined from a peak of 59% in 2013–14 to 55% in 2020–21. When ash is excluded, the decline is similar but more pronounced.

⁴² The materials newly excluded from recovery were agricultural and forestry organics, which are deemed out-of-scope by the standard. The material newly included in disposal was uncontaminated fill material sent to landfill and not used for construction or cover purposes.

9 Waste materials analysis

This chapter reports on the status and trends of particular waste materials. It opens with an overview comparing waste generation, management method, recovery rate and trends by material category. It then addresses the status and trends in generation and management of key waste categories in turn. The discussion on organics is more detailed and covers a broad set of organic materials in addition to those included as core waste.

9.1 Waste materials analysis overview

Figure 31 shows the generation and management methods of the core waste categories and ash generated in Australia in 2020–21. The categories arising in the largest tonnages were building and demolition materials (33%), organics (19%), ash (16%) and hazardous waste (10%). Figure 32 shows the estimated resource recovery and recycling rates. Metals (87% recovery) and building and demolition materials (81%) were the highest two on both measures. The recovery rate for plastics was the lowest at 13%. The recycling rate for textiles was the lowest at an estimated 5% but this excludes charitable donations (see Section 9.10).

Figure 31 Waste generation and management method by material category, Australia 2020–21

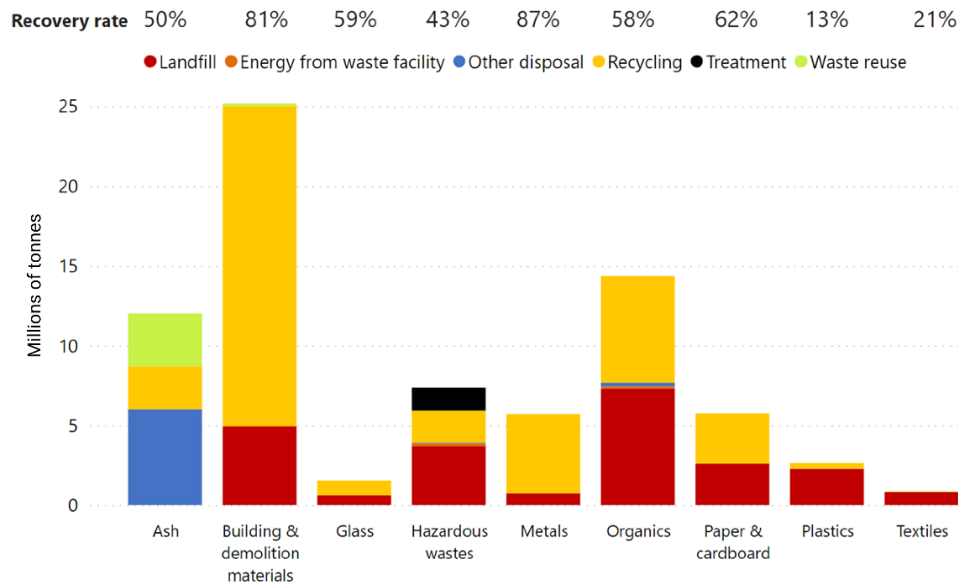


Figure 32 Resource recovery rates by material category, Australia 2020–21

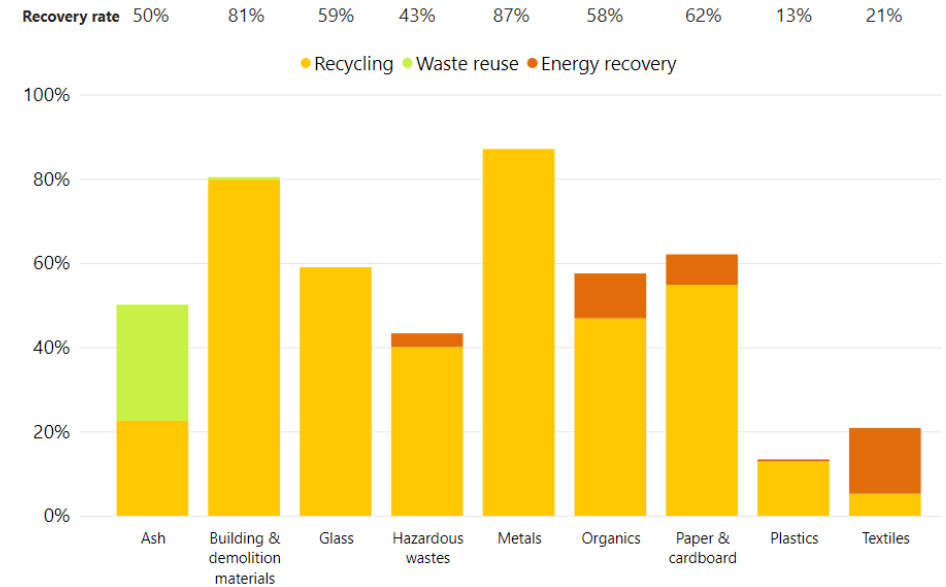
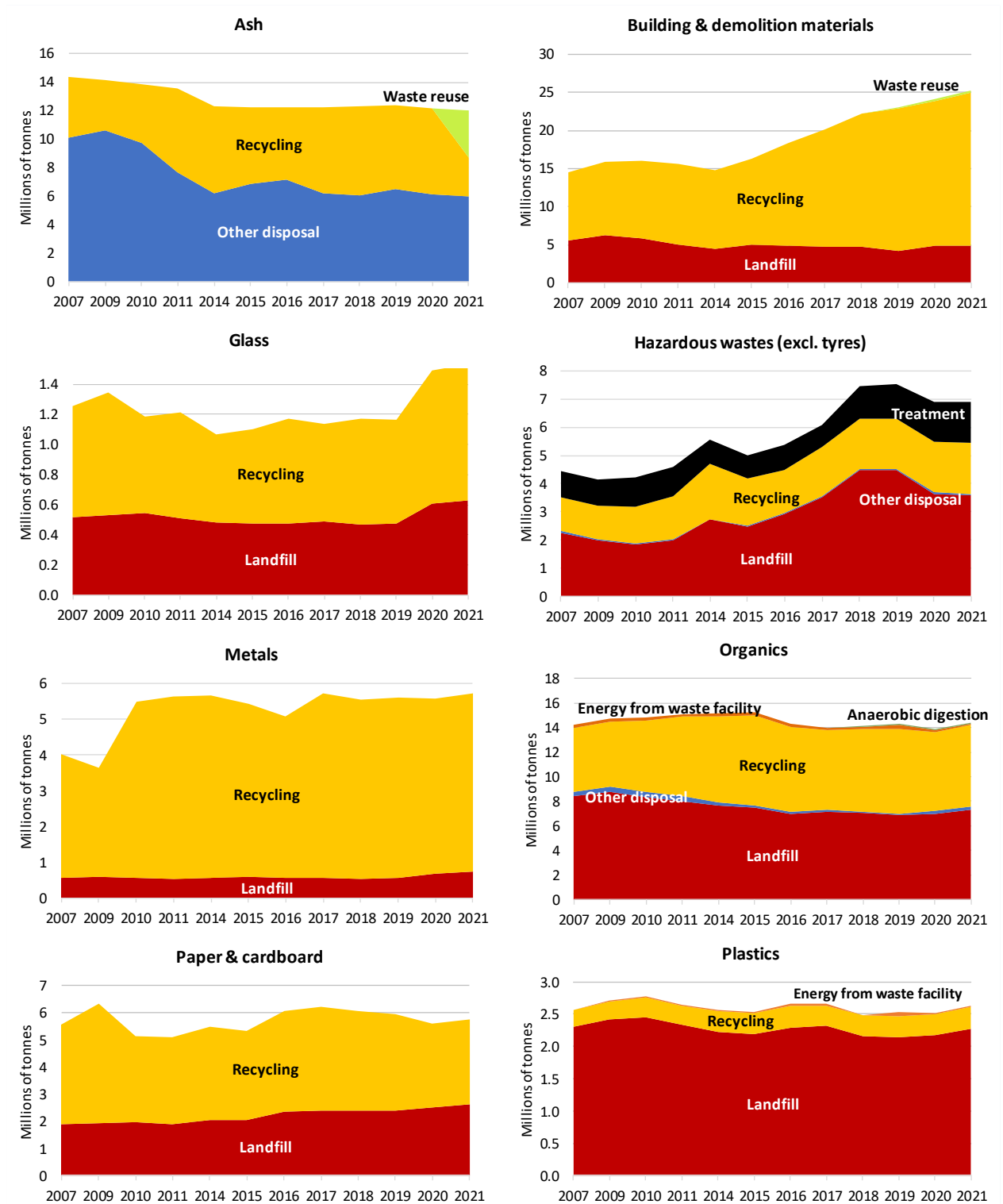


Figure 33 shows the trends in generation and management method for some important material categories. These are addressed in turn in the sections following. End-of-life tyres are generally included in the ‘hazardous waste’ category because of fire risk, but in this chapter are excluded from hazardous waste and addressed separately (Section 9.11). Waste reuse is calculated for the first time in this report and there is only one year of data in relation to ash.

Figure 33 Trends in the generation and management methods of key material categories, Australia 2006–07 to 2020–21



Note: ‘Other disposal’ is nearly all deposition in ash dams (for ash) and incineration (for other wastes).

9.2 Ash

Coal-based power accounted for 53% of Australia’s electricity in 2020–21 (DCCEEW 2022b) and generated about 12.0 Mt of ash, or 468 kg per capita, compared with 12.2 Mt in 2016–17 (ADAA 2022). This is about twice the quantity of all household waste recycled. About 89% is ‘fly ash’ – the lightweight particles that rise up with flue gases before being captured. The remainder is coarser ‘bottom ash’ that settles to the combustion chamber floor.

Half of the generated ash (6.0 Mt) was recycled or reused, up slightly from 49% in 2016–17. Its primary uses are site rehabilitation (this is the reuse component) and material substitutes in the mining and construction industries. Surplus material is typically placed in on-site ‘ash dams’ within the footprint of the coal fired power station. Australia’s rate of utilisation of coal ash is lower than the global average, and much lower than Japan (97%), China (70%) or Great Britain (70%) (REC 2020). Opportunities exist to recycle more ash, potentially making a major contribution to meeting the 80% recovery target. Internationally, ash repositories are sometimes harvested to supplement increased resource demand.

Figure 33 (p.43) shows the trend in ash waste generation and management method from 2006–07 to 2020–21.⁴³ Generation fell 16% over the period reflecting the decline in coal-fired power in Australia. Ash is produced by a host of other industrial operations but on a smaller scale. As energy-from-waste facilities become operational, there will be a need to recycle or dispose of their ash waste.

9.3 Building and demolition materials

In 2020–21 about 25.2 Mt, or 980 kg per capita, of building and demolition wastes were generated. This is about a 25% increase from 20.2 Mt in 2016–17. This material category includes heavy waste types such as concrete, bricks and rubble and is mostly recorded in the C&D stream. Building and demolition wastes are recovered from most large development projects (see Photo 6) but less so from smaller projects, from which mixed material loads are often sent directly to landfill. Development projects also often generate contaminated soils, which are dealt with under ‘Hazardous wastes’ (Section 9.5).

Photo 6 Alex Fraser recycling plant in Clarinda, Victoria, reprocesses demolition wastes including concrete, bricks, asphalt and mixed materials



Photo kindly provided by Alex Fraser

⁴³ Data estimated from calendar year reports.

Figure 33 (p.43) shows the trend in building and demolition waste generation and management methods from 2006–07 to 2020–21. Waste generation grew by about 74%, and nearly all of this growth occurred since 2013–14. This is associated with high rates of urban development, especially in Vic, NSW and SA.

The 2020–21 resource recovery rate for building and demolition materials was 80% (20.2 Mt), rising from 62% in 2006–07 and 76% in 2016–17. There are good markets for recycled concrete aggregate for use as road base, aggregates and hardstand areas. Recycled concrete aggregate consolidates well and forms a harder and more stable hardstand than pure virgin aggregate. There are also good options for recycling bricks and asphalt. Asbestos contamination risks are generally well-recognised and managed.

9.4 Glass

In 2020–21 about 1.54 Mt or 60 kg per capita of glass waste was generated, up 36% from 1.13 Mt in 2016–17. About three-quarters of this material was MSW. Figure 33 (p.43) shows the trend in generation and management method of glass from 2006–07 to 2020–21. The steep increase in 2019–20 was mostly reported by Victoria and was apparently due to processing of accumulated stockpiles. While this material is attributed to 2019–20, it was actually generated over previous years. The 2020–21 resource recovery rate was 59%, unchanged from 2006–06 but up from 57% in 2016–17.

Recycling rates have remained consistent and reasonably high given a relatively low commodity value per tonne compared to plastic or cardboard, and the difficulty of recovery from mixed waste loads. Waste sorting tends to break glass into small pieces that contaminate paper and cardboard recycling and are not easily recoverable. Victoria is establishing separate household glass collections to deal with this problem. Scrap glass can be colour separated, cleaned and used for making new glass packaging, and Australia’s major glass manufacturer Visy has promised to greatly increase the recycled content of its product. Container deposit systems tend to generate cleaner, sorted and higher value glass cullet, which may be displacing markets for mixed glass from domestic recycling. Another growing market for crushed glass is in civil construction projects.

Export of mixed glass has been regulated since January 2021 (see Section 10.3), requiring additional processing and licencing prior to export, the impact was small as little of this material was exported.

9.5 Hazardous waste (excluding tyres)

In 2020–21 Australia generated 6.89 Mt of hazardous wastes excluding tyres, or 268 kg per capita.⁴⁴ This is about 13% higher than in 2016–17, when about 6.49 Mt was generated. The bulk of this category comprised contaminated soils (including PFAS-contaminated soils, particularly in Vic.) and asbestos (which was also mostly soil contaminated with asbestos).

About 21% was sent for treatment processes that reduce or remove the hazard, facilitating recovery or disposal. When the outputs of treatment are added in, about 40% of hazardous waste was recycled, 1% was used for its energy value, and 59% was disposed of. Disposal was nearly all to landfill, with some incineration of medical wastes.

Feature 3 Asbestos insulation in the ACT

In 2014, the ACT Government announced the Loose-fill Asbestos Insulation Eradication Scheme, offering to buy all ACT homes affected by loose-fill asbestos (Mr Fluffy) insulation. Under the scheme, the ACT Government acquired, demolished and safely disposed of 1,029 affected homes and remediated each site. At the conclusion of the scheme approximately 399,000 tonnes of material and contaminated soil were disposed of at ACT’s landfill. Due to high increases in the value of land, the high cost of this operation to ACT residents has been recouped.

⁴⁴ When tyres are included, the 2020–21 quantity of hazardous waste generated was 7.37 Mt or 287 kg per capita.

Figure 33 (p.43) shows the trend in the generation and management method⁴⁵ of hazardous waste excluding tyres from 2006–07 to 2020–21. Quantities grew by 55% over the time series. Most of this occurred over the last six years, during which high levels of urban development generated increases of about 76% in contaminated soils and 130% in asbestos waste.

Hazardous waste generation and management are examined in detail in the Department’s *Hazardous Waste in Australia* report series, the latest version of which was produced in 2021.

9.6 Metals

In 2020–21 about 5.71 Mt, or 222 kg per capita, of metals waste was generated, unchanged from the tonnage in 2016–17. About half was from the C&I stream and a quarter each from MSW and C&D.

Figure 33 (p.43) shows the trend in metals waste generation and management method from 2006–07 to 2020–21. Waste generation and management have been relatively stable since 2009–10. The large jump from the preceding year followed price improvements. The 2020–21 resource recovery rate of 87% was higher than any other material category. Metal recycling is sensitive to global metals prices, which have been relatively strong in recent years. About half of Australia’s recovered metals are exported, including all aluminium and tin-plated steel cans. Some toxic (e.g. cadmium and cobalt) or precious (e.g. gold and palladium) metals are landfilled in composite material products such as electronic waste.

9.7 Organics

The analysis of organic wastes in this section focuses on ‘core’ organic wastes and then extends to ‘non-core’ organic wastes from primary production⁴⁶ and processing. This extension is more comprehensive than the previous national waste reports due to input from RMCG who are completing a study of primary production organic wastes for AgriFutures Australia. For clarity, in this report, organic wastes exclude plastics⁴⁷, paper, cardboard, textiles, leather and rubber.

Core organic wastes

The 2020–21 data show that about 14.4 Mt, or 562 kg per capita, of core organic wastes were generated, comprising about 4.7 Mt of food waste, 4.7 Mt of garden waste, 2.4 Mt of timber, 1.6 Mt of biosolids⁴⁸ and 0.94 Mt of other organics. This is an increase from 14.0 Mt generated in 2016–17. The MSW and C&I streams were the biggest organic core waste generators at 7.23 Mt and 6.29 Mt respectively. The recorded 2020–21 resource recovery rate of 58% and recycling rate of 47% are little changed since 2016–17. The longer-term trend presented in Figure 33 suggest recovery rates grew strongly in the early period of the national waste data set, up to about 2015.

Recovery of core organics included 5.44 Mt recycled via composting or mulching (see Photo 7), 1.2 Mt from the application of biosolids to land, 140 kt used as fuels, 75 kt processed via anaerobic digestion, and 1.41 Mt recovered through use of landfill gas to produce electricity.

⁴⁵ This chart shows the primary management method. Some material sent to the management method treatment would subsequently be sent for recycling or landfill.

⁴⁶ Includes waste from agriculture, aquaculture and forestry operations prior to leaving the farm, forest or fishing vessel. May include some wastes from on-farm packing (e.g. vegetable packing sheds) but excludes processing wastes.

⁴⁷ Chemically, plastic is organic because it is built from long-chain carbon to carbon and carbon to hydrogen bonds.

⁴⁸ The quantity of biosolids is obtained from a biannual survey by PSD (2022) assuming a moisture content of 79%.

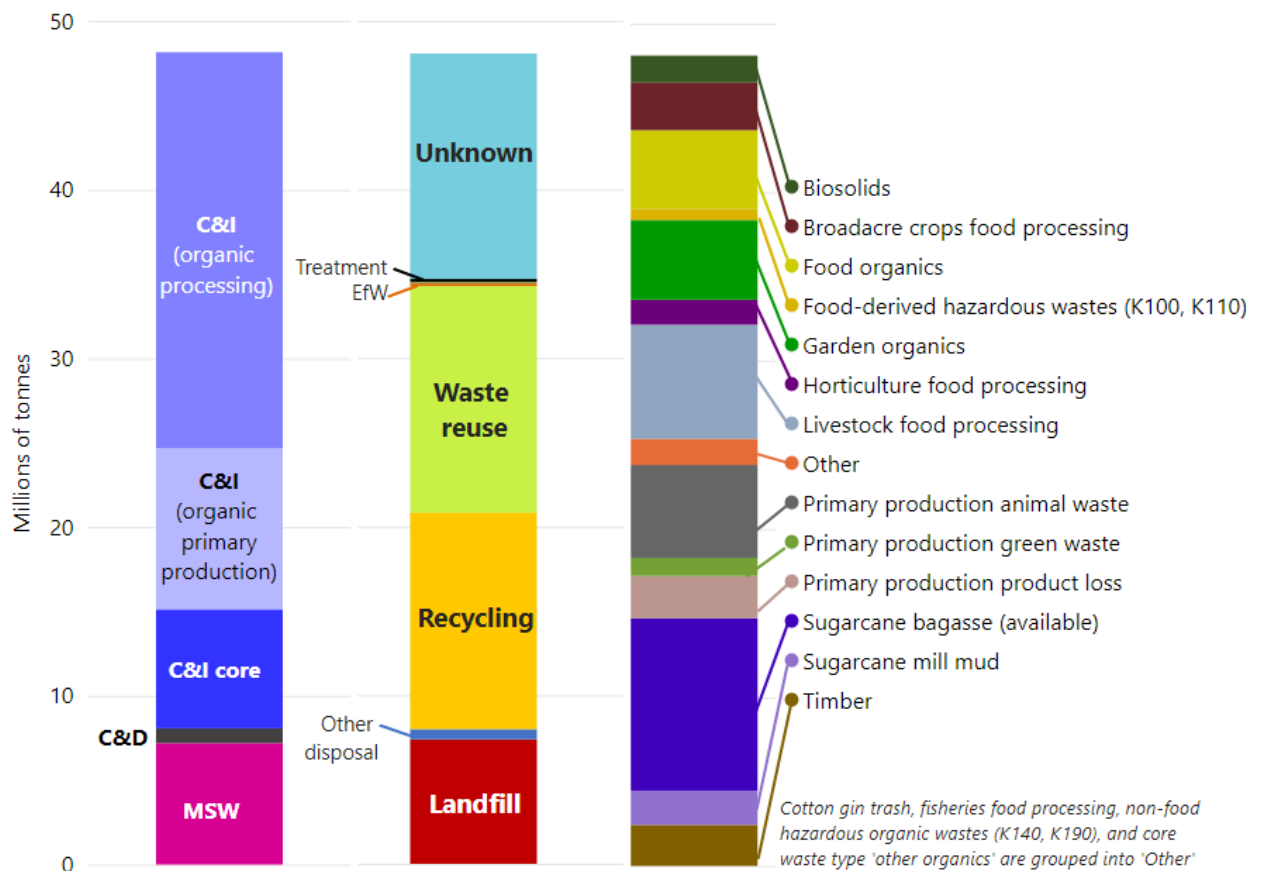
All organic wastes

Figure 34 shows the source stream, types and management methods of organic wastes more broadly. In addition to the 14.4 Mt of core organic wastes, it includes:

- 0.66 Mt of organic wastes that are recorded in the ‘hazardous’ category, comprising mostly grease trap sludge and waste from abattoirs and tanneries, nearly all of which was composted
- 9.55 Mt of primary production organic wastes from agriculture, forestry and aquaculture, and encompassing animal waste⁴⁹, sludges, garden waste, product loss⁵⁰ and actively managed⁵¹ residues
- 23.5 Mt of primary production processing waste including processing of horticulture crops, broadacre crops, livestock, cotton, sugar cane⁵² and fisheries (aquaculture and wild-caught).

This sums to 48.1 Mt of organic waste.

Figure 34 Generation of all organic waste by stream, management method and type, Australia 2020–21



⁴⁹ Animal waste includes mortalities from livestock and aquaculture, manures, animal bedding, egg waste and shell (from molluscs).

⁵⁰ Includes product left unharvested and losses from on-farm packing sheds.

⁵¹ Comprises residues from harvesting processes that are collected and/or consolidated such as forestry residues.

⁵² Includes only ‘available’ sugar cane bagasse, comprising the portion in excess of the amount estimated as required to power an efficiently operating sugar mill, based on calculations by the Queensland Government (2018a).

Organic waste from agriculture, aquaculture, and forestry

AgriFutures Australia⁵³ has established new guidelines for collection of waste data for the agriculture, forestry and fisheries sectors and produced the 2020–21 baseline used here. The data set is more extensive and accurate than that presented in the *National Waste Report 2020*.⁵⁴ Other than a minor proportion sent to landfill, all this material is non-core waste.⁵⁵

The quantity of primary production organic waste by category is set out in Tables 14, 15 and 16 by destination, jurisdiction category and industry. The data source is AgriFutures Australia.

Table 14 Primary production organic waste generation by category and management method (kt)

	Onsite beneficial reuse	Managed on site without benefit	Reused (animal feed)	Recovered for energy	Recycled	Landfilled ⁵⁶	Total
Animal waste	3,740	205	0	0	1,570	14	5,530
Sludges	197	4	0	0	0	0	201
Green waste	699	94	0	0	275	0	1,070
Product loss	2,060	82	275	0	89	0	2,510
Other organics	140	2	104	0	1	0	246
Total	6,840	387	379	0	1,930	14	9,550

Table 15 Primary production organic waste generation by category and jurisdiction (kt)

Waste type	ACT	NSW	NT	Qld	SA	Tas	Vic	WA
Animal waste	<1	1,460	30	782	659	320	1,820	455
Sludges	<1	24	<1	11	10	26	120	9
Green waste	<1	217	10	185	192	32	351	81
Product loss	<1	634	16	377	442	53	517	471
Other organics	<1	59	<1	23	26	48	60	31
Total	1	2,390	55	1,380	1,330	478	2,870	1,050

Table 16 Primary production organic waste generation by category and industry (kt)

Waste type	Horticulture /viticulture	Broadacre cropping	Livestock	Dairy	Forestry & logging	Aquaculture
Animal waste	0	0	3,620	1,900	0	13
Sludges	5	0	0	196	0	0
Green waste	1,070	0	0	0	0	0
Product loss	1,230	1,280	0	0	0	0
Other organics	1	1	0	0	244	0
Total	2,310	1,280	3,620	2,100	244	13

⁵³ AgriFutures Australia (unpublished at the time of writing).

⁵⁴ The one exception is fisheries by-catch, which is excluded from the new data set.

⁵⁵ Primary production waste sent to composting is also non-core waste, and is excluded from the data in Chapters 3 to 8.

⁵⁶ This component would be included in core waste.

Primary production processing waste

Processing of the products of agriculture, forestry and fisheries also generates significant organic wastes. The estimated quantity is estimated at 23.5 Mt. This is broken down by type in Table 17.

Table 17 Primary production processing waste total generation (kt)

Source	Quantity	Notes
Horticulture food processing	1,480	Data from 2021
Broadacre crops food processing	2,830	Data from 2021
Livestock food processing	6,770	Data from 2021
Fisheries food processing	16	Data from 2021
Available sugarcane bagasse	10,300	Data for 2020–21
Cotton gin trash	109	Data for 2022
Sugar cane mill mud	2,020	Data for 2019
Total available known in primary industries processing	23,500	

Source: *National Food Waste Strategy Feasibility Study (FIAL 2021) and Blue Environment research*

Food waste

The *National Food Waste Strategy* (Commonwealth of Australia 2017) sets a target of reducing food waste⁵⁷ by half by 2030. Progress is tracked in a separate process and the data applied differs from the data presented below.⁵⁸ Figure 35 illustrates food waste quantities by source stream, type and management method.

In 2020–21 there was about 31.2 Mt⁵⁸ of food waste comprising:

- 2.51 Mt of product loss, including fruit and vegetables lost in packing or grading, unharvested crop and harvesting residues left in-field
- 23.4 Mt of food processing wastes, including from fruit, vegetable, meat, fish, animal product and broadacre crop processing (listed in Table 17, but excluding cotton gin trash)
- 4.69 Mt of food waste from households (MSW) and businesses (C&I), either discarded in general putrescible garbage or recovered, mainly for composting or bioenergy facilities
- 0.67 Mt of food-derived hazardous waste, including from grease traps, abattoirs and tanneries.

Food waste from the primary production sector can be considered largely recovered. In 2020–21, about 2.06 Mt (82%) of primary production food waste was managed onsite for soil benefits (e.g. ploughed into the ground), 0.28 Mt (11%) reused (e.g. food donation, animal feed), 0.09 Mt (4%) composted or mulched, and 0.08 Mt (3%) managed onsite without benefit (e.g. stockpiled).

Of the estimated 23.4 Mt of food processing waste generated in 2020–21, the fate is known of only about half. Of this, about 6.33 Mt (27%) was reused, mainly through animal feed, 3.77 Mt (16%) was composted, and relatively minor quantities (2% or less) were disposed, sent to anaerobic digestion or recovered for energy. The fate of by-products of sugarcane production, including available bagasse⁵⁹ and mill mud, which made up 12.9 Mt (55%) of food processing waste, are not recorded.

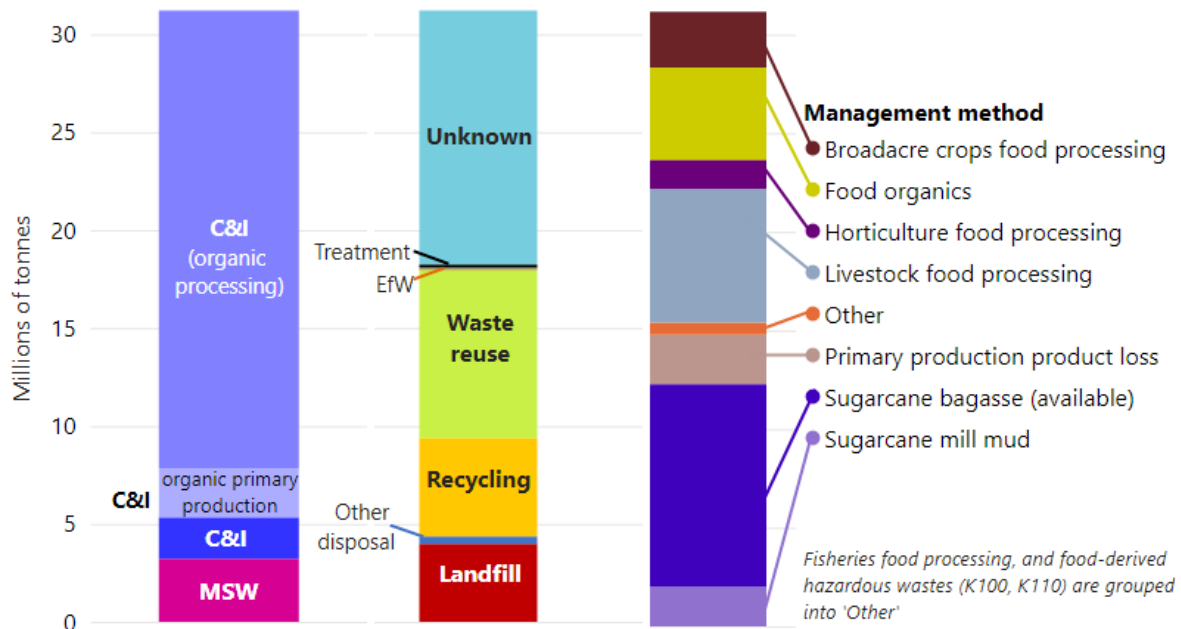
⁵⁷ Includes the edible and inedible parts of losses and discarded material.

⁵⁸ The data presented here includes core and non-core waste. It is based on AgriFutures Australia (unpublished), FIAL (2021), and updates of Blue Environment research presented in the *National Waste Report 2020*. The AgriFutures Australia approach involved a 12-month data collection process with interviews, survey and input from peak industry bodies. The data here differs from the FIAL data in including food waste reuse (e.g. food donation, animal feed) and sugarcane bagasse.

⁵⁹ The proportion of bagasse not required for use in for fueling an efficient sugar cane processing operation.

About 4.70 Mt of core food organics waste was generated from households and businesses in 2020–21, and most of this (3.90 Mt, or 83%) was sent to landfill. The remainder was recycled via composting or limited anaerobic digestion. Food waste generation from households and businesses remained approximately stable between 2016–17 and 2020–21 at about 180 to 190 kg per capita. Additionally, about 660 kt of food-derived hazardous waste was generated by businesses in 2020–21, 75% of which was sent for recycling and the remainder for treatment.

Figure 35 Generation of food waste by stream, management method and type, Australia 2020–21



Feature 4 Food waste reduction and recovery – opportunities and initiatives

Wasting food also wastes the inputs required to grow and process it, and is particularly problematic considering hunger and malnutrition in many parts of the world. Discarded food in landfill attracts pests and generates odour, leachate and greenhouse gases.

Some crop or product losses are inevitable, and on-farm management of organic residues is environmentally beneficial. However, losses can be excessive due to onerous product specifications and market competition as well as extreme weather events, labour shortages and export constraints. Crop wastage can be reduced through crop diversification and efficiencies, improved purchase and processing, conversion of food waste or by-products into new products, and changed consumer behaviours.

In accordance with the waste hierarchy, and as per the 2017 *National Food Waste Strategy*, efforts should be made to prevent food waste in the first instance. Food that does become waste should be recycled to improve soils or for energy recovery. Nationally, food waste recycling is challenged by limited access to suitable collection services (especially for retail premises), confusion or hesitation about using available services, and contamination from plastics and other materials that reduce demand for processed product and are costly to remove. Education, incentives and engagement are needed to encourage appropriate and responsible use of services.

Applying recycled organics to agricultural land improves soil health, increases soil carbon, reduces need for other inputs and can improve crop resilience and yield (Ricci-Jurgensen and Ramola 2020). A key barrier to greater agricultural use of recycled organics has been poor product quality, especially due to physical and chemical contamination. This is best addressed at the point of generation, but sophisticated screening is also needed.

FIAL (2019) has developed a roadmap for implementing the *National Food Waste Strategy* that addresses many opportunities for preventing food waste. In 2021, FIAL's *National Food Waste Strategy Feasibility Study* updated the baseline and tested different scenarios for Australia to meet its target to halve food waste by 2030.

In May 2021, the Australian Government announced \$67 million for the Food Waste for Healthy Soils Fund. With co-contributions from participating state and territory governments and industry, the fund aims to support diversion of organic waste from landfill by building new and expanding existing organic processing facilities, and support the creation of consistent, safe and high quality recycled organic products for soil improvement.

Photo 7 Aerial view of compost windrows at Jeffries in South Australia



Windrow composting lays mixed organics in rows typically 50 m long, covered in a layer of compost from previous batches. Specific temperature, moisture content, carbon to nitrogen ratio, acidity and oxygen conditions are maintained while the rows compost for six weeks, with a minimum of fifteen days of maintaining 55°C to achieve complete pasteurisation followed by a further six-week maturation period. Cured material is screened to remove contaminants such as glass, plastics, rocks and metals and sorted by particle size. Jeffries processes around 160,000 tonnes of organic waste a year. *Image kindly provided by Jeffries Group*

9.8 Paper and cardboard

About 5.76 Mt of scrap paper and cardboard was generated in 2020–21, or 224 kg per capita. This is down 12% from 6.19 Mt in 2016–17. About 60% was from the C&I stream and almost all the remainder from MSW.

Figure 33 (p.43) shows the trend in generation and management method of paper and cardboard. The total quantity increased by 3% between 2006–07 and 2020–21, equating to a per capita decline of about 17%. This fall is linked to the digitisation of information. Annual consumption of newsprint and magazine material has fallen over the last decade by 400 to 500 kt/yr and printing and writing papers by another 300 to 400 kt/yr. Packaging papers, including cardboard, have grown strongly but not enough to offset these major declines.⁶⁰

The estimated resource recovery rate was 62%, down from 72% in 2006–07 and 68% in 2016–17. The market for scrap paper and cardboard products has been strongly affected by Asian restrictions on waste imports since 2017–18. From July 2024, Australia will regulate paper and cardboard exports through the implementation of a licencing and declaration scheme (see Section 10.3).

⁶⁰ Commentary from Tim Woods of IndustryEdge, personal communication, 16 September 2022.

9.9 Plastics

About 2.63 Mt or 102 kg per capita of plastic waste was generated in 2020–21, down from 2.66 Mt in 2016–17. About half was from the C&I stream and most of the remainder was MSW.

Figure 33 (p.43) shows the trend in generation and management method of plastics from 2006–07 to 2020–21. Generation was stable over the period which, with a growing population, equates to a per capita decrease of 18%. Light-weighting is the likely cause.

The 2020–21 recovery rate for plastics was about 13%. This is nearly all recycling – less than 1% is recorded as used for its energy value, but this may be an underestimate as some data was unavailable due to commercial confidentiality. Landfills received an estimated 87% of plastics waste. The resource recovery rate for plastics was about 10% in 2006–07 and 13% in 2016–17.

Exports of scrap plastics to Asia grew in the early part of this century and by 2016–17 had become the dominant market for recovered material. Much of this material was in poorly sorted bales that were finished at lower cost overseas, resulting in poor environmental outcomes such as use as cheap fuel or unmanaged release into the environment (see Feature 5 below). Restrictions imposed by the receiving countries, starting with China in 2018, were matched by Australian export regulation. Exports are now much reduced (see Figure 39 on page 57) and regulated to sorted and processed product requiring no further preparation.

Major investments in plastics sorting and processing infrastructure are underway (see Section 13.5) to soak up the additional demand and meet Australia’s ambitious targets for recycling of plastic packaging (see Feature 8 on page 98). Greatly expanded recovery of soft or flexible plastics will be required (see Feature 5 below). Finding productive uses for recovered plastics in Australia is a key challenge. Use in civil infrastructure is a significant opportunity. Recovered plastics can also potentially be processed by chemical recycling, breaking them down into their chemical building blocks from which new plastics can be created.

Feature 5 Soft plastics recycling

‘Soft plastics’ are those that can be easily scrunched. They are widely used in packaging and agricultural applications. Recycling of these materials is limited, occurring mostly through business programs and supermarket drop-off (suspended at the time of writing). A major increase of soft plastics recycling is needed to meet the packaging targets (see Feature 8 on p.98). Some MRFs are now exploring soft plastics collection in the domestic kerbside recycling system.

Curbcycle’s ‘Curby Soft Plastics Program’ (see Photo 8) allows households to recycle their soft plastics by segregating them in a plastic bag, attaching a tag with a QR code and placing it their kerbside recycling bin. The bright yellow tag enables identification at the MRF. Separated material is transported to an iQRenew processing facility for automated sorting into the various polymer types suited to different offtake partners and manufacturing opportunities. The program has been adopted by the NSW Central Coast Council and is available in the Newcastle and Tamworth regions, with the aim of scaling up to more Councils.

Photo 8 The Curby soft plastics recycling program



Photos kindly provided by Curby and iQRenew.

9.10 Textiles, leather and rubber (excluding tyres)

Textiles, leather and rubber is single category with types comprising (1) textiles and (2) rubber and leather. Textiles includes a broad range of products including clothing, carpet, manchester and other products. In 2020–21, an estimated 860 kt, or 33 kg per capita, of textiles, leather and rubber waste were generated, up from about 780 kt in 2018–19. Almost two-thirds were from the C&I stream and most of the rest from MSW. The recycling rate for products in this category is estimated at only 5%, most of which is carpet recycling at a facility in Melbourne. The recovery rate is a much higher 21% because of collection and use of landfill gas generated from decaying textile wastes.

Textiles are the largest portion of this category. Import records show clothing is the largest component at 37%, manchester and homewares are 17% and carpet 10%. The management pathways of end-of-life clothing are described in detail in Feature 6. Trends are not included here as the historical data is not considered sufficiently reliable.

Feature 6 Clothing waste

Clothing is a major component of Australian textile waste. Reuse through donations greatly exceeds recycling.⁶¹ Clothing reuse is not included in the waste data sets in Chapters 3 and 5 to 8 but is described here for completeness.

About 300 kt of clothing is discarded each year, of which about 100 kt is sent to landfill and 200 kt is given to clothing donation or collection services (AFC 2022). The fate of estimated donations in 2020–21 is estimated as follows⁶²:

- 30-45 kt was resold in Australian charity shops, and a further 3 kt was used in charity welfare programs
- 3 kt was processed by Australian textile recyclers to rags, felting or raw chemicals using chemical recycling
- 35 kt was landfilled because it was poor quality or damaged
- 107 kt (nearly 60%) was exported, mostly to developing countries where some was sold as second-hand clothing.⁶³ Export of used clothing is common. European studies acknowledge this practice has complex social and economic implications.⁶⁴ Good sorting and grading reduces the likelihood of unintended consequences in recipient countries.

Photo 9 Baled waste textiles prepared for recycling in Australia



Upparel recycles clothes no longer suitable for reuse into super fine fibre material for use in pillows, insulation and furniture.

Image kindly provided by Upparel

9.11 Tyres

In 2020–21 about 478 kt, or 19 kg per capita, of end-of-life tyres were generated, up from 412 kt in 2016–17. The resource recovery rate was about 70%, split evenly between recycling and energy recovery. About 41% of end-of-life tyres are from passenger vehicles, 34% from trucks and 25% from off-road applications, especially mining.

Nearly all of the energy recovery was in export markets. The Australian Government regulated the export of end-of-life whole tyres in December 2021 to improve environmental and human health outcomes. Exports now comprise shredded tyre-derived fuels that meet a specification, whole tyres for reuse, large tyres for retreading or processed tyre material for recycling. Onshore processing of tyres is mostly for recycling. Markets include road construction additives, playground flooring, sports surfaces and retaining walls.

Trends in tyre flows are not included here as the historical data is not considered sufficiently reliable.⁶⁵

⁶¹ Based on the *Australian Standard for Waste and Resource Recovery Data and Reporting*, reuse differs from recycling in not requiring any reprocessing or remanufacture (although it can involve some repair).

⁶² Data from AFC (2022) and a range of other sources, including primary research by the project team.

⁶³ Section 11.3 shows details of scrap exports from Australia, including clothing.

⁶⁴ Baden and Barber (2005); Nordic Council of Ministers (2016); Institute of Economic Affairs (2021).

⁶⁵ Data on waste tyres has previously been reported within hazardous waste, as they are a fire hazard and listed as a 'controlled waste' in the *National Environment Protection (Movement of Controlled Waste between States and Territories) Measure*.

10 International comparisons and international trade

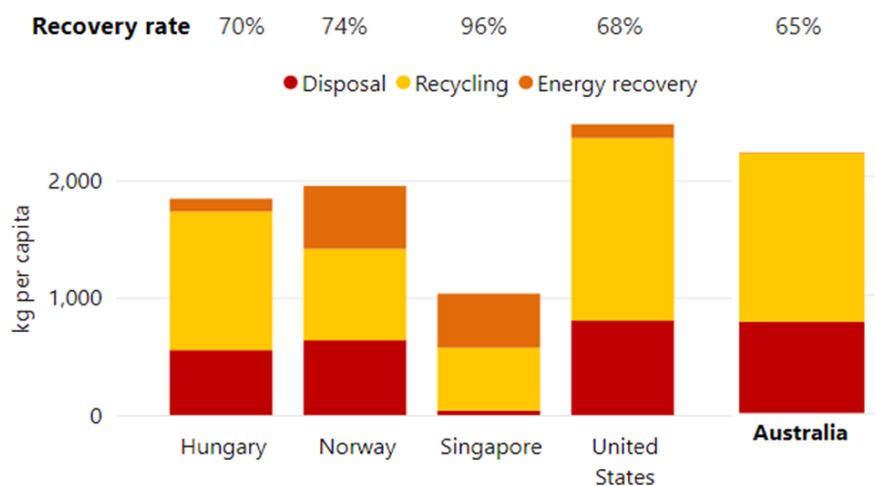
This chapter opens with comparisons between Australia’s waste generation, recovery and fates and those of other countries. The countries compared were selected based on the availability of detailed and up-to-date data. The first section compares overall core waste with other countries; the second section compares MSW only, since more countries report MSW data. The third and fourth sections report on international flows of waste and recovered material between Australia and other countries. Section 10.3 addresses exports and Section 10.4 covers imports.

A previous assessment of Australia’s national waste data found ‘the approach and presentation ... shows many similarities to examples from other nations ... , demonstrates international best practice in discussing waste policy and related factors ... and leads the field’ in relation to sensitive discussion of uncertainty, transparency in data handling, reporting by sub-regions (states and territories) and comparison with other countries (Resource Futures 2018).

10.1 Waste generation and fate comparisons

Figure 36 compares Australia’s overall waste generation, disposal, recycling and energy recovery with Hungary, Norway, Singapore and the USA. There is no international standard for waste data compilation so these countries’ reports differ in scope and method. For consistent comparisons, the Australian data presented is a modified version of core waste excluding hazardous waste, ash, and energy recovery from landfill gas. Table 18 lists the waste types included in the data for each analysed country. It highlights the wide variation in waste descriptions and categories between different countries.

Figure 36 Comparison of annual waste generation and fate per capita, Australia and selected countries



Values are indicative only. Data is compiled for different years (2018 to 2020) due to limited availability. Sources are – Australia: this project; Hungary: Hungarian Central Statistical Office (2022); Norway: Statistics Norway (2021); Singapore: Ministry of Sustainability and Environment Singapore (2021); United States – US EPA (2022).

The USA generated the highest amount of waste per capita at 2,480 kg, followed by Australia at 2,280 kg under the adjusted scope. Singapore generated only 1,040 kg of waste per person.

Australia’s adjusted recycling rate (65%) was similar to that of Hungary (64%) and the USA (63%). Singapore had the highest overall recovery rate (96%), followed by Norway (74%). These high recovery rates are both associated with high use of incineration to produce electricity, reflecting restrictions on landfill space in Singapore and European culture in Norway. Australia uses very little thermal energy from waste compared to most developed countries.

Table 18 Producing countries' descriptions of the wastes included in Figure 36

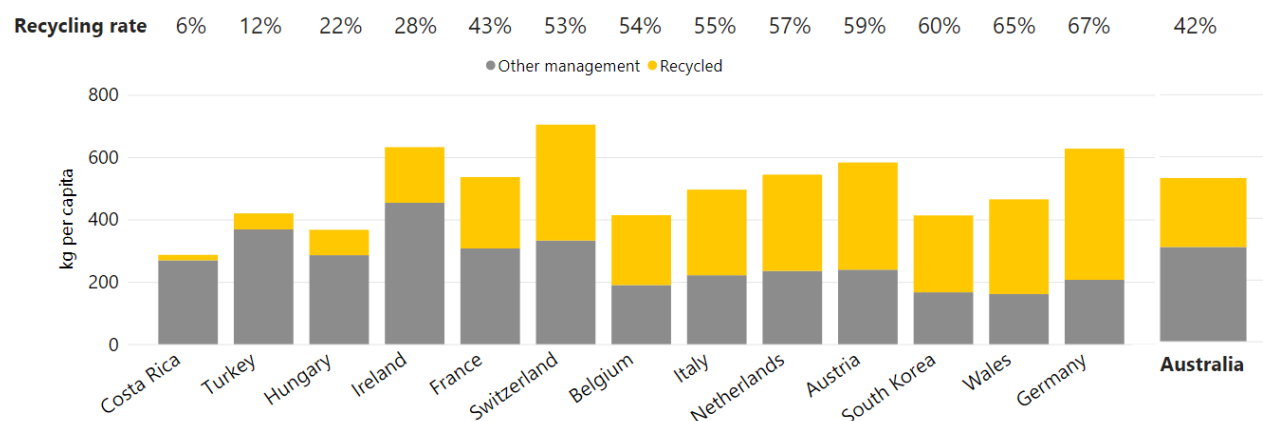
Country	Description of wastes included
Australia	MSW, C&I and C&D. Excludes ash from coal fired power generation, hazardous waste, and energy recovery from landfill gas recovery.
Hungary	MSW, C&D and industrial wastes from agricultural, food and economic waste. Excludes hazardous waste.
Norway	Organic waste, park and garden waste, wood waste, paper and cardboard, glass, metals, e-waste, concrete and bricks, cinders, dust, bottom ash and fly ash, plastic, rubber, textiles, discarded vehicles, mixed waste, and other waste. Excludes hazardous waste, radioactive waste, sludge, and slightly polluted soil.
Singapore	Ferrous metal, paper, cardboard, C&D, plastics, food, horticultural, wood, textiles and leather, non-ferrous metal, glass, scrap tyres and other including stones and ceramics. It excludes used slag, ash and sludge.
USA	C&D waste and household, commercial, business and institutional wastes.

10.2 Municipal waste generation and fate comparisons

Municipal solid waste is defined similarly in most countries, covering waste from households and some businesses collected by or counted by municipal authorities. This section compares MSW generation and fate in Australia to selected countries. It is based on data sourced from the Organisation for Economic Co-operation and Development (OECD 2022) which defines the recycling rate as the quantity of material to recycling, composting and anaerobic digestion divided by the total MSW generated (data for the countries presented in Figure 36 are unfortunately not available for this comparison). Due to limited data availability, some of the international data is from 2020 and some from 2019. Only material presented at regulated facilities is counted, which means waste generation may be understated in some cases. To maintain consistency, building and demolition wastes attributed to MSW were removed from the Australian data.

Figure 37 compares the adjusted Australian data to MSW generation in 13 selected countries. Germany had the highest reported recycling rate at 67% followed by Wales (65%) and South Korea (60%). Australia ranked 10th with an adjusted MSW recycling rate of 42%. Switzerland had the highest MSW generation per capita at 704 kg followed by Ireland with 632 kg. Australia ranked 7th with adjusted generation of 529 kg per capita while Costa Rica had the lowest reported rate at 287kg. Costa Rica also had the lowest recycling rate at 6%, behind Turkey at 12%. The low recycling rates for these countries reflect infrastructure and market limitations.

Figure 37 Comparison of MSW generation and recycling rates in Australia and selected countries

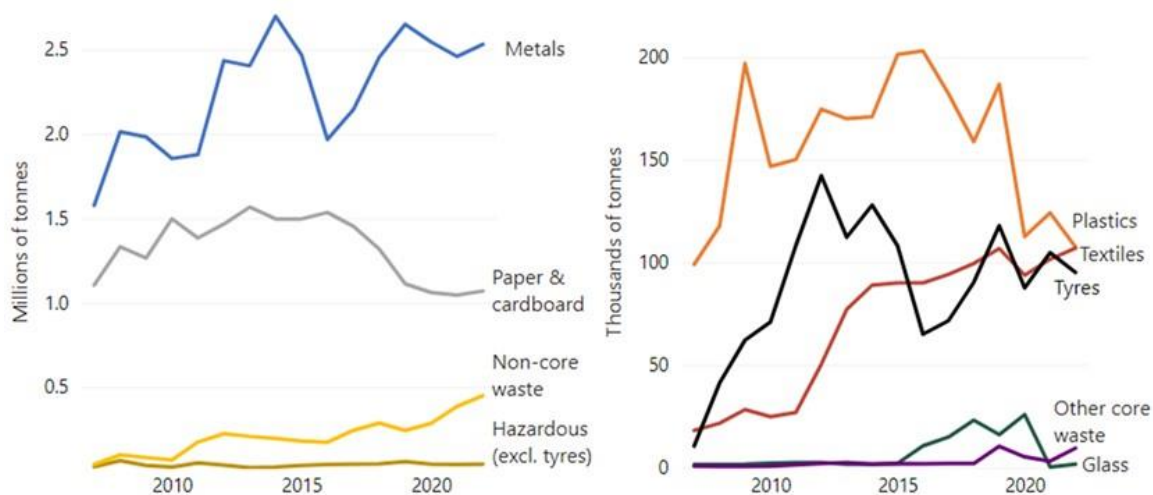


10.3 Exports of waste and recovered materials

Figure 38 shows trends in exports of apparent waste and recovered materials based on Australian Bureau of Statistics (ABS) data⁶⁶, from 2006–07 to 2021–22. Most Australian exports of waste and recovered materials go to Asia. China was the primary destination for many materials, especially domestic recyclables, until 2017–18. During that year China imposed import restrictions that drastically affected global markets for these materials. Since then, the main destinations by tonnage have been Indonesia, Vietnam, Bangladesh, India and Malaysia, with China at ninth highest. Total exports of waste and recovered materials have remained at around the 4.5 Mt/yr level since 2011–12.⁶⁷ This is about 6% of waste generation.

Australia has regulated its exports of glass, plastics and tyres, through the introduction of a licencing and declaration scheme. It will add paper and cardboard from July 2024. The rules generally aim to ensure that exports are ready for use as a product, and do not require further processing or cause environmental or human health problems overseas.

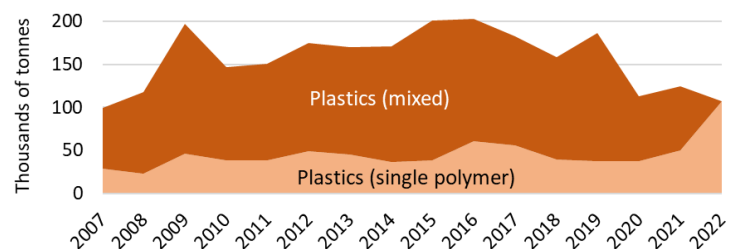
Figure 38 Trends in Australian exports of waste and recovered materials, 2006–07 to 2021–22



The largest export category is metals, which continue on a long-term upward trajectory. About 2.53 Mt of scrap metals were exported in 2021–22, mostly to Vietnam, Bangladesh and Indonesia. Exports of scrap paper and cardboard fell 26% since 2016–17 but have been stable over the past four years. Exports were 1.07 Mt in 2021–22 and went mostly to Indonesia.

Plastics exports were strongly affected by China’s import bans and then by Australia’s regulation of mixed plastics exports, which came into force in July 2021. Plastics exports fell markedly from a peak of 182 kt in 2016–17 to 107 kt in 2021–22. Figure 39 shows how additional on-shore sorting has greatly increased single-polymer exports.

Figure 39 Trends in Australian exports of scrap plastics, 2006–07 to 2021–22



⁶⁶ The Department produces monthly analyses and quarterly and annual reports on exports of waste and recovered materials to all fates. These analyses can be found [here](#) and form the basis of the assessment presented in this report.

⁶⁷ The previous National Waste Report showed only exports of core waste for recycling. This version shows all wastes and probable wastes.

Exports of end-of-life tyres barely featured in 2007 then expanded strongly until 2011-12 and have been volatile since.⁶⁸ In December 2021 Australia regulated the export of whole baled tyres, which were being commonly used as low-grade and environmentally damaging fuels. Tyre-derived fuel exports are now required to be shredded material meeting a specification. Reported exports in 2019-20 were 95.1 kt, mostly to India and Malaysia.

The remaining material streams shown in Figure 38 are: non-core waste, comprising rising amounts of agricultural processing wastes or products; apparent hazardous wastes, 95% of which are lead scrap and residues; scrap glass exports, which have fallen to less than 2 kt following Australia’s export regulations implemented at the start of 2021; and miscellaneous others, including e-waste.

Figure 40 shows that the quantities of waste-derived products exported for recovery are small compared with the total quantities recovered. For some materials; however, the exported proportion was substantial, as shown in Table 19.

Figure 40 Comparison of core waste exported and recovered by material category, Australia, 2020–21

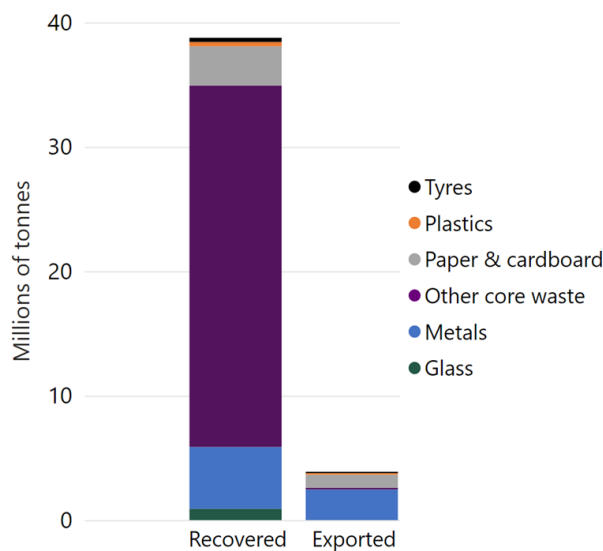


Table 19 Exports of core waste by category compared with total recovery, Australia 2020–21

Recovered material	Exported (kt)	Recovered ⁶⁹ (kt)	Estimated proportion exported
Glass	<1	906	0%
Metals	2,460	4,974	49%
Paper	1,045	3,155	33%
Plastic	124	351	35%
Tyres	105	335	31%
Other	146	29,047	1%
Total	3,880	38,800	10%

About 102 kt of discarded textiles were exported in 2020–21, almost entirely comprising clothing. More than two-thirds went to the United Arab Emirates, which hosts globally significant sorting and distribution operations. Textiles are excluded from Figure 40 and Table 19 because these exports are sourced from donations for reuse, and so are absent from the waste data included in this report.

⁶⁸ Review of other data sources suggests the ABS data on exports of waste tyres may not be comprehensive. This is probably because exporters do not always use export codes correctly.

⁶⁹ Comprises the tonnages allocated to the fates recycling and energy recovery excluding via landfill gas.

10.4 Imports of waste and recovered materials

Table 20 presents data on imports of waste and waste-derived materials into Australia based on ABS data. As the focus of this report is waste generated in Australia, waste imports are excluded from Chapters 3 to 9 to the extent they can be identified.

Table 20 Imports of waste and waste-derived materials into Australia, 2020–21

Recovered material	Quantity imported (kt)	Source and comments
Glass	16.7	Nearly all from NZ
Hazardous waste excluding tyres	23.8	Includes actual and potential hazardous waste. From a range of countries.
Metals	91.7	Mostly from NZ and the USA
Paper & cardboard	3.3	Mostly from the USA and Germany
Plastics	9.8	From a range of countries
Textiles, leather & rubber (excl. tyres)	3.9	From a range of countries
Tyres	13.9	From Malaysia and a range of other countries. Likely to be mostly reimported re-treads.
Non-hazardous slags	1,150	It is not always easy in trade data to distinguish wastes from by-products or secondary materials. This material is included as a non-core waste but may be better considered a by-product.
Organic waste products	882	It is not always easy in trade data to distinguish wastes from by-products or secondary materials. This material is included as a non-core waste but may be better considered a by-product.

11 The role of the states and territories

State and territory governments have primary responsibility for managing waste through legislation, policy, regulation, strategy and planning, as well as permitting and licensing waste transport, storage, treatment and disposal operations. The policy frameworks in each state and territory differ but there are common themes and directions, including commitments to safe management of waste, implementing the waste hierarchy (see Table 21 on p. 61) and transitioning to a circular economy (see Section 16.8).

Table 21 summarises selected elements of jurisdictional policy frameworks, considering:

- Landfill levies – most states and territories require landfills to pay some amount to their government for each tonne of waste deposited in landfill. The additional fee pushes up the cost of landfill, increasing the attractiveness of recycling. Often some of the collected funds are used to finance recycling infrastructure, programs or governance organisations. The table specifies levy rates operational in 2021–22.
- Strategy – most states and territories have a strategy to guide government organisations and industries in improving waste management. Strategies often set targets for resource recovery or other performance indicators. Table 21 specifies the strategy document and any targets within it.
- The status in each state and territory of various important or topical waste-related programs:
 - Does the jurisdiction require a deposit to be paid on drink containers to discourage littering?
 - Has the jurisdiction implemented bans on disposal of any wastes in landfill (other than liquids)?
 - Has the jurisdiction implemented bans on any single-use plastics?
 - Does the jurisdiction operate an internal tracking system requiring producers, transporters and receivers of hazardous waste to inform the environmental regulator of each movement of hazardous waste?
 - Does the jurisdiction provide a system for householders to dispose of waste chemicals locally?
 - Does the jurisdiction collect resource recovery data through a reporting program that is mandatory, rather than voluntary?

State and territory perspectives

States and territories were invited to contribute their perspectives on:

- data trends and their drivers
- major wins or initiatives (especially unique initiatives that other jurisdictions may seek to follow)
- policy developments
- current challenges and opportunities and significant events.

Their responses are given following Table 21.

Table 21 Summary of state and territory waste policy settings

Landfill levy (2021–22)		Strategy document (including headline targets)	Other policy settings	
ACT	Prices rather than levy amounts, as ACT owns the landfill and sets fees	<p><i>ACT Waste Management Strategy: Towards a sustainable Canberra 2011–2025</i></p> <p>Waste generation grows less than population. Expand reuse of goods. Waste sector is carbon neutral by 2020. Double energy generated from waste and recover waste resources for carbon sequestration</p> <p>Recovery rate increases to over 90% by 2025</p>	Container deposit scheme	Yes Introduced June 2018
	MSW \$100.20/tonne		Landfill bans	No
	C&I \$173.55/tonne		Single-use plastics ban	Yes Bags ban since 2011; some single use plastics including straws, oxo-degradable plastics, cutlery, stirrers and polystyrene containers and cotton buds with plastic sticks banned from July 2022; plastic takeaway containers, EPS packaging and microbeads mid-2023
	Mixed C&I with >50% recyclable material \$236.75/tonne		Internal hazwaste tracking	No
			Household chemical collections	Yes Free drop-off at two facilities
			Mandatory data collection program for recycling	Yes
NSW	<i>Metro levy area:</i>	<p><i>NSW Waste and Sustainable Materials Strategy 2041</i></p> <p>By 2025:</p> <ul style="list-style-type: none"> phase out problematic and unnecessary plastics reduce litter by 30%. <p>By 2030:</p> <ul style="list-style-type: none"> reduce per capita waste generation by 10% average recovery rate of 80% introduce litter reduction target of 60% triple plastics recycling rate halve organic waste to landfill net zero emissions from organics to landfill. <p><i>NSW Plastics Action Plan</i></p> <p><i>NSW Waste and Sustainable Materials Strategy: A guide to future infrastructure needs</i></p> <p><i>NSW Circular Economy Policy Statement: Too Good To Waste</i> outlines steps to incorporate circular economy principles into its 20-year waste strategy.</p>	Container deposit scheme	Yes Introduced December 2017
	Waste \$147.10/tonne		Landfill bans	No
	Virgin excavated natural material \$132.40/tonne		Single-use plastics ban	Yes Lightweight plastic bags from June 2022, single-use plastic straws, stirrers, cutlery, bowls, plates, cotton buds, and expanded polystyrene food service items and microbeads from November 2022
	Prescribed shredder floc \$84.60/tonne		Internal hazwaste tracking	Yes
	<i>Regional levy area:</i>		Household chemical collections	Yes CleanOut events and Community Recycling Centres
	Waste \$84.70/tonne		Mandatory data collection program for recycling	Yes EPA online Waste and Resource Reporting Portal to facilitate Waste Contribution Monthly Reports
	Virgin excavated natural material \$76.20/tonne			
	Prescribed shredder floc \$48.70/tonne			
Coal washery rejects \$15.20/tonne				

Landfill levy (2021–22)		Strategy document (including headline targets)	Other policy settings	
NT	No landfill levy.	<p><i>Waste Management Strategy for the Northern Territory 2015–2022</i> No specific targets are included in the strategy.</p> <p><i>Northern Territory Circular Economy Strategy 2022–2027</i> Strengthen regulatory waste framework, including for hazardous waste. Phase out and ban certain problematic single use plastic products by 2025.</p>	Container deposit scheme	Yes Introduced January 2012
			Landfill bans	No
			Single-use plastics ban	Yes Bags ban since 2011, single-use plastic straws, stirrers, cutlery, bowls, plates, and expanded polystyrene consumer food containers and goods packaging, microbeads in health products and helium balloons by 2025
			Internal hazwaste tracking	No
			Household chemical collections	Yes Drop-off at Shoal Bay Transfer Station and Alice Springs Regional Waste Management Facility
			Mandatory data collection program for recycling	No
			Qld	<p><i>General waste:</i> MSW, C&I, C&D \$85/tonne</p> <p><i>Regulated waste:</i> Category 1 \$165/tonne Category 2 \$115/tonne</p>
Landfill bans	No Proposed landfill ban on organic (compostable material) by 2030			
Single-use plastics ban	Yes Single-use lightweight bags ban since 2018; straws, stirrers, plates and cutlery, unenclosed bowls, EPS food and drink containers from September 2021			
Internal hazwaste tracking	Yes			
Household chemical collections	Yes Drop-off availability subject to arrangements by individual councils			
Mandatory data collection program for recycling	Yes Annual reporting requirements as per <i>Waste Reduction and Recycling Act 2011</i>			

Landfill levy (2021–22)		Strategy document (including headline targets)	Other policy settings		
SA	<i>Metro Adelaide:</i>	<p><i>South Australia’s Waste Strategy 2020–25</i></p> <ul style="list-style-type: none"> zero avoidable waste to landfill by 2030 5% reduction in waste generation per capita (from 2020 baseline) 2025 landfill diversion targets for metro areas: <ul style="list-style-type: none"> 75% for MSW 90% for C&I 95% for C&D. <p>Regional Waste Management Plans in place for non-metro areas by 2023 with progressive landfill diversion targets.</p>	Container deposit scheme	Yes Introduced 1977	
	Solid waste		\$146/tonne	Landfill bans	Yes Ban on some hazardous, problematic and recyclable materials, including most e-waste
	Shredder floc		\$73/tonne	Single-use plastics ban	Yes Bags ban since 2009; straws, cutlery and stirrers from March 2021; EPS food and beverage containers, oxo-degradable plastics from March 2022
	<i>Non-metro Adelaide:</i>			Internal hazwaste tracking	Yes
	Solid waste		\$73/tonne	Household chemical collections	Yes Statewide household chemical drop-off
	Shredder floc		\$36.50/tonne	Mandatory data collection program for recycling	Yes
Tas.	Previously voluntary levy adopted by regional waste groups at levels of \$0 to \$7.50/tonne	<p><i>Draft Waste Action Plan (2019)</i> (subject to change before finalisation)</p> <ul style="list-style-type: none"> introduce a waste levy by 2021 introduce CDS by the end of 2022 have the lowest littering incident rate in Australia by 2023. <p>By 2025:</p> <ul style="list-style-type: none"> 100% of packaging is reusable, recyclable or compostable 5% reduction in waste generation per person 40% average recovery rate for all waste 25% reduction in volume of organics waste sent to landfill. <p>By 2030:</p> <ul style="list-style-type: none"> 10% reduction in waste generation per person 80% average recovery rate for all waste 50% reduction in volume of organics waste sent to landfill phase out unnecessary plastics. 	Container deposit scheme	No Due to begin 2023	
	The Waste and Resource Recovery Act 2022 introduced Tasmania's first statewide levy of \$20/tonne on 1 July 2022. The levy will be increased in 2-yearly intervals:			Landfill bans	No
	<ul style="list-style-type: none"> increase to \$40/tonne 1 July 2024 increase to \$60/tonne 1 July 2026. 			Single-use plastics ban	Yes Bags ban since 2013 By-law implemented in the City of Hobart from July 2021 for certain single-use plastic food packaging
				Internal hazwaste tracking	No Framework in place but not operational
				Household chemical collections	Yes Selected regional programs
				Mandatory data collection program for recycling	Yes Began in July 2022

Landfill levy (2021–22)			Strategy document (including headline targets)	Other policy settings		
Vic	<i>Metro and provincial:</i>		<i>Recycling Victoria: A new economy (2020)</i> <ul style="list-style-type: none"> 100% of households to have access to separate glass services by 2027 introduce CDS by 2023. By 2025: <ul style="list-style-type: none"> 72% waste diversion from landfill 50% reduction in volume of organics waste sent to landfill. By 2030: <ul style="list-style-type: none"> 15% reduction in waste generation per capita 80% waste diversion from landfill 50% reduction in volume of organics waste sent to landfill 100% of households have access to food and garden organics services or local composting. 	Container deposit scheme	No	Due to begin 2023
	MSW	\$105.90/tonne		Landfill bans	Yes	'Category A' hazardous waste, paint, industrial transformers, grease trap waste, oil filters, whole tyres, large containers, e-waste ban
	C&I and C&D	\$105.90/tonne		Single-use plastics ban	Yes	Bags ban since 2019; straws, cutlery, plates, drink-stirrers, EPS food and drink containers, and cotton bud sticks from February 2023
	<i>Rural:</i>			Internal hazwaste tracking	Yes	
	MSW	\$52.95/tonne		Household chemical collections	Yes	Statewide program
	C&I and C&D	\$93.19/tonne		Mandatory data collection program for recycling	No	
	<i>Priority waste:</i>					
Category B – includes wastes from manufacturing industries and contaminated soils		\$262.22/tonne				
Category D – industrial waste that is soil		\$125.90/tonne				
Soil containing asbestos and packaged waste asbestos		\$31.49/tonne				
From 1 July 2021, 'priority waste' replaced 'prescribed industrial waste' and 'waste levy' replaced 'landfill levy'.						
WA	Putrescible	\$70/tonne	<i>Waste Avoidance and Resource Recovery Strategy 2030</i> From 2020, recover energy only from residual waste. By 2025: <ul style="list-style-type: none"> 10% reduction in waste generation per capita increase material recovery to 70%. By 2030: <ul style="list-style-type: none"> less than 15% of waste generated in metro regions is landfilled all waste is managed and/or disposed to better practice facilities 20% reduction in waste generation per capita increase material recovery to 75%. 	Container deposit scheme	Yes	Introduced October 2020
	Inert	\$105/m3 ~ \$70/tonnes		Landfill bans	No	Ban on e-waste to be implemented by 2024
				Single-use plastics ban	Yes	Bags ban since 2018; straws, stirrers, cutlery, plates, unlidged bowls and containers, shopping bags, cold beverage cups, EPS containers and helium balloon releases from January 2022; enforced July 2022 and cups on 1 October 2022. Further bans under Stage 2 come into effect from February 2023.
				Internal hazwaste tracking	Yes	
				Household chemical collections	Yes	Eight metropolitan and five regional, permanent household chemical drop-off points
				Mandatory data collection program for recycling	Yes	

11.1 Australian Capital Territory perspective

The ACT Government has a strong commitment to addressing climate change, with 100% of the Territory’s grid-based electricity derived from renewable sources and a commitment to net zero emissions by 2045. Our journey towards a more sustainable city continues with planning for a circular economy strategy and supporting legislation.



Key waste management initiatives delivered over the past two years in the ACT are:

- introduction of the *Plastic Reduction Act 2021*, banning single-use plastic cutlery, beverage stirrers, expanded polystyrene containers for serving food or beverages, single-use plastic straws (with exemptions for those who need them), cotton buds with plastic sticks and all oxo-degradable products
- banning additional single-use plastic items at identified events
- piloting food organics and garden organics (FOGO) collection and recovery across 5,000 households, with contamination rates below 0.1%
- introduction of a bulky waste collection service in July 2021, which currently achieves a 39% resource recovery rate
- creation of approximately 2.4 million cubic metres of additional landfill capacity.

The ACT continued to support and deliver a number of priorities in 2021–22 including:

- ongoing contribution to the *National Waste Policy* agenda through the Environment Ministers’ Meeting and participation in related interjurisdictional working groups
- improving the ACT Container Deposit Scheme redemption rate through targeted advertising and expanded numbers and types of collection points. Currently 75% of containers are returned via the scheme, an increase of 20% in two years
- continuation of landfill gas capture, creating enough energy to power 4,734 homes
- Recycling 43,742 mattresses from the ACT and the surrounding NSW region in 2020–21.
- undertaking a range of trials including a ‘Love Food Hate Waste’ food waste avoidance pilot; corflute recycling; and relocation of charity donation bins to recycling centres to reduce illegal dumping
- continuing to fund the not-for-profit organisation GIVIT, which acts as a virtual warehouse, matching public donations of items with individuals who need them.

Future priorities for the ACT Government include:

- ongoing work to roll-out FOGO collection to all ACT households, supported by building a large-scale processing facility
- releasing a draft ACT Circular Economy Strategy in late 2022 and related legislation in 2023
- delivery of a new materials recovery facility to increase recovery of suitable recyclable materials
- delivery and implementation of a Waste Regulation Management System, increasing the regulation and compliance of ACT waste businesses through improved data collection
- preparing a high-level waste and resource recovery infrastructure plan to assist with securing adequate land allocation, funding and cross-agency collaboration.

11.2 New South Wales perspective

Towards a circular economy

In June 2021, the NSW Government released the *NSW Waste and Sustainable Materials Strategy 2041 Stage 1: 2021–2027*, accompanied by the *NSW Plastics Action Plan* and a guide to future infrastructure needs.



Under the Strategy, [\\$356 million is being invested](#) over five years on programs that aim to minimise waste and value resources while decarbonising our economy. These include:

- phasing-out problematic single-use plastic items
- planning for our strategic waste and resource recovery infrastructure needs
- reducing organic waste sent to landfill
- reducing carbon emissions associated with the use and management of materials, including through stimulating use of low-carbon recycled materials in the NSW economy
- leveraging government procurement to increase the use of recycled content.

The Strategy adopts the targets endorsed by the NSW Government under the *National Waste Policy Action Plan* and establishes new targets for litter reduction and plastics recycling.

The NSW Government is also taking steps to address emerging waste streams such as solar panels and their associated batteries. NSW has [provided over \\$9m in grants to address this](#), including funding towards the first three recycling facilities in NSW that will process solar panels and batteries.

Setting the groundwork for a circular economy

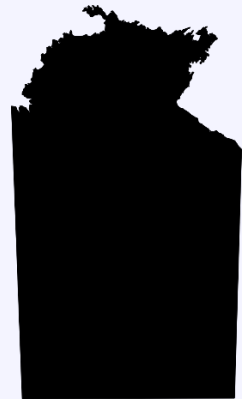
Since 2012, NSW has invested \$802.7 million under *Waste Less, Recycle More* to support infrastructure, education, innovation and regulation to increase waste avoidance and recycling, manage problem waste, and reduce litter and illegal dumping. [As at June 2021](#), *Waste Less, Recycle More* enabled:

- 2.7 Mt of additional recycling capacity
- support for over 37,000 businesses to reduce and recycle waste through Bin Trim
- almost 30,000 tonnes of household problem waste collected through Household Chemical CleanOut events and 96 Community Recycling Centres
- a 43% reduction in litter through prevention and enforcement programs.

Since December 2017, Return and Earn – the NSW container deposit scheme – has reduced 52% of beverage container litter in NSW, and enabled 755 kt of material collected through the scheme to be recycled. In March 2022, a PET recycling plant in Albury opened that is capable of processing 1 billion plastic bottles each year. All PET bottles collected under the scheme are now being recycled into new bottles and beverage packaging through this plant. The NSW Government also successfully negotiated an extension to the current Network Operator, TOMRA Cleanaway's contract to December 2026. This will lead to a greater number of return points across NSW and further automation, providing more convenient access to the scheme.

11.3 Northern Territory perspective

Waste generation in the NT is heavily influenced by major construction activity, the tourism sector and extreme weather events. During this period there has been a reduction in C&D waste generation and an increase in MSW generation compared to pre-COVID-19 levels. Consecutive poor wet seasons and corresponding low numbers of cyclonic events has resulted in no emergency waste disposal at landfills across the Territory.



The NT Container Deposit Scheme supports high levels of recycling with over 70% of all containers sold in the NT recovered. During 2020–21, 29% of all containers were redeemed at approved depots outside Greater Darwin, representing a 2% decrease over the previous financial year. Public access to the CDS in regional and remote areas has increased through a new depot in Borroloola and more mobile services. Aluminium, glass and PET containers account for most container sales and have high return rates.

The NT EPA's electronic tracking system for hazardous waste entering and leaving the NT was implemented in January 2021, with largely positive feedback from industry. The system will assist the NT EPA to meet national and international hazardous waste reporting requirements and may help identify areas for improved environmental regulation.

The NT Circular Economy Strategy 2022–2027 was published in May 2022 to guide implementation of the National Waste Action Plan by:

- identifying options to reduce use of single use plastics
- industry development and infrastructure to facilitate the growth of the waste sector
- initiating a feasibility study on use of crumbed rubber in road surface bitumen
- identifying opportunities for using recycled material in government procurement and construction and maintenance activities
- strengthening legislative frameworks to minimise landfilling of recyclable material.

The NT has a large number of unlicensed landfills servicing remote towns, roadhouses, Aboriginal communities and regional industrial sites. Because they have no approvals these types of landfills are not routinely recorded and are often geographically remote and resource intensive to visit. The Environmental Operations team recently inspected over 20 of these disposal sites, and found instances of waste tyres, industrial metal and building products, whitegoods and e-wastes, listed and hazardous wastes (oils, chemicals, paints etc), animal carcasses and asbestos in remote landfills. These findings will inform future compliance planning and strategies to improve landfill management and promote circular economy opportunities.

11.4 Queensland perspective

Queensland continues to implement initiatives under its *Waste Management and Resource Recovery Strategy*, which was released in July 2019.

In 2020–21, the Queensland Government announced the introduction of a ban on the supply of single-use plastic straws, stirrers, plates, unenclosed bowls and cutlery. This followed overwhelming support from the public consultation process. Expanded polystyrene takeaway food containers and cups were added to the ban following feedback during



consideration by the Agriculture, Health and Environment Parliamentary Committee. Exemptions that allow specified businesses to supply an otherwise banned item recognise people’s health and disability needs. The ban also exempts items that are made from compostable plastic that meet the requirements of the relevant Australian Standards.

Further on plastics, the Queensland Government continued to support the *Plastic Free Places* program in Queensland, with additional communities entering the program in 2020–21. Product stewardship programs remained a continued focus, where the Queensland Government continued its support to the national waste agenda and the ongoing development of these programs, including for mattresses, agricultural plastics and packaging.

Also, consultation was completed on a draft Organics strategy. The strategy aims to improve the management of organics in Queensland from ‘paddock to plate’ and support achieving *National Waste Policy Action Plan* and *National Food Waste Strategy* targets.

The government also started work on developing e-products and textiles action plans, co-designed with key stakeholders and particular focus on circularity, including avoidance, reuse, repair, refurbishment and remanufacture opportunities.

11.5 South Australian perspective

South Australia continues to perform well in its efforts to recycle material and reduce landfill disposal. However, the industry is challenged by volatile international prices and adjusting to waste export regulations. Household waste generation remain elevated due to COVID-19.



Key trends and issues

Waste levy initiatives are improving certainty, innovation and growth in the waste and resource recovery sector and the green economy. They include:

- an ongoing \$0 levy for packaged asbestos waste to promote its safe and lawful disposal
- 50% levy waiver for shredder floc from scrap metal recycling activities.

Major initiatives led by Green Industries SA

- the SA Waste Strategy 2020–2025 provides a framework for a transition to the circular economy
- national leadership to phase out certain single-use plastic products in response to strong community support (GISA 2021a)
- South Australia’s first comprehensive food waste strategy (GISA 2021b)
- co-investment in new and expanded infrastructure, financial incentives to develop markets, sustainable procurement, evidence-based community education and commercialisation of innovation.

Major initiatives led by the Environment Protection Authority

- Implementation of the *Single Use and other Plastic Products (Waste Avoidance) Act 2020*, which prohibited the sale, supply or distribution of single use plastic straws, cutlery
- release of the Container Deposit Scheme discussion paper (EPA SA 2021a) to realise the extended producer responsibility objectives for litter reduction and beverage container material recycling

- Release of the EPA information sheet (EPA SA 2019): Financial assurances and stockpiling – who, when, what and how much to strengthen our ability to regulate stockpile risks.

Policy developments

The final stages of EPA’s Waste Reform Program included regulations for:

- mass balance reporting on waste and other materials on licensed sites to identify further resource recovery and investment opportunities
- a modernised approach to how the waste levy is applied at landfills.

Five strategic priorities under Green Industries SA’s Strategic Plan 2021–25 are:

- circular products and services
- circular consumption
- circular resource recovery
- circular sectors
- circular capacity.

Major challenges and opportunities

- building the resilience, capabilities and competitiveness of the state’s waste management and recycling industry
- being more innovative with our resources and creating a circular culture to support economic growth and positive environmental outcomes
- supporting the sector’s adaptation to ongoing COVID-19 disruptions and the new national regulations phasing in licensing requirements for exporting plastic, paper and cardboard, glass and tyres.

Significant events

- COVID-19 – changes to the type and generation of waste with significant changes in kerbside bin collections as more householders carried out home clean-ups.

11.6 Tasmanian perspective

Data trends and drivers

As has often been the case historically, variations in Tasmanian waste data between reporting years have been affected by inconsistencies in reporting. It has therefore been difficult to discern meaningful trends in waste data, which has, until now, largely been reported voluntarily.



Major initiatives

2021–22 has been a watershed year for the management of waste in Tasmania, with the passing of the *Waste and Resource Recovery Act 2022* and Regulations. This legislation provides Tasmania with its first landfill levy, which commenced on 1 July 2022. The levy has commenced at \$20 per tonne and will increase to \$40 in 2024 and \$60 in 2026 (with adjustment for CPI).

Significantly, 100% of funds generated by the levy will be used for waste-related purposes and will be administered by the Waste and Resource Recovery Board, which has also been established under the legislation. This is believed to be unique in Australia.

The legislation also mandates the compulsory submission of waste data by the operators of landfill and resource recovery facilities. This has also commenced on 1 July and is being implemented broadly in line with the *Australian Standard for Waste and Resource Recovery Data and Reporting*.

11.7 Victorian perspective

The Victorian Government has invested more than \$515 million to deliver the biggest reform and transformation of the waste and recycling system in Victoria’s history. This includes \$380 million to deliver the Victorian circular economy policy, *Recycling Victoria: a new economy*, released in February 2020. This ambitious policy and framework aims to transition Victoria’s waste management to a functioning circular economy by 2030, setting out targets and programs that will fundamentally reduce waste, boost jobs and transform the waste and recycling sector in Victoria.



In 2019–20 Victoria recovered and collected more material for reprocessing than in any previous period. In 2019–20:

- A record amount of material was diverted from landfill and processed locally. A total of 11.05 Mt was recovered, and the state was able to reprocess 91% of these resources locally.
- Local councils collected more kerbside garbage, recyclables, and organics than ever before – 2.4 Mt. This included 0.57 Mt of organics coming from a doubling of Victorian households provided with a kerbside food and garden organic waste collection service.

These positive outcomes come despite a range of disturbances throughout 2019–20 and 2020–21. In October 2019, changes in global commodity markets led to service disruptions for household recycling services and the collapse of Victoria’s largest recycler, SKM Recycling. This impacted the ability of 35 of Victoria’s 79 councils to sort their kerbside recyclable collections. From March 2020 and throughout 2019–20 and 2020–21, the sector also had to adapt to changed operational requirements and consumer disposal patterns associated with COVID-19 pandemic response requirements.

A cornerstone of the Victorian government’s circular economy policy is the establishment of Recycling Victoria, which launched on 1 July 2022. The new entity aims to increase the reliability and transparency of the sector and maximise the ongoing use of products and materials that would otherwise be waste. It will collect data and report on waste and resource recovery to enable strategic planning for a better and more reliable system.

With a focus on data, Key Commitment 11 of Victoria’s circular economy policy commits the Victorian Government to go beyond tracking waste and resource recovery activities and ‘establish a framework for monitoring progress towards the circular economy, including the identification of indicators and metrics’. New circular economy metrics will measure increases in materials productivity and decreases in environmental impacts achieved through these reforms.

11.8 Western Australian perspective

Western Australia’s waste and recycling performance

Since 2014–15 there has been sustained improvement in recycling and a declining trend in waste to landfill in Western Australia. These trends correspond to increases to the waste levy, targeted funding programs, various waste and recycling initiatives and a move towards better practice resource recovery.



Improvements in data quality have followed the introduction of mandatory reporting in July 2019 and online reporting system launched June 2020. We now have a more complete dataset and an increase in reported waste generation.

The C&D waste stream has responded to waste levy increases. It reported surpassing the state’s Waste Strategy C&D material recovery target of 77% by 2025. However, this reported recovery rate may be being inflated by unprocessed stockpiled materials.

State Government’s commitment to better waste and recycling outcomes

The recovery of construction and demolition waste and municipal and commercial organics remain high priorities in pursuing the state’s Waste Avoidance and Resource Recovery Strategy 2030.

The State Government is facilitating the use of recycled C&D products through the Roads to Reuse program. The Department of Water and Environmental Regulation and Waste Authority have worked closely with Main Roads WA, the Department of Health, and the Waste and Recycling Industry WA on this project. Main Roads WA has now used over 100,000 tonnes of Roads to Reuse products, is committed to doubling this and is supporting its use across other applications including local government roads.

The recovery of municipal waste remains well below the state’s targets. The Waste Strategy includes a target to roll out better practice three bin FOGO services across Perth and Peel by 2025 to boost performance in this stream. This commitment is supported by the \$20m Better Bins Plus: Go FOGO program as well as other initiatives targeting market development, education and engagement, processing and local government services.

In February 2021, the Australian Government and the state government announced funding for eight infrastructure projects in Western Australia as part of national Recycling Modernisation funding. These are expected to add 140,000 tonnes of additional plastic and tyre waste processing capacity in response to the waste export regulations.

A ban on the disposal of e-waste to landfill by 2024 is being developed through commitment of \$14 million to support required regulatory and infrastructure changes.

Western Australia’s Plan for Plastics, released in June 2021, complements this work by phasing out a range of single-use plastics including cups, plates, cutlery, straws, thick plastic bags and more.

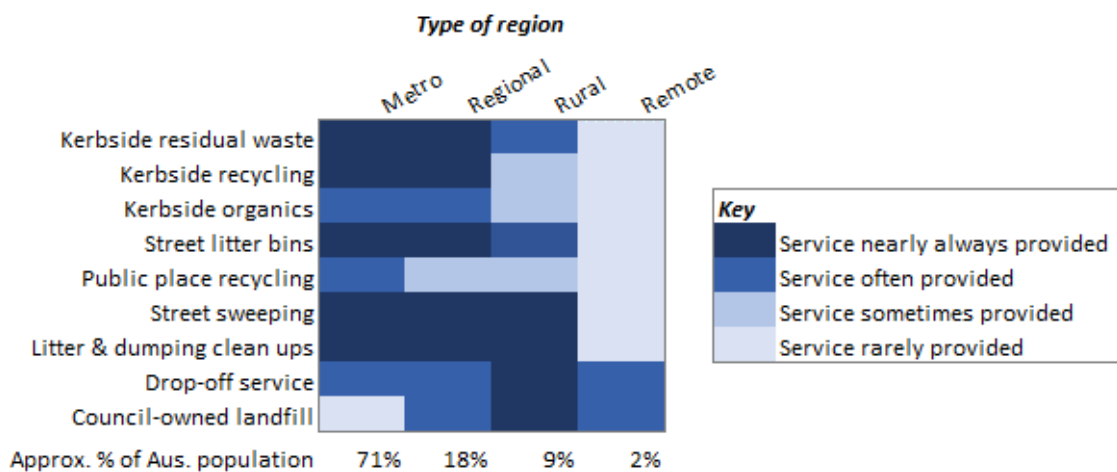
12 Local government waste management

This chapter addresses the critical role played by local governments in providing waste services to their communities and presents the Australian Local Government Association’s perspective on the status of waste in Australia.

12.1 Local government services

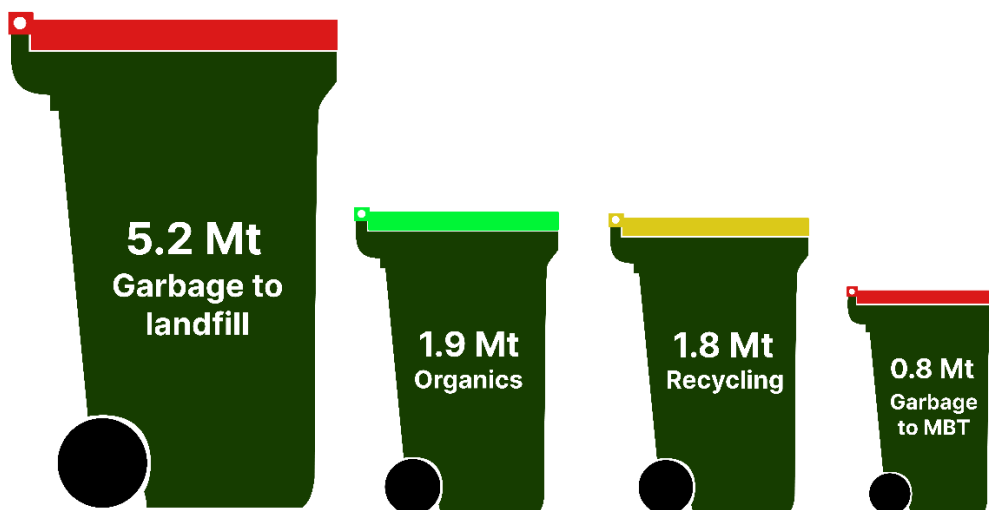
Local government waste services include kerbside collections, public place waste management and provision of recycling and disposal infrastructure. The services provided tend to vary by local government and region type, as illustrated in Figure 41.

Figure 41 Local government waste services by region type



In 2020–21, local governments collected about 9.7 Mt of waste via kerbside bin services. These included collections of residual waste (garbage) sent to landfill or sometimes mechanical biological treatment (MBT)⁷⁰, kerbside recycling and kerbside organics. Figure 42 illustrates the quantities collected in these types of kerbside service.

Figure 42 Waste collected by Australian local governments by service type, 2020–21



⁷⁰ A treatment that sorts residual waste and processes the organic-rich residuals by composting or anaerobic digestion.

In comparison to the 2018–19 data presented in the *National Waste Report 2020*, the reported quantity of materials collected at the kerbside increased by 816 kt, or 9%. Collected kerbside garbage grew by about 7%, comprising about 291 kt more waste to landfill and 92 kt to MBT. This is thought to be mainly due to COVID-19 pandemic lock-downs, during which most Australians spent more time at home than usual, diverting waste from commercial premises MSW.

There was a striking increase of about 35%, or 476 kt, in the quantity of kerbside organics. This is mostly attributable to greatly expanded access to kerbside organics bins, which attracts material previously managed on-site or sent to landfill. In addition, 2020–21 was a wetter year nationally than 2019–20, which tends to lead to greater volumes of wetter (and therefore heavier) garden organics (BoM 2021a, 2022).

Kerbside recycling collections fell by about 2%, or 43 kt, over the two years. However, during this period container deposit schemes were established in Qld⁷¹ and WA. Combining the yields of kerbside recycling and CDS systems in both years, the tonnage of dry recyclables grew by 6% between 2018–19 and 2020–21, from 2.2 Mt to 2.3 Mt.

In addition to these services, councils in urban and inner regional areas often offer periodic or ad-hoc collection of ‘hard’ waste such as furniture, bikes, etc. NSW, Qld, Vic and WA report combined collection of 472 kt of hard waste in 2020–21.

Figure 43 shows the proportion of a jurisdiction’s population with access to kerbside waste services in 2020–21. The data for this assessment is from Planet Ark’s [Recycling Near You](#) database, which provides public information on what can be recycled in any user’s vicinity.

Almost all Australians had a regular collection service for garbage; 98% had a recycling collection; and 79% had an organics collection. Drop-off services are generally available in areas lacking these services. Standard bin colours are illustrated in Photo 10.

Typically, recycling and organics collections are fortnightly and garbage weekly. However, with the modern trend towards placing food organics in with the garden organics, the collection frequency is often flipped so organics are collected weekly and garbage fortnightly.⁷² This is generally considered best practice.

Photo 10 Three-bin services are now commonplace even in regional areas



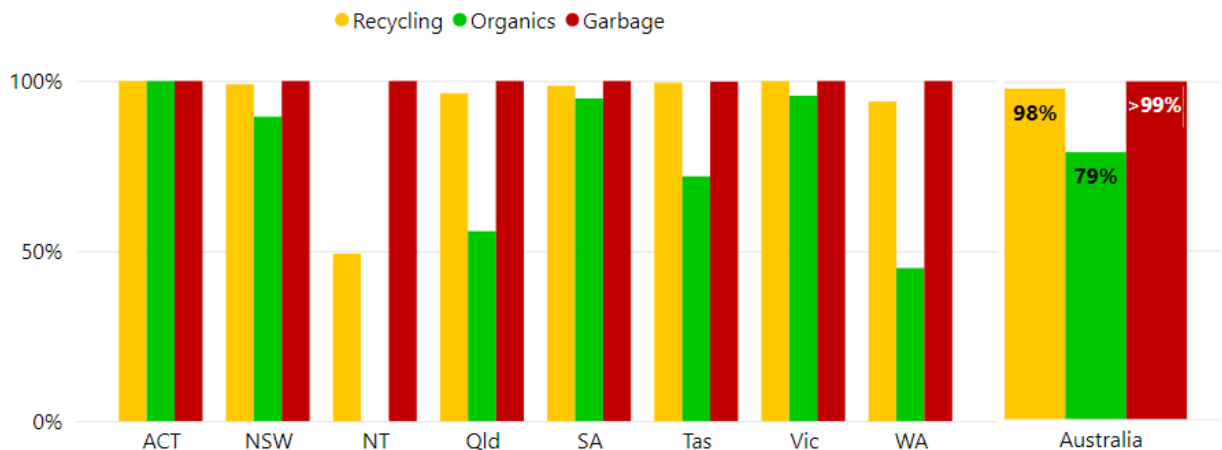
The Australian Standard mobile bin colours for these primary services is a dark-green or black body with a red lid for garbage, a yellow lid for recycling and a lime green lid for organic waste (AS4123.7-2006). Standardised bins help ensure correct usage.

Photo by Blue Environment

⁷¹ The Qld CDS was operational for half of 2018–19.

⁷² There are exceptions, for example for families with children in nappies.

Figure 43 Access to kerbside waste services by proportion of the jurisdictional population, 2020–21



Recycling services include kerbside collection via bins and crates.

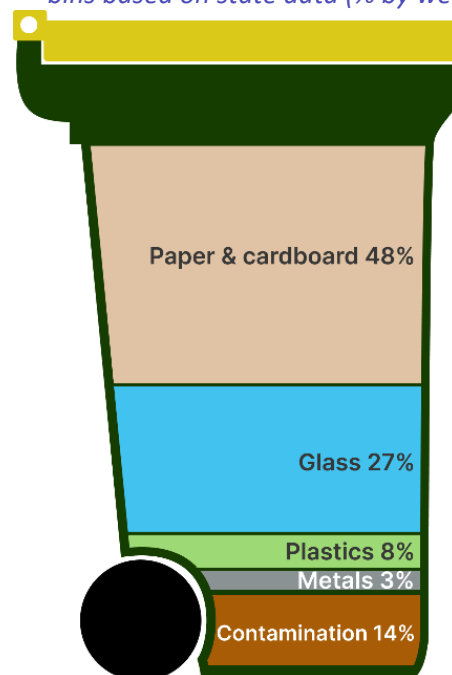
12.2 Kerbside recycling services

Kerbside recycling bins generally have a yellow lid, and typically collect glass packaging, aluminium and steel cans, mixed paper and cardboard, and plastic containers. There is some variation in materials accepted, depending on the processing capacity at the receiving MRF. Some councils have more than one recycling service type. In 2020–21, six councils in NSW and one in SA had a separate paper and cardboard bin in addition to commingled recyclables. Three councils had an e-waste kerbside collection service. Six Victorian councils and one in NSW had a glass-only kerbside bin. Victoria is moving towards separate glass-only bins as part of a standard four-bin kerbside collection system (organics, glass, commingled recyclables and garbage).

Figure 44 illustrates the composition of a typical recycling bin based on collations of recent audits in the five largest states. The population-weighted average composition (by weight) is 48% paper and cardboard, 27% glass, 8% plastics, 3% metals and 14% contamination.⁷³

Contamination comprises non-recyclable items such as soft plastics or organics. Contamination increases the cost and difficulty for MRFs to produce high-quality end-products and may pose safety issues for staff or damage machinery. In addition to contamination, there are product losses due to item size, shape and firmness, and bagged recyclables. Broken glass can make up a large proportion of product losses, as it is difficult to sort by colour and markets for mixed colour material are poor.

Figure 44 Typical composition of kerbside recycling bins based on state data (% by weight)



⁷³ Some states operated a CDS during the audit and some did not. The apparent impact of the CDS on the proportional composition of the recycling bins in the audit data is minimal.

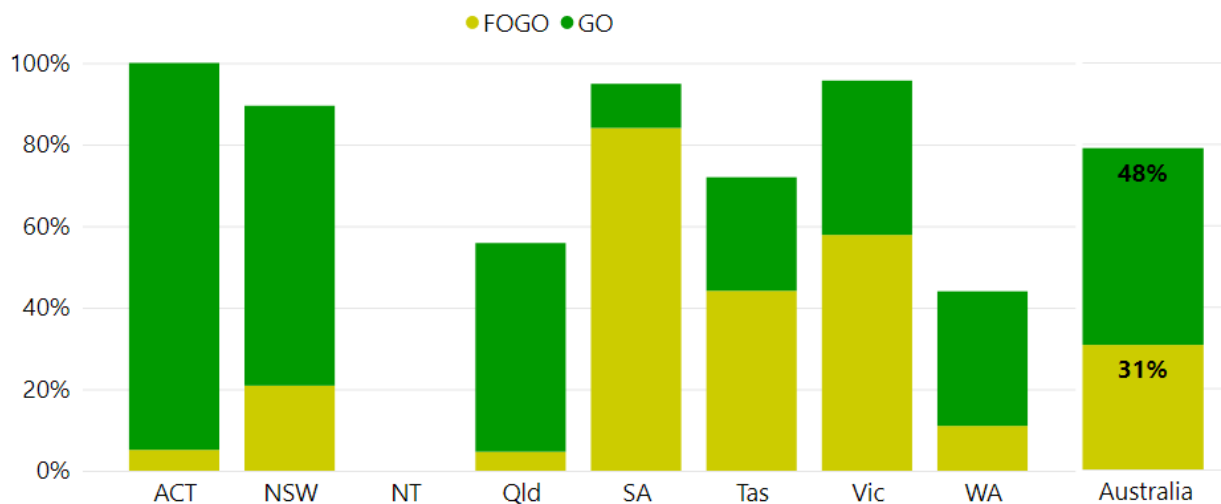
12.3 Kerbside organics services

Figure 45 shows the proportion of each jurisdiction’s population living in local government areas that offered a kerbside organics service in 2020–21. It is split into those with access to a service for garden organics only (GO) and those with a service for FOGO. About 79% of Australians had access to a kerbside organics collection service in 2020–21, mostly GO (48% of the population, compared to 31% for FOGO). Organics services were concentrated in the south-eastern portion of the mainland – ACT, NSW, SA and Vic. Collected material is generally composted, reducing waste to landfill, and enhancing soil in urban or agricultural markets.

Almost all the ACT population had access to an opt-in organics service in 2020–21, FOGO was at the trial stage covering 5% of the population. About 95% of SA and Vic populations also had an organics service, largely FOGO (84% and 58% respectively). SA had the highest proportion of FOGO services nationally. In NSW about 90% of the population had a kerbside organics service, mostly GO. Over half the Qld population had a kerbside organics service. NT did not have a regular kerbside organics collection service, although Alice Springs Town Council ran a small kerbside FOGO trial, since discontinued. Proportionately, Qld, Tas and ACT organics services grew the most in 2020–21 compared to 2018–19.⁷⁴

FOGO services tend to be well-used only when strongly promoted and well-designed. Provision of kitchen caddies with certified compostable liners is associated with high levels of use and capture rates of up to 70% of food waste from a local government area. Some councils provide a FOGO option without wide promotion, resulting in low capture rates from enthusiasts only. Many jurisdictional waste strategies have committed to expand FOGO services to help achieve targets for reducing organics in landfill.

Figure 45 Access to kerbside organic waste services by proportion of the jurisdictional population, 2020–21



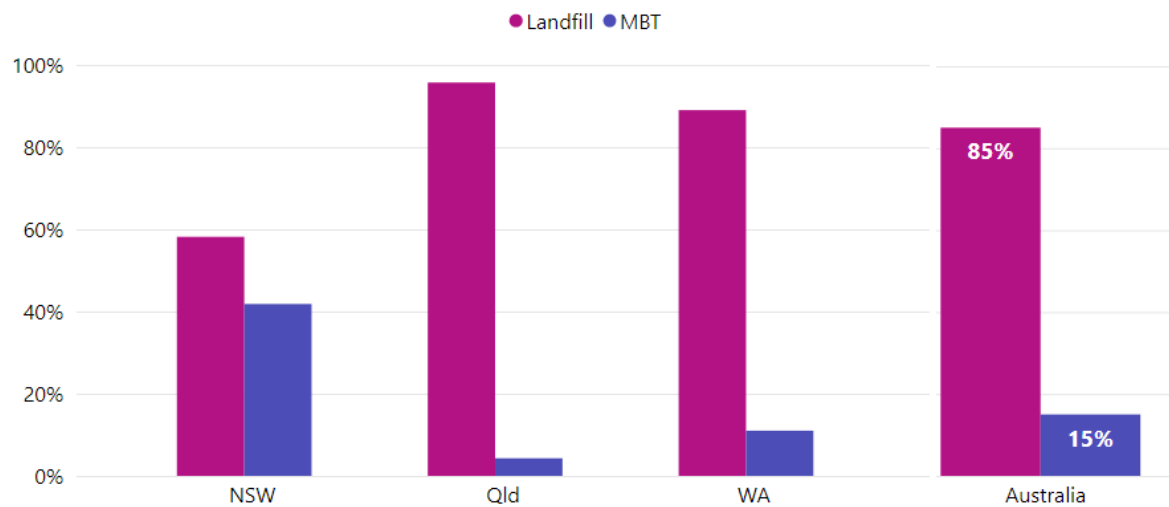
For all states and territories except WA, the figure shows organics services including kerbside collection via bins and bundles. For WA it shows bins only.

⁷⁴ Noting improved availability of data on kerbside waste services compared to the previous *National Waste Report 2020*.

12.4 Kerbside garbage services

In 2020–21, almost all Australia’s population had access to a kerbside garbage service. In most jurisdictions this material is deposited in landfill but in NSW, Qld and WA some is sent to MBT, in which metals and sometimes other recyclables are extracted and the remaining organics-rich fraction is processed by composting or anaerobic digestion. In WA and Qld the processed organics are typically applied to land but in NSW this is no longer allowed due to perceived contamination risks, and they are mostly sent to landfill, sometimes for use as cover material. The proportions of garbage going to landfill and MBT in 2020–21, in states with that technology, are shown Figure 46.

Figure 46 Management of garbage by proportion of the jurisdictional population – landfill vs mechanical biological treatment (MBT), 2020–21



12.5 Australian Local Government Association perspective

Impact of COVID-19



Local governments have maintained kerbside waste collection services, waste management facilities and landfills throughout the pandemic, despite on-going financial viability challenges. While there is evidence of increased kerbside waste disposal due to increased online shopping and consumption of takeaway and home-delivered food, there was no evidence of any disruptions to collection services.

What are the most significant challenges facing Australian waste management in 2022?

Getting ready to deal with an extra 645,000 additional tonnes of plastic, paper, glass and tyres that will need to be processed and recycled locally when Australia's waste export regulations come into full effect in mid-2024 remains a key issue. To avoid stockpiling or increasing waste to landfills, new markets will have to be found for low-value waste both in terms of processing plants and products to incorporate recycled feedstock. Key areas of focus should be:

- driving demand for recycled products through government procurement policies
- supporting improved infrastructure capabilities at materials processing facilities
- encouraging residents to continue or improve good waste management practices
- managing the impacts of different products and materials through mandatory product stewardship schemes.

The federal, state and territory governments have agreed to progress implementation of a standardised bin collection service across the country. Local governments will need financial support to help implement this initiative.

What are the greatest opportunities facing Australian waste management in 2022?

The progressive implementation of the *National Waste Policy Action Plan* offers an unprecedented opportunity to create a circular economy. New infrastructure, such as paper processing and chemical plastic recycling plants, will need to be sited appropriately and with consideration for a web of new waste hubs in regional Australia and their transport needs. Processed glass, tyre and plastic waste are being incorporated into new roads, and the harmonisation of road construction standards will facilitate this reuse of our rubbish.

There are especial needs to reduce food waste and the associated generation of harmful methane gas emissions through public education, and to ensure recycling is sufficiently resourced.

Where should Australian waste management aim to be in 10 years' time?

The waste industry in 2030 should be flourishing and economically viable. It should underpin a circular economy providing local jobs and increased demand for products made from recycled materials; it should enhance environmental sustainability through reduced quantities of waste going to landfill and more waste re-entering the product-lifecycle; and it should encourage and acknowledge the efforts and practices of Australian households and local governments.

13 The waste and resource recovery sector

This chapter overviews the waste and resource recovery sector, its services and infrastructure.

13.1 Sector overview

The ABS (2020) found that in 2018–19 the waste and resource recovery sector employed around 36,000 people and provided services valued at \$15.8 billion.

The sector is dominated by large companies that provide collection services and operate (and often own) waste and recycling infrastructure. A further concentration of the industry occurred in 2021–22 with Veolia's global takeover of Suez (although some Australian assets were sold to Cleanaway and Remondis). While many of these companies have foreign ownership and worldwide operations (e.g. Veolia, Remondis), there are large Australian players in the waste and resource recovery sector (e.g. Cleanaway, Visy). Many smaller operators specialise in specific markets, such as demolition waste processing, composting or skip bin operation, or work in particular jurisdictions or regions.

The sector is seeing rapid growth in recycling and processing operations in Australia. While this is mostly focused on materials that are, or will be, subject to export regulation (plastics, glass, tyres, paper and cardboard), recycling of other materials (e.g. food and garden waste) is also growing. This is supported through significant state and federal government funding programs (see Section 13.5).

13.2 Waste collection services

Local governments provide municipal waste and recycling collection services; typically this is contracted to private service providers, although a small number of local governments have recently reverted to in-house operations. An increasing number of local governments are collaborating on joint procurement arrangements in order to capitalise on economies of scale for delivery of services. Some councils extend their services to smaller businesses and organisations (particularly for FOGO and co-mingled recycling). Local government waste management is discussed in Chapter 12.

Large corporate waste generators often establish a relationship with a major waste company for national or regional services. Most other businesses engage service providers on short-term contracts or informal arrangements. Hazardous wastes are managed by contractors licensed to collect, transport and dispose of this type of waste. Tracking requirements are in place for hazardous waste in most states to ensure waste is managed at facilities licensed to accept it.

13.3 Waste and resource recovery infrastructure

The Australian Government developed national databases of waste and resource recovery infrastructure managing non-hazardous and hazardous wastes in 2020–21.⁷⁵ The infrastructure types and numbers of facilities of each type are summarised in the two tables that follow. The number of operating facilities changes over time, so the numbers cited in the tables below may differ in 2022.

Table 22 lists non-hazardous waste and resource recovery facilities and their activities. It excludes some private business collection points, such as stores accepting returned e-waste. It shows that transfer stations (see Photo 11 on page 81) are the predominant infrastructure type that most Australians rely on for waste disposal.

⁷⁵ Available at <https://www.dccew.gov.au/environment/protection/waste/how-we-manage-waste/data-hub/data-viewer>.

Table 22 Types and number of non-hazardous waste and resource recovery facilities (as listed in the national infrastructure database)

Facility type	Activities undertaken	No. facilities
Reuse		130
Reuse shop	Sells materials or products diverted from the waste stream. Sometimes referred to as a 'buy back centre', 'recycle market' or 'tip shop'.	130
Drop-off		2,324
Container deposit scheme drop-off	Accepts beverage containers for refund under a container deposit scheme. Excludes some reverse vending machines and automated depots.	294
E-waste drop-off	Accepts e-waste, which is subsequently transported offsite for further processing.	535
Transfer station ⁷⁶	Accepts waste and other materials, which are transported offsite for further processing and disposal (see Photo 11).	1,495
Recycling		1,204
Aluminium reprocessing	Reprocesses recovered aluminium.	1
Construction and demolition waste recycling	Sorts and/or reprocesses building and demolition materials.	202
E-waste recycling	Reprocesses e-waste for recycling.	20
Glass beneficiation	Processes glass packaging by cleaning, sorting and making into furnace-ready cullet and mixed glass fines.	10
Glass reprocessing	Reprocesses or remanufactures glass cullet into new glass products.	12
Material recovery facility (MRF)	Sorts, aggregates and bales mixed recovered materials (comprising mainly packaging) for further sorting or reprocessing. MRFs may be said to undertake primary sorting of these materials.	125
Mattress recycling	Reprocesses waste mattresses.	9
Metals recovery	Sorts and prepares mixed recovered metals for reprocessing or remanufacturing (including scrap metal yards).	223
Organics recycling	Processes food, garden and/or other organic wastes to manufacture beneficial products.	372
Other metal reprocessing	Reprocesses or remanufactures recovered metals other than steel.	6
Other recycling	Sorts, cleans, grades and/or reprocesses recovered materials and does not fit any of the definitions given above.	47
Mechanical biological treatment	Processes mixed putrescible waste and includes a biological treatment process. In NSW the organic product cannot be applied to land, so can be considered a disposal facility.	2 ⁷⁷

⁷⁶ Definition includes NSW Community Recycling Centres.

⁷⁷ Excludes one facility in WA and four in NSW that are transitioning away from mechanical biological treatment of mixed waste.

Facility type	Activities undertaken	No. facilities
Paper and cardboard recycling	Sorts, prepares, reuses, pulps and reprocesses recovered paper and cardboard. ⁷⁸	65
Plastic recovery	Sorts and prepares mixed or partially sorted recovered plastics for reprocessing or remanufacturing.	15
Plastic reprocessing	Reprocesses or remanufactures recovered plastics.	72
Rubber recycling	Reprocesses or remanufactures rubber.	13
Steel reprocessing	Reprocesses or remanufactures recovered steel.	6
Textile recycling	Reprocesses or remanufactures textiles.	4
Energy recovery		24
Anaerobic digestion	Processes organic waste using anaerobic digestion technology. Can also be considered a recycling facility as an organic product is produced.	4
Refuse-derived fuel	Produces fuel from recovered materials.	3
Thermal energy-from-waste	Generates energy from waste-derived materials using thermal technology, and has an energy efficiency of at least 0.65 calculated using the formulae and methods set out in EC (2011).	17
Disposal		1,272
Landfill – inert	Accepts inert waste for disposal to land.	36
Landfill – putrescible	Accepts putrescible (or biodegradable) waste for disposal to land.	1,035
Landfill – not classified	Landfills that accept waste for disposal to land but it is not known whether it is restricted to inert waste only.	201
Other		344
Other waste	Accepts waste for reuse, recycling, energy recovery or disposal and does not fit any of the definitions given above.	344

⁷⁸ The list of activities undertaken for this infrastructure type differs from the list in the *Australian Standard for Waste and Resource Recovery Data and Reporting* by also including sorting, preparation and activities. It is understood that the Department plans to revise the standard in the near future.

Table 23 lists hazardous waste infrastructure types and numbers of facilities in the Australian Government’s hazardous waste infrastructure database. In most cases, these are owned and operated by private businesses.

Table 23 Types and number of waste facilities listed in the national database of hazardous waste infrastructure

Facility type	Activities undertaken	No. facilities
Hazardous waste recycling facility	Reuse or recycling of hazardous waste, e.g., oils, solvents, paint, chemicals, e-waste, mercury, lead.	71
Hazardous waste energy recovery facility	Preparation of fuels from hazardous waste or use hazardous waste in thermal processes to derive energy.	12
Hazardous waste treatment facility	Application of chemical and physical treatments (e.g., oxidation, reduction, precipitation, neutralisation sedimentation, filtration, bioremediation, and thermal) to hazardous waste.	82
Hazardous waste disposal facility	Disposal of waste in licensed landfill or by thermal destruction.	23
Hazardous waste short-term storage or transfer facility	Short-term storage and subsequent transfer of hazardous wastes to another facility. Some short-term storage or transfer facilities receive a wide range of wastes, which may include non-hazardous wastes, while others receive only specific wastes.	19
Hazardous waste long-term storage facility	Storage or isolation of hazardous waste for long periods (>10 years) in designated areas.	1
TOTAL		208

Photo 11 Transfer stations, also known as resource recovery centres, accept a range of materials from the public for recycling or disposal



Woodend Resource Recovery Facility in Victoria collects and recycles garden waste, tyres, white goods, light globes, glass bottles, bicycles, plastics and e-waste (shown above), as well as cardboard, soft plastics, bread tags, mattresses, gas bottles, waste oil, X-rays, household and vehicle batteries. It also accepts general waste for landfill disposal.

Photos by Blue Environment, used with kind permission from Macedon Ranges Shire Council

13.4 Geographical variation in infrastructure availability

Waste management options vary according to location, with distance and population size contributing to different financial and service outcomes. Metropolitan and provincial city centres are usually well serviced and a range of waste and resource recovery facilities is available (often operated by private businesses). In remote and regional areas, the availability of facilities may be limited and local government usually plays a bigger role in infrastructure delivery.

Table 24 shows the number of non-hazardous waste management and resource recovery facilities by geographic distribution. Remote and very remote areas have 2% of the population but nearly half the landfills.

Table 24 Number of Australian non-hazardous waste and resource recovery facilities by geographic area

Remoteness area	Population (millions)	Disposal	Drop-off	Recycling	Reuse	Energy from waste	Other waste facilities
Major cities	18.40	121	1,957	633	30	14	176
Inner regional	4.61	234	1,105	392	60	7	52
Outer regional	2.20	329	814	142	37	1	41
Remote & very remote	0.53	591	263	74	3	1	31

Resource recovery rates in remote areas are generally lower than in urban areas. Factors contributing to this include lower levels of collection service (often due to limited municipal resources), lower material quantities and limited local markets for recovered materials. The need to transport waste and materials long distances is a significant cost factor affecting the viability of recycling, especially in rural and remote areas. Material pathways are much longer than in many other countries, with reprocessing facilities often quite distant (often interstate) from the point of waste generation.

13.5 Infrastructure development

Significant investment is occurring in Australian waste and resource recovery infrastructure, with outlays from the Commonwealth, states, territories and industry.

A major area of development is linked to the Australian Government’s regulation of the export of some materials not suitably processed for recycling. Glass, plastic and tyres are already regulated; and paper and cardboard will follow in mid-2024. Large investments have been made to help develop local processing and boost the capacity of existing facilities to meet increased demand. The centrepiece of this support is the Recycling Modernisation Fund, through which the Australian Government is investing \$250 million into new and upgraded recycling infrastructure. With contributions from the states and territories and industry, the fund will see over \$1 billion of investment in recycling infrastructure. Recycling Modernisation Fund projects announced by late 2022 are expected to sort, process, recycle and remanufacture over a million additional tonnes of waste glass, tyres, plastic and paper per year by July 2024. The additional capacity of projects announced by late 2022 (rounded to the nearest 100 tonnes) is summarised in Table 25.

Table 25 Projected additional capacity funded through the Recycling Modernisation Fund (kt/yr)

Material type	Remote and regional areas	Metropolitan centres	Total
Glass	129.9	197.2	327.1
Material recovery facility	30.2	123.5	153.7
Multi-material facility	7.0	3.0	10.0
Paper and cardboard	0.0	239.0	239.0
Plastics	54.8	238.6	293.4
Transfer stations	1.1	0.0	1.1
Tyres	4.9	83.5	88.5
Total	227.9	884.8	1,112.8

The Australian Government’s Food Waste for Healthy Soils Fund supports the establishment of new, and upgrades to existing, organics recycling infrastructure to increase the quantity and improve the quality of recycled organic products for use, especially on agricultural soils. This corresponds with a drive in many states and territories to increase food organics and garden organics collections from Australian households. As at September 2022, 16 projects had been awarded funding of \$23.6m. In some areas, wastewater authorities are proposing development of facilities that can handle both biosolids and FOGO, but this is in its infancy and is not widespread.

The use of energy from waste (EfW) as a practical management option for large waste volumes in Australia is increasing. Two large scale thermal EfW facilities are currently under construction in WA (at East Rockingham and Kwinana), with operations expected to commence in 2023. Other large facilities in NSW and Vic. have received regulatory approvals, although development is yet to commence. One proposed facility (the Maryvale EfW facility being developed by Opal Australian Paper and partners) has also received significant financial support from the Australian and Victorian Governments. These facilities generally incorporate municipal solid waste and rely on long term contracts with local governments to deliver the large waste volumes needed. There are a number of much smaller EfW facilities across Australia, generally focused on selected industrial waste streams.

Recent fires impacted on some waste infrastructure including MRFs and e-waste recycling facilities. Operations will cease until reconstruction is complete, which could be more than two years.

Photo 12 ‘Smart bins’ at Bondi Beach reduce the number of waste collections



Using solar power, these smart bins compact waste or recycling material to extend the time between collections. This leads to improved amenity and lower servicing costs.

Photo by Natalie_Board on iStock

14 Product stewardship

Product stewardship is an environmental management strategy that shares the responsibility for reducing the environmental, health and safety impacts of products amongst those involved in producing, importing and selling products. The involvement of private companies may be supported through government regulation, typically at the national level. Product stewardship involves managing the impacts of products and materials throughout the product life-cycle, including end of life. A product stewardship scheme may include, among other things:

- product and packaging design for efficient and effective recycling
- product and packaging design to incorporate more recycled materials
- minimising waste during manufacturing and distribution
- systems for managing product life cycles such as takeback programs
- promoting the development of secondary markets for products at end of life.

This chapter provides information about key product stewardship initiatives in Australia. It opens with a report on the largest overall program: the set of container deposit schemes for drink packaging administered by six of Australia's eight states and territories. The second section discusses all the other major product stewardship schemes that have industry involvement, including schemes accredited by the Australian Government and voluntary programs. The final section reports on household hazardous waste collection programs funded by state and local governments.

14.1 Container deposit schemes

A container deposit scheme (CDS) holds beverage manufacturers responsible for the environmental impact of their products through mandatory product stewardship. A CDS operates in all jurisdictions except Tas and Vic, both of which have committed to introducing a scheme. CDS provides a financial incentive to consumers to return eligible beverage containers, which keeps litter out of the natural environment, reduces the cost of kerbside collection and sorting, and provides an ongoing source of higher value materials for reprocessing into new products. Jurisdictions establish a legislative framework that provides for the governance and operation of the scheme and requires beverage suppliers to include refund markings on eligible containers. Consumers are provided with a 10-cent refund upon the return of the empty container at a depot or reverse vending machine.

The NSW EPA (2022b) reports that since the introduction of its Return and Earn CDS in 2017, overall litter volumes reduced by 43% with a 52% reduction in litter from eligible drink containers. However, CDS containers continued to make up the largest proportion of surveyed litter volume, accounting for 35% of the total.

While collection methods differ between jurisdictions, containers can typically be cashed in at: depots where

Photo 13 A Queensland reverse vending machine



Image kindly provided by Enviroware

containers are counted and refunded on the spot; at bag drops where containers are counted later; at pop-ups run by depot operators at set times and locations; or at reverse vending machines where containers are counted by scanning their barcodes and users receive an immediate refund (see Photo 13). MRF operators can also claim refunds on eligible containers recovered.

Recovered product is processed similarly to kerbside recyclables. The product value is typically higher because it is better separated and cleaner. During 2020–21, CDS systems collected about 5.7 billion containers. Table 26 summarises CDS performance for 2020–21 reported by the states and territories. It shows, for each scheme, the quantity of collections, collections per capita and the overall return rate. Based on this data, SA had the highest return rate at 76% and NT collected the highest number of containers per capita, returning an average of 413 containers per person. SA and NT run the oldest established systems in Australia.

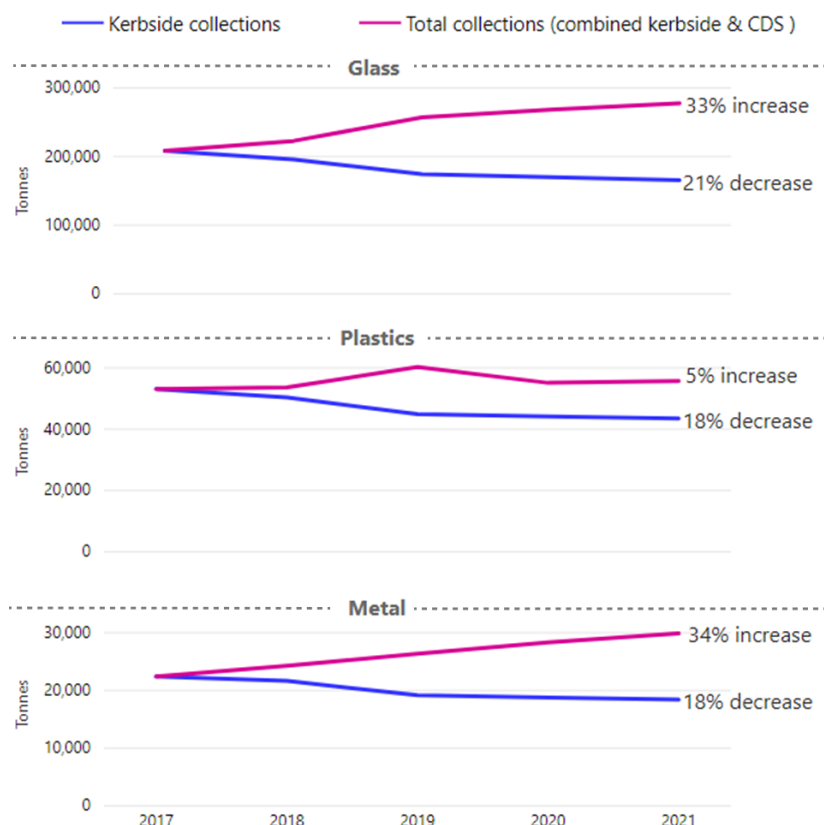
Table 26 Data on container deposit schemes by state and territory, 2020–21

	ACT	NSW	NT	Qld	SA	WA	Total	Average
No. of collected containers (millions)	108	2,416	102	1,821	664	571	5,681	n/a
Containers collected (kt)	11	265	10	194	42	51	573	n/a
No. of collected containers per capita	250	296	413	351	375	214	n/a	307
Containers collected per capita (kg)	25	32	40	37	24	19	n/a	31
Overall return rate	68%	67%	72%	62%	76%	53%	n/a	n/a

Data sources: Exchange for change (2021, 2022); NT EPA (2021); Queensland Container Exchange (2021); EPA SA (2021b); Western Australia Government (2021).

Figure 47 presents quantities of CDS eligible materials collected in NSW between 2016–17 and 2020–21, encompassing years before and after the introduction of the Return and Earn scheme in 2017. It shows that between 2016–17 and 2020–21, CDS eligible materials in kerbside recycling fell by 21% for glass and 18% for plastic and metals. However, combining kerbside and CDS collections, recovery increased by 33% for glass, 5% for plastics and 34% for metals.

Figure 47 Trends in the collection of CDS-eligible glass, plastics and metals for recycling in NSW



14.2 Other product stewardship programs

Many product stewardship schemes operate in Australia, ranging widely in scope, scale, maturity and status. The *Recycling and Waste Reduction Act 2020* (RAWR Act) provides a framework for three approaches to product stewardship in Australia: mandatory (i.e. required by Government), co-regulatory (industry led but underpinned by Government regulation), or voluntary (industry led). Accreditation of voluntary programs by the Australian Government provides some assurance that the scheme’s environmental and human health outcomes are verified and will contribute to Australia’s recycling and waste reduction objectives.

Product stewardship covered by Commonwealth legislation

Product stewardship schemes covered under the RAWR Act or pre-existing Commonwealth legislation are listed in Table 27 and described in the text that follows.⁷⁹

Table 27 Current product stewardship schemes covered under the Recycling and Waste Reduction Act 2020 or other Commonwealth legislation

Product stewardship scheme	Products covered	Legal framework	Start year	2020–21 collections (tonnes)	Est. capture rate ⁸⁰
Product Stewardship for Oil Scheme	Oil	Product Stewardship (Oil) Act	2000	420,000	n/a
Australian Packaging Covenant	Packaging	National Environment Protection (Used Packaging Materials) Measure	1999	3,787,000 ⁸¹	55%
National Television and Computer Recycling Scheme	TVs and computers	RAWR Act (co-regulatory)	2011	50,500	43% ⁸²
Fairview Aluminium Cladding Scheme	Aluminium composite panel waste	RAWR Act (voluntary)	2021	309	<15%
Battery Stewardship Scheme	Batteries	RAWR Act (voluntary)	2022	n/a	n/a
Big Bag Recovery	Large plastic bags	RAWR Act (voluntary)	2021	645 ⁸³	n/a
MobileMuster	Mobile phones	RAWR Act (voluntary)	1998	106	n/a
Tyre Product Stewardship Scheme	Tyres	RAWR Act (voluntary)	2014	246,000 ⁸¹	68%

n/a means not available

The **Product Stewardship for Oil Scheme** was established under the *Product Stewardship (Oil) Act 2000*. A duty is applied on oil and synthetic equivalents produced in or imported into Australia to incentivise the refining and reuse of used oil. This funds oil recycling, reducing the risk of inappropriate disposal.

⁷⁹ The collected tonnages are from a range of sources and are not all independently confirmed.

⁸⁰ The capture rate is the tonnes collected divided by the estimated total eligible for collection under the scheme.

⁸¹ The Australian Packaging Covenant and Tyre Product Stewardship Scheme support pre-existing collection programs. The value stated is the estimated total collected under these programs.

⁸² Based on modelling of e-waste generation by Blue Environment and Randell Environmental Consulting.

⁸³ Data is from the Farm Waste Recovery Program for 2020–21, which was replaced and expanded by Big Bag Recovery during 2021–22.

The **National Television and Computer Recycling Scheme (NTCRS)** is established under the RAWR Act and managed by Australia and New Zealand Recycling Platform Limited, E-Cycle, Sustainable Product Stewards, Activ Group Solutions and Ecocycle. Two other product stewardship organisations had their approval cancelled in 2021. The NTCRS gives households and small businesses access to free collection and recycling services for televisions, computers and parts and peripherals. Companies that meet the importing or manufacturing thresholds for televisions and computers are required to pay for a proportion of recycling.

The **Fairview Aluminium Cladding Scheme** collects aluminium composite panel waste from building construction or demolition, which is then separated into aluminium, polyethylene, ferrous metals and mixed residuals. The aluminium, polyethylene and ferrous metals are recycled and reused in new products, and the mixed residuals are converted in energy from waste processes. The Fairview Aluminium Cladding Scheme aims to divert 100% of non-compliant cladding waste from rectification projects from landfill.

Battery Stewardship Scheme is a national battery collection network launched in February 2022. It aims to divert 90% of collected batteries from landfill, where they can cause environmental damage by leakage of toxic chemicals. The scheme is run by the Battery Stewardship Council and incorporates a levy on imported batteries. Up to 75% of this levy is used to fund rebates for accredited collectors, processors and recyclers of used batteries.

Big Bag Recovery collects and recycles bags for products over 15 kg, preventing them from entering the waste stream. These bags are generally from the agriculture, mining, construction and food industries. Bags are baled and processed into resin pellets for manufacture into new products such as furniture for parks and schools, shipping pallets and evaporative pads for water reservoirs.

Feature 7 Australian Packaging Covenant Organisation and the National Packaging Targets

Australia’s largest product stewardship program is managed and administered by APCO and underpinned by the National Environment Protection (Used Packaging Materials) Measure 2011. APCO data for 2020–21 is presented below.

Packaging represented about 9% of core waste plus ash generated and 19% of core MSW and C&I wastes. Since the 2017–18 data presented in the *National Waste Report 2020*, packaging consumption has risen by about 12%⁸⁴ and the recovery rate has increased by about nine percentage points.

Material type	Consumption (Mt)	Recovered (Mt)	Recovery rate
Glass	1.28	0.80	63%
Paper & cardboard	3.39	2.37	70%
Plastic	1.18	0.21	18%
Metal	0.25	0.15	58%
Wood	0.64	0.26	41%
Total	6.74	3.79	56%

Source: APCO (unpublished at the time of writing)

APCO has led the development of Australia’s National Packaging Targets, which aim to ‘create a new sustainable pathway for the way we manage packaging in Australia’. The four targets, to be achieved by 2025, are:

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

The National Packaging Targets require a systemic change to the way product packaging is created, collected and recovered, and apply to all packaging made, used and sold in Australia. The targets are in line with broader sustainable packaging shifts taking place globally.

APCO has over 2,000 members from across the packaging supply chain including brand owners, packaging manufacturers, industry associations, government participants, community groups, and sustainability professionals, as well as waste management and recycling organisations.

For more details, see the APCO website: www.apco.org.au/

⁸⁴ Excluding ‘wood’, which was not included in the last data set.

MobileMuster provides a free mobile phone recycling program in Australia and is funded by all the major handset manufacturers and network carriers. More than 3,000 drop-off points are available in shops, workplaces, councils and schools, and 96% of the Australian population lives within 10 km of a drop-off point. A free postal service is also provided. The Australian Mobile Telecommunications Association manages MobileMuster. The recycling rate of collected materials is more than 99%.

The **Tyre Product Stewardship Scheme** is managed by Tyre Stewardship Australia and financially supported by eight global tyre brands and three automotive brands. The scheme imposes a voluntary 25-cent levy on participating brand owners, funds from which are then used for market development, consumer education and management of an accreditation program. State and territory laws regulate the sector, in particular placing limitations on stockpiling and licencing. Collected tyres are separated and processed into crumb, granules or shredded as well as re-treading of some portion of bus and truck tyres. Most processed material is exported in shredded form as a fuel for cement kilns overseas. A growing proportion is recycled into crumbed rubber asphalt, permeable urban paving, athletic tracks, and noise and acoustic barriers.

Non-accredited industry-led product stewardship schemes

The majority of product stewardship schemes are voluntary and led by industry. They provide an important service to consumers and give importers, manufacturers and retailers an opportunity to take responsibility for their products. Table 28 lists a selection of industry administered product stewardship schemes, but there are many more.

Table 28 Selected operational product stewardship programs not accredited under the Recycling and Waste Reduction Act 2020

Program name	Start year	2020–21 collections (tonnes) ⁸⁵	Details
Cartridges 4 Planet Ark	2003	573	Cartridges 4 Planet Ark collects and recycles printer cartridges. These are dismantled and separated into plastic, metal components and toner for recycling. If not recovered, toner would contribute to landfill leachate. Collections declined in 2020–21 due to major city COVID-19 lockdowns and newer printer cartridge models using lighter materials.
ChemClear	2003	44	ChemClear collects unwanted agricultural and veterinary chemicals.
drumMUSTER	1998	1,775	drumMUSTER collects unwanted agricultural and veterinary containers. In 2020–21, 50% of containers eligible for recovery were collected and recycled into products such as wheelie bins, fence posts and pipes.
Return Unwanted Medicines	1998	809	This is a national not-for-profit company funded by the Department of Health. It provides for convenient and safe collection of medicines via pharmacies. Returned medicines are disposed of by high temperature incineration in accordance with EPA requirements.
Paintback	2016	9,289	Paintback collects and manages unwanted paint and paint packaging. In 2020–21 it collected 15% more paint and containers than in 2019–20. Collected paint is used in energy recovery or treated and landfilled.
PVC Stewardship Program	2002	n/a	Run by the Vinyl Council of Australia. Aims to increase the use of recycled PVC product. 1,657 tonnes of domestic PVC were recycled in 2020-21, resulting in a 17% increase of recyclate uptake.
Soft Landing	2009	9,100	Soft Landing collects used mattresses for recycling. In 2020–21 538,000 mattresses were recycled. Three quarters of a mattress can be recycled, including components made of steel, foam, timber and latex.

⁸⁵ As reported by the scheme operators. Details in the National Waste Reporting Tool 2020-21.

Expanding product stewardship

Community support for expanding product stewardship is reflected in Australian Government programs.

The National Product Stewardship Investment Fund offered grants between \$300,000 and \$1 million towards the development of new schemes or expansion of existing schemes. At the time of writing, the Government reports investment of \$18.6 million into 24 projects. The funded schemes are projected to divert more than 1.6 Mt of waste from landfill and create more than 1,000 jobs. They include a wide range of products including coffee cups, furniture, mattresses, silage wrap, sporting equipment and vehicle waste. The fund has also invested \$1 million in setting up the Product Stewardship Centre of Excellence that aims to provide mentoring and best practice guidance, educate businesses and support industry-led product stewardship schemes.

The RAWR Act requires publication of an annual ‘Minister’s priority list’ of products and materials that need urgent product stewardship action. The list signals that the Minister may consider regulatory measures if the relevant industry does not act. Products on the 2021–22 list are listed in Table 29.

Table 29 Information about product stewardship priority list 2021–22

Product	Information
Photovoltaic systems	Waste from photovoltaic systems is projected to greatly increase over the coming decades. Systems contain recoverable materials and also hazardous substances that should be kept from landfill. At present, most of these materials are sent to landfill but an industry-led nationwide product stewardship scheme must be operational by June 2023.
Electrical and electronic products	Electronic and electrical waste (e-waste) can contain valuable components as well as toxic substances. Modelling commissioned by the Department (Bontinck et al. 2021) estimates that 531 kt of e-waste was generated in Australia in 2020–21, up 2.6% on the previous year. Roughly 54% of all e-waste is sent for recycling processes that recover about 35% of the material inputs. Recovery rates are highest for television and computing equipment (covered by the NTCRS, see Table 27), while simpler metal scrapping is highest for temperature exchange equipment, large appliances and other large equipment. Measurable product design improvements are expected from manufacturers, importers, distributors and retailers by 2025.
Oil containers	Residual oil in containers has the potential to be harmful to people and the environment from residual oil. An industry implemented product stewardship scheme for plastic oil containers is expected to be operational by December 2023.
Child car seats	End-of-design-life seats need to be removed from circulation as they pose a safety risk to babies and young children. About 200,000 child car seats go to landfill each year. A voluntary product stewardship scheme is expected to be implemented by December 2023.
Clothing textiles	The scope of textiles in the priority list is limited to clothing. Clothing is estimated at about a third of all textiles (BE 2022a). Nearly all end-of-life clothing is sent to landfill. No formal collection service exists for reused textiles; collections are mainly run by charities. Improvements in technology are producing higher material yields in recycling but these are not yet widely used in Australia. An industry wide stakeholder group has been established.
Problematic and unnecessary single use plastics	Australians consumed about 3.8 Mt of plastics in 2020–21. Almost 4% is estimated to leak into the marine environment every year (DAWE 2021). The <i>National Waste Policy Action Plan</i> set a target to phase out problematic and unnecessary plastics by 2025. Work on this program is ongoing. Table 21 gives many examples of bans implemented by the states and territories.

14.3 Household hazardous waste collections

Some state and local governments run programs to collect unwanted household products that are toxic, flammable, corrosive or explosive. While often expensive to run, these household chemical collection programs are justified by the high risks to human health and the environment from improper management or indefinite storage. Collected materials are recycled or used in energy recovery where possible, and otherwise are treated and destroyed or landfilled.

Table 30 shows the tonnes of household hazardous waste collected by state, territory and major local government jurisdictions that operate a household hazardous waste collection program. The high variability in collections reported by different jurisdictions may be attributed to different scopes of materials collected by the programs.

Table 30 Tonnes of household hazardous waste collected by jurisdictions with a collection program in 2020–21

	NSW	SA	Vic	WA	Brisbane	Darwin
Tonnes of household hazardous waste collected (excluding paint) ⁸⁶	3,186	253	158	427	4,961	101
Percentage change of collected materials from 2019–20 to 2020–21	60%	60%	-19%	14%	10%	-36%

⁸⁶ Paint is already reported in the data for the Paintback product stewardship scheme.

15 Liquid waste

This chapter provides an overview of liquid waste generation, management, treatment and fate in Australia in 2020–21. It covers non-hazardous liquid waste (sewage and trade waste) and hazardous liquid waste, and discusses interactions between the waste management and wastewater industries. Definitions for the terms used in this chapter can be found in the glossary after the tables of contents.

Data sources and method

The Bureau of Meteorology publishes an annual ‘urban national performance report’ (BoM 2021) and supporting dataset, providing a detailed account of non-hazardous liquid waste generation and management in Australia by financial year. The report covers sewage, trade waste, treated effluent discharges and treated effluent recycled, and is compiled from 85 service providers including bulk water authorities, water utilities, and councils servicing more than 80% of the Australian population. Another report prepared on commission to the Australia and New Zealand Biosolids Partnership (PSD 2022) provides data on biosolids generation.

Figure 48 provides an overview of liquid waste generation and fate in Australia in 2020–21. Liquid waste generation, management, treatment and fate are each discussed in the sections below.

15.1 Liquid waste generation 2020–21

Sewage

Sewage is the main liquid waste from households. In 2020–21 about 1,974 gigalitres (GL) of sewage was discharged to sewer, mostly from households. This quantity represents by far the largest portion of liquid wastes.

Trade waste

Many service and manufacturing businesses dispose of trade waste to the sewerage system. Trade wastes are usually controlled by individual licence agreements between a business and the local water authority. Typically, the agreement sets out contaminant types and maximum contaminant loadings that can be discharged per unit volume of discharge from the premises, and often also sets a volume limit. At about 160 GL, trade waste is the second largest of Australia’s liquid waste flows.

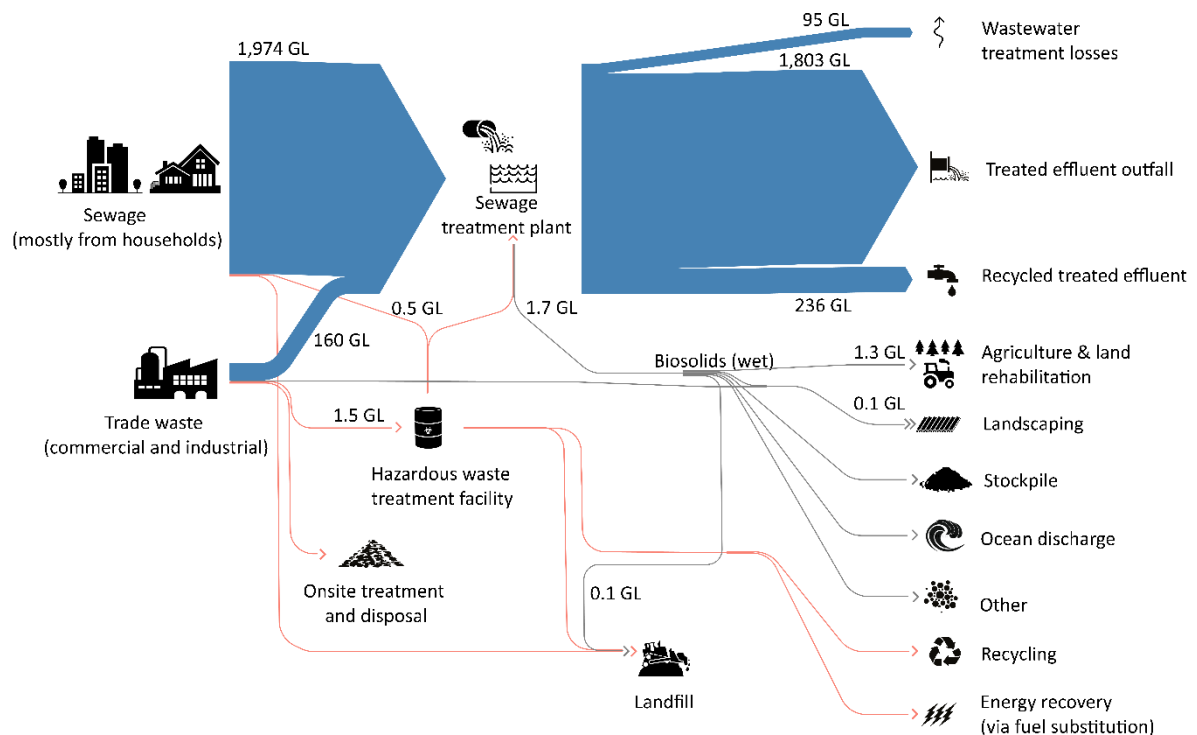
Hazardous liquid waste

Many manufacturing, food preparation and service industries generate various types of liquid hazardous wastes, totalling about 2 GL. Most of these are unsuited to management through the wastewater system, such as oil-based wastes (about 32% of the total) or acids, alkalis, solvents and organic and inorganic chemicals (about 17%). These materials are generally treated to reduce or neutralise the hazard levels and volumes, with residues discharged to sewer, landfilled or recycled. High calorific materials may be used as an energy source in cement kilns. Food-derived hazardous waste such as grease trap makes up a further 32% and is mostly composted.

Households also generate hazardous liquid waste when disposing of chemicals through programs run in most states and territories (see Section 14.3) or illegally to sewer or landfill.

Hazardous wastes are analysed in detail in the *Hazardous Waste in Australia* report series, most recently the 2021 version (BE and AWE 2021).

Figure 48 Overview of liquid waste generation and fate in Australia 2020–21



15.2 Liquid waste collection and movement

Liquid waste is collected and moved through the sewerage pipe network, specialist vehicles or private transport to central collection sites.

Sewerage pipe network

In most of Australia, sewage and trade wastes are collected through the sewerage system and stormwater is managed through separate collection and discharge system. Some combined stormwater and sewerage systems were built in the late 19th and early 20th centuries but have mostly been replaced. The sewerage system typically delivers the sewage to a treatment plant to enable recycling or discharge to the environment.

Commercial liquid waste transport

Hazardous liquid waste and some non-hazardous liquid waste is transported from industrial and commercial premises by private waste management companies. Non-hazardous liquid waste is usually transported to a recycling facility or to a permitted sewerage system inlet.

In NSW, Qld, Vic, WA and SA, hazardous waste transport within the jurisdiction's borders is subject to a tracking system that keeps government informed on the movement of the wastes. This requires transporters, generators and receivers to verify the quantity and type of waste moved, and report it to the regulator. Where hazardous waste is transported across state borders, the *National Environment Protection (Movement of Controlled Wastes Between States and Territories) Measure* establishes a different national system for reporting and control. Small amounts of liquid hazardous waste are exported overseas for treatment under permit.

15.3 Liquid waste treatment

Two types of facility treat liquid waste: sewage treatment plants and hazardous waste treatment facilities.

Sewage treatment plants

BoM (2021) reports 726 sewage treatment plants as operational in Australia, treating sewage and trade waste. Not all plants provide the same levels of treatment: the levels are generally defined as primary⁸⁷, secondary⁸⁸ or tertiary⁸⁹ treatment. Based on the BoM (2021) supporting database, 54% of Australian wastewater was treated to tertiary levels, 28% to secondary levels and 18% to primary levels.

After system losses, wastewater received by sewage treatment plants in 2020–21 had one of three main fates:

1. Discharge – about 1,803 GL of treated effluent was discharged to the ocean or a local water body
2. Recycling – about 236 GL was treated then recycled, mainly as irrigation water
3. The remainder is biosolids, which is the term for treated sludge from sewage treatment processes, after it has met stabilisation and contaminant guidelines. Based on a report by PSD (2022), in 2020–21 Australia generated about 1.7 GL of biosolids⁹⁰ of which about 83% was recycled to agriculture (73%), landscaping (7%), land rehabilitation (2%) or forestry (1%) and the remainder managed through stockpiling (13%), landfill (3%), ocean discharge or other means (1%).

Hazardous liquid waste treatment facilities

Large hazardous liquid waste treatment facilities are located in all jurisdictions except ACT, NT and Tas, which export the bulk of their hazardous liquid waste to other jurisdictions for treatment. In 2020–21 about 1.5 GL of liquid waste was sent to hazardous liquid waste treatment facilities.

Unlike the sewerage network and treatment system, these treatment facilities are wholly privately owned and operated. The services they provide vary widely. Some specialise in a single commonly arising type of liquid waste that is readily reused or recycled (e.g. waste oils and lubricants). Others receive an extensive and complex range of liquids and sludges. Facilities generally manage these liquid wastes by either:

- reducing the hazardous characteristics to enable recycling, energy recovery or disposal to sewer or landfill

⁸⁷ The UN (2007 p. 217) defines primary treatment of public wastewater as treatment of wastewater by a physical and/or chemical process involving settlement of suspended solids, or other process in which the 5-day biochemical oxygen demand of the incoming wastewater is reduced by at least 20% before discharge and the total suspended solids of the incoming wastewater are reduced by at least 50%.

⁸⁸ The UN (2007 p.217) defines secondary treatment of public wastewater as post-primary treatment of wastewater by a process generally involving biological or other treatment with a secondary settlement or other process, resulting in 5-day biochemical oxygen demand removal of at least 70% and a chemical oxygen demand removal of at least 75%.

⁸⁹ The UN (2007 p.217) defines tertiary treatment of public wastewater as treatment (additional to secondary treatment) of nitrogen and/or phosphorous and/or any other pollutant affecting the quality or a specific use of water (microbiological pollution, colour, etc.). For organic pollution, the treatment efficiencies that define a tertiary treatment are the following: removal of at least 95% for 5-day biochemical oxygen demand and 85% for chemical oxygen demand, and at least one of the following: nitrogen removal of at least 70%; phosphorus removal of at least 80%; and microbiological removal achieving a faecal coliform density less than 1,000 in 100 ml.

⁹⁰ Assumes an average solids content of 21%.

- chemically or physically immobilising the hazardous component of the liquid waste (for example by adding a binding agent such as lime) to solidify the waste and enable disposal to a hazardous solid waste landfill.

15.4 Interactions between the waste management and wastewater industries

There are several interactions between the waste management industry and the wastewater industry:

- Biosolids from wastewater treatment, while usually applied directly to land, may be sent to composting facilities for processing or landfills for disposal.
- Wastewater treatment companies are increasingly interested in processing food waste through anaerobic digestion, a technology already widely employed at sewage treatment facilities that generates methane that is combusted for its energy value. Yarra Valley Water operates a facility in Melbourne using about 33 kt/yr of commercial food waste from markets and food manufacturers to power its Aurora sewage treatment plant. Sydney Water is currently constructing a plant for co-digestion of food waste at its Liverpool Wastewater Treatment Plant.
- Many waste facilities have a trade waste discharge licence.
- Landfills collect and manage a liquid stream known as leachate, comprising mainly rainwater contaminated with particulate or dissolved material from the landfilled waste. This is managed through evaporation as much as possible but in some cases a portion is discharged or trucked to sewer.

16 Current and emerging challenges

Waste management and resource recovery operate in a dynamic environment, changing in response to government policy, industry development, market conditions and other circumstances. This chapter explores some of the challenges faced by the sector, both of current importance and those likely to play a role in the future.

16.1 COVID-19 pandemic

The COVID-19 pandemic continued to affect Australians into 2022 but with the end of widespread lockdowns, the impact on waste management diminished in varying degrees across the states and territories. SA, Tas and WA were less affected due to the recognition of waste as an essential service and collaborative arrangements with industry. Higher impacts were reported in the eastern states, potentially due to different demographics and government responses to testing and isolation requirements. The increased transmissibility of later COVID-19 variants, and subsequent staff shortages, led to increases in clinical waste and some delay of kerbside collections. However, management responses by both state governments and the waste sector saw few service failures.

Changes in waste generation patterns can be seen by comparing 2020–21 with the pre-pandemic year of 2018–19:

- MSW increased by 11%. Industry feedback suggests there was a significant increase in metropolitan areas of cardboard from food packaging and home deliveries of online shopping. Kerbside recyclables (including materials refunded under a CDS) increased by 6%, although industry also reports a rise in contamination.
- Core C&I waste declined by 6%, thought to relate to business closure during lockdowns.
- C&D waste grew by 7%, mostly in the second year of the pandemic after lockdowns diminished.

Early in the pandemic (when mask use was mandatory), used face masks were identified as a litter issue. With the mask mandates largely over, councils report the issue has largely diminished. There were also reports of increased litter and illegal dumping in areas that saw increased domestic tourist activity associated with international travel restrictions.

Photo 14 Face masks were a major litter issue in the early part of the COVID-19 pandemic



Single use face masks are easily air- or water-borne, and the layers of plastic will not readily break down in the environment. The ear loops pose a threat of entanglement to wildlife.

Photo by Lincoln Beddoe on iStock.

At the time of writing, post-pandemic inflationary pressures are affecting labour supply and costs across many sectors. This is likely to impact the waste management and resource recovery industry, too, potentially through labour shortages and higher costs.

16.2 Waste exports

Throughout much of the last decade, Australia exported a significant proportion of its domestic recyclables to Asia with often only crude separation into material types. The thorough sorting needed to extract product from the recyclables was done in China and other countries with lower labour costs and often poorer levels of environmental protection, where contaminants were not always well managed. China progressively excluded these materials starting in 2017. This disrupted recycling markets across the globe, including in Australia, where it bankrupted SKM, one of Australia's most prominent sorters of domestic recyclables.

In response, Australia determined to regulate exports of waste-derived materials. It has now regulated exports of scrap glass, plastics and tyres, and will regulate paper and cardboard from July 2024. The rules generally aim to ensure exports are ready for use as a product, and do not require further processing or cause harm to environmental or human health overseas.

The details of the regulatory program are addressed in Chapter 2 and the outcomes for exports of waste-derived materials are covered in Section 10.3.

16.3 Recycling infrastructure

Following the decision to regulate waste exports, the Australian and state governments decided to invest heavily in infrastructure to support onshore processing and markets for processed materials, as described in Section 13.5. These facilities are now being developed and will lead to a significant increase in recycling capacity in Australia for some materials. This rapid growth, and rapid industry changes more broadly, have seen some delivery challenges.

In some cases, the resource recovery industry has partnered with recyclers and manufacturers to deliver a material 'closed loop'. One example includes Circular Plastics Australia, a joint venture between Pact Group, Cleanaway, Asahi Beverages, and Coca-Cola Europacific Partners, which processes recovered plastics for remanufacture into packaging for food and beverages.

16.4 PFAS

Per- and poly-fluoroalkyl substances (PFAS) are a group of long-lasting chemicals, which have been identified as harmful to the environment and potentially harmful to human health. While initial attention focused on their use in fire-fighting foam, subsequent investigations have indicated they are widely used in a range of applications (including clothing, cookware and packaging). In Vic, the disposal of large amounts of PFAS-contaminated soil from a major road project became a significant and costly problem. There are also concerns about the presence of PFAS in organic waste, and its effects on recycled organics product quality and markets. In response, the Australian Government:

- is establishing the Industrial Chemicals Environmental Management Standard Register to help prevent chemicals contaminating wastes in the first place by managing their import, use and disposal
- has overseen the development of a new draft third version of the PFAS National Environmental Management Plan, which has additional guidance and standards on organic wastes and biosolids
- published a National PFAS Position Statement, which articulates shared goals of all Australian governments to reduce PFAS uses and releases
- provided funding to research and detect the presence of PFAS in fibre-based food packaging and supported APCO's voluntary industry-led *Action Plan to Phase Out PFAS in Fibre-Based Food Contact Packaging*.

Environment Ministers agreed to work together to phase out the use of harmful chemicals in food packaging.

16.5 Disaster waste

In the last few years, Australia has faced catastrophic bushfires and extensive flooding, both of which contributed to large amounts of waste. In 2020–21, 181,000 tonnes of disaster waste were recorded, comprising 86,000 tonnes from NSW (bushfire and flood), 77,300 tonnes from Vic (bushfire), 16,700 tonnes from WA (bushfire) and 940 tonnes from Qld (minor events). This data is incomplete.

Similar natural disasters are likely to increase in future as the climate changes. Disaster waste management planning (though in its infancy in some areas) is starting to address some of the challenges. The availability and accessibility of waste management and resource recovery infrastructure when needed has been identified as a particular issue. During recent flooding in NSW, the provision of waste disposal services in Sydney was severely impacted by the inaccessibility of regional landfills that usually accept much of Sydney’s waste. Some waste services in Sydney were suspended and the resulting stockpiles took time to clear after access was restored. Similar issues, though generally on a smaller scale, were experienced in areas (including in other states) subject to direct inundation.

16.6 Energy from waste

There has been interest in large-scale thermal energy from waste (EfW) facilities in Australia for some time. WA has led recent development, with two EfW facilities currently under construction (one is illustrated in Photo 4 on page 33), but there are multiple projects planned, including in NSW, Qld and Vic. While the role of EfW in waste management is acknowledged, some stakeholders express uncertainty about the long-term future of EfW within a circular economy and caution that facilities should not be reliant on plastic feedstocks or undermine recycling initiatives.

Consequently the policy frameworks to implement EfW across the eastern states differ, particularly with respect to industry capacity and location. This has led to a period of regulatory ambiguity, affecting investor confidence in further development of such capital-intensive infrastructure.

Preparation of waste-derived fuels for use in cement kilns and other facilities is increasing. Most of this product is currently exported.

16.7 Organics recovery

The recovery of food waste through FOGO kerbside collections is increasingly common practice among Australian local governments (see Section 12.3), with food waste diversion supported or mandated by some state governments (e.g. Vic, WA). This has seen significant diversion of organic waste to reprocessing facilities, and a need for rapid growth of the organics recycling sector. Food waste recovery from commercial operations, especially retail, is less developed. Matching supply and demand is an industry challenge, particularly where investment in enhanced compost technology is required (e.g. as a condition of approval to manage the higher odour risk associated with processing of food waste compared to garden waste).

With expanded FOGO services and increased material inputs come increased potential for contamination to affect the quality of the recycled organic products. Challenges include compostable items as a replacement for single use plastics that can confuse householders as they may not be accepted in FOGO collection services, and contaminants in some organic materials (e.g. PFAS,

herbicides) that do not breakdown through the compost process and could affect the marketability and use of compost products.

16.8 Circular economy

With circular economy widely accepted policy by Australian governments, attention has moved to implementation, that is, continued reuse and recycling of materials, reducing the need for extraction of virgin materials and minimising the amount of waste disposed to landfill. As a first step, many state and local governments are beginning to measure material flow, but with an Australian and global economy it is difficult to partition economic impacts to smaller regions.

Long-standing difficulties in ‘closing the loop’ also remain, with some buyers reluctant to purchase recycled or remanufactured materials. This is compounded by the low manufacturing base in Australia, with limited local demand for recycled materials as a manufacturing input.

16.9 Waste crime

Waste typically has zero or negative value to its owner, which can incentivise improper management at cost to the environment and society. Waste crime covers a spectrum from petty littering to organised criminal activity. It can occur along the length of the supply chain, from waste generators, to transporters, to waste facility operators. As well as active participation, those turning a ‘blind eye’ may also contribute to an illegal operation. Types of waste crime were canvassed in detail in Table 26 of the *National Waste Report 2020*.

The costs of waste crime can include reduced enjoyment of the environment, fire risks, health impacts, pollution, clean-up costs and lost government revenue. Waste crime undermines the waste sector and limits its ability to operate sustainably and profitably. Measures governments can take to control waste crime include monitoring and enforcement, ensuring waste generators take due care, incentivising proper management and phasing out easily littered materials.

16.10 Managing plastic waste

Plastics, and particularly single-use plastics, continue to be problematic. High consumption and low recycling rates remain a feature of plastic in Australia, as does plastic litter and contamination of recovered materials, such as recycled organics. Most states have introduced bans on selected-single use plastics, as listed in Table 21 on page 61.

Photo 15 Plastics in the ocean



Photo from Unsplash by Naja Bertolt Jensen

Feature 8 Plastics in the environment

More than 8 Mt/yr of plastics are estimated to enter the world’s oceans (EMF 2016) – triple Australia’s annual plastic waste generation. A third of marine turtles have likely ingested plastic debris. Marine wildlife is also impacted through entanglement with plastic twine or rope. Without change, EMF (2016) suggests that by 2050 the ocean will contain more plastics than fish by weight.

In Australia, an estimated 1.18 Mt of plastic packaging were consumed in 2020–21, representing about 26% of plastics consumption. Australian research found that three-quarters of coastal marine debris is plastic. Most is from Australian sources, with high concentration around major urban areas (CSIRO 2021).

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Appendix A National waste reporting history

Appendix A National waste reporting history

National waste reporting was first attempted in the 1990s to measure progress in implementing the 1992 *National Waste Minimisation and Recycling Strategy*. However, the categories and comprehensiveness of the data collected by each state and territory did not match the proposed system and there was little appetite for change. During the 2000s, the Department commissioned several snapshots of national waste quantities titled *Waste and Recycling in Australia*. Data quality and comprehensiveness improved over time but the differences meant trends could not be readily compiled. There were concerns from the states and territories about the transparency of the data transformations used to create a common national platform.

Following the release of the 2009 *National Waste Policy*, a first National Waste Report was released in 2010 using 2006–07 data. Following this release, a ‘method report’ was commissioned to describe what data would be collected and how it would be transformed. This was applied in the *National Waste Report 2013*, which drew on 2010–11 data and was released with a calculation workbook so states and territories could track their data transformations.

The method was subsequently updated in a procedural document that was agreed to by all states and territories (REC and BE 2015). It was accompanied by a National Waste Reporting Tool into which states and territories would enter their data and in which it would be transformed to standardised output tables and charts. Based on the agreed method and tool, historical data was revisited and transformed for consistency with the agreed approach, producing a historical record back to 2006–07 (but missing data for 2007–08, 2011–12 and 2012–13). National waste reports in 2016, 2018 and 2020 each incorporated two more data years and used the agreed method and tool.

Changes for the *National Waste Report 2018* were driven by national consultation on improving Australia’s waste data and reporting (BE et al. 2018), including a review by an international consultancy and consideration of the UN System for Environmental Economic Accounting (UN et al. 2014). These led to a significant restructure, enhanced graphical presentations, expansion of scope to primary production wastes, specification of ‘core waste’ and determination of ‘core waste plus ash’ as the primary performance measure. Data access was improved through the development of a National Waste Database.

The *National Waste Policy Action Plan* (Australian Government et al. 2019) established national waste reports as the mechanism for assessing progress against targets using a 2016–17 baseline, and committed to publishing national waste reports every two years. The *National Waste Report 2020* included material flow analyses and associated circular economy metrics for the first time.

The [Australian Standard for Waste and Resource Recovery Data and Reporting](#), first edition set a clarified and revised national framework for the scope and classification of waste data. This report has been revised from previous editions accordingly.

Detailed reporting and analysis of hazardous waste has been undertaken in separate *Hazardous Waste in Australia* reports in 2015, 2017 and 2019. The data collected for these reports is reclassified in summary form for inclusion in the National Waste Database and this report.

Appendix B Chart data

Appendix B Chart data

The data used in generating the charts in this report is set out below. ‘CAGR’ means compound annual growth rate.

The charts in the ‘At a glance’ section are extracts or duplicates of other charts given in the report – their data can be found in the data for the original chart as listed below:

- Figure 1 – see data table for Figure 10 (grey-highlighted data only)
- Figure 2 – see data table for Figure 13 (grey-highlighted data only)
- Figure 3 – see data table for Figure 19 and Figure 26 (grey-highlighted data only)
- Figure 4 – see data table for Figure 28
- Figure 5 – see data table for Figure 31
- Figure 6 – see data table for Figure 38.

Figure 10 Waste generation by material category and stream, Australia 2020–21 (core waste plus ash)

Material category	Generation (Mt)	Stream	Generation (Mt)	Jurisdiction	Generation (Mt)
Ash	12.0	MSW	14.0	ACT	1.1
Building & demolition materials	25.2	C&D	29.0	NSW	25.9
Glass	1.5	C&I core	20.8	NT	0.5
Hazardous wastes	7.4	C&I (elec. gen.)	12.0	Qld	15.1
Metals	5.7	C&I total	32.8	SA	5.4
Organics	14.4	Total core wastes	63.8	Tas	0.9
Paper & cardboard	5.8	Total	75.8	Vic	19.0
Plastics	2.6	n/a	n/a	WA	8.0
Textiles, leather & rubber (excl. tyres)	0.9	n/a	n/a	n/a	n/a
Unclassified materials	0.3	n/a	n/a	n/a	n/a

Figure 11 Waste generation (all measured materials) by stream, Australia 2020–21

Material category	Generation (Mt)
Core waste	63.8
Ash	12.0
Organic primary production	9.5
Organic processing	23.5
Mining	619.7
Mineral processing	29.2
Total	757.7

Figure 12 Estimated mining waste by commodity, Australia 2020–21

Mining type	Waste generation (Mt)
Bauxite mining	0.0
Coal mining	24.6
Copper ore mining	68.8
Gold ore mining	242.0
Iron ore mining	146.2
Mineral sand mining	4.4
Nickel ore mining	30.2
Oil and gas extraction	2.6
Other construction material mining	0.0
Other metal ore mining	18.1
Other non-metallic mineral mining and quarrying	4.7
Silver-lead-zinc ore mining	78.0

Figure 13 Trends in the generation of core waste (plus ash where shown) by stream in total (left) and per capita (right), Australia 2006–07 to 2020–21

	2007	2009	2010	2011	2014	2015	2016	2017	2018	2019	2020	2021	CAGR
Core waste plus ash (Mt)													
MSW	12.9	13.3	13.6	13.5	13.8	14.0	13.0	12.6	12.6	12.6	13.2	14.0	0.6%
C&I	33.3	33.5	34.0	33.9	33.8	32.9	33.3	33.7	34.0	34.5	34.3	32.8	-0.1%
C&D	16.8	18.4	18.4	18.3	17.8	19.1	20.9	23.4	26.4	27.1	27.6	29.0	4.0%
Total	63.0	65.2	65.9	65.7	65.3	66.0	67.2	69.7	73.0	74.2	75.1	75.8	1.3%
Core waste (Mt)													
MSW	12.9	13.3	13.6	13.5	13.8	14.0	13.0	12.6	12.6	12.6	13.2	14.0	0.6%
C&I	18.9	19.3	20.1	20.3	21.5	20.7	21.1	21.5	21.7	22.1	20.9	20.8	0.7%
C&D	16.8	18.4	18.4	18.3	17.8	19.1	20.9	23.4	26.4	27.1	27.6	29.0	4.0%
Total	48.6	51.1	52.0	52.1	53.0	53.7	55.0	57.5	60.7	61.8	61.7	63.8	2.0%
t per capita													
Core waste plus ash	3.05	3.04	3.02	2.96	2.81	2.79	2.80	2.86	2.95	2.95	2.94	2.95	-0.2%
Core waste	2.36	2.38	2.38	2.35	2.28	2.27	2.29	2.36	2.45	2.46	2.41	2.48	0.4%
MSW	0.62	0.62	0.62	0.61	0.59	0.59	0.54	0.52	0.51	0.50	0.52	0.54	-1.0%
C&I core plus ash	1.61	1.56	1.56	1.53	1.45	1.39	1.39	1.38	1.37	1.37	1.34	1.28	-1.7%
C&I core	0.92	0.90	0.92	0.92	0.92	0.88	0.88	0.88	0.88	0.88	0.82	0.81	-0.9%
C&D	0.81	0.86	0.84	0.83	0.76	0.81	0.87	0.96	1.06	1.08	1.08	1.13	2.4%

Figure 14 Trends in the generation of core waste by jurisdiction, Australia 2006–07 to 2020–21 (Mt)

Jurisdiction	2007	2009	2010	2011	2014	2015	2016	2017	2018	2019	2020	2021
ACT	0.72	0.75	0.73	0.91	0.86	0.73	0.93	1.03	1.05	1.22	1.16	1.05
NSW	15.79	18.42	17.31	17.19	17.92	17.58	18.47	19.96	19.68	19.44	20.32	20.28
NT	0.52	0.35	0.35	0.35	0.54	0.46	0.32	0.38	0.40	0.44	0.39	0.45
Qld	9.58	9.70	9.12	9.08	10.26	10.22	10.30	11.30	12.34	12.35	9.80	10.58
SA	3.15	3.36	3.37	3.94	3.97	3.95	4.13	4.21	4.56	4.42	4.67	5.35
Tas	0.80	0.76	0.82	0.90	0.91	0.97	1.09	0.94	0.82	0.97	0.92	0.90
Vic	12.15	11.68	12.89	13.22	12.51	13.08	13.95	14.38	16.43	17.30	17.85	18.12
WA	5.89	6.06	7.47	6.49	6.04	6.73	5.81	5.27	5.43	5.70	6.58	7.03
Australia	48.61	51.09	52.05	52.08	53.03	53.74	54.99	57.46	60.71	61.84	61.68	63.76

Figure 14 (cont.) Trends in the generation of core waste plus ash by jurisdiction, Australia 2006–07 to 2020–21 (Mt)

Jurisdiction	2007	2009	2010	2011	2014	2015	2016	2017	2018	2019	2020	2021
ACT	0.72	0.75	0.73	0.91	0.86	0.73	0.93	1.03	1.05	1.22	1.16	1.05
NSW	22.41	25.07	23.70	23.35	23.53	22.90	23.80	25.58	25.45	25.25	26.02	25.92
NT	0.52	0.35	0.35	0.35	0.54	0.46	0.32	0.38	0.40	0.44	0.39	0.45
Qld	14.46	14.60	13.83	13.63	14.28	14.46	14.55	15.78	16.94	16.98	14.34	15.07
SA	3.58	3.79	3.79	4.34	4.36	4.36	4.54	4.21	4.56	4.42	4.67	5.35
Tas	0.80	0.76	0.82	0.90	0.91	0.97	1.09	0.94	0.82	0.97	0.92	0.90
Vic	13.49	12.76	14.21	14.68	13.85	14.34	15.13	15.42	17.29	18.15	18.72	19.00
WA	6.97	7.15	8.51	7.50	7.01	7.74	6.83	6.35	6.53	6.81	7.61	8.05
Australia	62.96	65.24	65.93	65.66	65.35	65.98	67.19	69.68	73.05	74.24	73.83	75.78

Figure 17 Recycling and waste reuse of core waste plus ash by category, jurisdiction and stream, Australia 2020–21

Material category	Recycling (Mt)	Stream	Recycling (Mt)	Jurisdiction	Recycling (Mt)
Ash	6.02	MSW	5.88	ACT	0.67
Building & demolition materials	20.23	C&D	22.52	NSW	16.77
Glass	0.91	C&I core	11.02	NT	0.08
Hazardous wastes	2.95	C&I (electricity generation)	6.02	Qld	6.49
Metals	4.97	n/a	n/a	SA	4.09
Organics	6.76	n/a	n/a	Tas	0.40
Paper & cardboard	3.15	Total	45.44	Vic	11.99
Plastics	0.34	n/a	n/a	WA	4.95
Textiles, leather & rubber (excl. tyres)	0.04	n/a	n/a	n/a	n/a
Unclassified materials	0.06	n/a	n/a	n/a	n/a

Figure 18 Indicative scrap commodity prices (\$ per tonne, product leaving a material recovery facility)

Material	Jun-17	Mar-18	Jun-19	Jul-19	Jun-20	Jun-21	Jul-21	May-22
Fibre – Mixed paper & paperboard	123.6	-2.5	0.0	0.0	0.0	0.0	0	20.0
Fibre – Newsprint & magazine	0.0	0.0	186.8	182.0	90.0	139.0	155.8	420.0
Fibre – Old corrugated cardboard	204.6	125.0	196.0	196.0	105.0	118.0	140	285.0
Glass – Green	0.0	0.0	30.0	30.0	30.0	30.0	30	119.1
Glass – Mixed	0.0	0.0	-30.0	-30.0	-30.0	-30.0	-30	-30.0
Glass – Green (CDS)	0.0	0.0	100.0	100.0	75.0	75.0	75	119.1
Plastic – PET (1)	575.0	375.0	400.0	380.0	271.5	587.1	601.3	1270.0
Plastic – HDPE (2)	575.0	500.0	500.0	500.0	357.9	1239.4	1174.0	1358.1
Plastic – Mixed (1–7)	325.0	110.0	65.0	65.0	45.4	252.7	299.8	558.5
Steel	216.4	135.0	150.0	135.0	90.8	450.3	523.4	494.0
Aluminium	1248.5	1350.0	1100.0	1100.0	880.3	1821.4	1934.8	2834.2

Note this table only includes selected data. Further detailed data can be found in the National Waste Database 2022.

Figure 19 Trends in the recycling and waste reuse of core waste (plus ash where shown) by stream in total (left) and per capita (right), Australia 2006–07 to 2020–21

	2007	2009	2010	2011	2014	2015	2016	2017	2018	2019	2020	2021	CAGR
Core waste plus ash (Mt)													
MSW	4.8	5.3	5.5	5.8	6.3	6.3	5.5	4.9	5.0	5.1	5.5	5.9	1.4%
C&I	14.3	13.5	15.3	17.6	18.8	17.7	17.3	18.4	18.7	18.5	17.4	17.0	1.3%
C&D	10.2	11.2	11.4	12.2	11.4	12.3	14.6	16.8	19.4	20.8	21.0	22.5	5.8%
Total	29.3	30.0	32.1	35.5	36.5	36.4	37.4	40.1	43.2	44.4	43.9	45.4	3.2%
Core waste (Mt)													
MSW	4.8	5.3	5.5	5.8	6.3	6.3	5.5	4.9	5.0	5.1	5.5	5.9	1.4%
C&I	10.0	9.9	11.1	11.6	12.7	12.4	12.2	12.3	12.4	12.6	11.4	11.0	0.7%
C&D	10.2	11.2	11.4	12.2	11.4	12.3	14.6	16.8	19.4	20.8	21.0	22.5	5.8%
Total	25.0	26.4	28.0	29.6	30.3	31.0	32.3	34.1	36.9	38.5	37.9	39.4	3.3%
t per capita													
Core waste plus ash	1.42	1.40	1.47	1.60	1.57	1.54	1.56	1.64	1.74	1.76	1.72	1.77	1.6%
Core waste	1.21	1.23	1.28	1.34	1.30	1.31	1.35	1.40	1.49	1.53	1.48	1.53	1.7%
MSW	0.23	0.25	0.25	0.26	0.27	0.27	0.23	0.20	0.20	0.20	0.21	0.23	-0.2%
C&I core plus ash	0.69	0.63	0.70	0.79	0.81	0.75	0.72	0.75	0.76	0.74	0.68	0.66	-0.3%
C&I core	0.49	0.46	0.51	0.52	0.54	0.52	0.51	0.51	0.50	0.50	0.44	0.43	-0.9%
C&D	0.49	0.52	0.52	0.55	0.49	0.52	0.61	0.69	0.78	0.82	0.82	0.88	4.2%

Figure 20 Trends in the recycling and waste reuse of core waste by jurisdiction, Australia 2006–07 to 2020–21 (Mt)

Jurisdiction	2007	2009	2010	2011	2014	2015	2016	2017	2018	2019	2020	2021
ACT	0.49	0.51	0.52	0.64	0.62	0.49	0.59	0.46	0.67	0.92	0.78	0.67
NSW	9.52	10.82	10.98	10.93	10.88	10.95	11.38	12.58	12.82	12.20	12.06	12.40
NT	0.04	0.04	0.04	0.04	0.06	0.08	0.03	0.04	0.06	0.09	0.06	0.08
Qld	4.15	4.07	3.70	4.29	4.58	4.69	4.56	5.01	5.62	6.30	5.26	5.62
SA	2.31	2.52	2.55	3.08	2.98	3.05	3.19	3.32	3.62	3.53	3.64	4.09
Tas	0.30	0.30	0.36	0.39	0.45	0.45	0.56	0.48	0.34	0.45	0.42	0.40
Vic	6.33	6.24	7.53	7.68	7.69	8.26	9.06	9.32	10.88	11.72	11.77	11.99
WA	1.90	1.93	2.29	2.56	3.08	3.03	2.94	2.83	2.87	3.26	3.89	4.17
Australia	25.05	26.44	27.98	29.61	30.34	31.00	32.33	34.06	36.88	38.48	37.88	39.42

Figure 20 (cont.) Trends in the recycling and waste reuse of core waste by jurisdiction, Australia 2006–07 to 2020–21 (Mt)

Jurisdiction	2007	2009	2010	2011	2014	2015	2016	2017	2018	2019	2020	2021
ACT	0.49	0.51	0.52	0.64	0.62	0.49	0.59	0.46	0.67	0.92	0.78	0.67
NSW	12.38	12.99	13.83	15.28	15.35	14.73	14.95	16.98	17.42	16.48	16.48	16.77
NT	0.04	0.04	0.04	0.04	0.06	0.08	0.03	0.04	0.06	0.09	0.06	0.08
Qld	4.84	4.85	4.37	4.95	5.36	5.40	5.27	5.80	6.45	7.12	6.04	6.49
SA	2.57	2.74	2.72	3.28	3.10	3.20	3.29	3.32	3.62	3.53	3.64	4.09
Tas	0.30	0.30	0.36	0.39	0.45	0.45	0.56	0.48	0.34	0.45	0.42	0.40
Vic	6.33	6.24	7.53	7.68	7.69	8.26	9.06	9.32	10.88	11.72	11.77	11.99
WA	2.37	2.28	2.76	3.27	3.85	3.76	3.63	3.67	3.75	4.08	4.68	4.95
Australia	29.32	29.97	32.13	35.54	36.49	36.37	37.38	40.09	43.19	44.40	43.87	45.44

Figure 21 Energy recovery from core waste by management method, material category, stream and jurisdiction, Australia 2020–21

Management methods	kt	Material category	kt	Jurisdiction	kt
Landfill	1,955	Organics	1,542	ACT	53
Energy from waste facility	320	Paper & cardboard	417	NSW	617
Treatment	70	Plastics	14	NT	5
n/a	n/a	Textiles, leather & rubber (excl. tyres)	134	Qld	549
Stream	kt	Hazardous wastes	239	SA	194
MSW	1,201	n/a	n/a	Tas	58
C&I	1,056	Total	2,345	Vic	669
C&D	88	Tyres (T140)	169	WA	200

Figure 22 Greenhouse gas emissions from solid waste management, 1989–90 to 2019–20 (kt CO₂-e)

Year	Biological treatment of solid waste	Incineration and open burning of waste	Solid waste disposal
1990	22	87	17,065
1991	30	87	17,050
1992	38	87	16,878
1993	46	87	16,832
1994	55	87	16,180
1995	63	93	16,318
1996	71	67	14,735
1997	79	29	14,605
1998	87	29	13,832
1999	96	29	13,971
2000	104	28	13,752
2001	112	28	13,803
2002	120	29	13,999
2003	129	29	12,937
2004	137	29	12,446
2005	145	29	12,267
2006	156	29	11,959
2007	165	30	12,272
2008	178	30	12,724
2009	186	31	12,637
2010	211	30	12,949
2011	245	30	12,489
2012	249	31	11,110
2013	253	31	10,248
2014	257	32	10,212
2015	261	31	9,703
2016	267	31	9,987
2017	272	31	10,317
2018	276	31	10,108
2019	278	31	9,905
2020	282	31	9,532

Figure 23 Trends in core waste to energy recovery by jurisdiction, Australia 2006–07 to 2020–21 (kt)

	2007	2009	2010	2011	2014	2015	2016	2017	2018	2019	2020	2021
ACT	45	37	35	35	40	38	36	36	49	44	34	53
NSW	610	615	619	676	593	896	894	824	643	724	647	617
NT	19	28	29	19	18	16	13	15	15	18	4	5
Qld	426	388	407	379	441	387	422	390	430	531	538	549
SA	173	177	177	174	177	170	173	171	206	207	243	194
Tas	44	67	48	49	50	57	47	39	48	47	55	58
Vic	439	458	464	562	932	776	720	614	758	656	734	669
WA	222	250	184	182	226	262	180	200	230	159	194	200
Australia	1,979	2,020	1,964	2,077	2,478	2,603	2,485	2,288	2,379	2,385	2,448	2,345

Figure 25 Disposal of core waste plus ash by material category, jurisdiction and stream, Australia 2020–21

Material category	Disposal (Mt)	Stream	Disposal (Mt)	Jurisdiction	Disposal (Mt)
Ash	6.00	MSW	6.87	ACT	0.32
Building & demolition materials	4.94	C&D	6.45	NSW	8.53
Glass	0.63	C&I core	8.68	NT	0.37
Hazardous wastes	4.18	C&I (electricity generation)	6.00	Qld	8.04
Metals	0.74	n/a	n/a	SA	1.07
Organics	6.13	n/a	n/a	Tas	0.44
Paper & cardboard	2.18	Total	28.00	Vic	6.34
Plastics	2.28	n/a	n/a	WA	2.89
Textiles, leather & rubber (excl. tyres)	0.68	n/a	n/a	n/a	n/a
Unclassified materials	0.24	n/a	n/a	n/a	n/a

Figure 26 Trends in the disposal of core waste (plus ash where shown) by stream in total (left) and per capita (right), Australia 2006–07 to 2020–21

	2007	2009	2010	2011	2014	2015	2016	2017	2018	2019	2020	2021	CAGR
Core waste plus ash (Mt)													
MSW	7.03	7.04	7.06	6.63	6.28	6.28	6.12	6.43	6.32	6.32	6.46	6.87	-0.2%
C&I	18.13	19.04	17.85	15.38	13.90	14.11	14.95	14.39	14.24	14.84	15.82	14.68	-1.5%
C&D	6.50	7.18	6.92	6.03	6.20	6.62	6.25	6.48	6.91	6.30	6.53	6.45	-0.1%
Total	31.66	33.25	31.83	28.04	26.38	27.01	27.33	27.31	27.48	27.45	28.81	28.00	-0.9%
Core waste (Mt)													
MSW	7.03	7.04	7.06	6.63	6.28	6.28	6.12	6.43	6.32	6.32	6.46	6.87	-0.2%
C&I	8.06	8.41	8.12	7.73	7.73	7.23	7.81	8.20	8.22	8.36	8.37	8.68	0.5%
C&D	6.50	7.18	6.92	6.03	6.20	6.62	6.25	6.48	6.91	6.30	6.53	6.45	-0.1%
Total	21.58	22.62	22.11	20.39	20.21	20.13	20.18	21.11	21.45	20.97	21.36	22.00	0.1%
t per capita													
Core waste plus ash	1.53	1.55	1.46	1.26	1.13	1.14	1.14	1.12	1.11	1.09	1.13	1.09	-2.4%
Core waste	1.05	1.05	1.01	0.92	0.87	0.85	0.84	0.87	0.87	0.83	0.84	0.86	-1.4%
MSW	0.34	0.33	0.32	0.30	0.27	0.27	0.26	0.26	0.26	0.25	0.25	0.27	-1.7%
C&I core plus ash	0.88	0.89	0.82	0.69	0.60	0.60	0.62	0.59	0.58	0.59	0.62	0.57	-3.0%
C&I core	0.39	0.39	0.37	0.35	0.33	0.31	0.33	0.34	0.33	0.33	0.33	0.34	-1.0%
C&D	0.31	0.33	0.32	0.27	0.27	0.28	0.26	0.27	0.28	0.25	0.26	0.25	-1.6%

Figure 27 Trends in the disposal of core waste by jurisdiction, Australia 2006–07 to 2020–21 (Mt)

Jurisdiction	2007	2009	2010	2011	2014	2015	2016	2017	2018	2019	2020	2021
ACT	0.18	0.20	0.17	0.23	0.21	0.21	0.30	0.53	0.33	0.25	0.35	0.32
NSW	5.66	6.99	5.71	5.58	6.46	5.73	6.19	6.55	6.22	6.52	7.61	7.26
NT	0.46	0.28	0.28	0.29	0.46	0.37	0.28	0.32	0.33	0.33	0.32	0.37
Qld	5.00	5.24	5.02	4.42	5.24	5.15	5.31	5.89	6.30	5.52	4.00	4.41
SA	0.66	0.66	0.64	0.69	0.81	0.73	0.77	0.71	0.73	0.68	0.79	1.07
Tas	0.46	0.39	0.40	0.46	0.41	0.47	0.49	0.42	0.43	0.47	0.44	0.44
Vic	5.38	4.98	4.89	4.97	3.89	4.04	4.16	4.45	4.79	4.92	5.35	5.47
WA	3.76	3.88	4.99	3.75	2.74	3.43	2.69	2.24	2.33	2.28	2.50	2.67
Australia	21.58	22.62	22.11	20.39	20.21	20.13	20.18	21.11	21.45	20.97	21.36	22.00

Figure 27 (cont.) Trends in the disposal of core waste plus ash by jurisdiction, Australia 2006–07 to 2020–21 (Mt)

Jurisdiction	2007	2009	2010	2011	2014	2015	2016	2017	2018	2019	2020	2021
ACT	0.18	0.20	0.17	0.23	0.21	0.21	0.30	0.53	0.33	0.25	0.35	0.32
NSW	9.41	11.47	9.25	7.39	7.58	7.28	7.96	7.78	7.39	8.04	8.90	8.53
NT	0.46	0.28	0.28	0.29	0.46	0.37	0.28	0.32	0.33	0.33	0.32	0.37
Qld	9.19	9.36	9.06	8.30	8.47	8.67	8.86	9.59	10.06	9.33	7.77	8.04
SA	0.84	0.87	0.89	0.89	1.08	0.99	1.08	0.71	0.73	0.68	0.79	1.07
Tas	0.46	0.39	0.40	0.46	0.41	0.47	0.49	0.42	0.43	0.47	0.44	0.44
Vic	6.72	6.06	6.21	6.43	5.23	5.30	5.35	5.48	5.65	5.78	6.22	6.34
WA	4.38	4.62	5.57	4.04	2.93	3.73	3.03	2.48	2.55	2.57	2.73	2.89
Australia	31.66	33.25	31.83	28.04	26.38	27.01	27.33	27.31	27.48	27.45	27.52	28.00

Figure 28 Resource recovery rates of core waste plus ash by jurisdiction, 2020–21

Jurisdiction	Recycling	Rank	Energy recovery	Waste reuse	Total recovery	Rank
ACT	50%	5	5%	14%	69%	2
NSW	55%	4	2%	9%	67%	3
NT	18%	8	1%	0%	19%	8
Qld	37%	7	4%	6%	47%	7
SA	76%	1	4%	0%	80%	1
Tas	44%	6	6%	0%	51%	6
Vic	63%	2	4%	0%	67%	4
WA	61%	3	2%	0%	64%	5
Australia	55%	n/a	n/a	n/a	63%	n/a

Figure 29 Resource recovery rates by source stream, Australia 2020–21

Stream	Recycling	Energy recovery	Waste reuse	% Total recovery
MSW	42%	8.6%	0.2%	51%
C&I core + ash	42%	3.2%	10.1%	55%
C&I core	53%	5.1%	0.1%	58%
C&D	55%	0.3%	0.5%	78%

Figure 30 Resource recovery rate trends of core waste plus ash by jurisdiction (top) and stream (bottom), Australia 2006–07 to 2020–21

Jurisdiction	2007	2009	2010	2011	2014	2015	2016	2017	2018	2019	2020	2021	CAGR
ACT	75%	74%	76%	75%	76%	72%	68%	48%	69%	79%	70%	69%	-0.5%
NSW	58%	54%	61%	68%	68%	68%	67%	70%	71%	68%	66%	67%	1.0%
NT	12%	20%	20%	17%	15%	20%	14%	16%	18%	25%	17%	19%	3.6%
Qld	36%	36%	35%	39%	41%	40%	39%	39%	41%	45%	46%	47%	1.8%
SA	77%	77%	77%	79%	75%	77%	76%	83%	84%	85%	83%	80%	0.3%
Tas	42%	49%	51%	49%	55%	52%	55%	55%	47%	51%	52%	51%	1.3%
Vic	50%	53%	56%	56%	62%	63%	65%	64%	67%	68%	67%	67%	2.0%
WA	37%	35%	35%	46%	58%	52%	56%	61%	61%	62%	64%	64%	4.0%
Australia	50%	49%	52%	57%	60%	59%	59%	61%	62%	63%	63%	63%	1.7%
Stream													
MSW	45%	47%	48%	51%	54%	55%	53%	49%	50%	50%	51%	51%	0.8%
C&I core plus ash	46%	43%	48%	55%	59%	57%	55%	57%	58%	57%	56%	55%	1.4%
C&I core	57%	56%	60%	62%	64%	65%	63%	62%	62%	62%	60%	58%	0.1%
C&D	61%	61%	62%	67%	65%	65%	70%	72%	74%	77%	76%	78%	1.7%

Figure 31 Waste generation and management method by material category, Australia 2020–21

Material category	Anaerobic digestion (Mt)	Energy from waste facility (Mt)	Landfill (Mt)	Other disposal (Mt)	Recycling (Mt)	Treatment (Mt)	Waste reuse (Mt)	Generation (Mt)	% Generation	Generation (kg/cap)
Ash	0.00	0.00	0.00	6.00	2.71	0.00	3.31	12.02	16%	468
Building & demolition materials	0.00	0.00	4.94	0.00	20.08	0.00	0.15	25.17	33%	980
Glass	0.00	0.00	0.63	0.00	0.91	0.00	0.00	1.54	2%	60
Hazardous wastes	0.00	0.17	3.71	0.05	1.99	1.45	0.00	7.37	10%	287
Metals	0.00	0.00	0.74	0.00	4.97	0.00	0.00	5.71	8%	222
Organics	0.07	0.14	7.30	0.23	6.68	0.00	0.00	14.43	19%	562
Paper & cardboard	0.00	0.00	2.60	0.00	3.15	0.00	0.00	5.76	8%	224
Plastics	0.00	0.01	2.28	0.00	0.34	0.00	0.00	2.63	3%	102
Textiles, leather & rubber (excl. tyres)	0.00	0.00	0.81	0.00	0.04	0.00	0.00	0.86	1%	33
Unclassified materials	0.00	0.00	0.24	0.00	0.02	0.00	0.04	0.30	0%	12
Total	0.07	0.32	23.26	6.29	40.89	1.45	3.51	75.78	100%	n/a

Figure 32 Resource recovery rates by material category, Australia 2020–21

Material category	Recycling	Energy recovery	Waste reuse	% Total recovery
Ash	23%	0.0%	28%	50%
Building & demolition materials	80%	0.0%	0.6%	80%
Glass	59%	0.0%	0.0%	59%
Hazardous wastes	40%	3.2%	0.0%	43%
Metals	87%	0.0%	0.0%	87%
Organics	47%	11%	0.0%	58%
Paper & cardboard	55%	7.2%	0.0%	62%
Plastics	13%	0.5%	0.0%	13%
Textiles, leather & rubber (excl. tyres)	5.2%	16%	0.0%	21%
Unclassified materials	6.3%	0.0%	13%	19%

Figure 33 Trends in the generation and management methods of key material categories, Australia 2006–07 to 2020–21

Mt	2007	2009	2010	2011	2014	2015	2016	2017	2018	2019	2020	2021	CAGR
Ash													
Anaerobic digestion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Energy from waste facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Landfill	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Other disposal	10.1	10.6	9.7	7.7	6.2	6.9	7.1	6.2	6.0	6.5	6.2	6.0	-3.6%
Recycling	4.3	3.5	4.2	5.9	6.1	5.4	5.1	6.0	6.3	5.9	6.0	6.0	-3.2%
Treatment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Waste reuse	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
Total	14.4	14.2	13.9	13.6	12.3	12.2	12.2	12.2	12.3	12.4	12.1	12.0	-1.3%
kg/capita	695.8	659.2	634.8	612.6	528.7	517.8	508.7	501.3	498.2	492.8	475.4	468.2	-2.8%
Building and demolition materials													
Anaerobic digestion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Energy from waste facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Landfill	5.5	6.2	5.9	5.0	4.5	5.0	4.8	4.8	4.7	4.2	4.9	4.9	-0.8%
Other disposal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Recycling	8.9	9.7	10.2	10.6	10.3	11.2	13.5	15.4	17.5	18.7	19.0	20.1	6.0%
Treatment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Waste reuse	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	n/a
Total	14.5	15.9	16.0	15.7	14.8	16.3	18.3	20.2	22.2	23.0	24.1	25.2	4.0%
kg/capita	701.9	740.1	733.1	706.0	634.4	688.0	762.8	827.4	897.5	913.5	943.8	980.2	2.4%
Glass													
Anaerobic digestion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Energy from waste facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Landfill	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	1.4%
Other disposal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Recycling	0.7	0.8	0.6	0.7	0.6	0.6	0.7	0.6	0.7	0.7	0.9	0.9	1.5%
Treatment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Waste reuse	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Total	1.26	1.34	1.19	1.21	1.07	1.10	1.17	1.13	1.17	1.16	1.49	1.54	1.4%
kg/capita	60.9	62.6	54.3	54.6	45.8	46.5	48.9	46.5	47.4	46.2	58.4	59.8	-0.1%
Hazardous wastes (excl. tyres)													
Anaerobic digestion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Energy from waste facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Landfill	2.3	2.0	1.8	2.0	2.7	2.5	2.9	3.5	4.5	4.5	3.6	3.6	3.3%
Other disposal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	1.0%
Recycling	1.2	1.2	1.3	1.5	2.0	1.7	1.5	1.7	1.8	1.8	1.8	1.8	2.9%
Treatment	0.9	0.9	1.0	1.1	0.9	0.8	0.9	0.8	1.2	1.2	1.4	1.4	3.3%
Waste reuse	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Total	4.45	4.13	4.22	4.59	5.58	5.02	5.38	6.08	7.47	7.54	6.91	6.89	3.2%
kg/capita	215.6	192.4	193.1	207.0	239.5	212.2	224.5	249.3	301.8	299.6	270.4	268	1.6%
Contaminated soils (N120)	1.8	1.5	1.4	1.5	1.7	1.5	1.7	2.1	2.8	2.6	2.6	2.6	n/a
Asbestos (N220)	0.3	0.3	0.4	0.4	0.7	0.6	0.9	1.2	1.6	1.7	1.3	1.4	n/a
Metals													
Anaerobic digestion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a

Mt	2007	2009	2010	2011	2014	2015	2016	2017	2018	2019	2020	2021	CAGR
Energy from waste facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Landfill	0.6	0.6	0.6	0.5	0.6	0.6	0.6	0.6	0.5	0.6	0.7	0.7	2.0%
Other disposal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Recycling	3.5	3.0	4.9	5.1	5.1	4.8	4.5	5.1	5.0	5.0	4.9	5.0	2.6%
Treatment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Waste reuse	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Total	4.0	3.6	5.5	5.6	5.7	5.4	5.1	5.7	5.5	5.6	5.6	5.7	2.5%
kg/capita	194.9	169.0	250.8	253.4	243.0	229.9	211.9	234.1	224.1	222.6	218.1	222.5	1.0%
Organics													
Anaerobic digestion	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	n/a
Energy from waste facility	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.3	0.2	0.1	-2.2%
Landfill	8.4	8.8	8.4	8.0	7.6	7.5	7.0	7.2	7.0	6.9	7.0	7.3	-1.0%
Other disposal	0.4	0.4	0.4	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.2	0.2	-3.6%
Recycling	5.2	5.3	5.8	6.4	7.0	7.3	6.9	6.5	6.7	6.9	6.4	6.7	1.9%
Treatment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Waste reuse	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Total	14.2	14.7	14.8	15.1	15.2	15.3	14.3	14.0	14.2	14.3	13.9	14.43	0.1%
kg/capita	688.2	684.9	676.4	680.3	652.0	645.3	597.8	573.4	571.3	567.8	543.9	562	-1.4%
Paper & cardboard													
Anaerobic digestion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Energy from waste facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Landfill	1.9	1.9	2.0	1.9	2.1	2.0	2.3	2.4	2.4	2.4	2.5	2.6	2.3%
Other disposal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Recycling	3.68	4.4	3.1	3.2	3.4	3.3	3.7	3.79	3.7	3.5	3.1	3.15	-1.1%
Treatment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Waste reuse	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Total	5.6	6.3	5.1	5.1	5.5	5.3	6.1	6.19	6.1	5.9	5.6	5.76	0.2%
kg/capita	269.8	293.7	233.8	229.3	235.7	225.5	252.6	253.8	244.3	235.4	218.8	224.2	-1.3%
Plastics													
Anaerobic digestion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Energy from waste facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	n/a
Landfill	2.3	2.4	2.5	2.3	2.2	2.2	2.3	2.3	2.2	2.1	2.2	2.3	-0.1%
Other disposal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Recycling	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	2.0%
Treatment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Waste reuse	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
Total	2.6	2.7	2.8	2.6	2.6	2.5	2.7	2.66	2.5	2.5	2.5	2.63	0.2%
kg/capita	124.0	126.2	126.5	119.2	109.7	107.3	110.6	109.0	100.3	100.8	98.2	102.3	-1.4%

Figure 34 Generation of all organic waste by stream, management method and type, Australia 2020–21

Material type	Source stream (kt)				
	MSW	C&I core	C&I (organic primary production)	C&I (organic processing)	C&D
Food organics	3,220	1,452	0	0	4
Garden organics	3,342	1,167	0	0	222
Other organics	484	457	0	0	1
Timber	151	1,640	0	0	646
Biosolids	0	1,604	0	0	0
Food-derived hazardous wastes (K100, K110)	0	660	0	0	0
Other hazardous organic wastes (K140, K190)	0	8	0	0	0
Primary production animal waste	0	0	5,515	0	0
Primary production green waste	0	0	1,067	0	0
Primary production other organics	0	0	246	0	0
Primary production product loss	0	0	2,510	0	0
Primary production sludges	0	0	201	0	0
Broadacre crops food processing	0	0	0	2,826	0
Cotton gin trash	0	0	0	109	0
Fisheries food processing	0	0	0	16	0
Horticulture food processing	0	0	0	1,478	0
Livestock food processing	0	0	0	6,772	0
Sugarcane bagasse (available)	0	0	0	10,255	0
Sugarcane mill mud	0	0	0	2,020	0
Total	7,198	6,988	9,539	23,474	873

Figure 34 (cont.) Generation of all organic waste by stream, management method and type, Australia 2020–21

Material type	Management (kt)							
	Anaerobic digestion	Energy from waste	Landfill	Other disposal	Recycling	Treatment	Waste reuse	Unknown
Food organics	75	18	3,902	0	676	0	5	0
Garden organics	0	10	1,482	0	3,239	0	0	0
Other organics	0	0	463	0	479	0	0	0
Timber	0	109	1,450	0	879	0	0	0
Biosolids	0	0	0	234	1,370	0	0	0
Food-derived hazardous wastes (K100, K110)	0	0	4	0	494	161	0	0
Other hazardous organic wastes (K140, K190)	0	0	0	0	5	3	0	0
Primary production animal waste	0	0	0	0	1,568	0	3,742	205
Primary production green waste	0	0	0	0	275	0	699	94
Primary production other organics	0	0	0	0	1	0	244	2
Primary production product loss	0	0	0	0	89	0	2,338	82
Primary production sludges	0	0	0	0	0	0	197	4
Broadacre crops food processing	0	3	3	6	555	0	1,674	585
Cotton gin trash	0	0	0	0	0	0	0	109
Fisheries food processing	0	0	8	0	0	0	8	0
Horticulture food processing	16	26	27	26	644	0	717	22
Livestock food processing	0	0	38	348	2,566	0	3,820	0
Sugarcane bagasse (available)	0	0	0	0	0	0	0	10,255
Sugarcane mill mud	0	0	0	0	0	0	0	2,020
Total	91	165	7,377	613	12,841	164	13,444	13,377

Figure 35 Generation of food waste by stream, management method and type, Australia 2020–21

Material type	Source stream (kt)				
	MSW	C&I core	C&I (organic primary production)	C&I (organic processing)	C&D
Food organics	3,220	1,452	0	0	4
Food-derived hazardous wastes (K100, K110)	0	660	0	0	0
Primary production product loss	0	0	2,510	0	0
Broadacre crops food processing	0	0	0	2,826	0
Fisheries food processing	0	0	0	16	0
Horticulture food processing	0	0	0	1,478	0
Livestock food processing	0	0	0	6,772	0
Sugarcane bagasse (available)	0	0	0	10,255	0
Sugarcane mill mud	0	0	0	2,020	0
Total	3,220	2,112	2,510	23,365	4

Figure 35 (cont.) Generation of food waste by stream, management method and type, Australia 2020–21

Material type	Management (kt)							
	Anaerobic digestion	Energy from waste facility	Landfill	Other disposal	Recycling	Treatment	Waste reuse	Unknown
Food organics	75	18	3,902	0	676	0	5	0
Food-derived hazardous wastes (K100, K110)	0	0	4	0	494	161	0	0
Primary production product loss	0	0	0	0	89	0	2,338	82
Broadacre crops food processing	0	3	3	6	555	0	1,674	585
Fisheries food processing	0	0	8	0	0	0	8	0
Horticulture food processing	16	26	27	26	644	0	717	22
Livestock food processing	0	0	38	348	2,566	0	3,820	0
Sugarcane bagasse (available)	0	0	0	0	0	0	0	10,255
Sugarcane mill mud	0	0	0	0	0	0	0	2,020
Total	91	46	3,982	379	5,025	161	8,562	12,963

Figure 36 Comparison of annual waste generation and fate per capita, Australia and selected countries

Country	Disposal (Mt)	Recycling (Mt)	Energy recovery (Mt)	% Recycling	% Recovery
Australia	770	1,420	6	65%	65%
Hungary	554	1,181	109	64%	70%
Norway	638	778	537	44%	74%
Singapore	39	535	461	52%	96%
United States	805	1,557	117	63%	68%

Figure 37 Comparison of MSW generation and recycling rates in selected countries

Country	Recycled (kg per capita)	Other (kg per capita)
Australia	224	305
Austria	344	239
Belgium	224	190
Costa Rica	17	269
France	229	307
Germany	421	206
Hungary	81	286
Ireland	178	454
Italy	275	221
Netherlands	309	235
South Korea	247	166
Switzerland	372	332
Turkey	52	368
Wales	304	161

Figure 38 Trends in Australian exports of waste and recovered materials, 2006–07 to 2021–22

Material category (kt)	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	CAGR
Glass	2	2	2	2	2	3	2	2	2	11	15	23	16	26	0	-9.8%
Metals	1,578	2,014	1,983	1,854	1,877	2,435	2,404	2,698	2,469	1,968	2,144	2,455	2,650	2,546	2,460	3.2%
Paper & cardboard	1,105	1,332	1,265	1,497	1,384	1,466	1,567	1,497	1,497	1,535	1,453	1,317	1,112	1,060	1,045	-0.4%
Plastics	99	118	197	147	150	175	170	171	201	203	182	159	187	113	124	1.6%
Textiles	18	22	28	25	27	50	77	89	90	90	94	99	107	94	102	13.1%
Tyres	11	41	62	71	108	142	112	128	108	65	72	90	118	88	105	17.8%
Total	2,811	3,528	3,537	3,596	3,549	4,271	4,332	4,584	4,367	3,871	3,960	4,144	4,190	3,926	3,836	2.2%

Figure 39 Trends in Australian exports of scrap plastics, 2006–07 to 2021–22

Plastics type	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Plastics (mixed)	70	95	151	108	111	126	125	134	162	142	126	120	149	75	74	0
Plastics (single polymer)	29	23	46	38	39	49	45	36	39	61	56	39	38	38	50	107

Figure 40 Comparison of core waste exported and recovered by material category, Australia, 2020–21

Material	Exported (kt)	Recovered (kt)	Estimated proportion exported
Glass	0	906	0%
Metals	2,460	4,974	49%
Paper & cardboard	1,045	3,155	33%
Plastics	124	351	35%
Tyres	105	335	31%
Other	146	29,047	1%
Total	3,881	38,769	10%

Figure 43 Access to kerbside waste services by proportion of the jurisdictional population, 2020–21

Jurisdiction	Recycling service	Organics service	Residual waste service
ACT	100%	100%	100%
NSW	99%	90%	100%
NT	49%	0%	100%
Qld	96%	56%	100%
SA	99%	95%	100%
Tas	100%	72%	100%
Vic	100%	96%	100%
WA	94%	45%	100%
Australia	98%	79%	99.99%

Figure 45 Access to kerbside organic waste services by proportion of the jurisdictional population, 2020–21

Jurisdiction	% population with GO	% population with FOGO
ACT	95%	5%
NSW	69%	21%
NT	0%	0%
Qld	51%	5%
SA	11%	84%
Tas	28%	44%
Vic	38%	58%
WA	33%	11%
Australia	48%	31%

Figure 46 Management of garbage by proportion of the jurisdictional population – landfill vs mechanical biological treatment (MBT), 2020–21

Jurisdiction	Landfill bin service	MBT service
ACT	100%	0%
NSW	58%	42%
NT	100%	0%
Qld	96%	4%
SA	100%	0%
Tas	100%	0%
Vic	100%	0%
WA	89%	11%
Australia	85%	15%

Figure 47 Trends in the collection of CDS-eligible glass, plastics and metals for recycling in NSW

	Collection type	2017	2018	2019	2020	2021
Glass (kt)	Total collections (combined kerbside & CDS)	207.4	221.8	256.2	267.5	276.5
	Kerbside collection	207.4	194.7	173.3	169.0	164.7
Plastic (kt)	Total collections (combined kerbside & CDS)	52.9	53.4	60.1	54.9	55.5
	Kerbside collection	52.9	50.2	44.7	44.0	43.3
Metal (kt)	Total collections (combined kerbside & CDS)	22.3	24.1	26.2	28.2	29.8
	Kerbside collection	22.3	21.5	19.0	18.7	18.3

Appendix C Data for 2016–17 and 2020–21 compared

Appendix C Data for 2016–17 and 2020–21 compared

This appendix presents tables that compare data for the baseline year for the National Waste Policy (2016–17) with the most recent data (2020–21). Data is expressed in kilotonnes and rounded to no more than four significant figures. Due to the rounding, some totals and proportions may not appear to match. In 2016–17 some jurisdictions were unable to split some data by source stream or by waste type, so some of the data presentations are incomplete.

The 2016–17 data presented here may differ from the 2016–17 data presented in previous national waste reports due to corrections and updates subsequently undertaken.⁹¹ In this presentation ‘disposal’ includes long-term storage of ash.

Table 31 Data for 2016–17 and 2020–21 compared – core waste plus ash (kt)

Jurisdiction	Generation			Recycling			Energy recovery			Waste reuse		Disposal		
	2017	2021	Change	2017	2021	Change	2017	2021	Change	2017	2021	2017	2021	Change
ACT	1,034	1,051	2%	465	523	13%	36	53	49%	0	150	533	325	-39%
NSW	25,584	25,916	1%	16,982	14,320	-16%	824	617	-25%	0	2,450	7,778	8,528	10%
NT	376	452	20%	44	80	80%	15	5	-66%	0	0	317	367	16%
Qld	15,780	15,072	-4%	5,801	5,611	-3%	390	549	41%	0	874	9,588	8,038	-16%
SA	4,205	5,351	27%	3,324	4,066	22%	171	194	14%	0	23	711	1,068	50%
Tas	938	896	-4%	479	398	-17%	39	58	48%	0	0	420	440	5%
Vic	15,417	18,997	23%	9,321	11,987	29%	614	669	9%	0	0	5,482	6,341	16%
WA	6,349	8,048	27%	3,669	4,945	35%	200	200	0%	0	9	2,480	2,894	17%
Australia	69,683	75,784	9%	40,085	41,932	5%	2,288	2,345	2%	0	3,506	27,310	28,001	3%

Table 32 Data for 2016–17 and 2020–21 compared – MSW (kt)

Jurisdiction	Generation			Recycling			Energy recovery			Waste reuse		Disposal		
	2017	2021	Change	2017	2021	Change	2017	2021	Change	2017	2021	2017	2021	Change
ACT	220	290	32%	116	167	43%	20	31	53%	0	7	83	86	3%
NSW	3,926	4,969	27%	1,789	2,199	23%	456	377	-17%	0	0	1,681	2,394	42%
NT	139	150	8%	7	36	404%	10	1	-87%	0	0	122	112	-8%
Qld	2,554	2,603	2%	708	783	11%	236	296	25%	0	13	1,610	1,510	-6%
SA	838	764	-9%	446	394	-12%	43	57	32%	0	3	349	310	-11%
Tas	248	180	-27%	74	54	-26%	20	20	4%	0	0	154	105	-32%
Vic	3,111	3,478	12%	1,264	1,790	42%	380	330	-13%	0	0	1,467	1,358	-7%
WA	1,571	1,516	-3%	486	422	-13%	119	89	-25%	0	7	966	999	3%
Australia	12,605	13,950	11%	4,890	5,845	20%	1,284	1,201	-6%	0	30	6,432	6,874	7%

Table 33 Data for 2016–17 and 2020–21 compared – C&I (kt)

Jurisdiction	Generation			Recycling			Energy recovery			Waste reuse		Disposal		
	2017	2021	Change	2017	2021	Change	2017	2021	Change	2017	2021	2017	2021	Change
ACT	525	222	-58%	239	82	-66%	13	21	55%	0	9	272	111	-59%
NSW	11,729	11,098	-5%	7,239	4,612	-36%	358	230	-36%	0	2,450	4,132	3,806	-8%
NT	92	208	126%	32	42	28%	4	3	-9%	0	0	56	163	193%
Qld	8,854	8,960	1%	3,045	2,291	-25%	143	240	68%	0	861	5,666	5,567	-2%
SA	1,928	1,346	-30%	1,628	1,083	-33%	125	98	-22%	0	5	175	160	-8%
Tas	650	635	-2%	404	334	-17%	19	37	92%	0	0	227	264	16%
Vic	6,772	6,827	1%	3,826	3,277	-14%	221	321	45%	0	0	2,725	3,230	19%
WA	3,177	3,488	10%	1,958	1,999	2%	79	107	35%	0	2	1,141	1,380	21%
Australia	33,727	32,784	-3%	18,372	13,720	-25%	962	1,056	10%	0	3,327	14,394	14,681	2%

⁹¹ The most recent updates are given in Table 3 on page 6. A similar appendix in the *National Waste Report 2020* contained a more significant set of updates on the data presented in the *National Waste Report 2018*.

Table 34 Data for 2016–17 and 2020–21 compared – C&D (kt)

Jurisdiction	Generation			Recycling			Energy recovery			Waste reuse		Disposal		
	2017	2021	Change	2017	2021	Change	2017	2021	Change	2017	2021	2017	2021	Change
ACT	289	539	86%	109	275	152%	2	2	-23%	0	134	178	128	-28%
NSW	9,929	9,849	-1%	7,953	7,510	-6%	10	11	4%	0	0	1,965	2,329	18%
NT	145	95	-35%	5	3	-44%	1	0	-92%	0	0	140	92	-34%
Qld	4,371	3,509	-20%	2,048	2,536	24%	11	13	20%	0	0	2,312	960	-58%
SA	1,439	3,241	125%	1,250	2,589	107%	2	39	1646%	0	15	187	598	219%
Tas	41	81	99%	1	10	586%	0	1	216%	0	0	39	71	80%
Vic	5,535	8,692	57%	4,231	6,921	64%	13	19	43%	0	0	1,290	1,753	36%
WA	1,601	3,043	90%	1,226	2,524	106%	2	4	66%	0	0	373	515	38%
Australia	23,350	29,050	24%	16,824	22,367	33%	42	88	110%	0	149	6,484	6,446	-1%

Table 35 Data for 2016–17 and 2020–21 compared – ash (kt)

Jurisdiction	Generation			Recycling			Energy recovery			Waste reuse		Disposal		
	2017	2021	Change	2017	2021	Change	2017	2021	Change	2017	2021	2017	2021	Change
ACT	0	0	n/a	0	0	n/a	0	0	n/a	0	0	0	0	n/a
NSW	5,628	5,639	0%	4,398	1,919	-56%	0	0	n/a	0	2,450	1,230	1,271	3%
NT	0	0	n/a	0	0	n/a	0	0	n/a	0	0	0	0	n/a
Qld	4,483	4,492	0%	786	6	-99%	0	0	n/a	0	861	3,697	3,625	-2%
SA	0	0	n/a	0	0	n/a	0	0	n/a	0	0	0	0	n/a
Tas	0	0	n/a	0	0	n/a	0	0	n/a	0	0	0	0	n/a
Vic	1,034	876	-15%	0	0	n/a	0	0	n/a	0	0	1,034	876	-15%
WA	1,078	1,016	-6%	842	787	-7%	0	0	n/a	0	0	236	229	-3%
Australia	12,224	12,023	-2%	6,027	2,711	-55%	0	0	n/a	0	3,311	6,197	6,000	-3%

Table 36 Data for 2016–17 and 2020–21 compared – biosolids (kt)

Jurisdiction	Generation			Recycling			Energy recovery			Waste reuse		Disposal		
	2017	2021	Change	2017	2021	Change	2017	2021	Change	2017	2021	2017	2021	Change
ACT	93	20	-78%	0	0		0	0	n/a	0	0	93	20	-78%
NSW	305	352	15%	287	352	23%	0	0	n/a	0	0	19	0	-100%
NT	28	15	-47%	22	12	-45%	0	0	n/a	0	0	6	3	-51%
Qld	322	299	-7%	322	299	-7%	0	0	n/a	0	0	0	0	n/a
SA	125	151	21%	125	150	20%	0	0	n/a	0	0	0	2	n/a
Tas	31	34	8%	31	31	-2%	0	0	n/a	0	0	0	3	n/a
Vic	483	571	18%	478	394	-18%	0	0	n/a	0	0	5	177	3565%
WA	126	162	29%	101	133	32%	0	0	n/a	0	0	25	30	17%
Australia	1,513	1,604	6%	1,365	1,370	0%	0	0	n/a	0	0	148	234	58%

Table 37 Data for 2016–17 and 2020–21 compared – building & demolition materials (kt)

Jurisdiction	Generation			Recycling			Energy recovery			Waste reuse		Disposal		
	2017	2021	Change	2017	2021	Change	2017	2021	Change	2017	2021	2017	2021	Change
ACT	147	519	252%	109	272	150%	0	0	n/a	0	134	38	113	194%
NSW	8,679	8,157	-6%	7,152	6,497	-9%	0	0	n/a	0	0	1,527	1,660	9%
NT	120	91	-25%	4	17	306%	0	0	n/a	0	0	116	74	-36%
Qld	3,363	2,672	-21%	1,886	1,976	5%	0	0	n/a	0	0	1,477	696	-53%
SA	1,202	2,812	134%	1,088	2,309	112%	0	0	n/a	0	15	114	488	327%
Tas	67	84	27%	11	2	-84%	0	0	n/a	0	0	56	83	48%
Vic	5,081	7,860	55%	4,032	6,606	64%	0	0	n/a	0	0	1,049	1,254	20%
WA	1,517	2,975	96%	1,092	2,401	120%	0	0	n/a	0	0	424	573	35%
Australia	20,177	25,170	25%	15,375	20,080	31%	0	0	n/a	0	149	4,802	4,941	3%

Table 38 Data for 2016–17 and 2020–21 compared – glass (kt)

Jurisdiction	Generation			Recycling			Energy recovery			Waste reuse		Disposal		
	2017	2021	Change	2017	2021	Change	2017	2021	Change	2017	2021	2017	2021	Change
ACT	21	26	24%	14	18	30%	0	0	n/a	0	0	7	7	10%
NSW	369	482	31%	232	313	35%	0	0	n/a	0	0	137	169	23%
NT	14	15	5%	6	5	-5%	0	0	n/a	0	0	8	9	12%
Qld	241	240	0%	107	103	-4%	0	0	n/a	0	0	134	137	2%
SA	82	84	2%	67	68	2%	0	0	n/a	0	0	15	16	2%
Tas	38	30	-21%	24	17	-29%	0	0	n/a	0	0	15	13	-9%
Vic	235	509	117%	137	312	127%	0	0	n/a	0	0	98	198	102%
WA	134	151	13%	56	70	25%	0	0	n/a	0	0	78	81	4%
Australia	1,134	1,536	36%	642	906	41%	0	0	n/a	0	0	491	630	28%

Table 39 Data for 2016–17 and 2020–21 compared – hazardous wastes (kt)

Jurisdiction	Generation			Recycling			Energy recovery			Waste reuse		Disposal		
	2017	2021	Change	2017	2021	Change	2017	2021	Change	2017	2021	2017	2021	Change
ACT	221	34	-85%	8	8	6%	1	3	157%	0	0	212	22	-89%
NSW	1,713	2,121	24%	366	443	21%	42	69	67%	0	0	1,305	1,609	23%
NT	30	93	209%	10	32	206%	2	2	52%	0	0	18	59	224%
Qld	2,040	1,690	-17%	547	699	28%	18	38	111%	0	0	1,474	953	-35%
SA	461	439	-5%	319	289	-9%	21	20	-2%	0	0	121	130	7%
Tas	175	315	80%	127	257	102%	3	7	163%	0	0	46	51	11%
Vic	1,234	1,916	55%	443	774	75%	34	62	85%	0	0	758	1,080	42%
WA	616	764	24%	393	451	15%	23	36	58%	0	0	200	277	38%
Australia	6,490	7,372	14%	2,213	2,953	33%	142	239	68%	0	0	4,134	4,180	1%

Table 40 Data for 2016–17 and 2020–21 compared – metals (kt)

Jurisdiction	Generation			Recycling			Energy recovery			Waste reuse		Disposal		
	2017	2021	Change	2017	2021	Change	2017	2021	Change	2017	2021	2017	2021	Change
ACT	30	58	94%	23	51	122%	0	0	n/a	0	0	7	7	0%
NSW	1,887	1,854	-2%	1,715	1,613	-6%	0	0	n/a	0	0	172	240	40%
NT	13	17	32%	1	5	573%	0	0	n/a	0	0	12	12	1%
Qld	964	1,131	17%	790	970	23%	0	0	n/a	0	0	174	161	-7%
SA	332	377	13%	307	351	14%	0	0	n/a	0	0	25	26	5%
Tas	58	26	-55%	45	9	-80%	0	0	n/a	0	0	14	18	30%
Vic	1,780	1,619	-9%	1,699	1,442	-15%	0	0	n/a	0	0	81	177	120%
WA	644	632	-2%	567	533	-6%	0	0	n/a	0	1	77	98	28%
Australia	5,708	5,713	0%	5,147	4,973	-3%	0	0	n/a	0	1	560	739	32%

Table 41 Data for 2016–17 and 2020–21 compared – organics (kt)

Jurisdiction	Generation			Recycling			Energy recovery			Waste reuse		Disposal		
	2017	2021	Change	2017	2021	Change	2017	2021	Change	2017	2021	2017	2021	Change
ACT	388	263	-32%	264	146	-45%	24	36	47%	0	0	99	81	-18%
NSW	3,630	4,148	14%	1,616	2,079	29%	541	366	-32%	0	0	1,472	1,703	16%
NT	102	128	27%	0	8	n/a	10	2	-82%	0	0	91	119	30%
Qld	2,504	2,687	7%	759	959	26%	296	398	34%	0	0	1,448	1,330	-8%
SA	1,508	1,092	-28%	1,117	684	-39%	102	143	40%	0	5	290	261	-10%
Tas	260	211	-19%	79	35	-56%	27	37	35%	0	0	155	140	-9%
Vic	2,771	2,924	6%	948	1,137	20%	442	431	-3%	0	0	1,380	1,355	-2%
WA	1,307	1,368	5%	373	335	-10%	140	130	-7%	0	0	794	903	14%
Australia	12,469	12,821	3%	5,156	5,382	4%	1,584	1,542	-3%	0	5	5,729	5,893	3%

Table 42 Data for 2016–17 and 2020–21 compared – paper & cardboard (kt)

Jurisdiction	Generation			Recycling			Energy recovery			Waste reuse		Disposal		
	2017	2021	Change	2017	2021	Change	2017	2021	Change	2017	2021	2017	2021	Change
ACT	65	60	-9%	29	22	-23%	7	10	43%	0	0	29	27	-7%
NSW	1,995	1,959	-2%	1,118	991	-11%	186	145	-22%	0	0	691	823	19%
NT	28	38	34%	0	1	408%	2	0	-79%	0	0	26	36	42%
Qld	1,064	1,062	0%	560	562	0%	58	85	45%	0	0	446	416	-7%
SA	322	255	-21%	249	181	-27%	7	11	45%	0	0	65	63	-4%
Tas	216	102	-53%	159	44	-72%	7	10	50%	0	0	50	48	-4%
Vic	1,999	1,776	-11%	1,445	1,146	-21%	104	130	25%	0	0	450	500	11%
WA	500	504	1%	230	207	-10%	29	26	-12%	0	0	242	272	12%
Australia	6,189	5,756	-7%	3,791	3,155	-17%	401	417	4%	0	0	1,998	2,184	9%

Table 43 Data for 2016–17 and 2020–21 compared – plastics (kt)

Jurisdiction	Generation			Recycling			Energy recovery			Waste reuse		Disposal		
	2017	2021	Change	2017	2021	Change	2017	2021	Change	2017	2021	2017	2021	Change
ACT	26	29	12%	2	5	159%	0	0	n/a	0	0	24	24	1%
NSW	821	706	-14%	88	91	4%	0	0	n/a	0	0	733	614	-16%
NT	34	43	25%	1	1	18%	0	0	n/a	0	0	34	42	25%
Qld	645	620	-4%	41	37	-11%	0	0	n/a	0	0	604	583	-3%
SA	104	95	-9%	28	32	14%	28	14	-51%	0	0	47	49	3%
Tas	69	70	1%	2	5	148%	0	0	n/a	0	0	68	66	-3%
Vic	617	697	13%	131	143	10%	0	0	n/a	0	0	486	554	14%
WA	341	367	8%	13	22	68%	0	0	n/a	0	1	328	344	5%
Australia	2,658	2,628	-1%	306	336	10%	28	14	-51%	0	1	2,323	2,276	-2%

Table 44 Data for 2016–17 and 2020–21 compared – textiles, leather & rubber (excl. tyres) (kt)

Jurisdiction	Generation			Recycling			Energy recovery			Waste reuse		Disposal		
	2017	2021	Change	2017	2021	Change	2017	2021	Change	2017	2021	2017	2021	Change
ACT	14	14	2%	0	0	-100%	3	4	44%	0	0	11	10	-7%
NSW	254	248	-2%	2	4	137%	55	37	-32%	0	0	198	207	5%
NT	7	13	87%	0	0	-100%	1	0	-69%	0	0	6	12	107%
Qld	154	166	8%	1	0	-96%	17	28	63%	0	0	136	138	1%
SA	57	42	-26%	24	2	-93%	12	6	-49%	0	0	21	35	63%
Tas	22	23	1%	2	0	-84%	2	4	61%	0	0	18	19	3%
Vic	183	249	36%	7	33	363%	34	46	35%	0	0	142	171	20%
WA	87	102	17%	2	7	205%	9	8	-4%	0	0	76	87	14%
Australia	779	857	10%	38	45	19%	132	134	1%	0	0	609	679	12%

Table 45 Data for 2016–17 and 2020–21 compared – unclassified materials (kt)

Jurisdiction	Generation			Recycling			Energy recovery			Waste reuse		Disposal		
	2017	2021	Change	2017	2021	Change	2017	2021	Change	2017	2021	2017	2021	Change
ACT	29	29	0%	15	0	-100%	0	0	n/a	0	16	13	13	-3%
NSW	302	251	-17%	9	19	119%	0	0	n/a	0	0	293	232	-21%
NT	0	0	n/a	0	0	n/a	0	0	n/a	0	0	0	0	n/a
Qld	0	13	n/a	0	0	n/a	0	0	n/a	0	13	0	0	n/a
SA	12	3	-73%	0	0	n/a	0	0	n/a	0	3	12	0	-100%
Tas	0	0	n/a	0	0	n/a	0	0	n/a	0	0	0	0	n/a
Vic	0	0	n/a	0	0	n/a	0	0	n/a	0	0	0	0	n/a
WA	0	7	n/a	0	0	n/a	0	0	n/a	0	7	0	0	n/a
Australia	343	303	-12%	24	19	-21%	0	0	n/a	0	39	319	245	-23%

Appendix D Data on waste to landfill

Appendix D Data on waste to landfill

The primary presentation of waste data in this report is by fate. Waste to landfill has two potential fates:

- energy recovery, for waste calculated to produce methane that is captured for producing energy
- disposal, for other waste.

Supplementing this data, the tables below present the quantity of waste delivered to landfill by material before allocating any tonnage to energy recovery. Note that these estimates are based on audits that may not be wholly representative of each jurisdiction's waste composition. Waste to landfill by stream and jurisdiction is given in Table 13 on page 37. Data is expressed in kilotonnes and rounded to no more than four significant figures. Due to the rounding, some totals and proportions may not appear to match.

Table 46 Estimated waste sent to landfill by material and jurisdiction (kt), Australia 2020–21

Material category	Material type	ACT	NSW	NT	Qld	SA	Tas	Vic	WA	Australia
Building & demolition materials	n/a	113	1,660	74	696	488	83	1,254	573	4,941
Glass	n/a	7	169	9	137	16	13	198	81	630
Hazardous wastes	n/a	21	1,543	51	856	87	32	903	221	3,714
Metals	n/a	7	240	12	161	26	18	177	98	739
Organics	Food organics	57	998	68	978	178	99	948	576	3,902
Organics	Garden organics	14	566	25	372	44	32	203	226	1,482
Organics	Timber	38	398	21	251	71	37	479	155	1,450
Organics	Other organics	8	107	7	96	26	9	153	57	463
Paper & cardboard	n/a	37	968	37	500	74	58	630	297	2,601
Plastics	n/a	24	614	42	583	49	66	554	344	2,276
Textiles, leather & rubber (excl. tyres)	n/a	14	244	13	166	41	22	216	95	812
Unclassified materials	n/a	13	232	0	0	0	0	0	0	245
Total	n/a	354	7,740	359	4,797	1,097	468	5,717	2,724	23,256

Table 47 Estimated waste sent to landfill by material and source stream (kt), Australia 2020–21

Material category	Material type	MSW	C&I	C&D	Total
Building & demolition materials	n/a	231	968	3,742	4,941
Glass	n/a	463	163	5	630
Hazardous wastes	n/a	0	1,720	1,994	3,714
Metals	n/a	394	289	55	739
Organics	Food organics	2,696	1,203	3	3,902
Organics	Garden organics	1,068	330	84	1,482
Organics	Timber	111	1,014	325	1,450
Organics	Other organics	371	91	1	463
Paper & cardboard	n/a	1,277	1,249	75	2,601
Plastics	n/a	1,070	1,139	68	2,276
Textiles, leather & rubber (excl. tyres)	n/a	273	507	32	812
Unclassified materials	n/a	116	106	23	245
Total	n/a	8,070	8,777	6,409	23,256