Australian Government
Department of the Environment and Energy

Analysis of Australia's municipal recycling infrastructure capacity

October 2018

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Contents

Key findings

- Most Australians have access to municipal waste management and recycling, but kerbside municipal waste collection and recycling services are *not* available to most communities in remote and regional Australia.
- Australia's recycling infrastructure is generally capable of managing current volumes of waste but most collection and recycling services have limited capacity to process certain types of recyclable waste.
  For example:
  - Only 10 Local Government Areas (LGAs) have municipal kerbside collections that can accept all types of recyclable plastic and plastic bags
  - 58 per cent of Australian households have no access to kerbside collection of organic materials.
- Compacting of co-mingled municipal waste by collectors is leading to greater levels of contamination in recycled materials.
- Most of Australia's materials recovery facilities lack technical capacity to sort co-mingled, highly-contaminated municipal waste into many specific material types that have low levels of contamination.
- Large volumes of recycled materials end up in landfill due to contamination.
- Since China introduced restrictions on waste imports in 2017, Australia's exports of recycled material to China have fallen but Australia's exports of recycled materials have increased overall during 2018.
- Some large businesses have been able to respond to new international waste market restrictions, but most collection and recycling operators in Australia remain vulnerable to changing international waste markets.
- Improvements in access to municipal collection and recycling services across Australia will improve waste management – particularly in regional and remote areas – and increase Australia's recycling rates generally.
- Improvements to the technical capacity of existing municipal collection and recycling services will better enable dealing with contamination in recycled materials, lifting recovery rates and aiding access to markets for all recycled materials.

Introduction

In 2016–17, Australia generated 67 million tonnes (Mt) of waste per year, sending 55 per cent (37 Mt) to recycling, three per cent to energy recovery (2 Mt) and 40 per cent (27 Mt) to disposal. Municipal waste (from households and council operations) makes up about 21 per cent of Australia's annual waste generation and 17 per cent of national recycling.

In 2017, China announced restrictions on imports of recycled materials. The restrictions, which took effect on 31 December 2017 and 1 March 2018, forbid the importation of 24 waste types and placed strict contamination limits on others—0.5 per cent for materials such as paper, cardboard and plastics and one per cent for metals.

Australia is one of more than 100 countries impacted by China's waste import restrictions. Australia's municipal-waste streams have been particularly affected.

At the time China's restrictions were announced, Australia exported about 1.3 million tonnes of recycled material to China. This accounted for four per cent of Australia's recyclable waste, but 35 per cent of our recyclable plastics and 30 per cent of recyclable paper and cardboard.

Approximately 25 per cent of Australia's recycling involves paper and cardboard, plastics, metals and packaging glass. These waste streams make up the vast majority of the kerbside recycling bin. Global changes in waste markets have drawn attention to the capacity of our domestic waste management infrastructure to collect and process recycled materials from the kerbside.

This report summarises targeted assessments of flows of recycled materials from municipal sources through collection and recycling infrastructure. Focus is given to materials particularly relevant to municipal kerbside collections: paper and cardboard, plastics, metals and packaging glass. This report presents preliminary analysis of the capacity of Australia municipal waste and collection infrastructure by Australian LGAs, and it outlines a review of contemporary international flows of Australian waste following announcement of China's import restrictions.

Data and information

This report draws on data and information presented in the *National Waste Report 2018* (Blue Environment, forthcoming), and six other analyses commissioned by the Department of the Environment and Energy (attached as appendices to this report):

- Four analyses separately examining material flows of paper and cardboard, plastics, metals and glass packaging
- An analysis of state waste infrastructure plans
- An analysis of exports of Australian wastes.

A database maintained by Geoscience Australia on waste and recycling infrastructure has provided the basis for identifying the location of recycling facilities, landfills and transfer stations (Geoscience Australia, 2017). This report also draws on the Planet Ark Recycling Near You dataset (Planet Ark, 2018). This dataset comprises data self-reported to Planet Ark by local councils and other local government groups and includes information on the types of materials that can be recycled within each LGA. The dataset consolidates data for entire LGAs so does not allow for analysis of infrastructure or waste-management access by communities *within* an LGA.

Collection of municipal waste in Australia

The majority of Australians have access to waste and recycling collection services. Australia's waste and recycling infrastructure generally follows population, with the majority of facilities located close to Australia's cities and larger towns.

About 95 per cent of Australian *households* have access to a kerbside garbage collection and 91 per cent have access to a kerbside recycling collection. About 98 per cent of the Australia *population* has access to some kind of kerbside waste or recycling service. The Australian Capital Territory has the leading rate of kerbside recycling service provision to households at 100 per cent, closely followed by South Australia at 98 per cent. Victoria follows at 95 per cent, Tasmania at 93 per cent, Western Australia at 92 per cent, New South Wales at 89 per cent, Queensland at 86 per cent and the Northern Territory at 60 per cent.

Despite high rates of access to kerbside collection and recycling nationally, many collection and recycling services have limited capacity to process many types of recyclable materials. For example, 2.4 per cent of Australia's population has no kerbside paper and cardboard recycling collection (Map 4), 2.4 per cent of the population have no kerbside recycling collection for metals (Map 7), 3.3 per cent of the population have no kerbside recycling collection for glass (Map 6), and 5.6 per cent of the population have no kerbside plastics recycling collection (Map 5).

Even some services close to major cities are not currently capable of processing certain types of recyclable materials. A common example is plastic bags and films. In some cases, rigid or semi-rigid forms of certain plastic resin types can be processed but soft forms of the same plastic type are not accepted. In some areas expanded polystyrene is excluded from collection services, but polystyrene in non-expanded (non-foam) forms is accepted.

Only 51 per cent of LGAs have a kerbside collection service that accepts all seven types of plastic. Only 10 Local Government Areas accept all types of plastic and plastic bags. Less than half of Australia's households have access to kerbside collection and recycling of organic waste.

There are also significant geographic disparities. Of a total of 544 LGAs[1] across Australia, 123 (or 23 per cent) offer no collection or recycling service at all. These areas are overwhelmingly in remote and regional parts of Australia.

Local governments were already facing significant waste and recycling challenges from growth in waste generation, before the additional impact of China's restrictions on waste imports. These challenges are compounded by growing community expectations for recycling.

Organic material collection

Organic waste is a component of the waste stream from plant or animal sources that is readily biodegradable, such as paper and cardboard, food waste, biosolids, green waste and timber. It forms a significant proportion of waste generated in Australia (19 per cent in 2016-17), and an even more significant portion of waste sent to landfill (26 per cent). Degradation of organics in landfill generate greenhouse gases including methane (a greenhouse gas 25 times more potent than carbon dioxide), and also can also produce polluting leachate.

Almost all organic materials can be recycled via composting processes which generate products that improve soil productivity and health. Some organic materials, particularly high-content organics such as food waste, are suited to anaerobic digestion processes, which can generate electricity and produce a useful product that can be used in compost and soil conditioner products.

1 This figure includes local government authorities that are Councils and Indigenous land management bodies.

South Australia provides a kerbside organic material collection to 92 per cent of households, NSW follows at 60 per cent and Victoria 56 per cent. Rates of organic material collection are significantly lower in other jurisdictions. The *National Waste Report 2018* shows that 58 per cent of Australian *households* have no access to kerbside collection of organic material.

Most state/territory waste infrastructure strategies and plans identify the need to improve capability in collection and processing of organic materials as a priority based on waste reduction and recycling targets, industry development and greenhouse gas abatement (Attachment G).

Processing of municipal waste in Australia

The majority of Australia's municipal waste is collected in dedicated trucks that compress material collected at kerbside, delivering it to Materials Recovery Facilities (MRFs) and other types of infrastructure such as organics processing facilities. Collected loose co-mingled material is then generally 'dumped' on the floor of the MRF and pushed by mechanical loaders on to conveyor belts for processing.

MRFs in Australia vary from reasonably sophisticated to basic sorting facilities. MRFs in major city locations generally sort materials through a mix of human, mechanical and electronic processes, and all are capable of loading to export with container loading ramps, docks and certified weighbridges.

Many other MRFs, usually in regional areas, process materials manually, sorting for materials that have higher value. This process is very labour intensive and is only viable if the labour cost and conveyor belt speed allows for the material to be picked off in sufficient qualities.

The total volume of Australia's municipal waste is increasing, but the quality of some recovered materials is diminishing. Under the pressure of commercial contracts, it is widely reported that collectors are compressing co-mingled loads more than ever before, causing materials such as paper and paperboard to become both more difficult to sort and increasingly contaminated, especially by glass fines.

A major issue for MRFs in Australia is a lack of technical capacity to sort co-mingled, highly-contaminated municipal waste materials to a standard of sorted outputs that meet stringent export specifications. Retro-fitting of sorting infrastructure tends to be difficult and expensive, markets for processed materials fluctuate, and the nature of some commercial contracts has led to uncertainty over ongoing outlets for recovered materials.

Paper and cardboard

Recovery of paper and cardboard in Australia is relatively high: the *National Waste Report 2018* shows that about 60 per cent of Australia's paper and cardboard waste is recycled. Most LGAs (92 per cent) provide infrastructure for kerbside collection of some or all types of paper and cardboard waste (Map 4).

Municipal collections of paper and cardboard include a significant volume of material derived from small businesses as well as household material. Paper and cardboard make up the largest proportion (46 to 57 per cent) by weight of a typical household recycling bin. This proportion has declined in recent years as newspaper circulation has fallen.

The quality of recycled paper and paperboard material collected from municipal sources is declining. Higher rates of compaction, particularly since global prices for recovered plastic material have dropped in the wake of China's import restrictions, have led to more glass breakage. This, in turn, has led to more plastic, paper and cardboard contamination further reducing the value of these materials.

'Mixed' or 'unsorted' waste paper and cardboard is almost entirely derived from municipal collections and may consist of any and all grades of paper and paperboard. As it is mixed and unsorted, this grade is prone to very significant variations in quality and value. At least 95 per cent of the export volume of mixed grades of waste paper and cardboard is sourced from municipal collections.

Together with plastics, Australia's exports of waste paper have been most affected by China's restriction on waste imports. However, in both cases, displaced materials have mostly found new export destinations: Australia's exports of these commodities have increased in 2017–18, mainly to Indonesia, Vietnam, India, Malaysia and Thailand.

Plastics

Recovery of plastic material in Australia is low; the *National Waste Report 2018* shows that only 12 per cent of Australia's plastics are recycled. 146 LGAs (or 27 per cent) have no infrastructure for kerbside collection of plastic waste (Map 5).

Australia's existing waste-management infrastructure is capable of managing current volumes of plastic waste, and some recyclers have indicated that they have capacity to handle double the current volumes, if larger end markets could be assured. However Australia's existing waste management infrastructure generally does not have the capacity to process all recyclable types of plastics.

Most plastic waste recovered in Australia for recycling is rigid plastic packaging from municipal kerbside collections (49.6 per cent of total recovery). Plastics collected through municipal kerbside collections are generally sent to MRFs and sorted from co-mingled recycling into either a single, mixed-plastics grade, or more commonly three grades: PET, HDPE and other residual mixed plastics.

Plastic materials sorted into clean batches of specific polymer types tend to be of greater value and have greater access to market opportunities than mixed baled plastic and some other resin types. While the prices of sorted PET and HDPE have fallen significantly over the past year, the price of mixed plastics has dropped most sharply and is not anticipated to recover significantly during 2018.

Sophisticated technology is required to sort and process clean bales of plastic waste by type. Any significant improvements in Australia's recovery of plastic material will require introduction of better sorting infrastructure and upgrades to existing MRF technology.

Metals

Australia's metals recovery and recycling rates are high: the *National Waste Report 2018* shows that five million tonnes of metal wastes were recovered for recycling in Australia in 2016–17. This represents a total recovery rate of 90 per cent, around a quarter of which was from municipal sources.

Steel and aluminium cans, mostly recovered through household kerbside recycling collections, account for only about two per cent of overall metals recovery. There are about 94 MRFs sorting household recycled metal in Australia and all are well equipped to separate and process metals. Although only a small volume (four per cent) of the average household recycling bin, recycled metals are a viable source of revenue for MRFs. 133 LGAs (25 per cent) across Australia have no kerbside collection of waste metals (Map 7).

Aluminium cans collected through container deposit schemes in South Australia, the Northern Territory and more recently NSW, move through purpose-built centres for sorting used beverage containers. While this stream is growing, it remains very small relative to the streams of metals wastes sourced from industry.

A wide network of private scrap-metal collectors and merchants recover scrap metal from municipal sources, and relatively high commodity prices mean metal yards with minimal mechanised sorting are competitive. In general, metals' recycling collectors and processors have not been impacted by shifts in international waste markets, and recyclers have been able to adjust to Chinese import restrictions.

Glass packaging

Around 56 per cent of Australia's glass packaging is recovered for recycling. The rate is considered to be reasonable given the relatively low commodity value of glass per tonne compared to plastic or cardboard, and the difficulty of recovery from mixed waste loads. 134 LGAs (or 24 per cent) do not have infrastructure to collect waste glass at the kerbside (Map 6).

Most glass packaging is collected in co-mingled form from households or commercial sites such as pubs, clubs, sporting venues, hotels and restaurants. Glass is also collected through container deposit depots and allied return routes.

Co-mingled material is sent to MRFs in capital city and regional centres where the glass is sorted from paper grades, plastics and metals. Mixed glass (with tops and labels included) is then sent to one of six beneficiation plants in Melbourne, Adelaide, Sydney and Brisbane. These plants receive some loads from regional locations including glass into Adelaide from Western Australia and the Northern Territory, and glass into Melbourne from Tasmania.

Recyclable glass packaging is generally collected at the kerbside in mechanised, bin-based, fully co-mingled systems. While this delivers collection efficiencies, mixing materials and compaction result in cross contamination and reduced quality of the material collected. Highly-mechanised sorting also tends to break glass into small pieces that are not easily recoverable. These fragments can get lost to landfill or be sorted with other materials. They can also be at a size that prevents detection from stone and ceramic fragments. Of concern is the impact of glass fragments on other materials, particularly paper. The glass itself is of much lower value when collected through co-mingled kerbside systems. Larger recycling sorting plants increasingly have technologies to deal with these small fragments.

Glass collected from kerbside recycling is recycled back into glass packaging in Brisbane, Sydney, Melbourne, and Adelaide. Glass from the Northern Territory and Tasmania is shipped to Adelaide or Melbourne. Some glass shipped to Adelaide is used in wine bottle production. Glass collected in Western Australia is almost entirely used in civil construction projects such as road base applications.

Stockpiling of recycled glass has occurred in the past before state-of-the-art optical sorting equipment was available in beneficiation facilities. The poor quality of Australia's collected glass and the relatively low price received for this material has been an issue in kerbside recycling collection, sorting and sale for many years.

Export of recycled materials

Municipal waste management and recycling in Australia has been significantly impacted by China's waste import restrictions. Operators of MRFs processing municipal waste have been heavily affected, as international prices for plastics, paper and cardboard (especially lower grade mixed products) have dropped significantly. Scrap metal exports have been less impacted because China was receiving a much smaller proportion of these materials prior to its announcements.

Australia's exports of recycled materials to China dropped sharply during 2017–18, reaching one third of the July 2017 quantity in March 2018. Exports to China have subsequently recovered strongly, mainly through growth in exports of paper and cardboard. Waste exports from Australia have also increased overall during 2017–18 in both quantity and value. This is due to alternative markets being found in other countries, particularly Thailand, Malaysia, India, Vietnam and Indonesia. Overall, in 2017–18, Australia sent 4.3 Mt (12 per cent) of our recycled material overseas, up from 4.25 Mt (12 per cent) in 2016–17.

China's import restrictions have diverted demand towards higher quality recycled materials. Some Australian operators have been able to respond by redirecting higher-grade materials to export and lower grades to domestic production. A small number of operators have also been able to apply higher levels of sorting to meet strict contamination limits.

Recent reports suggest that several Asian countries are reviewing their policies in relation to waste imports. If Malaysia, Vietnam and Thailand stopped, or restricted, waste imports, Australia would need to find substitute domestic or export markets for approximately 1.29 Mt (or $530 million) of waste a year, based on 2017–18 export figures.

Challenges and opportunities for municipal recycling infrastructure in Australia

Improve provision of kerbside municipal waste collection and recycling services

The majority of Australians have access to kerbside municipal waste collection and recycling services. However, much of remote and regional Australia has limited or no kerbside municipal waste collection.

Improving regional and remote kerbside collection services across Australia will improve waste management and increase opportunities for recycling in these areas. Major improvements in national recovery rates and recycling tonnages from municipal sources could be achieved through improved kerbside collection of organic (food and garden) waste.

Improve collection and processing infrastructure to process all forms of waste

Existing collection and processing infrastructure is generally equipped to process current volumes of Australia's recycled materials. However, current infrastructure is not well equipped to process all forms of recyclable waste, particularly all forms of recyclable plastic and organic waste.

Opportunities exist to increase Australia's capacity to manage organic waste, including through provision of new infrastructure supporting kerbside collection of organic material, and processing those organics into compost and other products. There are also opportunities to develop infrastructure that enables alternative waste treatment options, such as removing organic waste from the landfill bin. Better management of organic waste will also reduce contamination in co-mingled bins and increase resource recovery rates.

Improve collection and processing infrastructure to better process co-mingled waste

Australia's waste management and recycling infrastructure is vulnerable to international markets for recycled materials. Collection infrastructure is generally designed for collection of co-mingled municipal waste. This presents significant challenges for sorting and processing infrastructure. Few sorting facilities are equipped to process co-mingled municipal waste in a way that enables assured, sorted flows of uncontaminated plastics, paper and cardboard.

A small number of large waste management and recycling operators have demonstrated that they are capable of responding to shifts in global prices for recycled materials. This has led to increased waste exports overall since China introduced restrictions on waste imports. However, most recycling collectors and downstream processors have not been able to meet new standards imposed by China on contamination limits of recycled materials.

Opportunities exist to improve the technical capacity of existing collection and recycling services processing co-mingled municipal waste, for example through investment in state-of-the-art optical sorting equipment. Improving collection and processing infrastructure to better process co-mingled waste will reduce contamination in recycled materials and improve resource-recovery rates. It would also improve the quality and value of recycled materials, and improve access to markets for recycled materials, including international markets.

References

Blue Environment (2016), *National Waste Report 2016*. http://www.environment.gov.au/protection/waste-resource-recovery/national-waste-reports/national-waste-report-2016

Blue Environment (forthcoming), *National Waste Report 2018*. http://www.environment.gov.au/protection/waste-resource-recovery/national-waste-reports

Geoscience Australia (2017) *Waste management infrastructure database*. (https://data.gov.au/dataset/waste-management-facilities)

Planet Ark (2018), *Recycling Near You*. https://recyclingnearyou.com.au/

Map 1: Location of waste management facilities – including landfill, reprocessing facilities, multipurpose facilities and transfer station

Date: 31/10/2018

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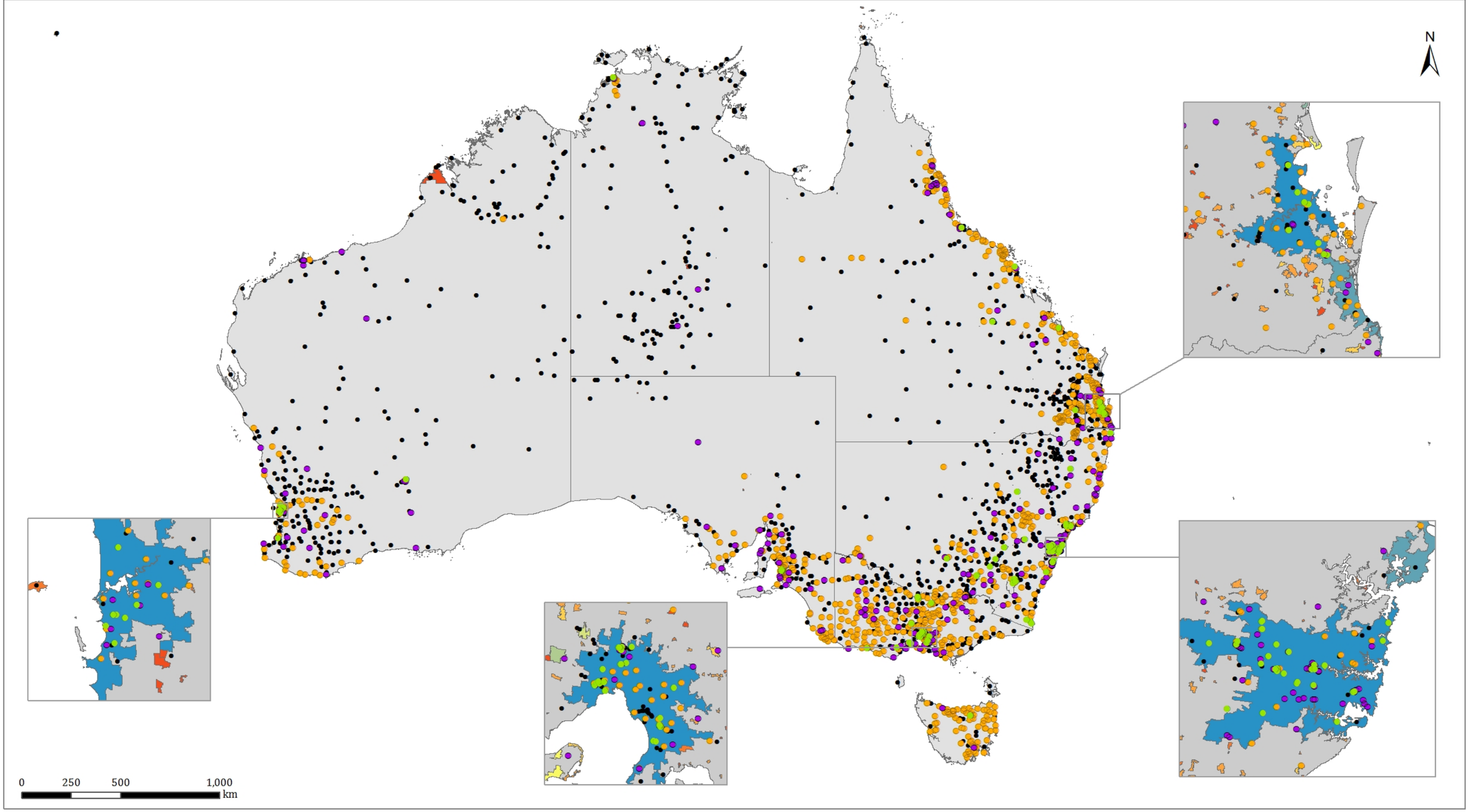

Operational waste facility
- Landfill
- Reprocessing
- Multi-Purpose
- Transfer Station

Urban areas - population
- > 1 million
- 250k - 1M
- 100k - 250k
- 50k - 100k
- 20k - 50k
- 10k - 20k
- 5k - 10k
- 1k - 5k
- 500 - 1k
- 200 - 500
- Remainder

Urban areas - represent areas of concentrated urban development with populations of 200 people or more. These areas of urban development are primarily identified using objective dwelling and population density criteria using data from the 2016 Census.

Acknowledgements:

Operational waste facilities: © Commonwealth Govemment of Australia (Geoscience Australia) 2017.

Significant urban areas 2016: © Commonwealth of Australia (Australian Bureau of Statistics), 2016.

Coordinate System: GCS GDA 1994
Datum: GDA 1994
Units: Degree

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Map 2: Location of material resource facilities across Australia

Date: 31/10/2018

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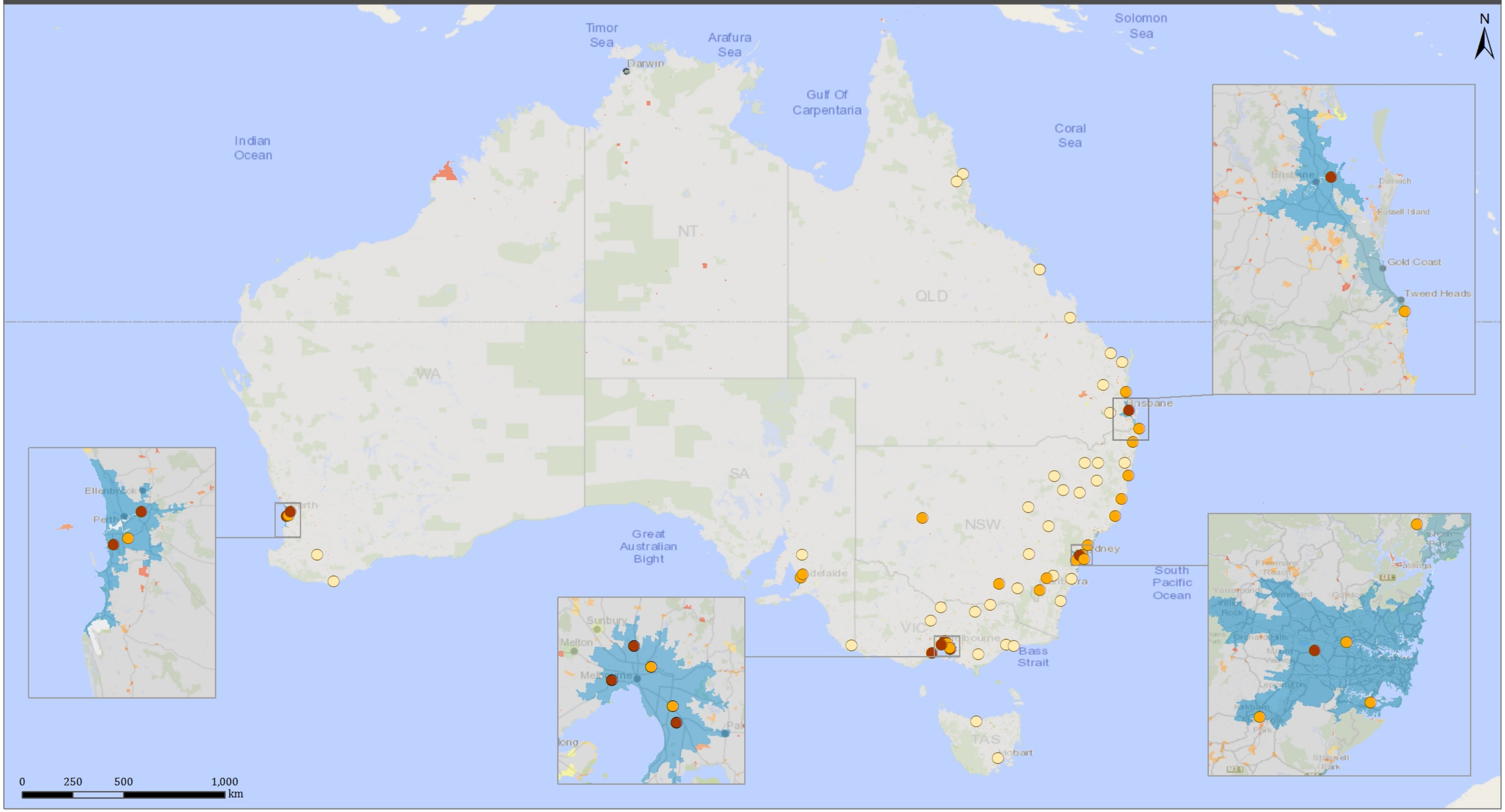

Materials Recovery Facilities v2 (tonnes a year)

- Large > 100,000
- Medium = all other
- Small < 30,000

Urban areas - population

- > 1 million
- 250k - 1M
- 100k - 250k
- 50k - 100k
- 20k - 50k
- 10k - 20k
- 5k - 10k
- 1k - 5k
- 500 - 1k
- 200 - 500
- Remainder

Material Recovery Facilities - Facilities that, as a major part of their operation, receive and sort mixed comingled recyclables from municipal sources 2016/17 throughput.

Urban areas - represent areas of concentrated urban development with populations of 200 people or more. These areas of urban development are primarily identified using objective dwelling and population density criteria using data from the 2016 Census.

Acknowledgements:
-Materials recycling facilities © Commonwealth Government of -Australia (Department of Environment and Energy) 2018
-Significant urban areas 2016 © Australian Bureau of Statistics.

Coordinate System: GCS GDA 1994
Datum: GDA 1994
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Map 3: Availability of kerbside collection services across Australia

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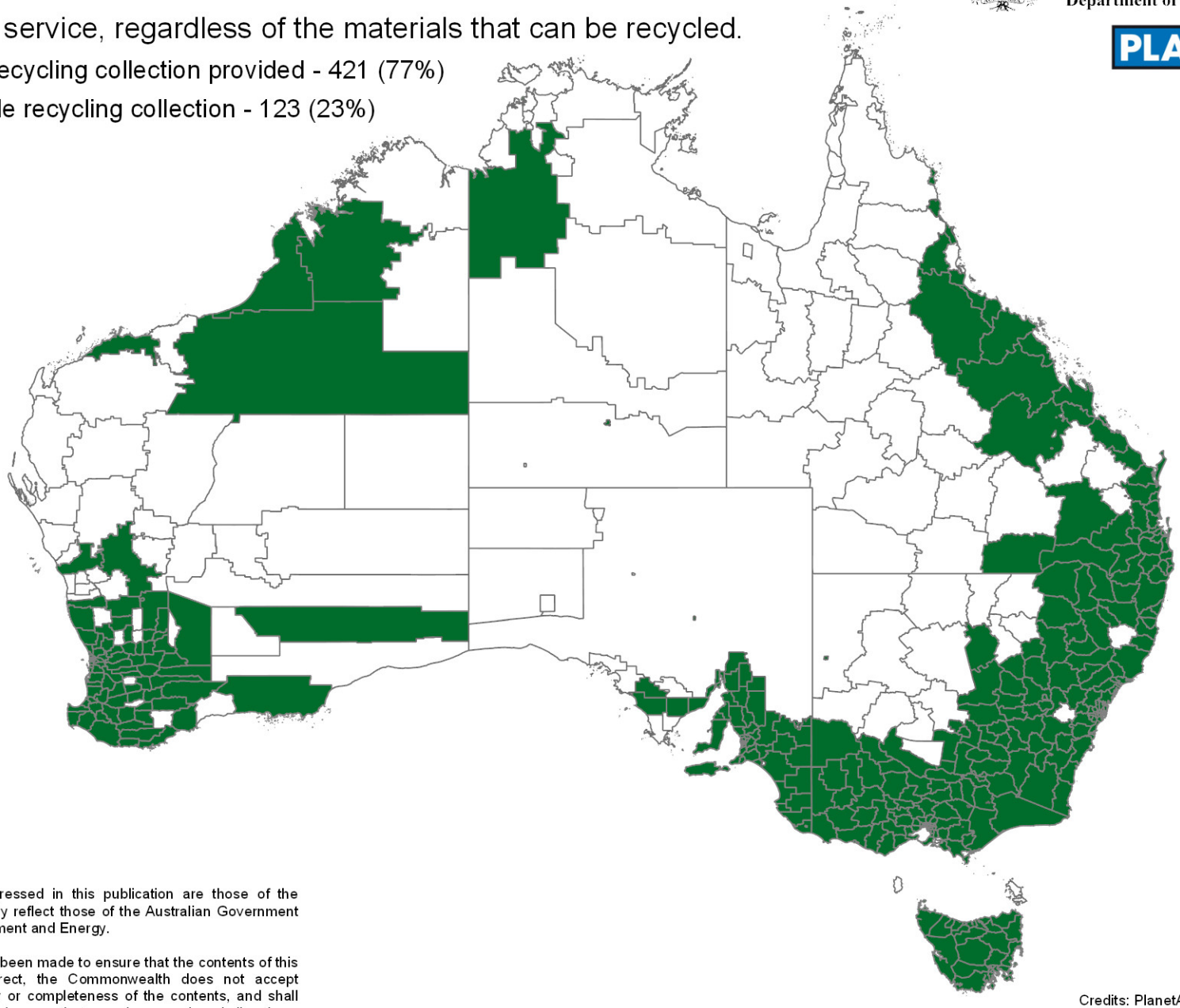
Any recycling service, regardless of the materials that can be recycled.

- Kerbside recycling collection provided - 421 (77%)
- No kerbside recycling collection - 123 (23%)



Credits: PlanetArk, Australian Bureau of Statistics

Produced by the Environmental Resources Information Network (ERIN), Australian Government Department of the Environment and Energy

Projection: GCS GDA 1994, Datum: GDA 1994

Map 4: Availability of kerbside collection of paper and cardboard products across Australia.

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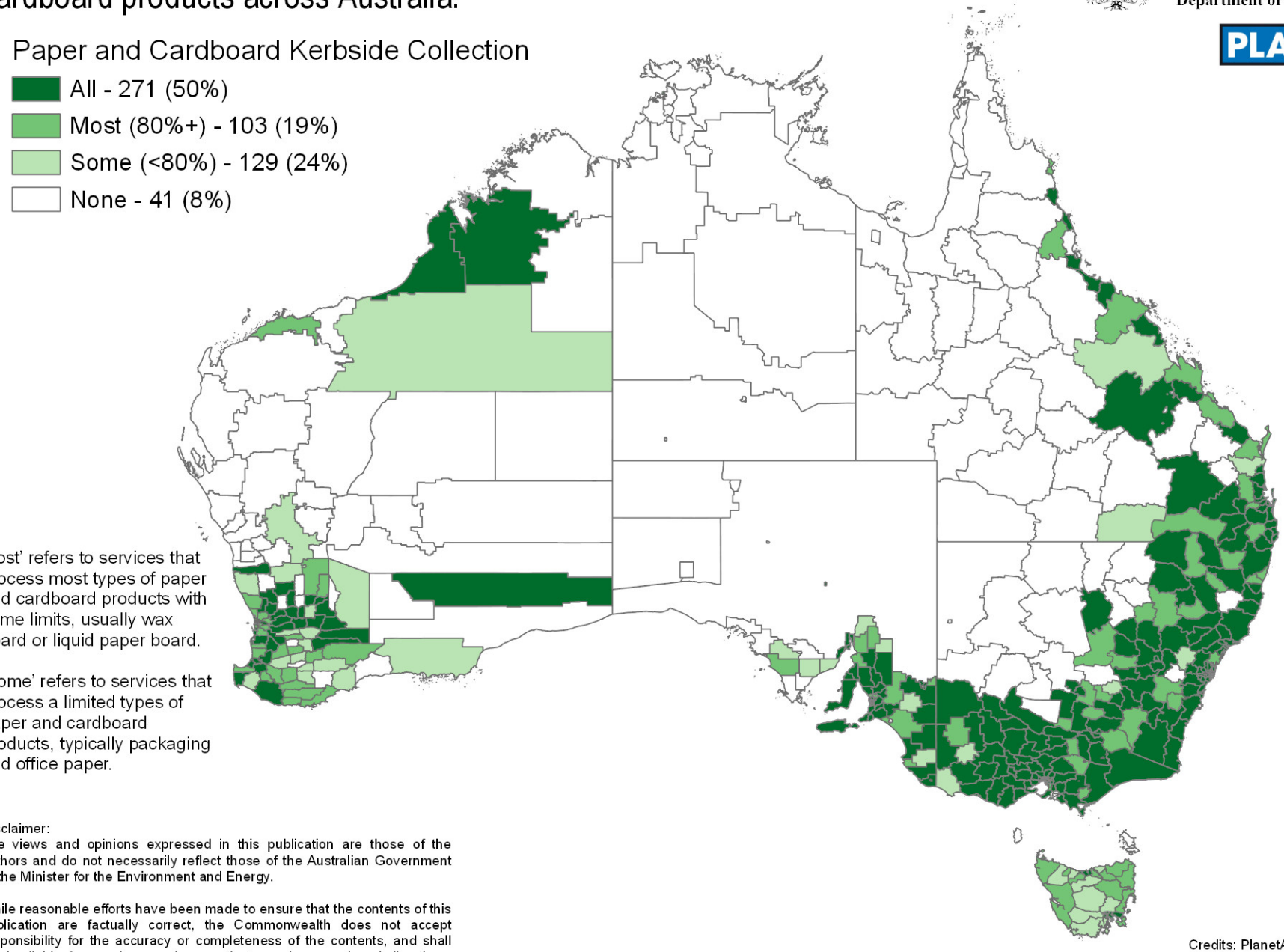

Most' refers to services that process most types of paper and cardboard products with some limits, usually wax board or liquid paper board.

'Some' refers to services that process a limited types of paper and cardboard products, typically packaging and office paper.

Credits: PlanetArk, Australian Bureau of Statistics

Produced by the Environmental Resources Information Network (ERIN), Australian Government Department of the Environment and Energy

Projection: GCS GDA 1994, Datum: GDA 1994

Map 5: Availability of kerbside collection of plastic products across Australia.

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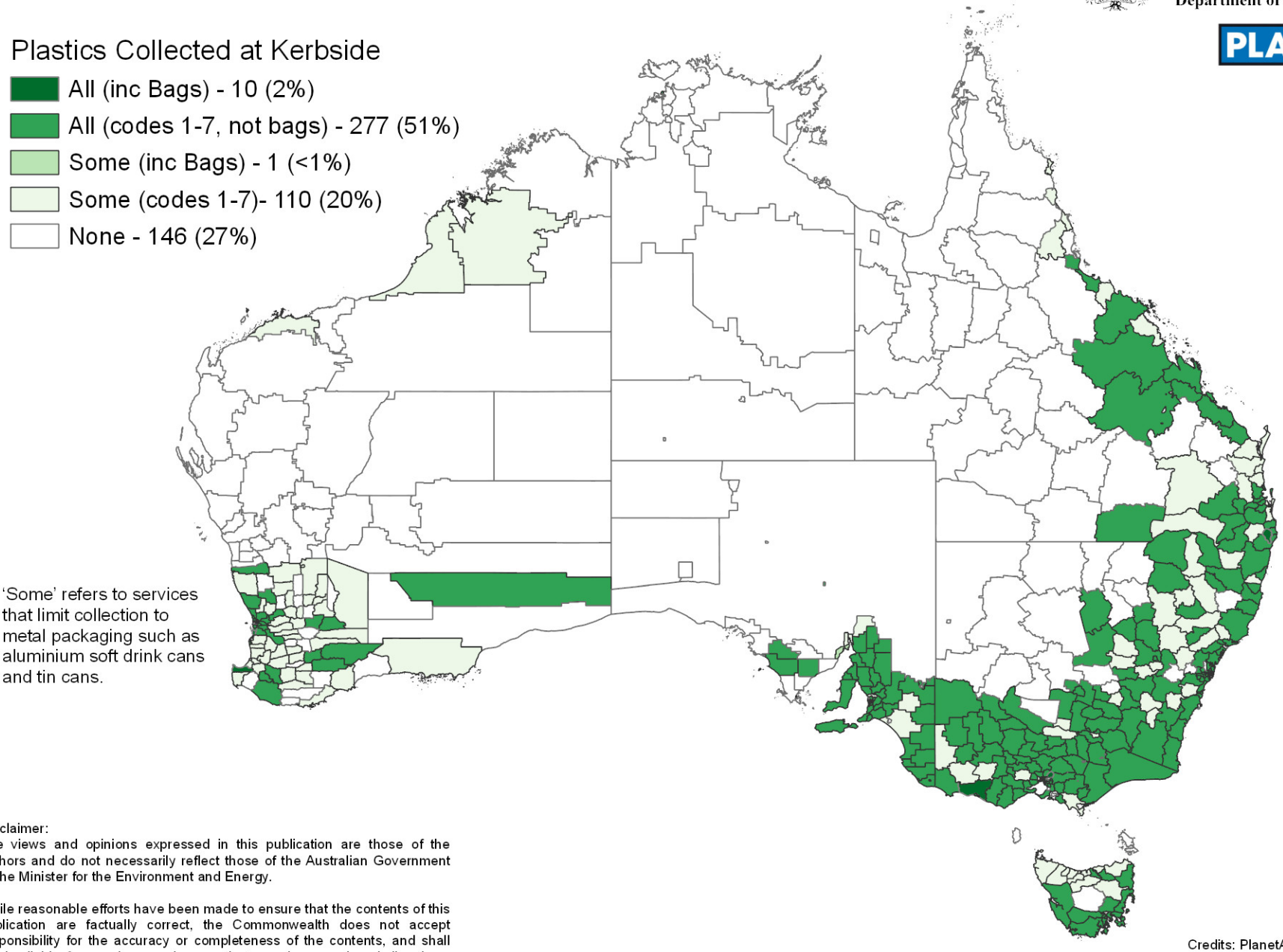

'Some' refers to services that limit collection to metal packaging such as aluminium soft drink cans and tin cans.

Credits: PlanetArk, Australian Bureau of Statistics

Produced by the Environmental Resources Information Network (ERIN), Australian Government Department of the Environment and Energy

Projection: GCS GDA 1994, Datum: GDA 1994

Map 6: Availability of kerbside collection of glass across Australia

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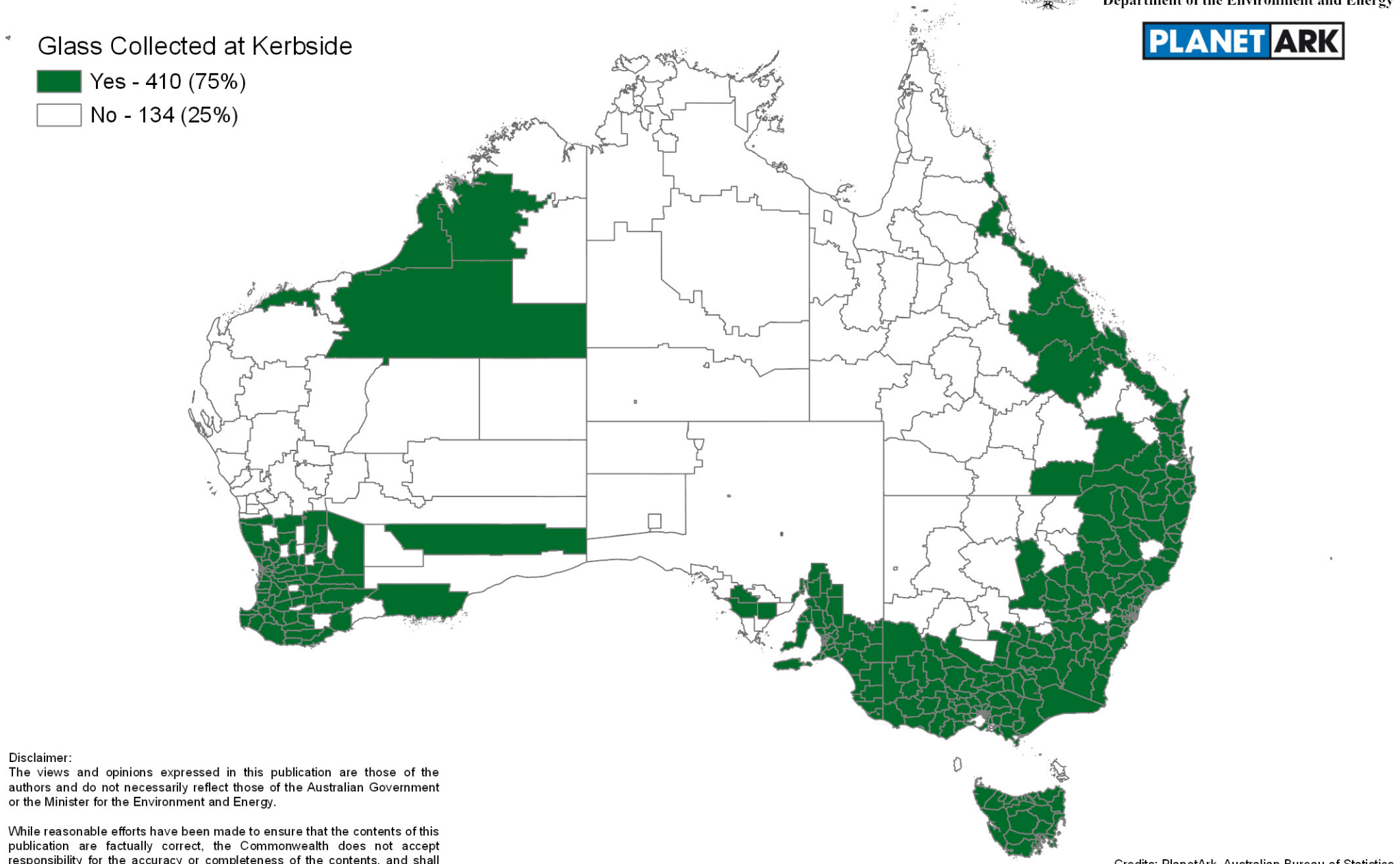

Credits: PlanetArk, Australian Bureau of Statistics

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Projection: GCS GDA 1994, Datum: GDA 1994

Map 7: Availability of kerbside collection of metals across Australia

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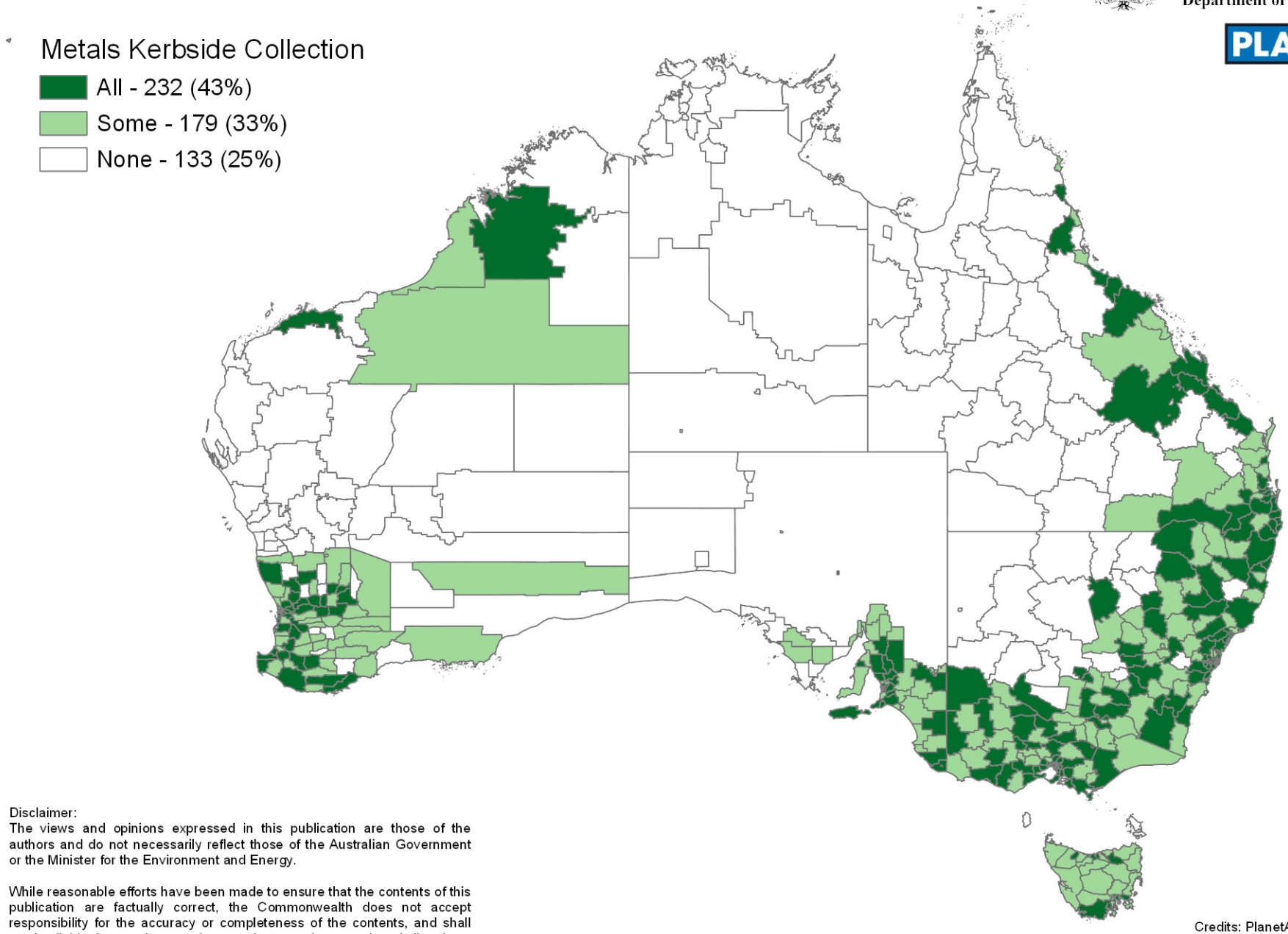

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Projection: GCS GDA 1994, Datum: GDA 1994

Map 8: Availability of kerbside collection of foil-lined packaging across Australia

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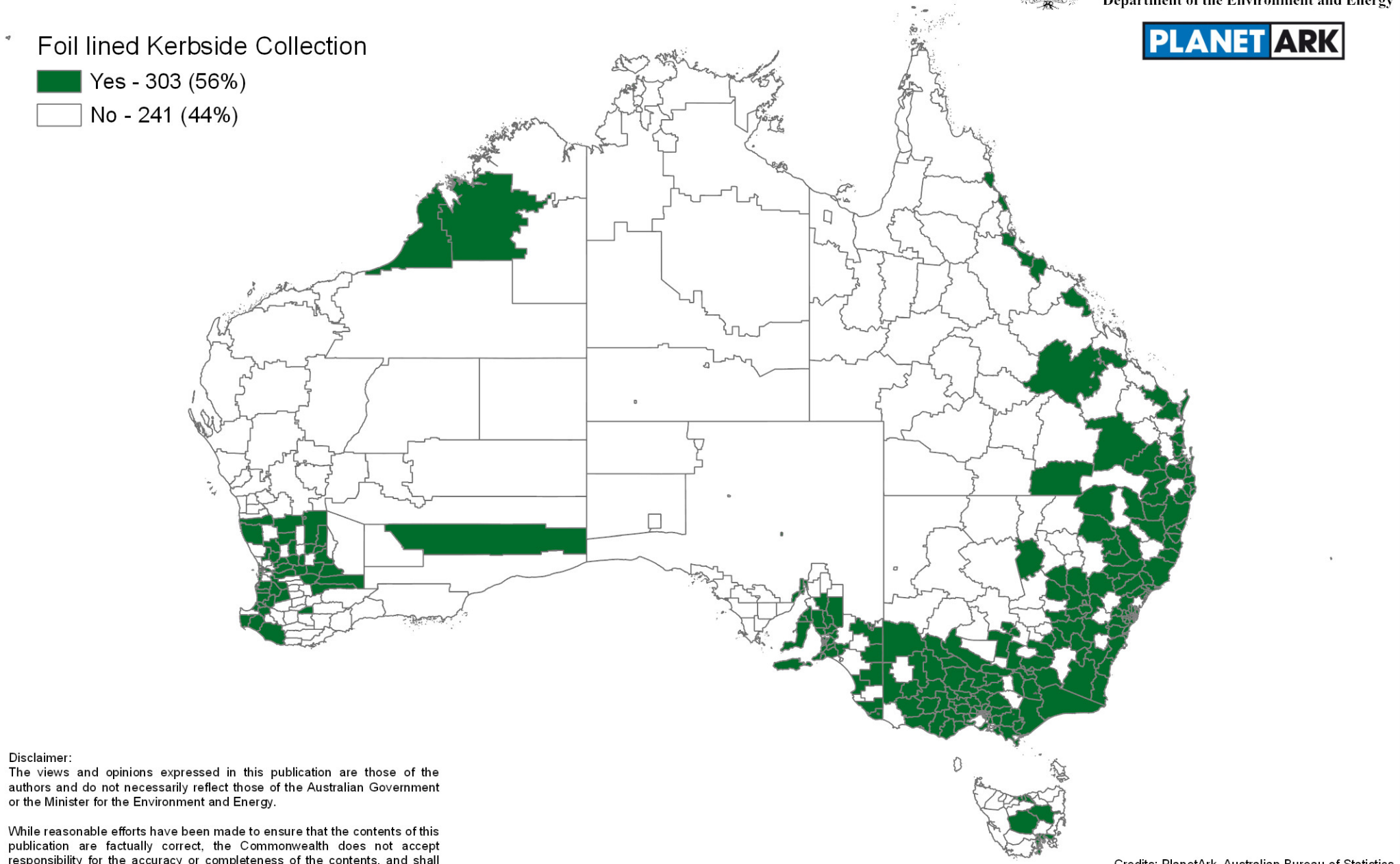

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Projection: GCS GDA 1994, Datum: GDA 1994

Map 9: Availability of kerbside collection of organics across Australia

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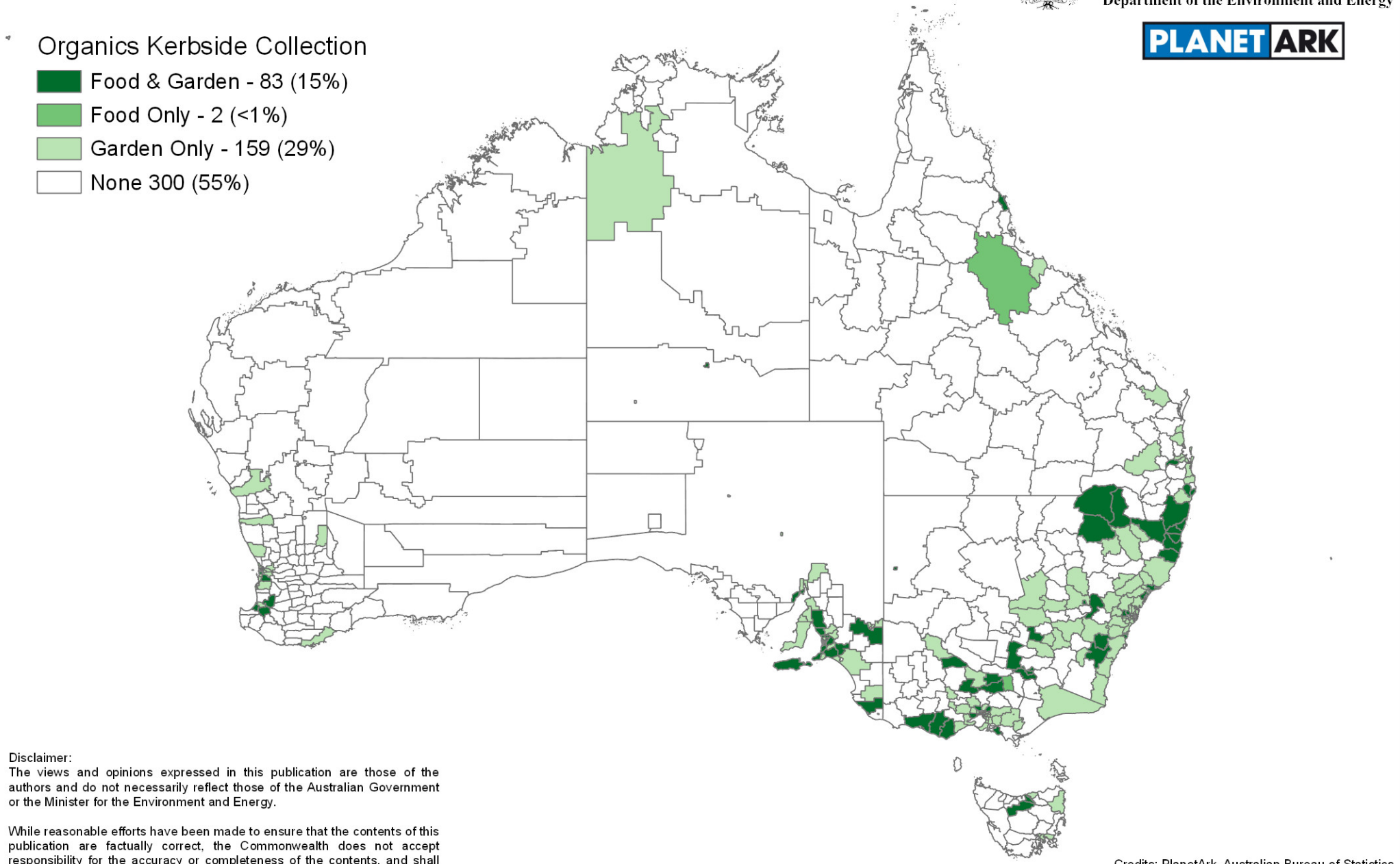

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Assessment of Australian recycling infrastructure and 2016-17 exports to China – paper and paperboard

IndustryEdge
June 2018

About IndustryEdge

IndustryEdge is Australia's leading trade data, market analysis and intelligence firm in the fibre resources, wood products and pulp & paper sectors.

Established in 1991, the firm publishes independent monthly market analysis for forestry and wood products (Wood Market Edge) and pulp and paper products (Pulp & Paper Edge). *IndustryEdge* also publishes a range of annual reviews, multi-client guides, research reports and associated publications in paper, paper products, pulp, recovered fibre and similar sectors.

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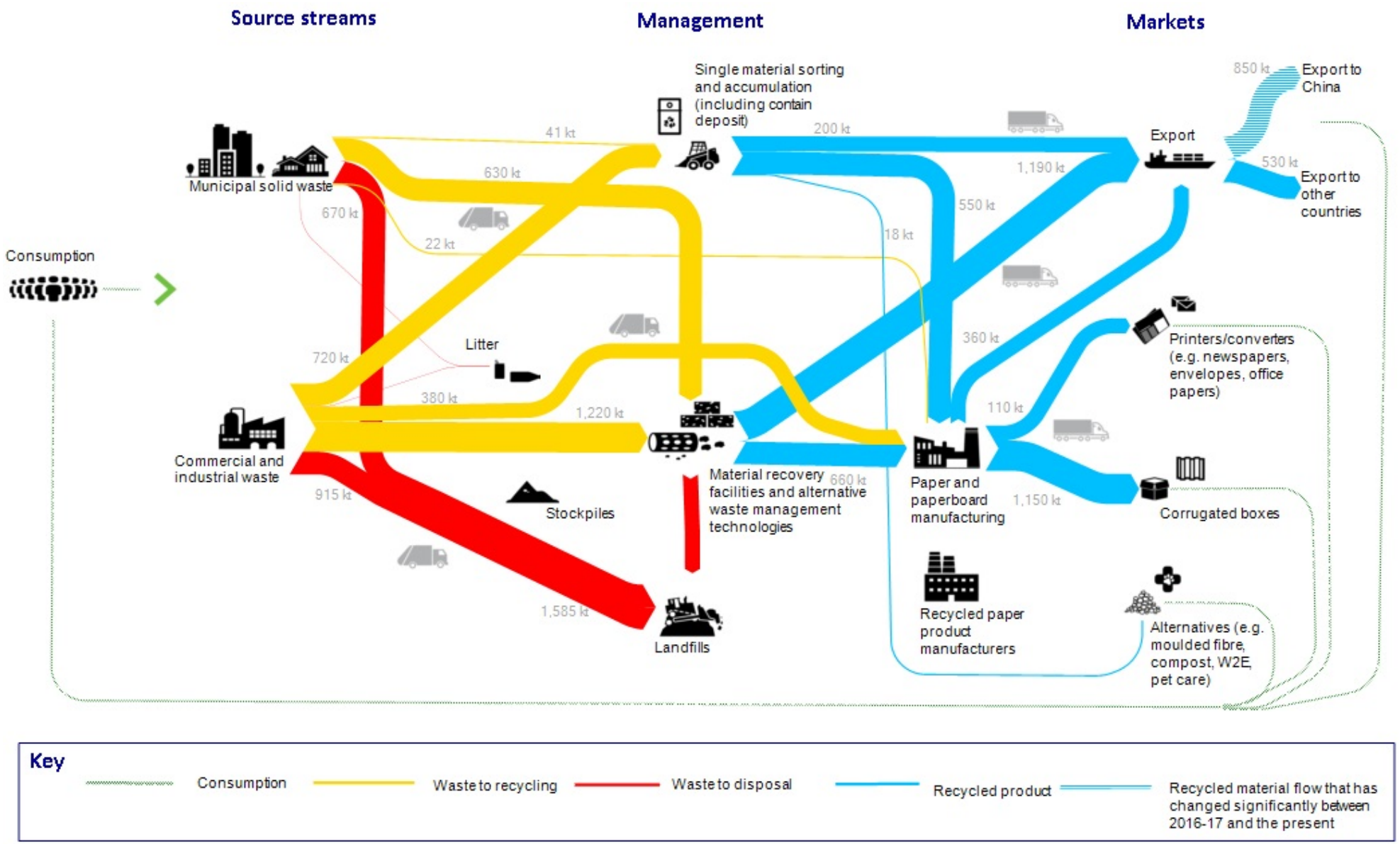
Qualifications and Disclaimers

The data used in preparing the report was collated and analysed by *IndustryEdge* from sources at its disposal, with due care and attention to detail. The data was up to date at the time the analysis was prepared, but *IndustryEdge* cannot warrant the accuracy of information from data or information from external sources.

We note that the recovered paper export data detailed in this analysis is different to some other datasets addressing the same materials and timeframes. This is most likely due to changes in the ABS datasets over time, the different times at which data extraction occurred and potentially, different materials definitions.

The data was extracted by *IndustryEdge* in May 2018, from original data supplied by the Australian Bureau of Statistics.

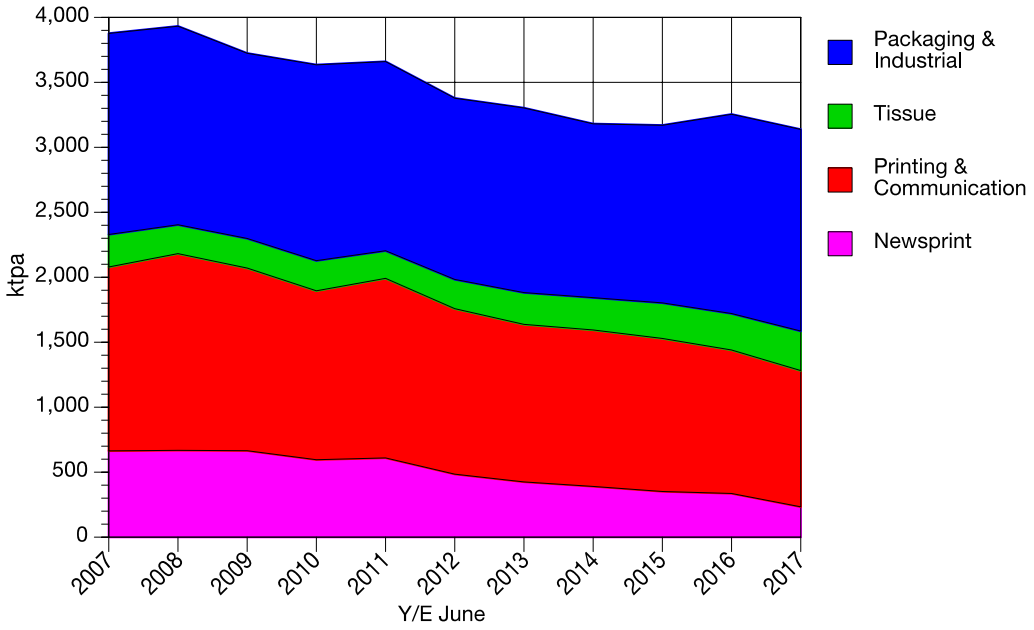

Source streams
Management
Markets
Consumption
Municipal solid waste
Commercial and industrial waste
Litter
Stockpiles
Single material sorting and accumulation (including contain deposit)
Material recovery facilities and alternative waste management technologies
Landfills
Export
Export to China
Export to other countries
Paper and paperboard manufacturing
Printers/converters (e.g. newspapers, envelopes, office papers)
Corrugated boxes
Recycled paper product manufacturers
Alternatives (e.g. moulded fibre, compost, W2E, pet care)
41 kt
630 kt
670 kt
22 kt
720 kt
380 kt
1,220 kt
915 kt
1,585 kt
200 kt
1,190 kt
550 kt
18 kt
360 kt
110 kt
660 kt
1,150 kt
850 kt
530 kt
Key
Consumption
Waste to recycling
Waste to disposal
Recycled product
Recycled material flow that has changed significantly between 2016-17 and the present

Consumption of paper and paperboard in Australia

Australia's consumption of paper and paperboard totalled 3,137.9 kt in 2016-17. At an aggregate level, paper and paperboard consumption in 2016-17 was similar to prior years and within expectations.

The chart below shows consumption, by major grade for the decade up to and including 2016-17.

Australian Apparent Consumption of Paper & Paperboard by Main Grade: 2007 – 2017 (kt)



Source: ABS & IndustryEdge

The four main grades of paper and paperboard and their production and trade details for 2016-17 are shown in the table below.

Consumption, Production and Trade of Paper & Paperboard by Main Grade: 2016-17 (kt)

Grade	Production	Exports	Local Sales	Imports	Consumption
Newsprint	320.0	151.8	168.2	65.0	233.2
Printing & Communication	483.0	95.9	387.1	661.5	1,048.6
Tissue	198.0	18.6	179.4	124.7	304.1
Packaging & Industrial	2,184.0	945.1	1,238.9	313.1	1,552.0
Total	**3,185.0**	**1,211.4**	**1,973.6**	**1,164.3**	**3,137.9**

Source: ABS & IndustryEdge

It should be noted that this consumption data does not include imports of:

- Pre-converted fibre packaging (approx. 110.0 kt per annum)
- Pre-printed material (books, newspapers and magazines) and stationery (import data only records value, not quantity or volume)
- Converted tissue products (import data only records value, not quantity or volume)
- Fibre packaging imported with goods (approx. 1,250 kt per annum)

Brief descriptions of each of the main grades, their end-use markets and recycling outcomes follow.

Newsprint

Although generally a Printing & Communication paper, Newsprint has traditionally been treated separately because of its once substantial volumes and distinct supply chain. Newsprint is manufactured from pulp which has been produced using mechanical pulping techniques, rather than chemical pulping techniques.

Post-consumer Newsprint is extensively recovered and recycled into Newsprint and Packaging & Industrial paper and paperboard, as well as insulation, soil stabilizer,

moulded fibre products such as egg cartons and pet-care products such as kitty litter.

Recovery is generally through co-mingled kerbside collections, with the significant majority of supply passing through MRFs, supplemented by specific collections ('newspaper drives') that may bypass MRFs and be returned to the Newsprint manufacturers or direct to Packaging & Industrial paper manufacturers.

Printing & Communication

Printing & Communication papers refer to those grades of paper used in printed applications (other than Newsprint). This is an extensive range of products including directories, catalogues and inserts, magazines, brochures, forms, envelopes posters, stationery, books and more, including copy paper. While consumption is in decline, this is still a substantial grade.

The majority of recovery is through co-mingled kerbside collections, passing through MRFs.

Printing & Communication papers are made from two virgin fibre inputs – chemical pulp and mechanical pulp. Recovered material is, in part, segregated between the Bleached Chemical and Mechanical grades, as well as the 'Other' grade.

Post-consumer recovery volumes are used in recycled office-products (including copy paper), as recycled content for tissue production and in some 'white recycled' packaging grades.

Tissue

Dominated by toilet paper, the Tissue grade includes facial tissues and hand towels primarily. There is no post consumer recovery or recycling.

Packaging & Industrial

Representing the largest volume of consumption, Packaging & Industrial paper and paperboard grades are used to manufacture bags (retail), sacks (industrial), wrapping papers and folding cartons such as cereal and pharmaceutical boxes, but is dominated by use in manufacture of corrugated cartons, almost entirely manufactured from fibre that was originally chemically pulped.

Corrugated cartons can be manufactured from virgin fibre pulp or recycled fibre pulp, and often from a mix of the two. Recovery and post-consumer recycling of Packaging & Industrial grades of paper and paperboard is extensive and is generally deployed back into the manufacture of corrugated cartons.

Traditionally, the substantial volume of post-consumer recovery has been through Commercial & Industrial collections, due to the business-to-business nature of the use of packaging. Although this remains substantial, the rise of e-commerce and home deliveries has resulted in increased collections arising through co-mingled kerbside collections and its passage through MRFs.

Recovered paper types, grades and sources

Globally, recovered paper types are defined – at the primary level – by the type of pulp from which they are manufactured, and within that, whether they are bleached. This typology is used because the different pulp types have different applications.

Types and Grades of Recovered Paper

The table below sets out the types and grades of recovered paper. The 'Recovered Paper Grades' are international trade grades. Within each, there are a considerable number of specific grades, for which specifications and prices are different. Although not definitive and certainly not up to date with the fast moving market dynamics, reference to the *Australian Recovered Paper Specifications*[1] may be of benefit.

Types (Pulp type)	**Recovered Paper Grades (inc. for Export)***	**Paper & Board Inputs**
Chemical	Bleached Chemical (may include some Packaging & Industrial paper & paperboard)	Office paper
		Printing papers
		Magazines (some)
		Envelopes & stationery
	Unbleached Kraft (may include some bleached content material)	Corrugated containers
		Industrial sacks
		Folding boxes (some)
Mechanical	Mechanical	Newsprint
		Catalogues
		Magazines (some)
Mixed	Other/Unsorted	All

Source: IndustryEdge

[1] *Australian Council of Recycling, Australian Recovered Paper Specifications, (retrieved 24 May 2018), http://www.acor.org.au/uploads/2/1/5/4/21549240/paperspecs_v3.pdf*

* At export, the formal description of each of the grades is:

HS code	Description
470710	Paper or paperboard; waste and scrap, of **unbleached kraft** paper or paperboard or corrugated paper or paperboard
470720	Paper or paperboard; waste and scrap, paper or paperboard made mainly of **bleached chemical** pulp, not coloured in the mass
470730	Paper or paperboard; waste and scrap, paper or paperboard made mainly of **mechanical** pulp (e.g. newspapers, journals and similar printed matter)
470790	Paper or paperboard; waste and scrap, of paper or paperboard n.e.c. in heading no. 4707 and of **unsorted** waste and scrap

A working definition and the material composition of each of the grades is:

- **Unbleached Kraft** is entirely recovered Packaging & Industrial paper grades, where there is no bleached content. This grade is dominated by corrugated boxes and is often known as Old Corrugated Containers (OCC).
- **Bleached Chemical** is almost entirely bleached office and printing papers, made from chemical pulps.
- **Mechanical** includes Newsprint and most forms of catalogues and some magazines, where they are manufactured from pulp made by mechanical processes
- **Other** is also known as 'mixed' or 'unsorted' recovered paper. It includes the significant majority of recovered paper sourced from co-mingled kerbside collections that pass through MRFs.

Sources of Recovered Paper

The paper and paperboard inputs to each of the major recovered paper grades provides relatively clear indication of some of their sources. The following table sets out the main sources by input type, estimates them proportionally and details the volume of material recovered in 2016-17 from these sources.

	Municipal Solid Waste		Commercial & Industrial		Total
Recovered Paper Grade	*Est. %*	*kt*	*Est. %*	*kt*	*kt*
Mechanical	55%	96.7	45%	79.1	175.8
Bleached Chemical	25%	162.5	75%	487.6	650.1
Unbleached Kraft	20%	434.6	80%	1,738.3	2,172.9
Total		**693.8**		**2,305.0**	**2,998.9**

Source: ABS & IndustryEdge

Note: The 'Other' ['Mixed'/'Unsorted'] grade of recovered paper is derived almost entirely from the Municipal Solid Waste stream and is made up of the three main grades set out above, but is, as the name suggests, the unsorted portion from the Municipal Solid Waste stream.

The **'Mechanical'** grade of recovered paper consists largely of Newspapers, Catalogues and Magazines that use paper produced by mechanical pulping processes.

Recovered material is estimated to be derived primarily from Municipal Solid Waste collections (55%), supported by the pre-consumer material from printers and publishers, as well as 'returns' of unsold publications, which are derived from the Commercial & Industrial stream (45%).

The **'Bleached Chemical'** grade recovered paper consists of white printing and communication papers manufactured from chemical (mainly Kraft) pulping processes.

It is estimated that 75% of this grade is derived from the Commercial & Industrial stream and the remainder from the Municipal Solid Waste stream. The latter stream has been growing its share of this grade, as printing has been migrating from commercial activity to household and small-business activity, driven by the advent of digital technologies.

Commercial collections occur at office buildings and for large organisations, including government departments and agencies. Importantly, this supply includes material collected pre-consumer, from processing facilities that are dominated by commercial printers and secondary manufacturers such as envelope and label manufacturers.

For **'Unbleached Kraft'** recovered paper, the situation is effectively reversed, with the significant majority of the recovery occurring through Commercial & Industrial

processes, representing the more business-to-business nature of much of these collections. The grade consists of packaging and industrial grades of paper and paperboard, dominated by corrugated cartons and often already containing significant proportions of recovered paper and board. This grade may also include other unbleached paper and board products, including sack-kraft and some grades of cartonboard or folding box board.

The Commercial & Industrial stream supplies an estimated 80% of this grade's exports, with the remainder (<20%) supplied by the Municipal stream and a very small proportion (<1%) is estimated to be derived from the Construction & Demolition stream, largely from packaging of products installed in construction.

It should be noted that the Commercial & Industrial source stream is also the predominant supply for Australia's containerboard manufacturers, whose emphasis is to extract the required quality of material for their own use, prior to exports occurring. The implication is that material exported to China (and other destinations) includes a larger proportion of lower quality material.

Municipal collections include a significant volume of material derived from small-businesses, as well as household level material.

The 'Other' grade of recovered paper defined earlier is also known as 'Mixed' or 'Unsorted'. It should be noted that it is generally considered an export designation, but that does not preclude its domestic utilization. It is almost entirely derived from Municipal Solid Waste collections and may consist of any and all grades of paper and paperboard.

Because it is mixed and unsorted, this grade is prone to very significant variations in quality. There is evidence that volumes may be exported and sorted in the destination country.

At least 95% of the export volume of this grade is sourced from Municipal collections. The very small quantity that may be derived from Commercial and Industrial streams is considered to be – on average – of better quality than the material derived from the Municipal Solid Waste stream and is more likely to be exported.

Recovery and recycling infrastructure

Collection

The majority of Municipal Solid Waste (MSW) is collected in dedicated trucks that compress material collected at kerbside, delivering it to MRFs. The volume from this source is increasing, but the quality of the material – from a paper and paperboard perspective is diminishing.

Under the pressure of commercial contracts, it is widely reported that collectors are compressing co-mingled loads more than ever before, causing paper and paperboard to become both more difficult to sort and increasingly contaminated, especially by glass fines.

Recovery

Australia's fixed recovery infrastructure for paper and paperboard has two main types:

- Materials Recovery Facilities (MRFs) and
- 'Single-stream' facilities that receive only one paper and paperboard

MRFs – the paper & paperboard perspective

MRFs in Australia vary from reasonably sophisticated to basic sorting facilities. The successful have invested considerable capital to ensure their equipment is up to date.

MRFs in Australia receive material in loose form, from MSW collections. They also have the capacity to accept Commercial and Industrial recyclables such as cardboard, paper, cores, plastic, glass, aluminium, and in some cases steel.

The loose co-mingled material sourced from MSW collections is 'dumped' on the floor of the MRF and is then pushed by a mechanical loader on to a conveyor in mixed form where it is transferred in to a revolving cylinder called a trommel

The trommel has various size openings that allow the heavier materials to fall through and are recovered at that point or transferred to a secondary sort facility. It

is where most of the glass components of the mixed material is separated.

The paper steam is then usually sent over either a bounce conveyor or a shaker screen that separates the heavier and larger pieces of cardboard.

Magnets installed over moving conveyor belts remove the steel and tin containers while eddy current separators are used to remove aluminium cans and other nonferrous metals.

Plastics can be identified by type and separated with the use of optical sorters.

Usually the remaining paper stream is conveyed past a sort station where foreign materials are removed by workers standing on either side of the conveyor. This is a manual process and the proportion of contaminants able to be physically removed depends largely on the speed of the conveyor, the extent of the contamination and the number of employees on the belt.

Contaminants are dropped in to various segregated holding bays where that are either sent to landfill or in some cases, if they have value they can be recycled.

Some dedicated MRFs, usually in regional areas, undertake a 'positive sort', involving those on the sort conveyor manually picking the nominated material such as newsprint or a similar commodity that has a higher value. This process is very labour intensive and is only viable if the labour cost and conveyor belt speed allows for the material to be picked off in sufficient qualities.

The paper and paperboard streams are conveyed direct to a baler where the material is pressed in to bales that typically weighs 1 tonne and is stored onsite or loaded direct in to containers should the product be going to export. Baled paper and cardboard can be loaded onto local transport, should there be a domestic re-processing facility within reasonable access.

MRFs in major city locations are all capable of loading to export with container loading ramps and docks and certified weighbridges.

Major Issues for MRF's

- Contamination – biggest problem
- Unable to sort to the new China specifications of <0.5% contaminants
- Volumes from kerbside collections are increasing
- High cost of capital investment to install modern high technology
- Retro fitting sort lines is difficult and expensive

- Fluctuating prices for commodities processed.
- Uncertainties over ongoing outlets for materials recovered.

It is estimated that in 2016-17, MRFs received 1,850 kt of paper and paperboard.

Single-stream facilities

Single-stream recovery facilities – known to some as Non-MRFs – receive only one material. They are a significant presence in the paper and paperboard sector, receiving and processing paper and paperboard to the exclusion (generally) of other materials. Their existence underscores the specific importance of recovered paper to the manufacture of paper and paperboard in Australia and globally.

The single-stream collectors can be considered as two distinct groups – the industrial, and the small or social level.

At the **industrial** level, the facilities often include weighbridges and balers, but do not have sorting lines. Most target Unbleached Kraft recovered paper, but some focus specifically on the other grades. Collection techniques include contractual relationships with major aggregators such as shopping centres and large users of paper and paperboard.

It should be noted this dedication does not mean they will refuse other paper and paperboard material (including drop-offs), but they will ensure that it is received sorted and there is no cross-contamination.

Even at the industrial level it is difficult to assess exactly which facilities are dedicated to single-stream collections. However, the following companies are known to operate these non-MRFs in each of the indicated States.

State	Operator
Victoria	Cleanaway, One Paper, Australian Paper Recovery
NSW	Cleanaway, Remondis, Orora (Orora is on site at its Botany Mill)
Queensland	Cleanaway
Tasmania	SKM, Veolia, Cleanaway
SA	Cleanaway, Orora, Scout Recycling
WA	Cleanaway, Remondis, SMRC

Nearly all of the major recovery facility operators have drop-off options for pre-sorted material, many of which are not located at their MRFs, and the material from

which is rarely re-directed to the sorting system.

Many of these 'satellite' facilities receive only small quantities of material, some linked to Container Deposit Schemes as is the case for Scout Recycling in South Australia. However, the material they receive has a specific focus and value, sufficient to sustain their operations and recover and recycle material effectively.

At the other end of the industrial collections, larger facilities receive volumes in sufficient quantity to supply major reprocessors. The best example is Orora's own operation at its Botany paperboard mill. It receives only recovered paper and paperboard, and within that, only the Unbleached Kraft grade.

At the small or social level, there is a wide range of organisations that collect specific grades of paper and paperboard – mainly newsprint – for transfer to the re-processors. The Cycling Club in Albury works directly with Norske Skog for instance and Scout groups (as distinct from the commercialized Scout Recycling in SA) are renowned for their 'newspaper drives'. It is estimated that in 2016-17, these forms of collection delivered as much as 5 kt of paper and paperboard to specific end-users, including those deploying recovered newsprint to alternative applications like the production of pet-care products (kitty litter) and similar.

It is estimated that in 2016-17, single-stream facilities received 764 kt of paper and paperboard.

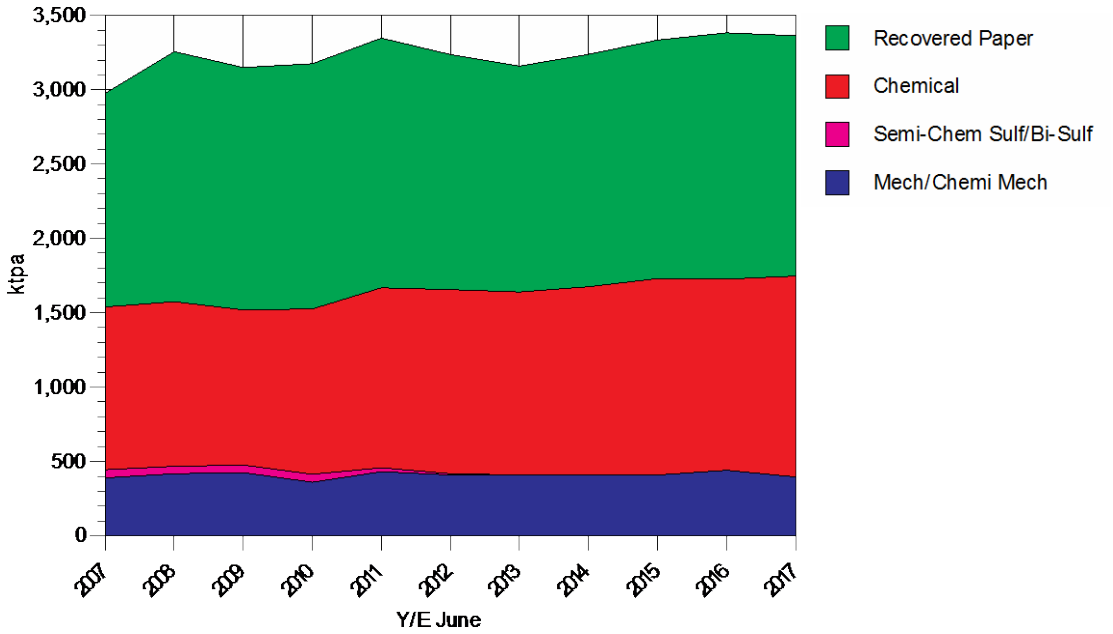
Recycling in Australia

Recovered fibre (both pre and post-consumer) is used extensively in the production of paper and paperboard in Australia, as is the case in most countries. Recovered fibre is used because it is widely available and is usually a cheaper form of fibre than virgin fibre pulp.

In Australia, recycling of recovered fibre has the added advantage of being a local fibre supply, reducing imports of pulp and decreasing the cost variations associated with currency movements and global pulp price movements.

In 2016-17, Australia's total use of fibre for the manufacture of paper and paperboard was a record 3,477 kt. Of this, 46.5% or 1,616 kt was supplied by recycled fibre in 2016-17. This proportion has declined marginally from 48.3% a decade ago in 2006-07, but is relatively stable, as the chart below shows.

The Australian Fibre Furnish – Consumption of Virgin Pulp by Main Grade & Utilisation of Recovered Paper: 2007 – 2017 (ktpa)



Source: ABS & IndustryEdge

On an export parity basis, the 1.616 million tonnes of recovered paper used domestically in 2016-17 was valued at approximately AUD323.2 million on an export parity, Free-On-Board basis.

Representing approximately 54% of the total recovered paper and paperboard, the locally used proportion was deployed on ten paper machines (primary processing facilities), at eight facilities, operated by four companies[2] and in four states[3]. A conservative estimate of the value of this infrastructure (on a replacement value alone) is AUD3.0 billion.

Alternative recycling in Australia

A small number of relatively minor alternative recycling outcomes exist in Australia.

These activities are:

[2] *Australian Paper, Norske Skog, Orora and Visy Industries*
[3] *New South Wales, Queensland, Tasmania and Victoria*

- Moulded fibre production ~ egg cartons, fruit trays etc ~ est. 4 kt
- Pet care ~ kitty litter etc ~ est. 14 kt
- Compost and soil stabilizer ~ est. 2 kt

In total, in 2016-17, it is estimated these accounted for just 18.0 kt or 1.1% of total consumption of recovered paper and paperboard.

Recycled products and markets

Recycled paper and paperboard products are ubiquitous in the global economy, primarily as packaging and industrial paper grades. In the very significant majority of cases, recycled paper and paperboard are recycled back into other grades of paper and board.

However, as set out below, by volume, there is one significant product manufactured from recovered fibre – corrugated cartons.

Although extensively recycled, it deteriorates over time and each 'fibre' can only be recycled a limited number of times.

Paperboard for corrugated cartons (and other packaging & industrial paper grades)

By far the most significant product manufactured from recycled paper and paperboard is corrugated cartons. Approximately half of all corrugated cartons are manufactured from recycled material, most of which were previously corrugated cartons, typically considered to be recycled up to seven times.

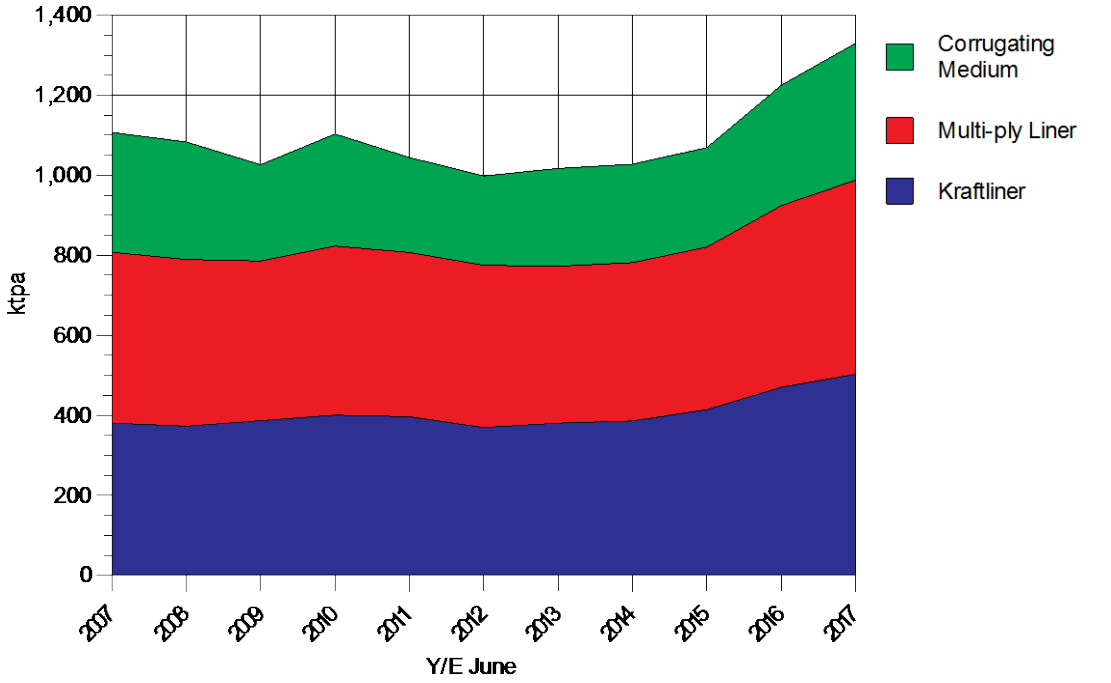
The grades of paper and paperboard recycled into corrugated cartons are Unbleached Kraft and to a much lesser extent the Other grade (see below for definitions). In 2016-17, it is estimated that 1,508 kt of recovered paper was used to manufacture packaging and industrial paper and paperboard in Australia. Of this, 359 kt of recycled corrugated carton paperboard was exported and 1,149 kt of recovered paperboard was used to manufacture corrugated cartons used in Australia and as inputs to the production of other packaging and industrial paper grades (eg. Plasterboard liners, Recycled sacks and bags).

Australia's consumption of paper and paperboard for use in manufacturing corrugated cartons totalled a second successive annual record of 1,330 kt in 2016-17, rising 8.6% on the prior year. The chart shows this growth, by the grades of paper and paperboard. In total, consumption of corrugated carton materials over the decade has been growing 1.9% per annum, but at the faster rate of 5.9% per annum over the last five years. The drivers for faster consumption growth are a mix of growing food transportation (including exports) and rising e-commerce deliveries.

The two grades of paperboard used to manufacture corrugated cartons are corrugating medium and multi-ply liner. In 2016-17, their combined consumption was 827 kt including a small quantity of imports. It should be noted that some

Kraftliner products contain up to 15% of recovered paperboard and the consumption includes use in some other forms of fibre packaging.

Australian Corrugated Carton Materials Consumption by Main Grade: 200 – 2017 (kt)



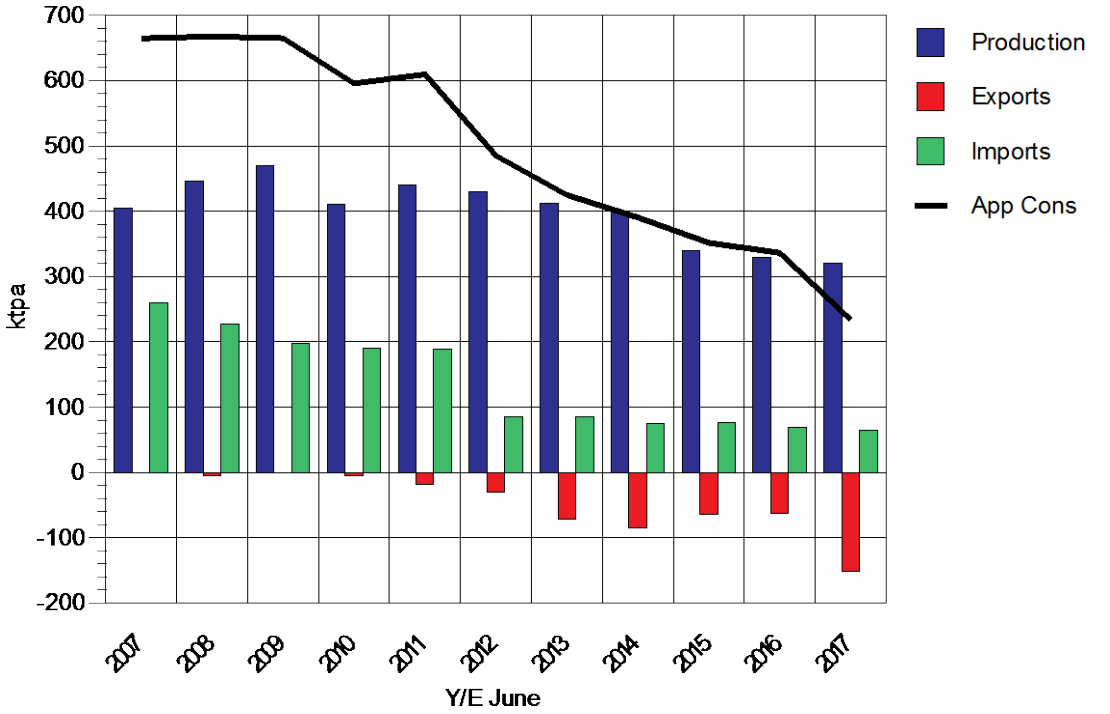
Source: ABS, IndustryEdge research and company reports

Newsprint

Consumption of Newsprint is declining very rapidly and will not recover. Shown in the chart below consumption of Newsprint has fallen an average 10.0% per annum over the last decade

Some grades of newsprint include a proportion of recovered newsprint (mechanical) and a small proportion of other recovered fibre, as a cheaper fibre source than virgin fibre. This was once a substantial component of newsprint, but is now diminished, just as consumption of the product itself has declined. It is estimated, based on survey work undertaken and reported by *IndustryEdge* for NewsMediaWorks, that in 2016-17, approximately 30 kt of recovered paper and paperboard was used in the manufacture of newsprint.

Australian Newsprint Apparent Consumption: 2007 – 2017 (kt)



Source: ABS, IndustryEdge research and company reports

Recycled office papers

A small but growing proportion of Australia's office papers – especially copy paper – are manufactured from recycled Bleached Kraft grade recovered paper. Some has a proportion of recovered paper and some are 100% recycled.

The specific market for recycled grades of office paper is very difficult to assess, but it has ben sufficiently robust for Australian Paper to invest in a De-Inked Pulp production facility at its Maryvale Mill in Victoria, to manufacture recovered fibre pulp to make recycled office paper grades. In 2016-17, the relatively new facility received an estimated 80 kt of recovered paper.

Exports

Exports of recovered paper are products in their own right, supporting a large and sophisticated supply-chain that provides products – recovered paper – to the international market.

In 2016-17, Australia's recovered paper exports totalled 1,381.4 kt, a fall of 2.8% on

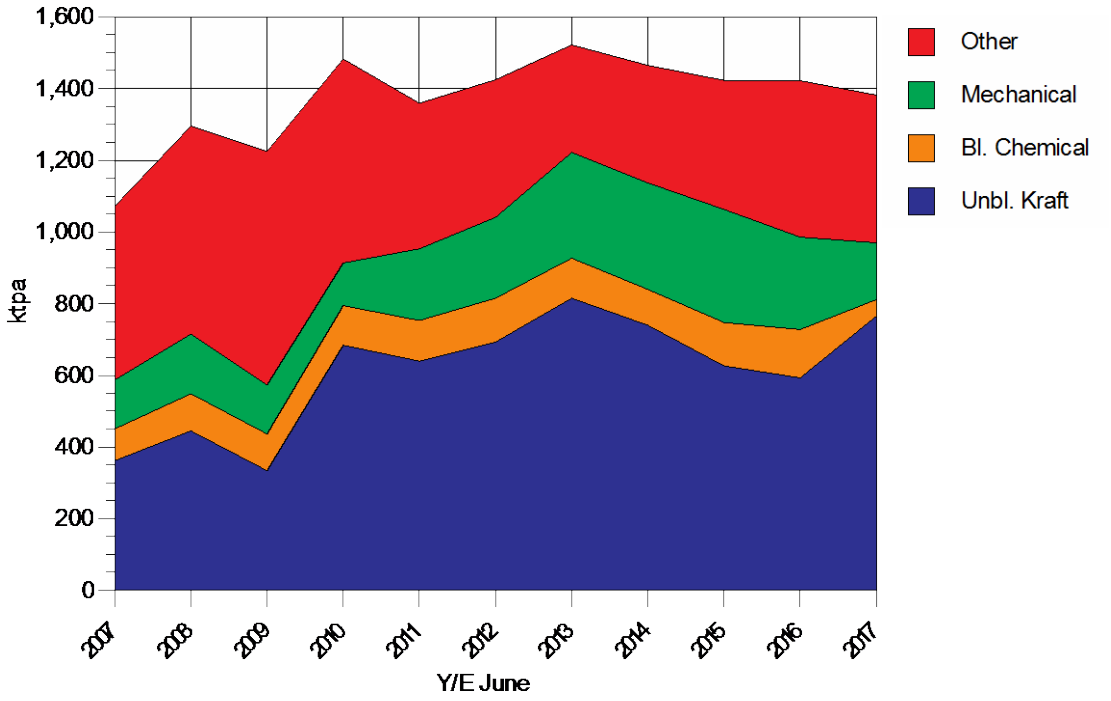
the prior year.

At export, as defined earlier there are four 'products' or at least, grades of recovered paper:

- **Unbleached Kraft** (shown in blue) is entirely recovered Packaging & Industrial paper grades, where there is no bleached content. This grade is dominated by corrugated boxes and is often known as Old Corrugated Containers (OCC).
- **Bleached Chemical** (shown in orange) is almost entirely bleached office and printing papers, made from chemical pulps.
- **Mechanical** (shown in green) includes Newsprint and most forms of catalogues and some magazines, where they are manufactured from pulp made by mechanical processes
- **Other** (shown in red) is also known as 'mixed' or 'unsorted' recovered paper. It includes the significant majority of recovered paper sourced from co-mingled kerbside collections that pass through MRFs.

These are set out in the chart below, for the decade to 2016-17 and in the subsequent table, in detail, for 2016-17.

Australian Exports of Recovered Paper by Grade: 2007 – 2017 (ktpa)



Source: ABS

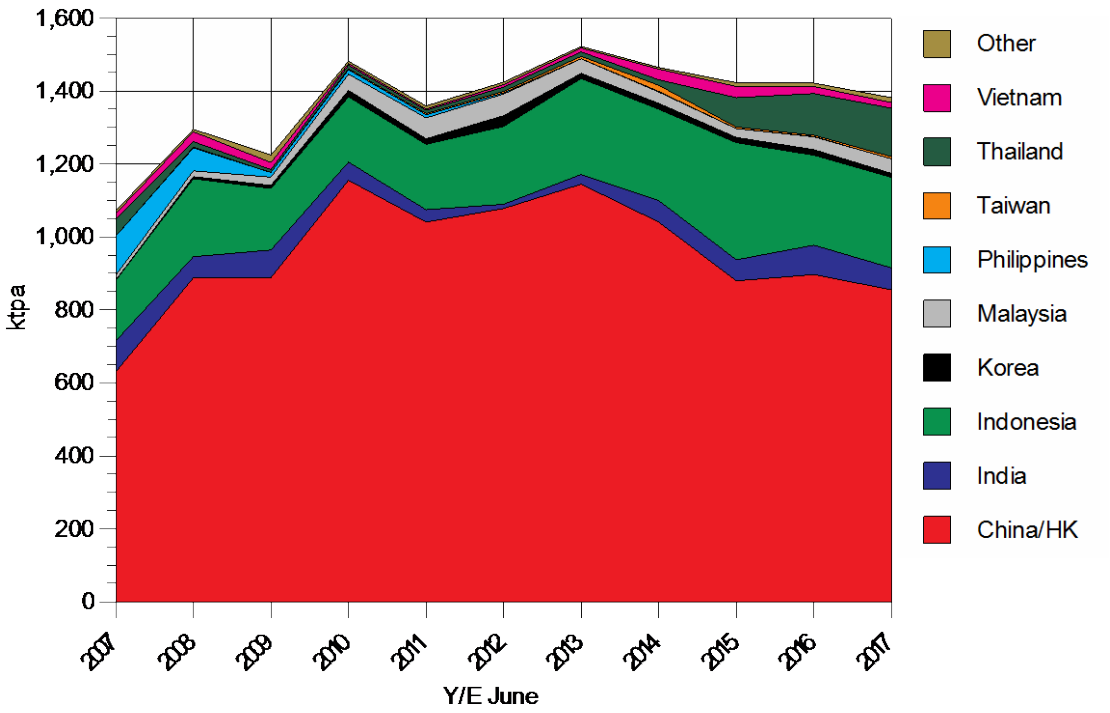
Grade	Volume 2016-17	% Change on 2015-16	% Share of Exports 2016-17
Unbleached Kraft	764.7	+29.0	55.3
Bleached Chemical	46.4	-65.6	3.4
Mechanical	158.6	-38.6	11.5
Other	411.7	-5.7	29.8
Total	1,381.4	-2.8	

Source: ABS

It should be noted that this data, although extracted from ABS datasets, is different to that reported elsewhere.

Australia's total recovered paper exports to China peaked at 1,155.2 kt in 2009-10, coming close to this volume again in 2012-13. Since then, exports to China have declined, falling to 855.0 kt in 2016-17. Exports to Indonesia and Thailand have increased since those to China commenced their decline.

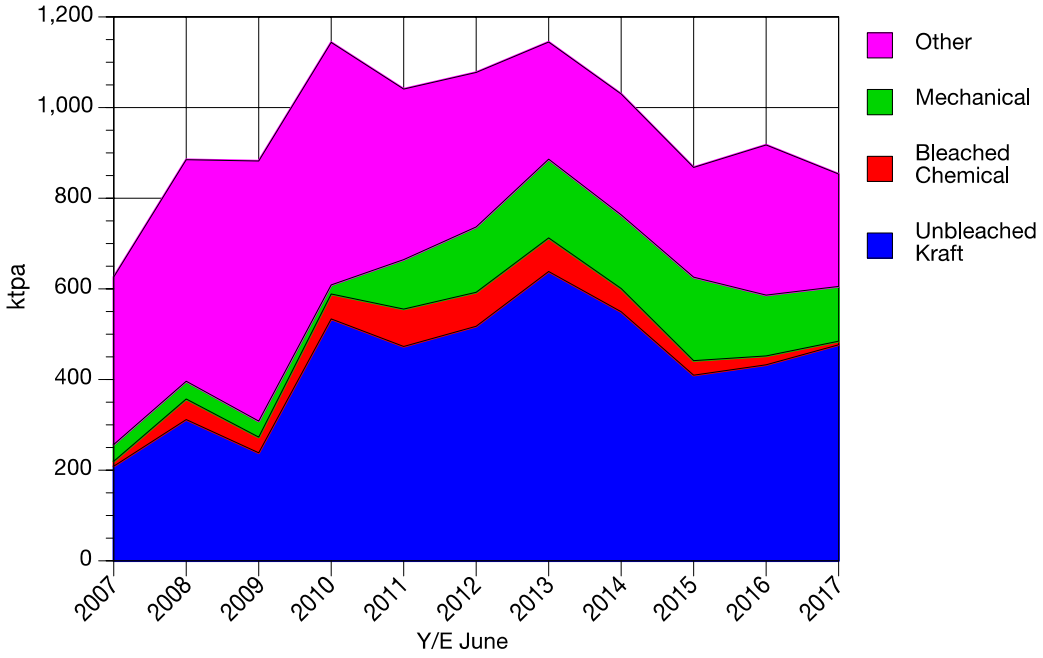
Australian Exports of Recovered Paper by Country: 2007 – 2017 (ktpa)



Source: ABS

Examining exports to China specifically, 2016-17 was something of a harbinger of things to come. Exports from Australia to China totalled 853.3 kt, some 7.0% lower than the prior year. Exports in 2016-17 were their lowest in total to China since 200809, as the chart below shows.

Australian Exports of Recovered Paper to China, by Grade: 2007 – 2017 (ktpa)



Source: ABS

The chart shows exports to China, by Grade. The table below shows that experience on a relative basis.

Grade	Volume 2016-17	% Change on 2015-16	% Share of Exports to China 2016-17
Unbleached Kraft	476.4	+10.1	55.8
Bleached Chemical	8.0	-58.7	0.9
Mechanical	120.8	-10.2	14.2
Other	248.2	-25.0	29.1
Total	853.3	-7.0	

Source: ABS

It should be noted that this data, although extracted from ABS datasets, is different to that reported elsewhere.

It is important to note that the decline in exports of the Bleached Chemical grade to China is a result of increased domestic processing (to manufacture increased volumes of recycled office papers, including copy paper). It is not related to any situation arising in China or elsewhere.

Relevantly, the grade that experienced the substantial decline in 2016-17 was the 'Other' or Mixed / Unsorted grade which is almost entirely derived from Municipal Solid Waste source streams and therefore, from co-mingled kerbside collections.

Recent Export Experience

Given the application of China's prohibitions, it is useful to examine recovered paper exports for the first nine months of the current financial year, compared with the prior corresponding period. The table below shows total exports, by grade for those periods.

Australian Recovered Paper Exports by Grade, All Countries: Jul '16 – Mar '17 v Jul '17 – Mar '18 (kt & %)

	Jul '16 - Mar '17	Jul '17 - Mar '18	% Change
Unbleached Kraft	564.5	670.9	18.8%
Bleached Chemical	34.6	59.4	71.4%
Mechanical	119.2	98.9	-17.1%
Other	334.5	253.8	-24.1%

Source: ABS

The table shows that Australia's aggregate exports for the first three quarters of 2017-18 are higher for some grades and lower for others. The Unbleached Kraft grade, in the main corrugated boxes, saw exports swell as the price of virgin fibre pulp rose dramatically, placing pressure on other sources of cheaper fibre. Growth in exports of the Bleached Chemical grade or office papers, is relatively small and can safely be considered within range, as can exports of the Mechanical grade, consisting largely of newspapers, for which demand continues to decline.

Aggregate decline of 24.1% over the period, for the 'Other' grade of recovered paper is telling. It is this grade which is almost entirely derived for kerbside collections, has the least sorting, and is most prone to contamination and therefore rejection, in China and elsewhere.

The table below shows exports to China, by grade for the same periods.

Australian Recovered Paper Exports by Grade, to China: Jul '16 – Mar '17 v Jul '17 – Mar '18 (kt & %)

	Jul '16 - Mar '17	Jul '17 - Mar '18	% Change
Unbleached Kraft	362.0	304.4	-15.9%
Bleached Chemical	6.2	4.5	-27.0%
Mechanical	92.3	64.3	-30.3%
Other	216.8	56.1	-74.1%

Source: ABS

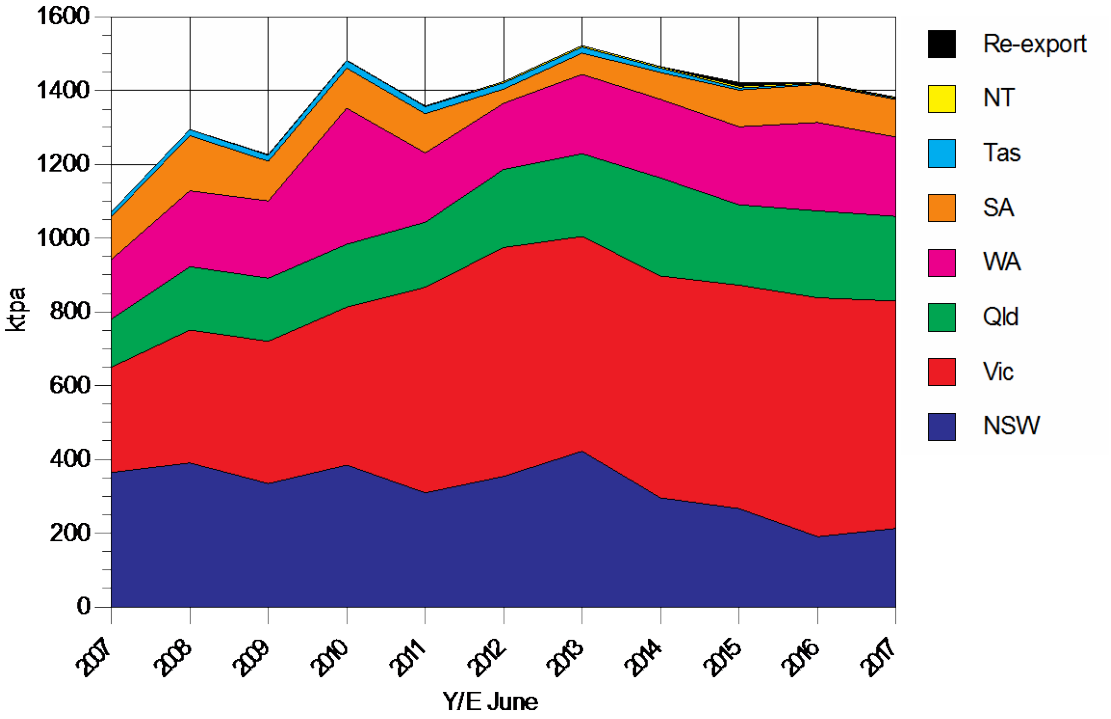
It is plain to see that China's reliance on imports of Australia's recovered paper has declined dramatically over the three quarter of 2017-18 concluded to date. Exports of all grades are lower, but particular note should be made of Unbleached Kraft, where the 15.9% decline is reportedly due to contamination and quality issues with material that has been recovered thro9ugh some MRFs.

However, it is the 'Other' grade that is most stark. Exports to China have virtually stalled, and were largely non-existent by February 2018.

Exports by State

It is also relevant to consider recovered paper exports by State. As the chart below shows, Victoria dominates exports. This is because most material originating from Tasmania and South Australia is exported via the Port of Melbourne. This is a commercially derived strategy to maximize the quality of resource and optimize its domestic and export utilization.

Australian Exports of Recovered Paper by State: 2007 – 2017 (ktpa)



Source: ABS

Australia's recovered paper exports by State, for 2016-17 is detailed in the table below.

Australian Recovered Paper Exports by State: 2016-17 (kt & %)

	Volume 2016-17 (kt)	% Share of Exports 2016-17
NSW	213.2	15.4%
Vic	616.2	44.6%
Qld	229.4	16.6%
WA	215.7	15.6%
SA	101.0	7.3%
Tas	3.6	0.3%
NT	2.3	0.2%

Source: ABS

IndustryEdge

June 2018

Report prepared by:

Report prepared on behalf of:

Department of the Environment and Energy

Assessment of Australian recycling infrastructure and 2016–17 exports to China – Plastics

Project report

Project name:	Assessment of Australian recycling infrastructure and 2016–17 exports to China – Plastics
Author:	Kyle O'Farrell
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CONTENTS

GLOSSARY / ABBREVIATIONS

ABS/SAN	Acrylonitrile butadiene styrene and styrene acrylonitrile (PIC 7).
Bioplastics	Plastics that are biobased, biodegradable or both. Bioplastics fall into three broad groupings, which are: biobased (but not biodegradable); biodegradable (but not biobased); or biobased and biodegradable. Conventional polymers (e.g. PET and HDPE) can also be fully or partially 'biobased'.
Commercial and Industrial (C&I)	Material from all commercial and industry sources other than construction and demolition (C&D) related sources.
Construction and Demolition (C&D)	Material from the construction, refurbishment and building demolition industries.
Consumption	Total use of product by Australian industry and consumers. Includes locally made and used product, imported product and locally utilised recyclate. Does not include locally made product that is exported for sale.
Converter	Company which converts polymer resin, either virgin resin or recycled content resin, into plastic products.
Diversion rate	Recycling as a proportion of end-of-life disposal.
Domestic	Material from domestic (household) sources.
Export for reprocessing	Material sent for reprocessing overseas.
EXW / ExWorks	Incoterm (trade term) defining the sale (transfer of ownership) of goods at the gate of the seller. The buyer must carry out all tasks of export & import clearance. Carriage & insurance is to be arranged by the buyer.
Feedstock (chemical) recycling	The use of chemical processes such as pyrolysis to convert scrap plastics into a hydrocarbon gas or liquid (often a polymer to monomer conversion) that is usable as a fuel or as an input for manufacturing plastics resins.
Flexible plastics	Plastic material that does not hold a three-dimensional shape during sorting and transport.
Household	Material from domestic (household) sources.
In the gate	Material entering a facility for reprocessing. This may include material that is unusable due to contamination.
Internal use	Recyclate processed and used within the one company.
Local use	Recyclate used within Australia by an Australian company in the manufacture of a new product.
Local/Locally	In Australia.
Mechanical recycling	The use of physical processes such as sorting, chipping, grinding, washing and extruding to convert scrap plastics to a usable input for the manufacture of new products.
MRF	Material Recovery Facility – a facility for the sorting of recyclables (typically packaging) into various product streams.
Municipal	Household material plus material from public place recycling and other council services.
Non-packaging / durable	Long-term use item; not designed to be single use or disposable within a 12-month period.
Other	Other polymers types not specifically defined, including various acrylics, acetals, polyethylene oxide, polyisobutylene and other polymers of propylene (other than PP), and polymers of styrene (other than PS, P-ES and ABS/SAN).
Out the gate	Material leaving a facility following reprocessing, and excludes most contamination.
Out-throws	Gross contamination of scrap plastics entering a reprocessing facility with non-plastic or otherwise unrecoverable materials. For example, the contamination of a mixed plastic packaging bales, as produced by MRFs, with paper, cardboard or metal packaging.
Packaging	Plastic material used for the containment, protection, marketing or handling of product. Includes primary, secondary and tertiary/freight packaging in both consumer and industrial packaging applications.
PE-HD or HDPE	High density polyethylene (PIC 2). Typically referred to as HDPE.
PE-LD/LLD or LDPE/LLDPE	Both low density polyethylene and linear low density polyethylene (PIC 4). Typically referred to as LDPE/LLDPE.
PE-LD or LDPE	Low density polyethylene (PIC 4). Typically referred to as LDPE.
PE-LLD or LLDPE	Linear low density polyethylene (PIC 4). Typically referred to as LLDPE.

PET	Polyethylene terephthalate (PIC 1).
PIC	Plastics identification code. Also known overseas as the Resin Identification Code (RIC).
PU or PUR	Polyurethane (PIC 7).
Post-consumer domestic	Used material from household sources. Mostly packaging material from kerbside recycling collections.
Post-consumer industrial	Used material from non-household sources.
PP	Polypropylene (PIC 5).
Pre-consumer industrial	Scrap off-cuts and off-specification items in the manufacturing industry which are not used by the consumer which are collected for reprocessing at a different site. Does not include material that is recycled directly back into manufacturing processes at the same site. Does not include material that has reached the end consumer, whether domestic or industrial.
PS	Polystyrene (PIC 6).
PS-E or EPS	Expanded polystyrene (PIC 6). Typically referred to as EPS.
PVC	Polyvinyl chloride (PIC 3).
Recovery	The amount of material collected for reprocessing. Typically includes some contaminate materials and also materials intended for reprocessing but which are lost during the overall recycling process.
Recyclate	Scrap material either before or after reprocessing.
Recycling	A general term covering the process chain of collection, sorting, reprocessing and the manufacture of new products. In this report where the terms 'recycling' or 'recycling rate' are used this typically refers to recyclate at the point of entering a plastics reprocessing facility, or when sent directly to export.
Reprocess	Process(es) by which aggregated end-of-life materials are converted into a raw material that can be used as an input into new product manufacturing.
Resin	Raw polymer material.
Sorting	A process typically between collection (recovery) and reprocessing in which collected end-of-life materials are sorted (or disassembled) into more usable and economically valuable material fractions.
Virgin	All-new polymer material containing no recycled material.
Waste plastics export	Export of (typically baled) scrap plastics material sent off-shore for reprocessing.
XPS	Extruded polystyrene (PIC 6).

1 INTRODUCTION

1.1 Project purpose and scope

The purpose and scope of this project is to inform, in relation to plastics consumed in Australia and subsequently recovered either locally or overseas, across the following areas:

- A simple flow diagram including source streams, landfill, MRF, export, primary infrastructure, secondary infrastructure/
- Brief descriptions of the flows of the relevant materials in society, with tonnages where available – onshore manufacture, imports, uses, waste streams.
- Brief descriptions of the types and grades of waste materials and where they come from (to the extent this is relevant to waste infrastructure).
- Descriptions of the waste infrastructure types and wastes received, including information on capacity and quantities received to the extent this is already known or easily available.
- Descriptions of recycled product types.
- Descriptions of recycled product markets.

The structure of this report parallels each of the scope elements outlined above.

1.2 Definition of 'plastic'

For clarity, the definition of a 'plastic' that has been applied in the survey scope coverage and this report is:

> *A plastic material is any of a wide range of synthetic or semi-synthetic organic solids that are mouldable. Plastics are typically organic polymers of high molecular mass, but they often contain other substances. They are usually synthetic, most commonly derived from petrochemicals, but many are either partially natural or fully natural (i.e. biobased).*

The polymer types covered in the report are summarised in the following table.

Table 1 – Polymer types and Plastics identification code (PIC)

PIC	Polymer type
1	Polyethylene terephthalate (PET)
2	High density polyethylene (PE-HD)
3	Poly-vinyl chloride (PVC)
4	Low / linear low density polyethylene (PE-LD/LLD)
5	Polypropylene (PP)
6	Polystyrene (PS) and expanded polystyrene (PS-E)
7	Acrylonitrile butadiene styrene / styrene acrylonitrile / acrylonitrile styrene acrylate (ABS/SAN/ASA)
7	Polyurethane (PU)
7	Nylon
7	Bioplastic
7	Synthetic and natural rubbers
7	Other aggregated polymer types

The plastic resin types which make up most of the 'other aggregated' category are various acrylics, acetals, polyethylene oxide, polyisobutylene and other polymers of propylene (other than PP), and polymers of styrene (other than PS, PS-E and ABS/SAN).

1.3 Definitions of 'recycling', 'reprocessing' and 'recovery'

In the plastics industry, the term 'recycling' is used to cover a range of activities including collection, sorting, reprocessing, export for reprocessing and manufacture of new products. To avoid double-counting of material flowing through the system to local plastics reprocessors, the focus of data gathering in this survey was placed on the reprocessing stage of the plastics life cycle.

The applied definition of Australian based plastics reprocessing is the off-site sourcing of waste plastics (including returned product, baled plastics sourced from MRFs, and other aggregated plastic products) which are then converted into either a finished or semi-finished product, or into a chipped format or similar. In-house recovery/regrind, or the baling and compaction of plastics where further reprocessing is required (e.g. size reduction) before the recyclate can be used to manufacture a new product is not reported as reprocessing.

Plastic scrap that is collected and exported for reprocessing and use overseas is defined as reprocessed. Sorting, reprocessing and manufacturing losses that occur overseas are not estimated.

The term ‘recovery’ is also used in this report and is defined as the amount of material collected for reprocessing (i.e. in-the-gate of reprocessors or to export). Typically recovery includes some contaminate materials, out-throws, and also materials intended for reprocessing but which are lost during overall recycling process.

1.4 Major scope exclusions

Major plastic product exclusions from this report are:

- Tyres.
- Paints, adhesives and other plastic films/coatings.

1.5 Data limitations and assumptions

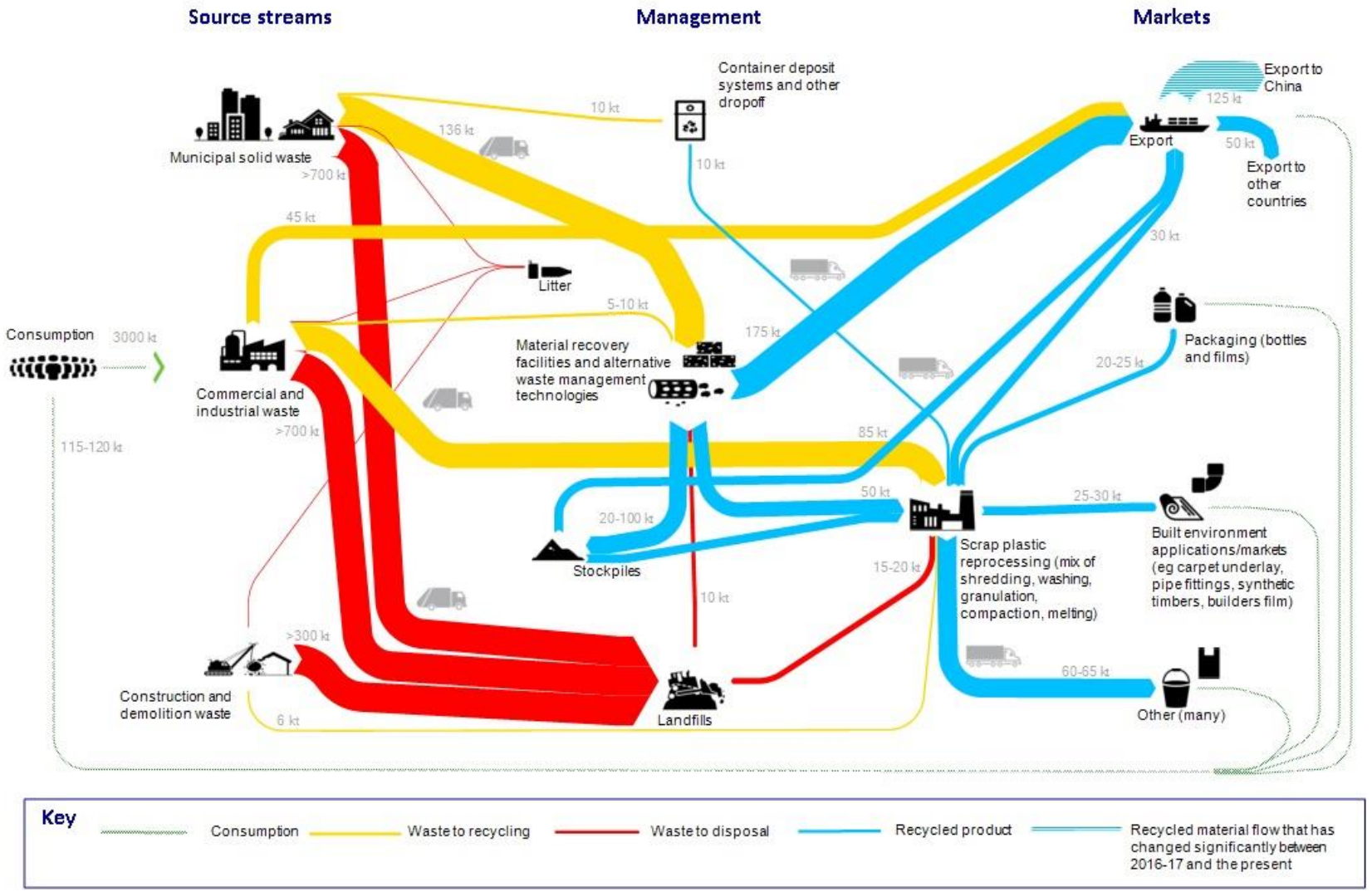
To avoid overstating the accuracy of the data and the subsequent calculations, data in this report has generally been rounded to the nearest 1 000 tonnes.

Summary tables and figures presented in this report, minor discrepancies may occur between stated totals and the sums of the component items. Totals are calculated using component item values prior to rounding, and therefore a minor discrepancy may occur from the total that can be calculated from the rounded values.

2 PLASTICS FLOW DIAGRAM

Australian plastics flows in 2016–17 are outlined in Figure 1 below. Note that exports to China had effectively ceased by the end of March 2018.

Figure 1 – Australian plastics flows in 2016–17



3 PLASTICS FLOWS IN AUSTRALIA

3.1 Consumption

3.1.1 Consumption by polymer type

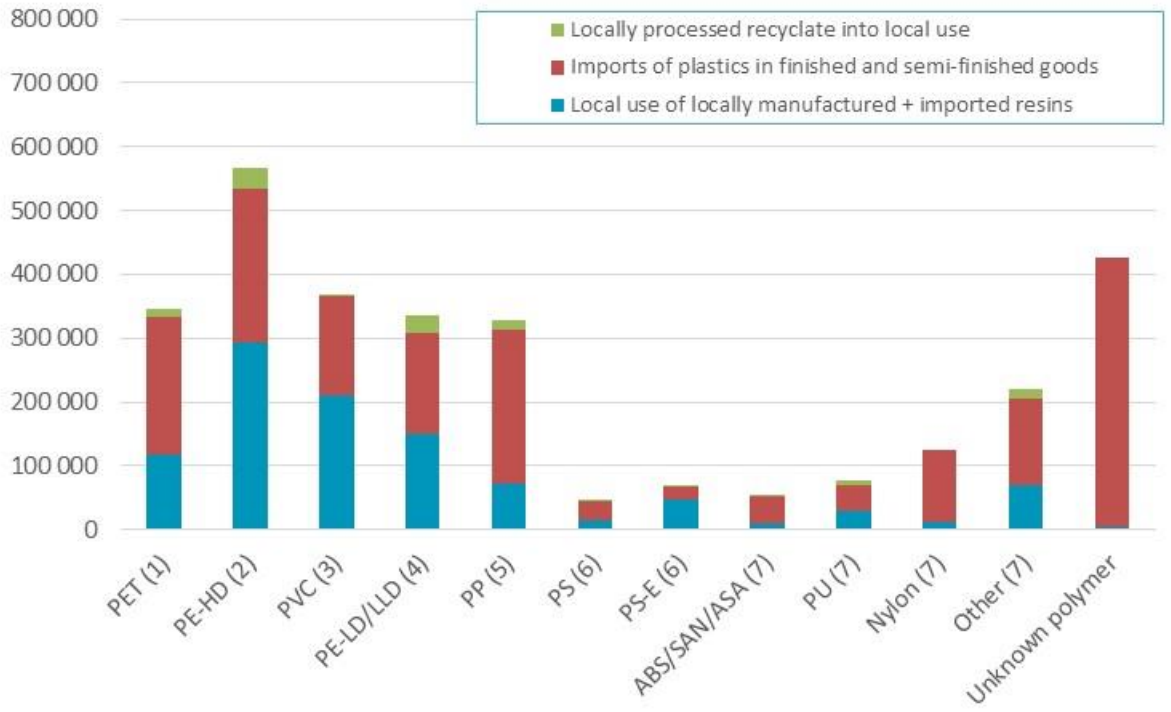
Outlined in Table 2 below is the consumption of plastics in Australia during 2016–17, which totalled a little under 3 million tonnes. Of this consumption 34.7% was sourced from locally manufactured products from virgin resin (using both locally manufactured and imported resins), 4.0% was sourced from locally manufactured products made from processed recyclate, and 61.3% was sourced through imports of finished and semi-finished goods.

Table 2 – Australian plastics consumption by polymer type and source in 2016–17 (tonnes)

Polymer type	Local use of locally manufactured + imported resins	Imports of plastics in finished and semi-finished goods	Locally processed recyclate into local use	Australian consumption
PET (1)	118 000	214 000	13 000	**346 000**
PE-HD (2)	294 000	239 000	33 000	**565 000**
PVC (3)	211 000	154 000	3 000	**368 000**
PE-LD/LLD (4)	151 000	156 000	28 000	**335 000**
PP (5)	72 000	242 000	15 000	**329 000**
PS (6)	13 000	32 000	2 000	**47 000**
PS-E (6)	46 000	20 000	1 000	**67 000**
ABS/SAN/ASA (7)	8 000	43 000	1 000	**52 000**
PU (7)	29 000	40 000	9 000	**77 000**
Nylon (7)	12 000	113 000	0	**126 000**
Bioplastic (7)	69 000	137 000	13 000	**219 000**
Other (7)	3 000	423 000	0	**426 000**
Unknown polymer	118 000	214 000	13 000	**346 000**
Total	**1 027 000**	**1 813 000**	**118 000**	**2 958 000**

Source: Envisage Works (2018a).

Figure 2 – Australian plastics consumption by polymer type and source in 2016–17 (tonnes)



Source: Envisage Works (2018a).

3.1.2 Consumption by application area

Presented in Table 3, Table 4 and Figure 3 is national plastics consumption in 2016–17 by application area. Consumption estimates of under 1 000 tonnes are reported as "<1000".

Table 4 shows that the consumption of PET is predominately split between packaging and other applications (mainly clothing and textiles). HDPE and LDPE are mainly consumed in packaging applications, with PVC consumption dominated by built environment applications. PP consumption is primarily automotive, packaging and other application areas. A large proportion of PS goes into electrical and electronic applications, and EPS is spread more evenly across built environment, electrical & electronic and packaging applications.

Table 3 – Application area destinations of all plastics by polymer type in 2016–17 (tonnes)

Polymer type	Agriculture	Automotive	Built environment	Electrical & electronic	Packaging – municipal	Packaging – C&I	Other applic. area	Unidentified applications	Total
PET (1)	2 000	5 000	26 000	<1000	123 000	12 000	140 000	38 000	**346 000**
PE-HD (2)	23 000	7 000	78 000	7 000	221 000	98 000	100 000	32 000	**565 000**
PVC (3)	<1000	18 000	253 000	32 000	16 000	<1000	38 000	10 000	**368 000**
PE-LD/LLD (4)	41 000	<1000	38 000	5 000	124 000	90 000	19 000	19 000	**335 000**
PP (5)	4 000	66 000	30 000	11 000	98 000	<1000	76 000	45 000	**329 000**
PS (6)	<1000	3 000	5 000	26 000	5 000	3 000	6 000	<1000	**47 000**
PS-E (6)	<1000	<1000	33 000	13 000	7 000	11 000	3 000	<1000	**67 000**
ABS/SAN/ASA (7)	<1000	40 000	<1000	10 000	1 000	<1000	<1000	<1000	**52 000**
PU (7)	<1000	23 000	24 000	<1000	<1000	<1000	26 000	4 000	**77 000**
Nylon (7)	2 000	15 000	17 000	<1000	<1000	<1000	77 000	14 000	**126 000**
Other (7)	<1000	21 000	44 000	<1000	8 000	<1000	43 000	105 000	**219 000**
Unknown polymer	<1000	36 000	20 000	31 000	63 000	<1000	215 000	61 000	**426 000**
Total	**72 000**	**232 000**	**569 000**	**135 000**	**666 000**	**214 000**	**741 000**	**329 000**	**2 958 000**

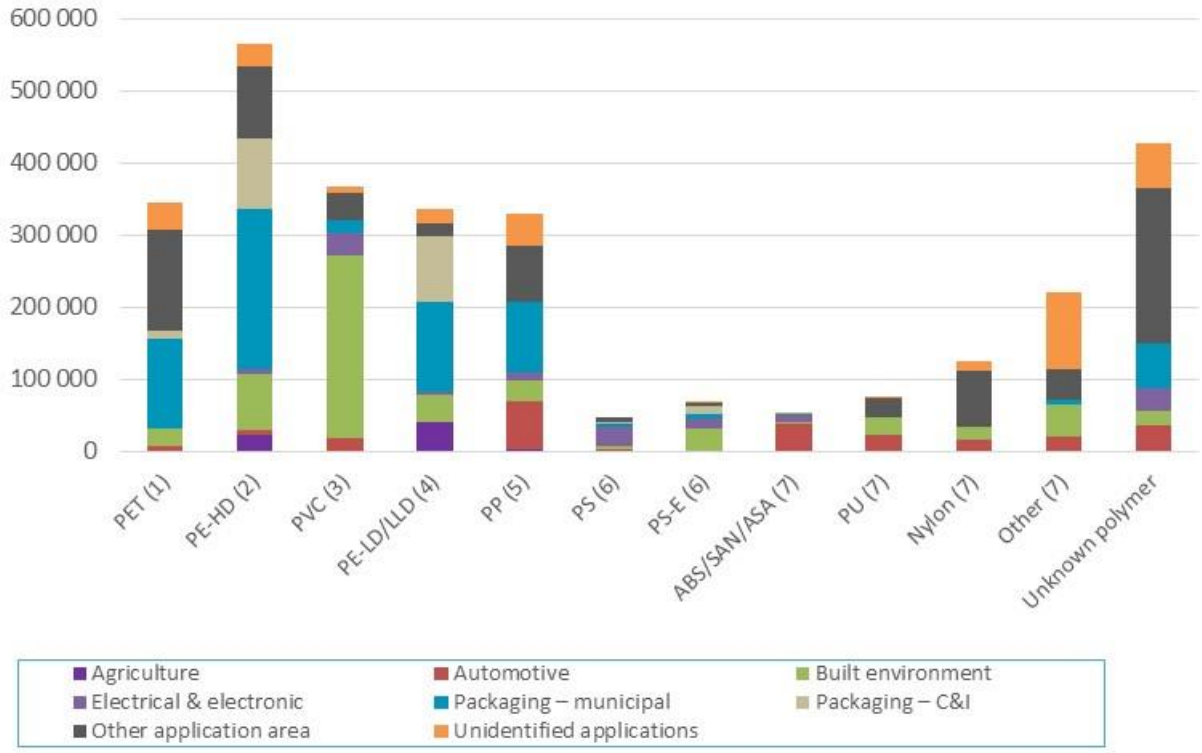
Source: Envisage Works (2018a).

Table 4 – Application area destinations of all plastics by polymer type in 2016–17 (%)

Polymer type	Agriculture	Automotive	Built environment	Electrical & electronic	Packaging – municipal	Packaging – C&I	Other applic. area	Unidentified applications	Total
PET (1)	0.5%	1.4%	7.7%	0.0%	35.5%	3.4%	40.5%	11.0%	**100.0%**
PE-HD (2)	4.1%	1.2%	13.8%	1.3%	39.1%	17.3%	17.6%	5.6%	**100.0%**
PVC (3)	0.0%	4.9%	68.7%	8.8%	4.5%	0.0%	10.3%	2.8%	**100.0%**
PE-LD/LLD (4)	12.3%	0.0%	11.4%	1.4%	36.9%	26.8%	5.6%	5.6%	**100.0%**
PP (5)	1.1%	20.1%	9.0%	3.3%	29.9%	0.0%	23.0%	13.7%	**100.0%**
PS (6)	0.0%	5.5%	11.1%	55.6%	11.4%	5.5%	12.2%	0.0%	**100.0%**
PS-E (6)	0.0%	0.0%	48.5%	19.8%	10.0%	17.0%	3.9%	0.7%	**100.0%**
ABS/SAN/ASA (7)	0.0%	75.6%	1.6%	18.3%	2.8%	0.0%	0.4%	1.3%	**100.0%**
PU (7)	0.0%	29.5%	31.3%	1.1%	0.0%	0.0%	33.0%	5.1%	**100.0%**
Nylon (7)	1.8%	11.7%	13.9%	0.0%	0.1%	0.0%	60.9%	11.5%	**100.0%**
Other (7)	0.0%	9.5%	20.0%	0.0%	3.5%	0.0%	19.6%	47.8%	**100.0%**
Unknown polymer	0.1%	8.5%	4.7%	7.3%	14.8%	0.0%	50.5%	14.2%	**100.0%**
Total	**2.4%**	**7.9%**	**19.2%**	**4.6%**	**22.5%**	**7.2%**	**25.1%**	**11.1%**	**100.0%**

Source: Envisage Works (2018a).

Figure 3 – Application area destinations of all plastics by polymer type in 2016–17 (tonnes)



Source: Envisage Works (2018a).

3.2 End-of-life

The national waste report (Blue Environment, 2017, p. viii) provides estimates of total plastics reaching end-of-life and entering waste streams in 2014–15. Total plastics waste generation is estimated at 2.5 million tonnes, with 300 000 tonnes to recycling, 20 000 tonnes to energy recovery, and around 2.2 million tonnes to landfill.

The total waste generation appears reasonably consistent with the plastics consumption estimates provided in Section 3.1 of just under 3 million tonnes (2016–17 financial year data), allowing for plastics consumption into medium to longer term applications (greater than 12 months), ongoing growth in plastics consumption, and the use of plastics in applications that often do not enter waste streams at end-of-life (e.g. underground pipes).

3.3 Recovery

3.3.1 Recovery by waste stream

When assessed from a waste/disposal stream perspective, discarded materials are often divided into three waste streams, which are:

- Municipal sector – This sector is dominated by kerbside recycling.

- Commercial and industrial (C&I) sector – This sector includes both manufacturing scrap and post-consumer industrial.
- Construction and demolition (C&D) sector.

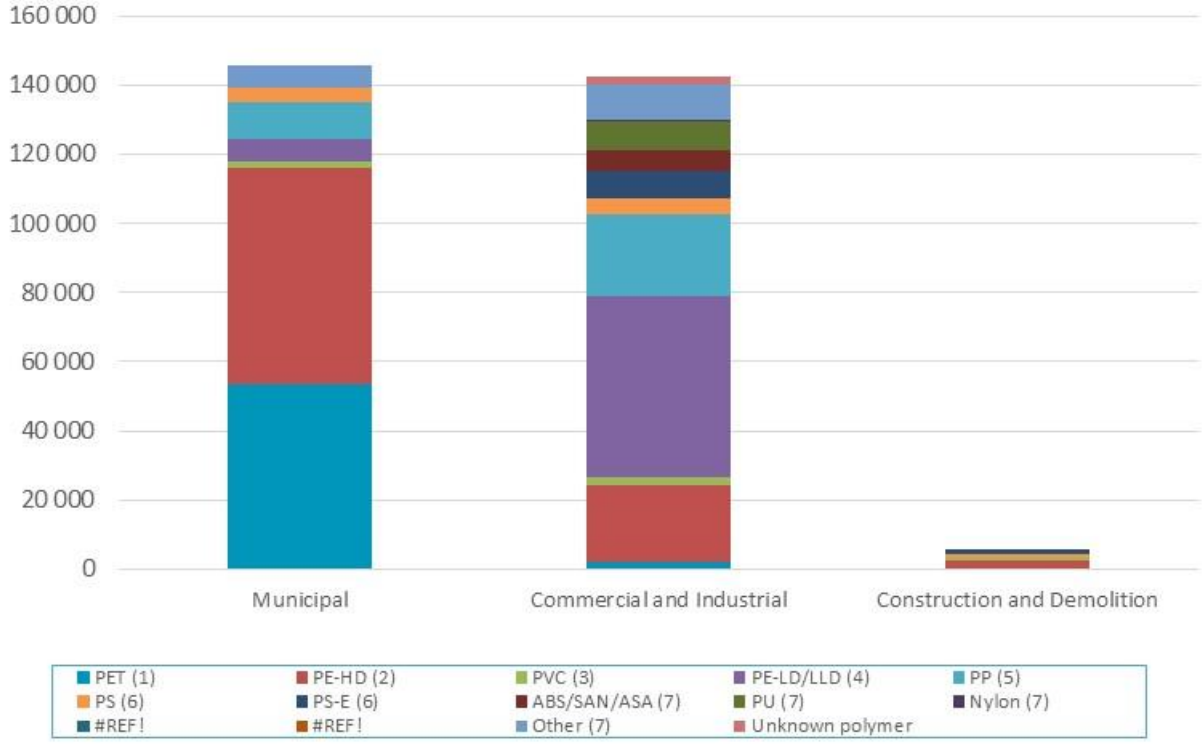
Presented in Table 5 and Figure 4 is plastics recycling by waste stream during 2016–17, during which period there were 294 000 tonnes of plastics recovered by local reprocessors or sent to export. In aggregate 49.6% of plastics were recovered from the municipal sector, 48.5% from the C&I sector, and 1.9% from the C&D sector.

Table 5 – Waste stream sources of recyclate by polymer type in 2016–17 (tonnes)

Polymer type	Municipal	Commercial and Industrial	Construction and demolition	Total
PET (1)	53 400	1 800	0	**55 300**
PE-HD (2)	62 800	22 300	2 600	**87 600**
PVC (3)	1 500	2 600	900	**5 100**
PE-LD/LLD (4)	6 500	52 200	0	**58 700**
PP (5)	10 800	23 500	0	**34 300**
PS (6)	4 000	4 900	1 000	**9 900**
PS-E (6)	200	7 800	1 100	**9 200**
ABS/SAN/ASA (7)	0	5 700	0	**5 700**
PU (7)	0	8 500	0	**8 500**
Nylon (7)	0	400	0	**400**
Other (7)	6 500	10 300	0	**16 800**
Unknown polymer	0	2 400	0	**2 400**
Totals	**145 800**	**142 600**	**5 600**	**294 000**

Source: Envisage Works (2018a).

Figure 4 – Waste stream sources of recyclate by polymer type in 2016–17 (tonnes)



Source: Envisage Works (2018a).

3.3.2 Recovery by polymer type

Presented in Table 6 and Figure 5 are plastics recycling rates by polymer type during 2016–17. The overall national recycling rate was 11.8%, a small increase on the national recycling rate in 2015–16 of 11.3%.

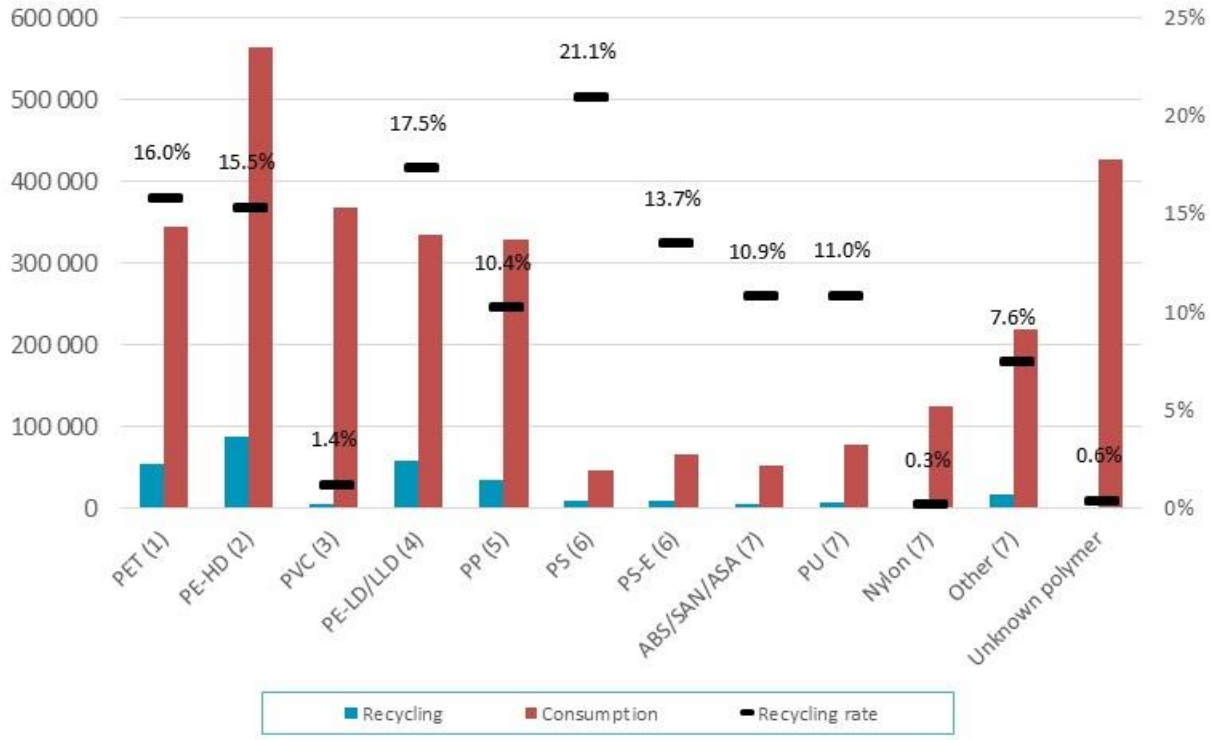
Among the major polymer types the highest recycling rates were for LD/LLDPE (17.5%), PET (16.0%) and HDPE (15.5%). This reflects the relatively high proportion of the consumption of these polymer types going into packaging applications (both flexible and rigid), with the generally higher recycling rates of plastics going into packaging applications relative to other application areas.

Table 6 – Plastics consumption and recovery by polymer type in 2016–17 (tonnes and % recycling rate)

Polymer type	Recovery	Consumption	Recycling rate
PET (1)	55 300	345 600	**16.0%**
PE-HD (2)	87 600	565 000	**15.5%**
PVC (3)	5 100	368 200	**1.4%**
PE-LD/LLD (4)	58 700	335 000	**17.5%**
PP (5)	34 300	329 200	**10.4%**
PS (6)	9 900	46 900	**21.1%**
PS-E (6)	9 200	67 200	**13.7%**
ABS/SAN/ASA (7)	5 700	52 400	**10.9%**
PU (7)	8 500	77 500	**11.0%**
Nylon (7)	400	125 600	**0.3%**
Other (7)	16 800	219 300	**7.6%**
Unknown polymer	2 400	426 300	**0.6%**
Total	**294 000**	**2 958 300**	**9.9%**

Source: Envisage Works (2018a).

Figure 5 – Plastics consumption and recovery by polymer type in 2016–17 (tonnes and % recycling rate)



Source: Envisage Works (2018a).

3.3.3 Recovery by application area

Presented in Table 5 and Figure 6 is summary data of plastics recovery across all application areas of plastics. Plastic packaging has both the largest quantities of recovery and recycling rate of 27.6% (combined municipal and C&I) are relatively good compared to all other application areas for plastics. All other recycling rates are well under 10%.

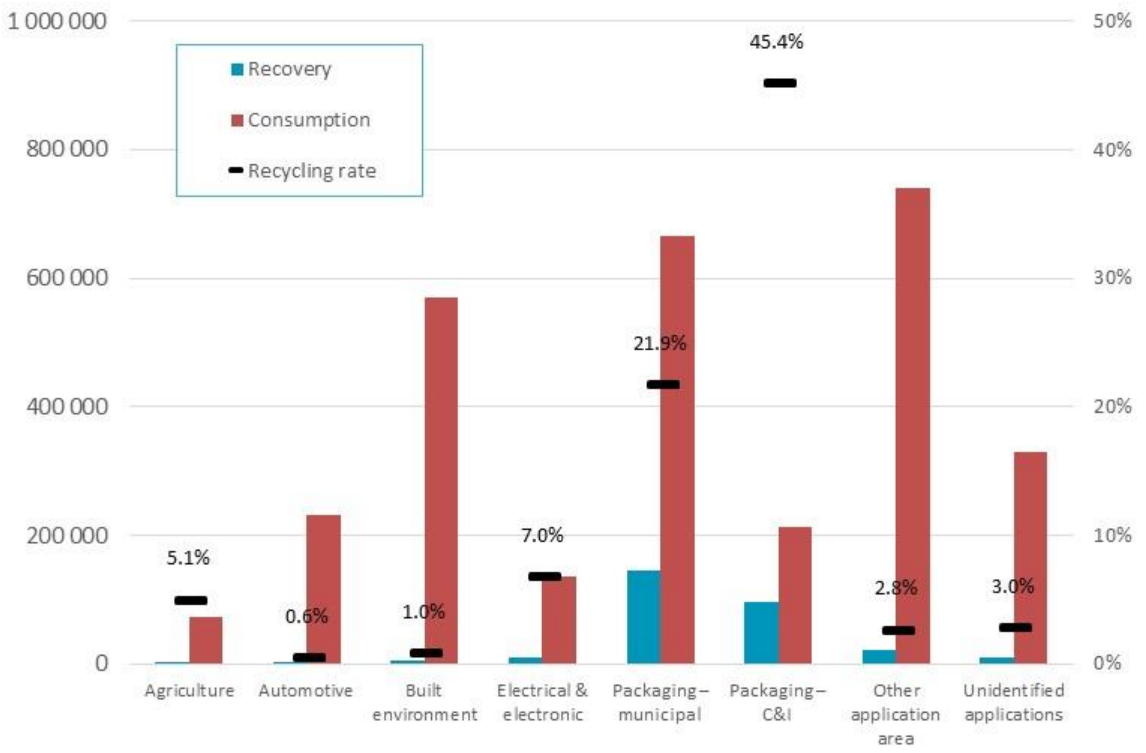
Table 7 – Plastics recovery and consumption by application area in 2016–17 (tonnes and % recycling rate)

Application area	Recovery	Consumption	Recycling rate
Agriculture	3 700	72 000	**5.1%**
Automotive	1 500	232 000	**0.6%**
Built environment	5 600	569 000	**1.0%**
Electrical & electronic	9 400	135 000	**7.0%**
Packaging – municipal	145 800	666 000	**21.9%**
Packaging – C&I	97 100	214 000	**45.4%**
Other application area	21 000	741 000	**2.8%**
Unidentified applications	9 900	329 000	**3.0%**
Total	**294 000**	**2 958 000**	**9.9%**

Source: Envisage Works (2018a).

It is important to note that the 'recycling rate' presented in the table above is an approximation calculated by dividing plastics recovery for recycling in any given year, by consumption in that year. A true recycling rate (or diversion rate) is calculated by dividing recycling recovery by end-of-life arisings (i.e. the quantity of plastics that is available to be diverted to recycling from landfill). The approximation of dividing recycling by consumption is adequate for short-lived plastic applications, such as packaging. However, it is less appropriate for plastics going into longer lived applications, such as the built environment, as it would be generally anticipated that in any given year less plastic is reaching end-of-life, than is going into use. For this reason, the estimated recycling rates are probably conservative and the true recycling rates are likely to be somewhat higher.

Figure 6 – Plastics recovery and consumption by application area in 2016–17 (tonnes and % recycling rate)



Source: Envisage Works (2018a).

3.3.4 Recovery by export and local destination

Presented in Table 8 is overall plastics recycling, in terms of the destination of recovered recyclate for reprocessing (i.e. local reprocessing or export for reprocessing).

In total, 40.1% of recovered plastic scrap is processed locally and then used by local manufacturers in new products, 10.1% is processed locally and then sold to export markets, and 49.8% of collected scrap plastics is exported directly overseas without any local reprocessing being undertaken.

Table 8 – Australian plastics recycling destination by polymer type in 2016–17 (tonnes)

Polymer type	Locally reprocessed to local use	Locally reprocessed to export	Direct to overseas	Total recovery
PET (1)	13 300	7 700	34 200	**55 300**
PE-HD (2)	32 800	3 800	51 100	**87 600**
PVC (3)	3 400	200	1 500	**5 100**
PE-LD/LLD (4)	28 300	8 800	21 700	**58 700**
PP (5)	14 800	3 300	16 200	**34 300**
PS (6)	1 600	500	7 900	**9 900**
PS-E (6)	1 100	1 900	6 200	**9 200**
ABS/SAN/ASA (7)	700	700	4 300	**5 700**
PU (7)	8 500	0	0	**8 500**
Nylon (7)	100	200	100	**400**
Other (7)	13 200	2 600	1 000	**16 800**
Unknown polymer	0	0	2 400	**2 400**
Total	**117 800**	**29 600**	**146 500**	**294 000**

Source: Envisage Works (2018a).

3.3.5 Energy recovery

The data previously outlined in Section 3.3 does not include scrap plastics sent to energy recovery. Available estimates of the combustion of waste plastics for energy recovery are in the range of 6 000–20 000 tonnes/yr (Envisage Works, 2018a; Blue Environment, 2017).

4 RECOVERED PLASTICS TYPES AND GRADES

4.1 Overview

As outlined in Section 3.3.3 scrap plastics recovery is dominated by municipal kerbside collections of rigid plastic packaging (49.6% of total recovery), and C&I packaging (33.0% of total recovery). Significant components of C&I packaging recovery are; pallet film (mainly LDPE/LLDPE), pre-consumer packaging manufacturing scrap, HDPE and PP plastic drums and other rigid forms of business-to-business packaging, and EPS foam packaging.

Plastics collected through municipal kerbside collections are generally sent to MRFs and sorted from commingled recycling into either a single mixed plastics grade (PIC[1] 1–7), or more commonly three grades, which are PET (PIC 1), HDPE (PIC 2) and the residual mixed plastics grade (PIC 3–7, with some residual PIC 1 and 2).

The price of sorted PET packaging has seen significant falls in value over the past year. Between mid-2015 and mid-2017 the price was generally in the range $550–$600 /tonne (EXW[2]). Since then the price paid for this material has fallen to around $350–$400 (end March 2018), but now appears stable (Envisage Works, 2018b).

The price of sorted HDPE packaging has also seen falls in value over the past year. Between mid-2015 and mid-2017 the price was generally in the range $550–$600 /tonne (EXW). Since then the price paid for this material has recovered more strongly than PET, to around $450–$550 /tonne (end March 2018) (Envisage Works, 2018b).

The price of mixed plastics packaging has experienced much more significant falls than either PET or HDPE over the past year. Between mid-2015 and mid-2017 the price was generally in the range $300–$350 /tonne (EXW). Since then the price paid for this material has dropped sharply. By the end of March the price had fallen to around $0 /tonne for mixed plastics coded 3–7 (which has been polymer sorted to remove PET (1) and HDPE (2)) and around $110 /tonne for mixed plastics coded 1–7 (i.e. no polymer sorting undertaken). The price is not anticipated to recover significantly for either of these product streams during the first half of 2018.

LDPE film from C&I sources (e.g. pallet wrap and similar) material is more affected, with some challenges in market destinations for this material. Export prices for this material are said to be down around 33%.

[1] Plastics identification code.

[2] Incoterm (trade term) defining the sale (transfer of ownership) of goods at the gate of the seller, which is define as the out-going MRF gate throughout this report.

4.2 Scrap plastics export codes

In 2016–17 approximately 176 000 tonnes of scrap plastics that are subject to the Chinese import restriction were exported from Australia. Prior to implementation of the import restrictions in 2016–17 around 70% of scrap plastics exports from Australia were sent to China. Chinese imports dropped away sharply in the second half of the 2017 calendar year, and by February of this year only accounted for 8% of Australian scrap plastics exports (Envisage Works, 2018b).

Outlined in Table 9 are the four HS 3915 working tariff export codes that cover exports of scrap plastics.

Table 9 – Scrap plastics classified under each HS 3915 tariff code

Harmonised system (HS) tariff code	Overview of scrap plastics generally classified to each code
39151000 Waste, parings and scrap, of plastics –Of polymers of ethylene	No consistent classifications for exported polymers with inconsistent use of descriptors by local exporters and their freight forwarders, however probably primarily consists of sorted HDPE packaging from MSW sources (e.g. milk bottles) and LDPE/LLDPE film packaging from C&I sources (e.g. pallet wrap).
39152000 Waste, parings and scrap, of plastics –Of polymers of styrene	No consistent classifications for exported polymers with inconsistent use of descriptors by local exporters and their freight forwarders, however probably primarily consists of sorted PS (from MSW sources) and EPS packaging (from C&I sources).
39153000 Waste, parings and scrap, of plastics –Of polymers of vinyl chloride	Only very low quantities exported, but probably primarily consists of post-industrial scrap from PVC product manufacturers (C&I sources).
39159092 Waste, parings and scrap, of plastics –Of other plastics	No consistent classifications for exported polymers with inconsistent use of descriptors by local exporters and their freight forwarders, however probably primarily consists of mixed plastics packaging, across PET, HDPE, PVC, LDPE, PP and PS from MSW sources. Also probably includes mixed polymer e-waste plastics exports recovered (primarily) through the National TV and Computer Recycling Scheme (NTCRS).

39151000

The 39151000 code is dominated by exports of LD/LLDPE tertiary freight packaging film, which is primarily pallet wrap sourced through commercial collections of this material from major retailers and other business to business generators of this film. Over the last decade C&I film collections have become reasonably well established in most states where sufficient quantities are generated at commercial facilities to justify baling and collection. This packaging film is generally quite clean with low contamination levels, and is reasonably sought after.

Another significant contributor to the HS 39151000 code is baled milk and coloured HPDE bottles, sourced from material recovery facilities (MRFs) which undertake polymer specific sorting. This is defined as MSW packaging material. Opaque HDPE milk bottle bales are highly sought after both locally and internationally, and much of this material generated locally goes to local reprocessors and subsequently to local HDPE product manufacturers.

A proportion of baled PET bottles (MSW/packaging) may also be exported under 39151000, due to the presence of 'polyethylene' in its name, however PET is actually a polyester, and should arguably be exported under the 39159092 code. The proportion of PET exported under the 39151000 code versus the 39159092 code is unknown.

39152000

A significant contributor to the 39152000 code is exports of EPS packaging material, primarily sourced from C&I sources, and consisting of produce boxes from fruit and vegetable markets, supermarkets and other retail outlets. Smaller quantities of EPS packaging is also collected from electrical and electronic retail outlets, as well as other retail outlets that retain EPS packaging on large products, often as a value add service to customers. There is very little EPS packaging recovered nationally through MSW collections.

Another significant contributor to 39152000 is pre-consumer manufacturer scrap, which is high quality manufacturing scrap generated by PS and EPS product (both packaging and non-packaging) manufacturers.

A minor contributor to the HS 39152000 code is PS packaging (rigid containers) collected through MSW collections (MSW/packaging), however this material rarely sorted locally into a PS only bale, and is usually exported as a mixed polymer product, probably under 39159092.

Another potential source of PS exports is from e-waste processing (C&I/non-packaging), however again, this material is rarely sorted into a PS only bale and is more likely to be exported as a mixed polymer product under 39159092.

39153000

There is very little PVC scrap material exported from Australian. The small quantities that are exported are probably almost entirely very clean pre-consumer scrap from PVC product manufacturers. This is C&I/non-packaging material.

39159092

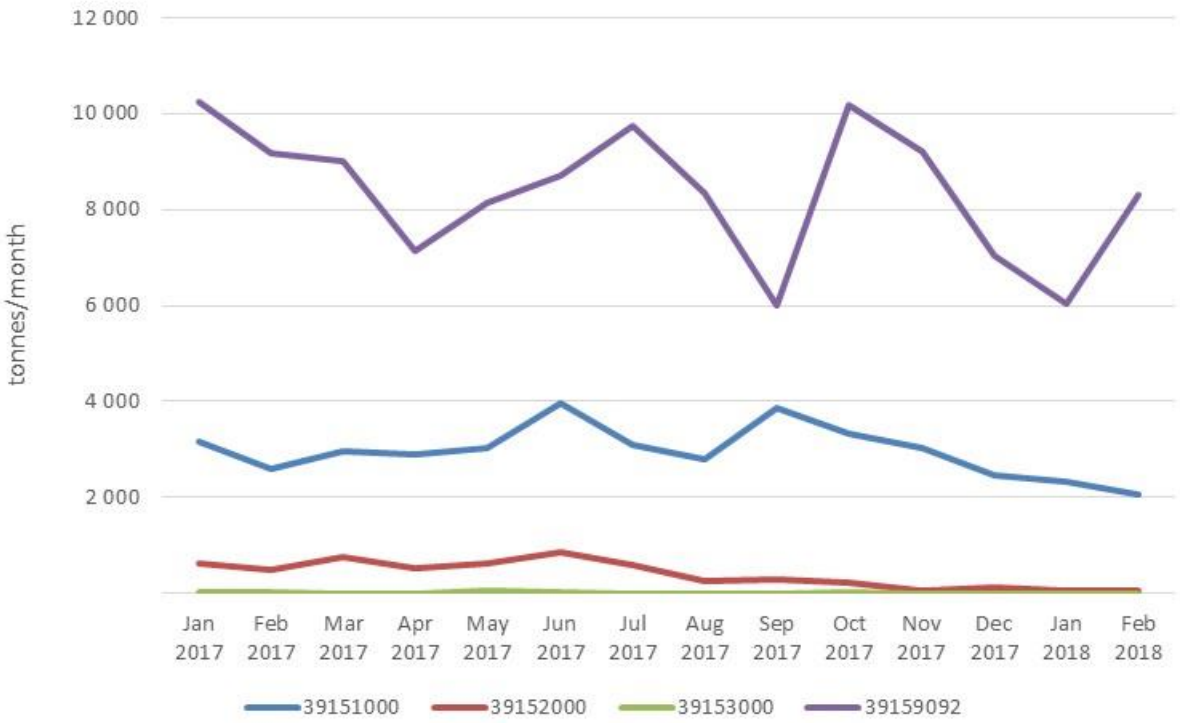
The 39159092 code is dominated by exports of mixed polymer material sourced from kerbside collections (MSW). This material is typically either a full PIC 1–7 mix (primarily PET and HDPE rigid packaging), produced by MRF operators that do not undertake any polymer sorting. The other major product is a PIC 3–7 mix, coming out of MRFs that do undertake a (typically) three way polymer sort, for PET, HDPE and all other rigid plastic containers. The 3–7 mix still contains significant quantities of PET and HPDE. These mixed polymer MSW packaging mixed baled products often contain high levels of contamination with plastics films, glass fragments, labels, liquid paper board (LPB) packaging and any other rigid non-metal items that enter MRFs.

The other major contributors to 39159092 are probably baled PET bottles, sorted e-waste plastics (including whole computer peripherals such as keyboards and mice), pre-consumer manufacturing scraps of many types, and all other scrap plastics that can not be readily allocated to the other three codes as previously outlined.

Provided in Figure 7 and Figure 8 on the following page are scrap plastics exports, by HS code, to all receiving countries and to China only. National exports of scrap plastics to China fell from over 10 000 tonnes in January 2017 to 900 tonnes in February 2018 (recovering slightly from a low of 400 tonnes in January), a fall of 96%.

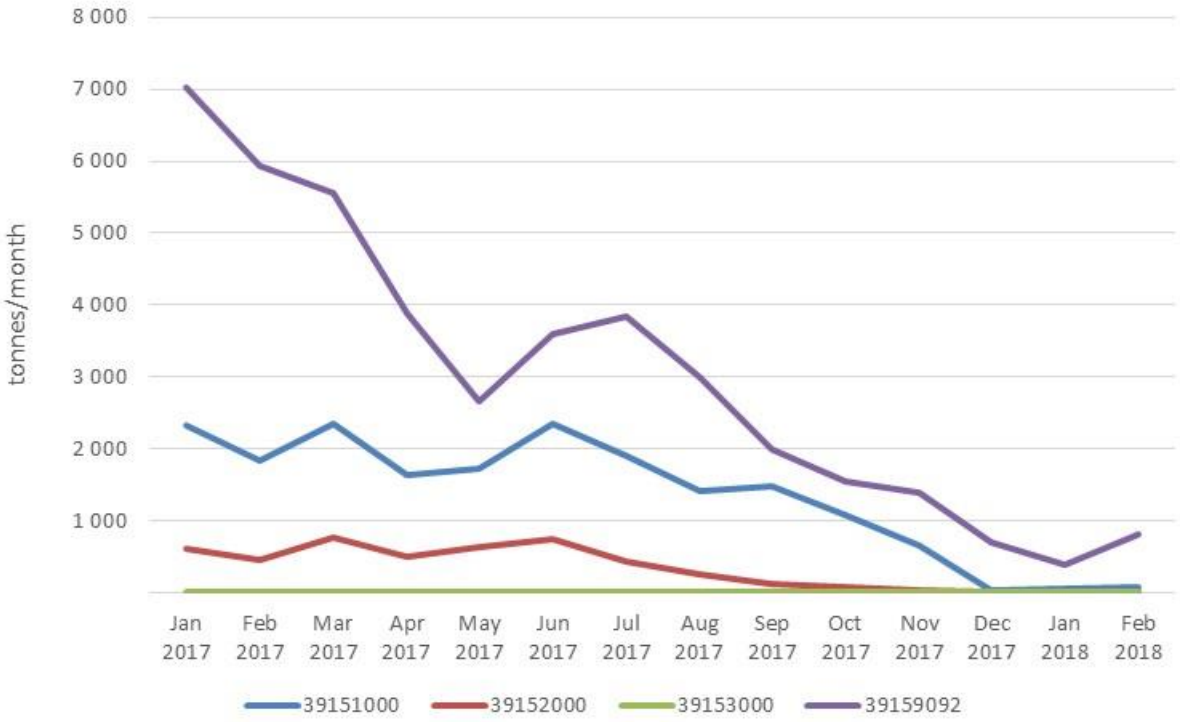
Other countries only took about half the scrap plastics quantity that had previously been exported to China and Hong Kong. The top seven receiving countries for Australia's exports of scrap plastics are: Malaysia, Thailand, Indonesia, Vietnam, Republic of Korea, Taiwan and India.

Figure 7 – Australian exports of HS 3915 codes (scrap plastics) – All countries



Source: DFAT (2018)

Figure 8 – Australian exports of HS 3915 codes (scrap plastics) – China and Hong Kong



Source: DFAT (2018)

5 SORTING AND REPROCESSING INFRASTRUCTURE

5.1 Reprocessor numbers by state/territory

Presented in Table 10 is the available data on the numbers of reprocessors identified as operating in each state or territory. Data is provided for 58 reprocessing facilities nationally, out of 64 reprocessors known to be operating during 2016–17.

Many reprocessors handle more than one polymer type, resulting in improved depth to the reprocessing market. For example, in NSW there are 13 reprocessing facilities included in the survey dataset, however between them these facilities handle a total of 32 polymer types in aggregate across the facilities.

Almost all plastics recycling in Australia is undertaken mechanically, where the use of physical processes such as sorting, chipping, grinding, washing and extruding to convert scrap plastics to a usable input for the manufacture of new products is undertaken.

Mechanical recycling of polymer sorted scrap is generally preferable to feedstock recycling[1] because it maintains the economic value of the polymer at a relatively high level and reduces the amount of energy required to manufacture new plastic products.

Mechanical recycling is also the most economically viable for plastics that are available in large quantities, in a clean and homogenous (or sortable) form, and in locations with reasonable access to recycling facilities. Mixed polymer plastics can also be recycled mechanically, however they are more challenging as they either need to be separated, or recycled into a reduced range of mixed polymer product types. These mixed polymer products often have long lifespans, and may be recycled back into similar products at end of life.

[1] The use of chemical processes such as pyrolysis to convert scrap plastics into a hydrocarbon gas or liquid (often a polymer to monomer conversion) that is usable as a fuel or as an input for manufacturing plastics resins.

Table 10 – Reprocessor counts by facility location and polymer types reprocessed in 2016–17

	ACT	NSW	NT	QLD	SA[1]	TAS	VIC	WA	Total
Number of reprocessors	**0**	**13**	**0**	**9**	**11**	**1**	**22**	**2**	**58**
Polymer reprocessed	**Number of reprocessors in the jurisdiction reprocessing the polymer type**								
PET (1)	0	3	0	1	N/A	0	8	0	**12**
PE-HD (2)	0	8	0	5	N/A	0	14	1	**28**
PVC (3)	0	2	0	0	N/A	0	3	1	**6**
PE-LD/LLD (4)	0	5	0	4	N/A	0	12	1	**22**
PP (5)	0	4	0	5	N/A	1	11	1	**22**
PS (6)	0	1	0	2	N/A	0	7	1	**11**
PS-E (6)	0	3	0	3	N/A	1	2	0	**9**
ABS/SAN/ASA (7)	0	3	0	1	N/A	0	6	1	**11**
PU (7)	0	1	0	0	N/A	0	1	0	**2**
Nylon (7)	0	1	0	1	N/A	0	3	0	**5**
Other (7)	0	1	0	1	N/A	0	4	1	**7**
Unknown polymer	0	0	0	0	N/A	0	0	0	**0**
Total count	**0**	**32**	**0**	**23**	**N/A**	**2**	**71**	**7**	**135**

1. SA data on the number of reprocessors handling each polymer type not available to be reported.

Source: Envisage Works (2018a).

5.2 Reprocessing by state/territory

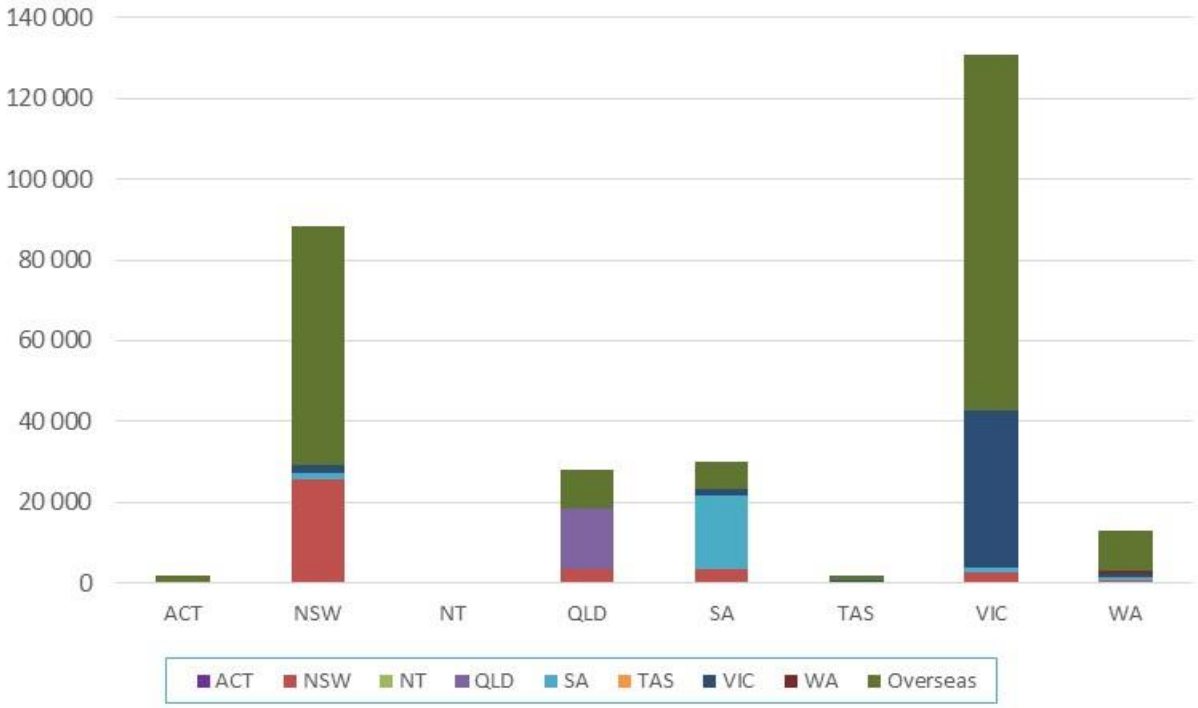
Presented in Table 11 and Figure 9 is data on recyclate movements to intrastate (same state), interstate and overseas reprocessors by source jurisdiction in 2016–17. Victoria and NSW have the largest reprocessing sectors with both jurisdictions locally reprocessing around 30% of recyclate that is recovered in each jurisdiction. SA and Queensland have smaller reprocessing sectors but reprocess around 53% and 44% respectively of recyclate generated locally within each state.

Table 11 – Recyclate to intrastate (same state), interstate and overseas reprocessors by source jurisdiction in 2016–17 (tonnes)

Destination jurisdiction	Source jurisdiction								
	ACT	NSW	NT	QLD	SA	TAS	VIC	WA	Total
ACT	0	0	0	0	0	0	0	0	0
NSW	100	25 800	0	3 600	3 300	200	2 600	600	36 100
NT	0	0	0	0	0	0	0	0	0
QLD	0	0	0	14 800	0	0	200	0	14 900
SA	0	1 300	0	100	18 500	0	900	1 000	21 700
TAS	0	0	0	0	0	0	0	0	0
VIC	0	2 300	0	0	1 400	700	39 000	800	44 300
WA	0	0	0	0	0	0	0	800	800
Overseas	1 800	58 800	100	9 500	7 000	900	88 000	9 900	176 100
Total	**1 900**	**88 200**	**100**	**27 900**	**30 200**	**1 900**	**130 700**	**13 100**	**294 000**

Source: Envisage Works (2018a).

Figure 9 – Recyclate to intrastate (same state), interstate and overseas reprocessors by source jurisdiction in 2016–17 (tonnes)



6 RECYCLED PLASTICS PRODUCT TYPES AND MARKETS

After reprocessing, recycled plastics are used to manufacture new products, with new applications typically quite different from those of the original use. The applications for recycled plastics are only slowly growing in Australia. Outlined in Table 12 are many of the uses of recycled plastics in Australia.

Table 12 – Typical uses of recycled plastics in Australia

Polymer	Major uses of recycled polymer	Minor uses of recycled polymer
PET	Beverage bottles	Timber substitutes, geo-textiles, pallets and fence posts.
PE-HD	Films, pallets, wheelie bins, irrigation hose and pipes	Cable covers, extruded sheet, moulded products, shopping and garbage bags, slip sheets, drip sheets for water, wood substitutes and mixed plastics products (e.g. fence posts, bollards, kerbing, marine structures and outdoor furniture), materials handling and roto-moulded water tanks.
PVC	Pipe, floor coverings	Hose applications and fittings, pipes including foam core pipes, profiles and electrical conduit, general extrusion and injection moulding, clothing, fashion bags and shoes.
PE-LD/LLD	Film (incl. builders' and agricultural film, concrete lining, freight packaging, garbage bags, shopping bags), agricultural piping	Trickle products, vineyard cover, pallets, shrink wrap, roto-moulding, slip sheets, irrigation tube, timber substitutes, cable covers, builders' film, garbage bags, carry bags, and other building industry applications.
PP	Crates boxes and plant pots	Electrical cable covers, building panels and concrete reinforcement stools (bar chairs and shims), furniture, irrigation fittings, agricultural and garden pipe, drainage products (such as drain gates) and tanks, builders film, kerbing, bollards, concrete reinforcing and a wide variety of injection moulded products.
PS	Bar chairs and industrial spools	Office accessories, coat hangers, glasses, building components, industrial packing trays, wire spools and a range of extrusion products.
PS-E	Waffle pods for under slab construction of buildings	Synthetic timber applications (including photo frames, decorative architraves, fence posts), XPS (extruded polystyrene) insulation sheeting, and lightweight concrete.
ABS/SAN	Injection moulded products	Automotive components, laminate edging, sheet extrusion, coffin handles, drainage covers, auto parts and a range of injection moulded products.
Polyurethane	Carpet underlay	Mattresses
Nylon	Injection moulded products	Furniture fittings, wheels and castors and a range of injection moulded products.
Other and mixed	Timber substitute products in general and piping	Fence posts, bollards, garden stakes, kerbing, marine structures, post and rail systems, scaffold pads, piggery boards, shipping dunnage, rail bridge transoms.

For single polymer consumer packaging, the dominant plastics are PET, HDPE, LDPE and PP. There are also packaging formats made from PS, EPS, PVC and ABS. For commercial packaging, the most common materials are LDPE, HDPE and PP. Flexible and drum packaging of these polymers dominates commercial sector packaging. There is a much smaller component of EPS packaging (primarily C&I sourced).

There are strong local and export markets for single polymer PET material that is collected and sorted to specification, however, as outlined in Section 4.1 local reprocessors and exporters are reporting a significant decline in the price received. The price of recycled resin is often linked closely to the price for virgin material. In the case of PET, the virgin price has increased recently, in part due to China utilising more of this material as it receives less imported recyclate.

There is minimal difficulty in finding a destination for collected PET packaging. The exception to this is the recovery of PET packaging that has modified polymer layers or film barriers (intended to improve barrier properties to light, moisture, carbon dioxide or oxygen), such as those going into some food and beverage packaging applications. This can hamper recycling and affect prices received. The price of RPET (recycled PET) for use in bottle manufacture has also increased, reflecting a strong demand for this high-quality material. However, it is believed that local reprocessing capacity bottleneck constraints are placing a ceiling on the closed loop recycling of PET beverage packaging (and HDPE beverage packaging) back into beverage packaging.

The situation is similar for HDPE, with markets for clean material remaining fairly strong, but with some drop in prices. Despite the loss of China as a market for this material (unless a contaminant level of 0.5% or less can be achieved), strong local and South East Asian market destinations remain.

LDPE film from C&I sources (e.g. pallet wrap and similar) is more affected, with some challenges in market destinations for this material. Export prices are said to be down around 33%.

Many local plastic recyclers seek post-industrial waste plastic as it is a more consistent feedstock with a single known polymer origin. By contrast, once the PET and HDPE fractions of the plastics are sorted, kerbside material is a mix of polymers coded 3–7 in poorly specified ratios (but still including significant proportions of PET and HDPE). This severely restricts the applications for this material.

Several plastic recyclers are geared to take mixed kerbside plastics and make a mixed polymer product suitable for applications such as posts, seating and boardwalks. The ability of these recyclers to accept mixed plastics is limited by demand for the finished products. While they have expanded the market in recent years, the failure to get strong growth in major purchases from customers such as road authorities, parks agencies and local councils restricts production levels.

Some recyclers have indicated that they have capacity to handle double the current volumes if larger end markets could be assured. They are advocating more supportive procurement practices from governments at all levels and major industries as a key to more local processing of kerbside materials (Envisage Works, 2018c).

At a global level, most mixed plastics have been sent to China and other markets with low labour costs and the ability to sort mixed material into different polymers. Chinese import restrictions have substantially curtailed this. Some of this material is being transferred to other low labour cost centres but there is likely to be a shortfall in demand for this material for the near future. The key to resolving the market challenges for mixed plastic is a combination of:

- Better packaging design to specify more recyclable polymers (e.g. PET) and to ensure that all components, such as labels, caps and adhesives, are compatible in the recycling system.
- More diligent sorting of the recycled material by automated and manual means. This could be achieved, for example, by upgrading polymer sorting equipment to positively identify and sort additional polymer types, such as; LDPE, polypropylene and polystyrene packaging, and additionally, to improve the current positive polymer sorting of PET and HDPE to increase sorting recovery rates. This would reduce the amount of mixed, low value plastic product being generated.
- Drive recycled content plastic products market pull-through with more supportive procurement practices from governments at all levels and major businesses, particularly those with a product stewardship exposure.

As strong markets exist for PET, HDPE, LDPE and PP, the use of these plastics in consumer packaging, without other polymer additives, would see more packaging sorted and sold at high prices. At the sorting level, all facilities should be equipped to detect and sort these polymers with automated equipment. Some newer MRFs are so equipped. Other major industry participants do no polymer sorting at all and this approach has arguably no role in a reliable recycling future.

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RANDELL ENVIRONMENTAL CONSULTING

Assessment of Australian recycling infrastructure and 2016-17 exports to China – METALS

04/06/2018

Assessment of Australian recycling infrastructure and 2016-17 exports to China – METALS

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RANDELL ENVIRONMENTAL CONSULTING

Contents

1 Introduction

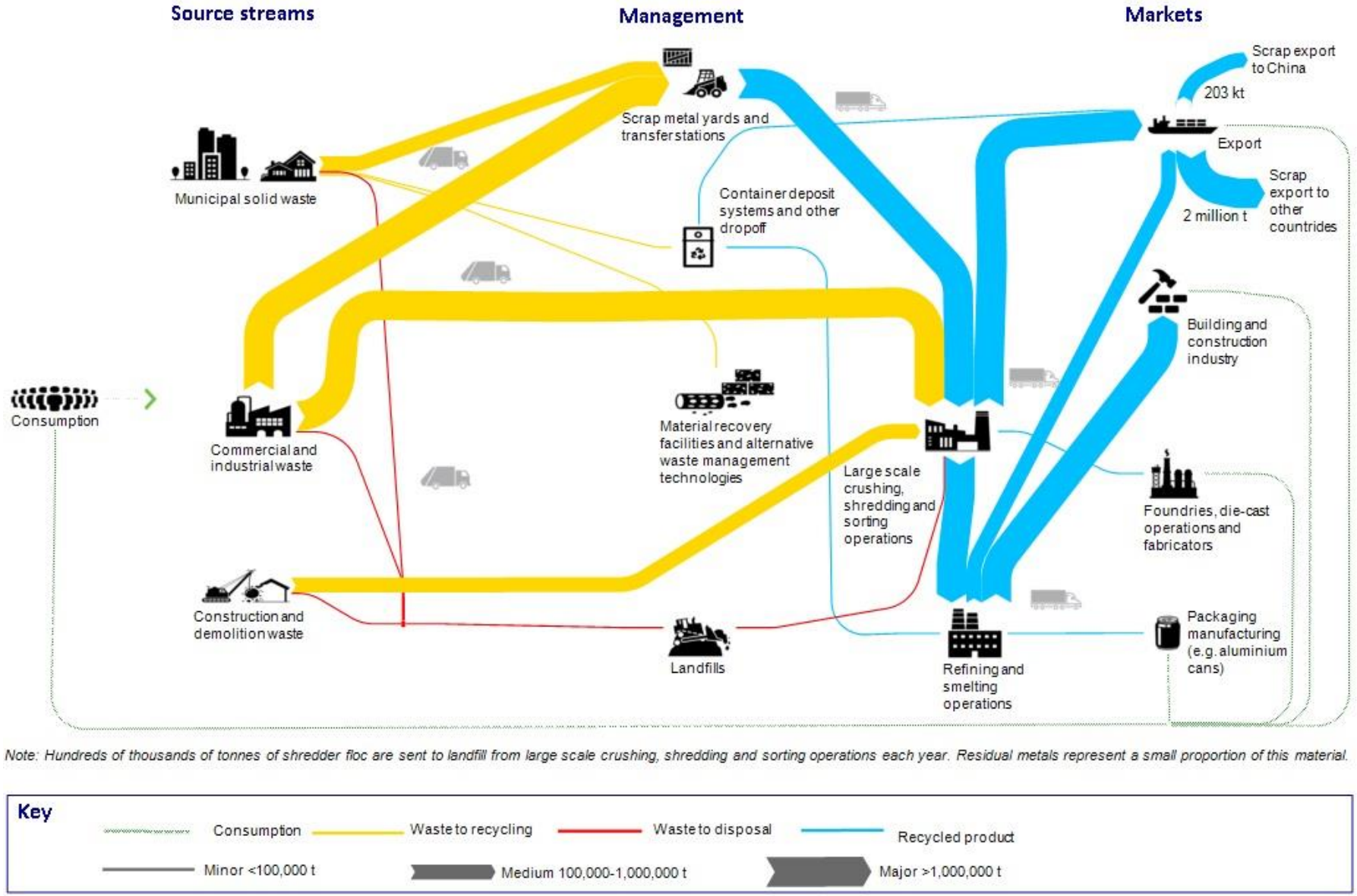
This report was commissioned by the Department of Environment and Energy (DoEE) to investigate the current situation with metals recycling in Australia. In recent months there has been a significant downturn in markets for some streams of recyclables due to the Chinese National Sword policy. This report investigates metals recycling within this context, covering both domestic and export markets.

Part 1 analyses domestic production of the major metal types that eventually reach the waste stream, their main end uses and the main sources of scrap material. It also identifies local infrastructure for aggregating, processing and re-smelting scrap metal into new products. It analyses current problems in the flow of these streams through this infrastructure to reach domestic and export markets.

Part 2 analyses the major streams of scrap metal exports, quantifying the flows of the major scrap metal types and identifying the states and territories from which they are shipped. It also quantifies exports of scrap metal to China relative to other export countries and evaluates the impact to date of National Sword on metals recycling in Australia.

The flow diagram in Figure 1 on the following page provides an overview of metal recycling flows in Australia.

Figure 1 Scrap metal flows in Australia



Note: Hundreds of thousands of tonnes of shredder floc are sent to landfill from large scale crushing, shredding and sorting operations each year. Residual metals represent a small proportion of this material.

2 Waste metal flows and infrastructure

2.1 Metal flows in society

In the context of Australia as a major minerals producer, this opening analysis focuses on the production and markets for the ferrous metals (consisting of iron or steel) and non-ferrous metals aluminium and copper. These materials together account for more than 90% of metals waste exports to China when they reach the end of their product life.

Steel smelters in Australia produce approximately 5.3 million tonnes per year from iron ore and recycled scrap[1]. The largest volumes are produced through blast furnace operations in Whyalla (South Australia) and Port Kembla (New South Wales), while electric arc furnaces or mini-mills in Melbourne (Victoria), Sydney (Rooty Hill) and Newcastle (New South Wales) produce more than a million tonnes of steel per year (from mostly recycled steel).

The industry has significant levels of vertical integration, with Liberty OneSteel owning mining resources, smelters, downstream product manufacturing and scrap recycling operations. BlueScope Steel operates a blast furnace and rolling mills that produce a wide range of flat products.

Australia's four primary aluminium smelters produced 1.5 million tonnes in 2017.[2] Listed in order from largest to smallest producer, these smelters operate in Gladstone (Queensland), Newcastle (New South Wales), Portland (Victoria) and Bell Bay (Tasmania). Smelter output is cast into ingot and billet. Aluminium is the most widely used non-ferrous metal.

Australia is also a major primary producer of copper, with mine production of copper totalling one million tonnes of contained copper in 2015[3]. While much of these ores and concentrates are exported, smelters and refining operations produce the metal in Mt Isa, Olympic Dam and in other locations in Queensland and South Australia.

The main domestic markets for metal are shown in Table 1:

Table 1 ***Main domestic markets for steel, aluminium and copper***

Steel	Aluminium	Copper
• construction industry materials such as structural and sheet steel, and steel reinforcing to strengthen concrete • steel rail and sleeper systems • sheet products for appliance manufacture	• extruded aluminium alloy building products such as windows and doors • cast aluminium alloy in engine componentry and wheels in transport vehicles • de-oxidant for steel manufacturing	• plumbing materials such as pipe • electrical equipment including motors and transformers

[1] Australian Steel Institute website http://steel.org.au/about-our-industry/ accessed 24/5/18

[2] World Aluminium Organisation website http://www.world-aluminium.org/statistics/primary-aluminium-production/ accessed 24/5/18. (Oceania production adjusted for New Zealand output)

[3] Australia's Major Export Commodities – Copper, Department of Industry, Innovation & Science, https://industry.gov.au/resource/Mining/AustralianMineralCommodities/Documents/Australias-major-export-commodities-copper-fact-sheet.pdf accessed 24/5/18

While much of its manufactured metals reaches domestic markets, Australia is also a major exporter. BlueScope Steel is the third largest manufacturer of painted and coated steel products globally,[4] exporting to markets in Asia, the Pacific and the USA. In relation to aluminium, Australia's four aluminium smelters are major exporters, with Portland Aluminium and Tomago Aluminium exporting 100%[5] and 90%[6] of their output respectively.

2.2 Metals wastes

About 4.6 million tonnes of metals wastes were recovered for recycling in 2014-15, representing an estimated 88% recovery rate from total metal wastes generated nationally. About 50% of the recovered scrap is estimated to have originated from the commercial and industrial sector, with about 25% coming from both the municipal and construction and demolition sectors[7]. Table 2 shows typical sources of scrap metal.

Table 2 ***Typical sources of recovered scrap metal***

Steel	Aluminium	Copper
• manufacturing scrap off-cuts • cars • steel structures e.g. pipes, structural steel from building structures • reinforcing steel recovered from concrete • household appliances • railroad tracks • steel cans	• manufacturing scrap off cuts • building materials e.g. window frames • engine components e.g. alloy cylinder heads and other castings • electrical wire e.g. from power transmission • used beverage cans	• plumbing pipe • radiators, air conditioner and refrigeration componentry • copper windings from electric motors • electrical cable

Some of these materials are recovered in a clean, "smelter ready" state, whereas others require varying degrees of manual or mechanised processing before they can be remanufactured or reach an export market. Cars and large household appliances, for instance, are processed through industrial shredders and eddy current separators to recover ferrous and non-ferrous scrap. Many of the smaller scrap metal yards manually disassemble motors and other fabricated items so as to maximised their value for export markets. Steel reinforcing is also a significant source of recovered ferrous scrap, and is separated from concrete after it has been processed through mechanised crushing operations. These are among the processes outlined in the following section.

Approximately 93,000 tonnes of aluminium and steel cans were collected for recycling in 2015-16. While approximately 74% of these materials were exported, the quantity exported to China is estimated to be only 1,500 tonnes.

2.3 Infrastructure for recycling metals wastes

There are large cost savings in producing metal from recycled scrap instead of the highly capital- and energy-intensive processes of refining and smelting metals from ore. Recycled scrap metals have a

[4] BlueScope Steel Limited website https://www.bluescope.com/about-us/ accessed 24/5/18
[5] https://www.alcoa.com/australia/en/pdf/smelting-portland-aluminum-smelter-fact-sheet.pdf accessed 30/5/18
[6] http://www.tomago.com.au/about-us/our-story accessed 30/5/18
[7] Based on data sourced from the states and territories for Blue Environment, *Australian National Waste Report 2016*

high commodity value relative to the other major recycling streams. Together with the disincentive of landfill fees, this has meant that metals recycling has historically had a solid economic basis in Australia, both supplying domestic and export markets.

In broad terms the flow of these materials relies on four types of infrastructure which underpin metals recovery. These facilities range from a wide network of basic drop-off facilities with minimal processing, through to a narrow base of highly specialised refining and secondary smelting operations. They are discussed below.

Materials Recovery Facilities (MRFs)

Steel and aluminium cans, mostly recovered through kerbside recycling collections from households, account for only about 2% of overall metals recovery. There are about 94 MRFs sorting household recyclables in Australia, most of which process between 10,000 and 100,000 tonnes per year. MRFs are well equipped to separate these materials from household collections into marketable grades of recyclate, which although small in volume – 4% of the average household recycling bin - represent a viable source of revenue for MRFs. Magnets separate the steel cans, while eddy current separators separate the non-ferrous component comprising aluminium cans and small amounts of foil. In terms of throughput, the major MRF operators are Visy Recycling, SKM, Polytrade and Cleanaway, and there are a host of smaller MRF businesses.

Aluminium cans collected through container deposit schemes (CDS) in South Australia, the Northern Territory and more recently NSW also move through purpose-built centres for sorting used beverage containers. While this stream is growing due to the December 2017 introduction of CDS in NSW, with a scheme also due to commence in Queensland by the end of 2018, it remains very small relative to the streams of metals wastes sourced from industry.

Scrap metal yards and transfer stations

A wide network of private scrap merchants collects scrap metal from mainly C&I and some MSW sources. Scrap metal may be disposed of at these sites free of charge, or depending on volumes and quality, there may be a reimbursement reflecting the value of the material. These are generally quite basic facilities that collect and aggregate scrap metal, with minimal processing taking place.

Manual separation of different metals at scrap metal yards, or in many cases prior to receival, enables scrap merchants to receive much higher earnings for scrap, with non-ferrous metals such as aluminium and copper valued several times higher than steel on a per tonne basis.

Municipal transfer stations also offer drop-off services for households as well as small-scale contractors. Gate fees apply for scrap metals at some transfer stations, while others allow metals to be dropped off free of charge.

Large-scale shredding and crushing operations

Major metals recyclers consolidate large volumes of scrap metal both directly from industry and through scrap merchants, and much of this material undergoes shredding and mechanised sorting. The largest national operators are Liberty OneSteel and Sims Metal Management, however there are other significant operators in more localised markets: for example Norstar Steel Recyclers in Victoria, and Sell & Parker Metal Recycling Services predominantly in NSW.

Heavy industrial shredders typically process larger metal items such as end-of-life vehicles and whitegoods where source separation cannot readily be achieved. This enables subsequent sorting of different component metals: applying magnets to separate the ferrous stream (i.e. steel and iron), then eddy current separators to sort the non-ferrous component including aluminium and copper.

While capital-intensive, this type of separation greatly improves the value of recovered scrap metals, enabling the supply of smelter-ready materials as opposed to lower-value mixed scrap. This is playing an increasingly important role in the wake of the restrictions China has placed on the imports of scrap materials.

A significant quantity of recycled metals is recovered from the construction and demolition sector. Much of this comprises steel reinforcing, requiring mechanical separation from concrete wastes through crushing facilities. Suppliers of civil construction materials, such as the Alex Fraser Group, undertake these operations in Victoria and Queensland.

Smelting and refining operations

While local refining or remanufacture of non-ferrous scrap metals such as aluminium and copper is small, metal recycling in Australia is dominated by five smelters that process scrap steel.

Scrap steel in Australia undergoes smelting at two blast furnaces:

- BlueScope Steel Limited's Illawarra Steelworks in Port Kembla. While its largest feed is from iron ore, the Illawarra Steelworks also captures scrap into its steel making operations.
- Liberty OneSteel's blast furnace in Whyalla, also primarily sourcing feed from iron ore but incorporating scrap metal into its steel making operations.

Three electric arc furnaces, or mini-mills, produce steel from scrap:

- Liberty OneSteel's Sydney (Rooty Hill) and Melbourne (Laverton North) steel operations. These operations were formerly part of Arrium Limited, which was placed in voluntary administration in July 2017. These operations were subsequently acquired by international mining and energy business GFG Alliance, together with Arrium Limited's Whyalla Steelworks. The two electric arc furnaces now operate under the Liberty OneSteel business name.
- The Moly-Cop Newcastle (Waratah) electric arc furnace. This site was originally established as The Commonwealth Steel Company (Comsteel), and subsequently became part of Arrium Limited. The site now operates under the Moly-Cop business name, and is owned by American Industrial Partners, as distinct from the Liberty OneSteel smelters.

In relation to non-ferrous scrap, Boyne Smelters Limited in Gladstone has operated Australia's largest reprocessing operations of aluminium can scrap since 2015, however their output only adds 2,400 tonnes to the smelter's annual production. There are also a small number of local foundries and die-cast operations who remanufacture products from non-ferrous scrap feedstocks, with aluminium ingot locally produced from recovered scrap. These industries however have significantly declined in recent decades. Because of this Australia exports most of its non-ferrous scrap.

2.4 Recycled product types

The main products made from recycled steel in Australia are:

- Steel reinforcing, produced by the Liberty OneSteel electric arc furnaces in Sydney and Melbourne, which is used to strengthen concrete in residential and commercial buildings.
- Axles and wheelsets for the international rail and heavy haul industry, produced by the Moly-Cop furnace in a highly specialised operation in Newcastle.
- Building and construction products including structural as well as sheet steel used in applications such as roofing. These materials are predominantly made from blast furnace operations processing iron ore, but the scrap fed into BlueScope Steel's Illawarra Steelworks means that many of these steel products have a recycled component.
- Rail and sleeper systems and structural steel from Liberty OneSteel's Whyalla operations, as well as billet for its downstream rod and bar mills. The output is mainly derived from iron ore through its blast furnace operations, but also incorporates scrap.

From non-ferrous scrap metals, foundries and die cast manufacturers produce specialised engineering components and other materials such as door furniture. While these industries have been in decline, they continue to use small amounts of recovered non-ferrous scrap in Australia. In another end use, Weston Aluminium in the Hunter Valley use recovered scrap aluminium to manufacture de-oxidant for steel making.

2.5 Current problems with infrastructure and markets

Recycling of metals in Australia continues to perform strongly, but currently faces a number of domestic and global challenges.

For steel making domestically, the most significant development in the last 12 months has been the acquisition by international mining and energy business GFG Alliance of Arrium Limited after a period of voluntary administration. In terms of steel making capacity, the acquisition encompassed Arrium's Whyalla blast furnace operations, as well as the Laverton North and Rooty Hill electric arc furnaces, all of which now operate under the Liberty OneSteel business name.

At the time of the acquisition, the GFG Alliance announced its intention to invest further in the Whyalla Steelworks as well as in improving capacity utilisation of the electric arc furnaces[8]. However, there remains some uncertainty within the steel industry as to how competitively placed the electric arc furnaces are within the current vertically integrated business model.

Demand for steel in Australia is strongly driven by building activity. Besides this, the steel reinforcing business of Liberty OneSteel is being impacted by imports of steel reinforcing from Asia. Efforts by the Australian steel reinforcing industry to remain competitive focus on quality, including the Australasian Certification Authority for Reinforcing and Structural Steels ("ACRS") – an independent product certification scheme to Australian and New Zealand Standards.

In terms of overall scrap recovery, metals recycling is not facing the same degree of threat as other recycling sectors thanks to the high commodity value of metals. These values make it viable for

[8] http://www.gfgalliance.com/media/gfg-alliance-completes-landmark-acquisition-arrium/ accessed 28/5/18

relatively small-scale scrap metal yards with minimal mechanised sorting to compete in the presence of much larger operators with heavy industrial shredding and sorting. In an opinion gathered for this report, a representative from one of Australia's largest metals recyclers expressed concern about the heavier regulatory compliance standards imposed on the larger competitors.

Even with its domestic steel smelting capacity, Australia still relies on export markets for much of its recovered scrap. Non-ferrous scrap also relies on overseas markets, and altogether Australia exports more scrap metal than any other recycling stream[9].

China accounted for only 9% of Australia's scrap metal exports in 2016-17, and the Chinese trade restrictions imposed under its National Sword policy have had little overall impact to date on the overall quantity of Australian scrap metal exports. This is outlined further in the following section. However, the industry has had to adapt with the management of some mixed streams, especially non-ferrous scrap. Larger shredding and sorting operations report having to increase manual separation and slow down automated sorting processes for China exports. This comes at a cost, but has been necessary to meet the stricter contamination standards imposed by China. Even with these changes it has been necessary to find other export markets particularly for some non-ferrous scrap.

Much scrap, however, is supplied to recyclers in a pure state and requires a minimal level of processing such as baling before it is exported. Examples include manufacturing scrap, window frames and copper pipe. Exports of these streams have been largely unaffected by National Sword.

The streams reported to have been impacted are mixed non-ferrous streams such as copper windings in electric motors and PVC coated copper wire. Together these are not the largest sources of non-ferrous scrap, but still represent significant quantities that are now being shipped in larger quantities to other Asian export markets.

Australia is one of many exporters of scrap metal to China, and PVC coated copper wire is an example where the Chinese restrictions have resulted in a market over-supply. Prices have consequently fallen, but recycling of this stream remains economically viable for scrap merchants. Some larger metal recyclers are understood to be considering investing in granulators that can separate PVC coating from copper. This non-thermal technology is already being used in some parts of China, whereas in other areas the plastic is separated from the copper by melting in poorly managed operations, resulting in toxic emissions.

USA trade policy is a further geo-political influence on global markets, with considerable uncertainty prevailing in the wake of tariffs on imports of steel and aluminium to the USA signalled earlier this year. Citing national security risk following investigations under Section 232 of the Trade Expansion Act of 1962[10], this represents a major shift in US trade policy. Following separate announcements to import tariffs imposed on China in response to breaches of intellectual property[11], this has also fueled concerns about a rise in protectionism that would likely be detrimental to Australia's scrap metal exports.

The global market situation was described as "highly fluid" by one major metal recycler, citing recent retaliatory moves by India and Turkey threatening higher tariffs on scrap imports from the USA. With

[9] Blue Environment, *Data on exports of recyclables from Australia to China Version 2*, 11 May 2018
[10] https://www.washingtonpost.com/news/monkey-cage/wp/2018/03/01/trump-has-announced-massive-aluminum-and-steel-tariffs-here-are-5-things-you-need-to-know/?noredirect=on&utm_term=.808778bc569f accessed 29/5/18
[11] https://www.nytimes.com/2018/03/21/us/politics/trump-china-tariff-trade.html accessed 29/5/18

exporters required to maintain a high level of vigilance, it is important for the government to understand the importance of exports to metals recovery in Australia in monitoring international trade developments. In recent news, exporters were unable to avoid scrap shipments being left stranded at US ports in May this year, when it was announced that mandatory Chinese inspections would be suspended for a month[12]. Developments such as this justifiably attract the attention of Australian scrap exporters.

3 Exports analysis

The strong basis of global markets underpins Australia's high metals recovery rate – an estimated 88% of all metal wastes generated (2014-15), higher than any other waste stream. Recovered metals are a globally tradeable commodity with high market value relative to other recycling streams, as shown in the table of market prices from the London Metals Exchange in Table 3. While steel accounts for the greatest volumes of Australia's metal exports, by weight aluminium and copper fetch much higher values, helping drive recovery levels.

Table 3 ***Commodity prices for metals, London Metals Exchange (LME), 25 May 2018***

LME Steel		LME Aluminium	LME Copper
LME steel scrap	**US$350 per tonne**	US$2,280 per tonne	US$6,884 per tonne
LME steel rebar (reinforcing bar)	**US$555 per tonne**	Scrap prices for primary aluminium and copper are based on a percentage of the above primary LME prices	

Exports of scrap metals amounted to 2.2 million tonnes in 2016-17, with China being Australia's fourth largest export market accounting for 9% of exports, as shown in Table 4, based on Australian Bureau of Statistics trade data. Indonesia and Taiwan are comparably sized export markets. This section, including detailed analysis of export trade data up to March 2018 at the end of this section, shows that exports of scrap metals remain strong.

Table 4 ***Australia's exports of scrap metals 2016-17 – by country of destination, tonnes[13]***

Country of Destination	Total
Vietnam	373,439
India	285,485
Malaysia	208,254
China (including Hong Kong and Macau)	203,268
Indonesia	199,278
Taiwan	184,353
Bangladesh	157,125
Kuwait	128,005
South Korea	124,773
Pakistan	103,410
Other countries	223,231
Total	2,190,623

A breakdown of Australia's scrap metal exports 2016-17 is provided in Table 5. While ferrous (steel) scrap is by far the largest overall export stream, the quantity exported to China is small, accounting

[12] http://www.recyclingtoday.com/article/china-usa-scrap-inspection-offices-closed-may-2018/ accessed 29/5/18

[13] Totals in this graphic are slightly higher than the export totals released by Blue Environment on 11 May 2018 in "Data on exports of recyclables from Australia to China" version 2, because they also include small quantities of scrap exports not affected by the restrictions imposed by China. The difference amounts to 31,000 tonnes (exports to all countries).

for 26% of Australia's scrap metal exports to the country (total of HS codes 720449 and 7204 other). Though comparable in overall tonnage, Australia has relied more heavily on China for exports of non-ferrous scrap, in particular being the destination for 71% of scrap copper exports.

Table 5 ***Australia's scrap metal waste exports 2016-17 - by state, tonnes***

	HS Codes (see explanation)					Total exports to China	Total exports
	Ferrous		Copper	Aluminium			
Jurisdiction	720449	7204 other	7404	7602	Other		
Australian Capital Territory	0	0	0	0	0	0	0
New South Wales	55,146	115,584	27,250	79,371	58,813	62,604	336,164
Northern Territory	242	35	117	288	0	139	682
Queensland	481,577	147,259	19,719	60,624	4,673	35,714	713,853
South Australia	81,556	32,262	6,441	19,166	637	14,531	140,062
Tasmania	50	2,212	22	2,191	47	1,771	4,522
Victoria	226,545	85,441	17,506	82,888	16,342	43,302	428,722
Western Australia	315,355	196,782	10,397	33,282	2,012	44,694	557,827
Re-exports	2,864	4,500	22	1,390	14	514	8,791
Exports to China	38,459	14,801	57,990	87,896	4,123	203,268	
Total	1,163,336	584,075	81,474	279,199	82,538		2,190,623

Source: Australian Bureau of Statistics data

Note - Harmonised system (HS) codes:

720449 *Ferrous waste and scrap; not elsewhere classified in heading no. 7204*

7204 other *Ferrous waste and scrap excluding 720449*

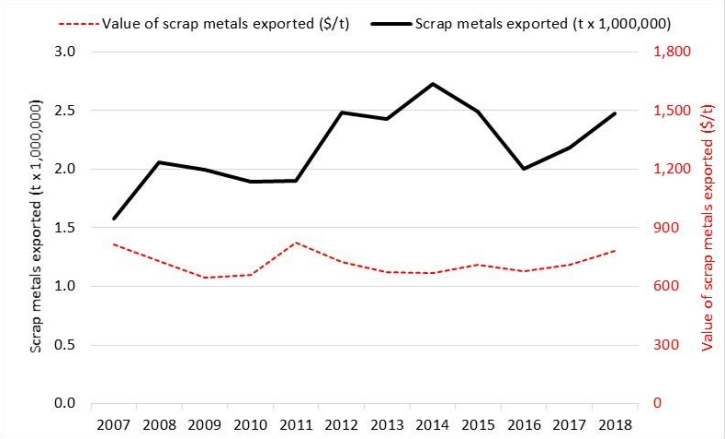
7404 *Copper; waste and scrap*

7602 *Aluminium; waste and scrap*

Exports from individual states and territories follow population and levels of economic activity in broad terms. However, ferrous scrap exports differ in several instances due to local smelter demand. Ferrous scrap exports from NSW in particular, as well as Victoria, are kept lower by the scrap demand from the three steel smelters in NSW and the one in Victoria. By contrast, ferrous scrap exports from Queensland and Western Australia are high because it is more expensive to transport this material interstate to domestic smelters.

Figure 2 shows Australian scrap metal exports, with 2017-18 exports extrapolated from the first nine data to reach 2.5 million tonnes. This indicates no slowdown in overall metals exports to all countries, and no decline in overall values.

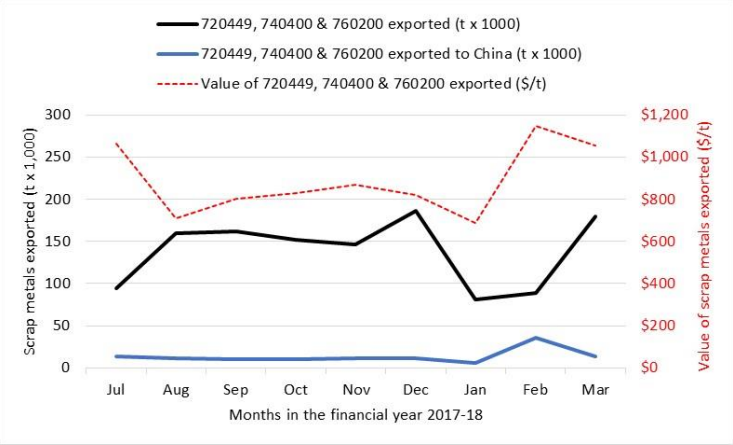
Figure 2 ***Values and quantities of scrap metals exported to all countries, 2006-07 to 2017-18 (last three months extrapolated)***



Source: Australian Bureau of Statistics data

Looking at month by month data in the current financial year, Figure 3 includes the main categories of scrap metal exported to China, showing that exports to China in February and March 2018 are slightly higher than the previous months. In this period, scrap metal exports to all countries have, in fact, risen.

Figure 3 ***Values and quantities of main scrap metals exported to all countries, July 2017 – March 2018***



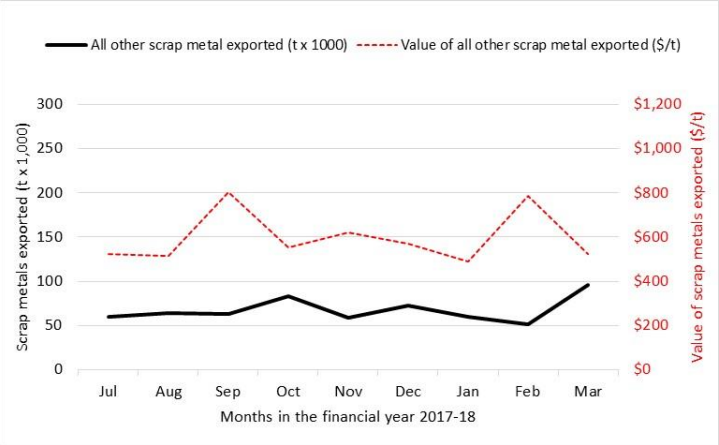
Note - Harmonised system (HS) codes in Figure 2:

720449	*Ferrous waste and scrap; not elsewhere classified in heading no. 7204*
740400	*Copper; waste and scrap*
760200	*Aluminium; waste and scrap*

Source: Australian Bureau of Statistics data

Figure 4 shows exports to all countries of the remaining categories of scrap metal, the quantity of which destined for China is small. Exports of these materials have not declined.

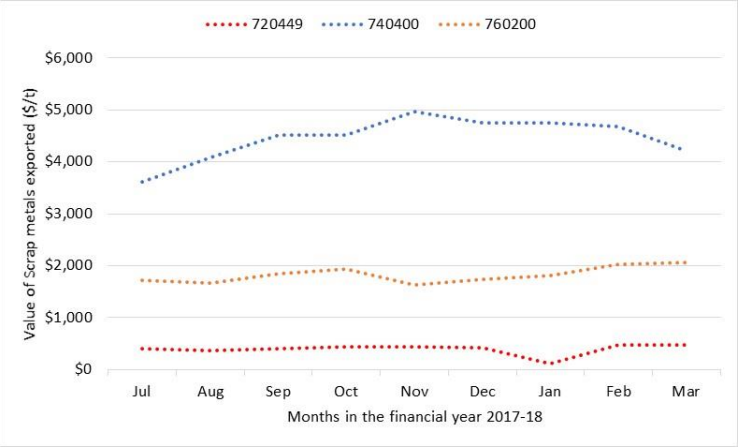
Figure 4 ***Values and quantities of other scrap metals exported to all countries, July 2017 – March 2018***



Source: Australian Bureau of Statistics data

While the previous graphs show no slowdown to date in overall scrap metal exports to date, there is some evidence of a recent decline in scrap copper values, as shown in Figure 5. This may reflect the difficulties in finding new export markets for some lower grades of copper such as PVC coated wire.

Figure 5 ***Value of scrap metal exports to all countries by HS code, July 2017 – March 2018***



Source: Australian Bureau of Statistics (export quantities divided by their value)

Harmonised system (HS) codes in Figure 5:

720449	*Ferrous waste and scrap; not elsewhere classified in heading no. 7204*
740400	*Copper; waste and scrap*
760200	*Aluminium; waste and scrap*

4 Conclusion

The overall conclusion is that Australia's scrap metal exports to date are not experiencing difficulties comparable to some other recycling streams in the wake of the Chinese National Sword restrictions. This is firstly because China is not a dominant export market for most Australian scrap metals. Secondly, for the streams that have been exported to China, most continues unaffected as the scrap can readily be supplied conforming to the stricter contamination standards. For the smaller streams of mixed non-ferrous scrap that are most greatly affected, Australian scrap metal exporters are managing to adapt by improving their sorting processes or by finding alternative Asian export markets.

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Department of the Environment and Energy

Assessment of Australian recycling infrastructure – Glass packaging

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CONTENTS

1 GLASS PACKAGING USE

Glass has been used as a packaging medium in Australia for well over 150 years. In the 19th and 20th centuries it was the dominant packaging format for beverages, and also commonly used for food and other applications. During this period, a lot of the glass packaging was returned, washed and reused. To encourage high levels of return and reuse rates (trippage), the bottles often remained the property of the brand-owners/product manufacturers. Large scale product applications such as milk and beer and wine were all packaged almost exclusively in reusable glass.

During the latter part of the twentieth century, consumer patterns changed with less home delivery of milk, more at home consumption of alcohol. There was also competing packaging materials with steel and aluminium cans for food and beverage, and cartons and plastic for milk. The glass industry responded with light weighting of glass containers and a switch to single use glass where the material was crushed and remade.

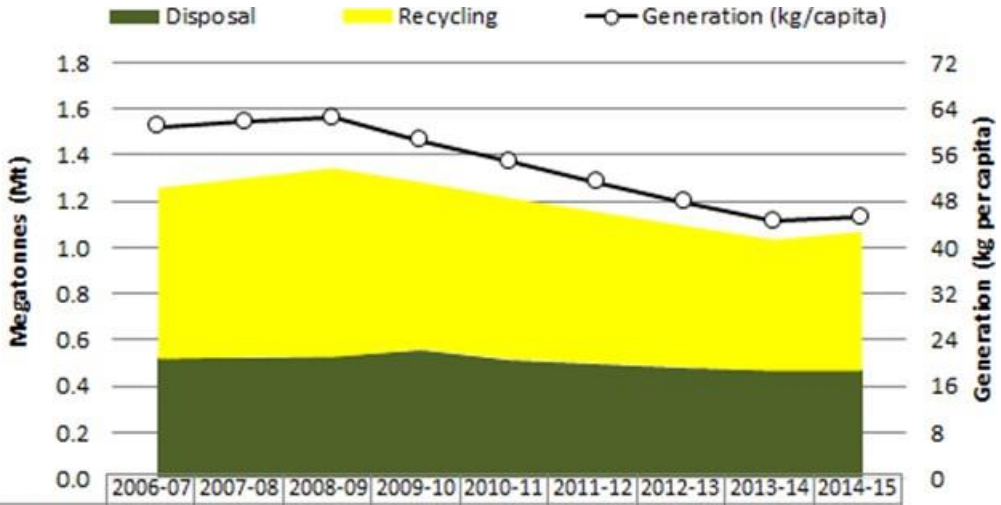
Over the past twenty-five years glass packaging production has dropped due to both lighter containers and loss of market share to other materials. It was widely expected that glass would disappear from consumer packaging, but it has retained strong markets in wine and beer and developed new food packaging markets.

Glass has been equated with quality for many product lines and this has led to its selection by many brands. Many premium brands choose glass over alternatives in applications from jams to cooking oil to cordials. The technical properties of glass have also helped it to retain the wine market and an increased share of the beer market.

There are applications where glass has been replaced or reduced such as pharmaceuticals, sauces, chemicals, soft drink. It is also banned as a packaging format at many sporting and cultural venues based on safety concerns related to potential for being thrown and for breakage.

Estimates of the consumption of glass packaging in Australia vary. For the 2014–15 financial year the Australian National Waste Report 2016 (Blue Environment, 2017 p. 23) provides an estimate of total glass reaching end-of-life (not consumption or limited to packaging) of 1.07 million tonnes, with recovery of 0.60 million tonnes and a 56% recovery rate (i.e. waste glass recovered over waste glass generated).

Figure 1 – Trends in glass wastes generation and fate, Australia 2006–07 to 2014–15 (Blue Environment, 2017 p. 23)

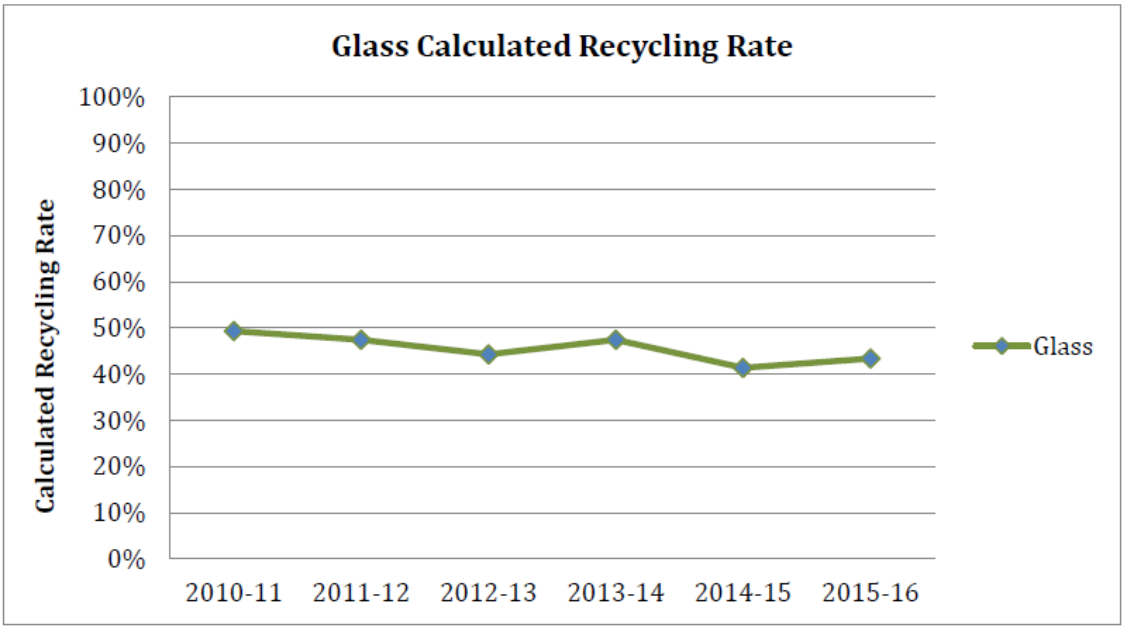


	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Generation (kg/cap)	61	62	62	59	55	51	48	44	45
Generation (Mt)	1.26	1.30	1.34	1.28	1.22	1.16	1.10	1.04	1.07
Recycling (Mt)	0.74	0.78	0.81	0.72	0.70	0.66	0.61	0.57	0.60
Disposal (Mt)	0.52	0.52	0.53	0.56	0.51	0.50	0.48	0.47	0.47
Recovery rate	59%	60%	61%	56%	58%	57%	56%	55%	56%

The most recent Australian Packaging Covenant Organisation (APCO) National Recycling and Recovery Survey for glass packaging estimated that glass packaging consumption was 1.25 million tonnes in 2015–16, with recovery of 0.54 million tonnes and a 43% recovery rate (i.e. waste packaging glass recovered over glass packaging consumed) (IndustryEdge, 2018 p. 7). There is a reasonable discrepancy between the National Waste Report and APCO estimates.

Figure 2 – APCO reported glass recycling rates 2010–11 to 2015–16 (IndustryEdge, 2018 p. 7)

Financial Year	Total Consumption (kt)	Total Recycled (Processed & Exported) (kt)	Calculated Recycling Rate
2010-11	1 054	520	49%
2011-12	1 210	552	46%
2012-13	1 248	552	44%
2013-14	1 259	597	47%
2014-15	1 364	564	42%
2015-16	1 253	543	43%
% +/- pa	**3.5**	**0.9**	



Industry estimates of national packaging glass consumption in 2016–17 are around 1 million tonnes or a little more, however this may not fully account for the import of empty glass packaging for local filling. During 2015–16, the trend towards the importation of empty glass packaging increased sharply. Compared with the prior year, imports were up 15.6% in 2015–16 (SRU, 2018). This is an important trend, because the growth in imports potentially displaces domestic production, thereby reducing demand for recovered glass for use in local packaging production.

Some glass packaging is imported into Australia as packaging around goods such as: beer, sauces, wine and oils. There is no precise data on the total quantities of glass entering Australia related to these imports.

Glass packaging is reported by industry to be continuing to lose market share to plastics packaging. For example, Coles has indicated that it intends to reduce or eliminate glass packaging from its own brands. With this decline, the major manufacturer of glass packaging, Owens Illinois (O-I) closed some furnaces at its glass plants in Melbourne, Adelaide, Sydney and Brisbane. Glass packaging is also manufactured in Adelaide by Orora.

It is likely that glass will maintain some ‘prestige’ applications but will see its market continue to decline as more brand-owners switch to plastics and other materials.

2 END-OF-LIFE OUTCOMES

According to the available sources the total amount of glass packaging collected for recycling in Australia in 2014–15 was around 0.56–0.60 million tonnes (Blue Environment, 2017; IndustryEdge, 2018). According to the National Waste Report this is a reduction of 200,000 since 2006–07. The current rate of glass recycling is around 43–56%, with both of the available datasets indicating that the recovery rate has fallen over the last five years. There is some concern that historic recycling rates were calculated by comparing total glass recovered to consumption of glass beverage packaging, which would overstate the recycling rate. Due to the variance in estimates of both glass consumption and recycling it should be a priority to establish packaging and non-packaging glass consumption and recovery rates with more certainty.

Across all materials, recycling is highest for large packaging and beverage packaging over food and other product applications. This is partly due to the product residue and washing requirements. The higher beverage recovery is also due to high recovery levels in pubs and restaurants where glass beverage packaging is widely recycled.

The recycling rate also benefits from container deposit schemes with higher return rates by consumers and businesses. Currently South Australia is the only state with a long-standing deposit system and return infrastructure. The Northern Territory also has a deposit system in place.

This is changing with NSW introducing a deposit scheme in early 2018. Queensland has announced it will also be introducing deposits on many forms of beverage packaging from November 2018. The next stage is to develop the network of refund collection points across the state. With Queensland Government endorsement, the industry-based not-for-profit group 'Container Exchange' (CoEx), has issued a Request for Proposal, allowing organisations, charities and community groups to register their interest to become a refund or donation point.

The Western Australian Government is also introducing a state-wide container deposit scheme. Consumers will be able to get a 10-cent refund on all eligible beverage containers – plastic and glass bottles, paper-board cartons, and steel and aluminium cans between 150 millilitres and three litres. This will include:

- soft drink cans and bottles
- bottled waters – both plastic and glass
- small flavoured milk drinks
- beer and cider cans and bottles
- sports drinks and spirit-based mixed drinks.

Beverage containers included in the scheme will carry a refund mark to identify them to consumers. Western Australia's container deposit scheme is expected to start on mid-2019.

This will leave Victoria as the only major state without beverage container deposits and there is a strong likelihood that the Victorian Government will soon follow the other states in introducing deposits.

There is no export of glass cullet from Australia for recycling. Most glass coming through commingled kerbside collections is going to beneficiation and cullet feed at Owens Illinois' glass plants. Some quantities are going into lower grade construction applications and some is being stockpiled. The Orora glass plant in Gawler, South Australia, utilises glass from container deposit sources in that State.

The recovery rate of 56% is considered a reasonable performance given the relatively low commodity value of glass per tonne compared to plastic or cardboard, and the difficulty of recovery from mixed waste loads. On the other hand, a material that is used mainly for beverages with a lower Away from Home consumption pattern, should expect high returns through household kerbside systems and commercial collections.

Highly mechanised commingled recycling collection and sorting tends to break glass into small pieces that are not easily recoverable. These fragments can get lost to landfill or be sorted with other materials. They can also be at a size that prevents detection from stone and ceramic fragments. The larger recycling sorting plants increasingly have technologies to deal with these small fragments.

The glass packaging from container deposit systems remains intact until sorted manually from other materials with each colour being kept separate.

3 SORTING AND RECYCLING INFRASTRUCTURE

Most glass packaging is collected in commingled collections from households or commercial sites such as pubs, clubs, sporting venues, hotels and restaurants. Some glass is collected separately from other materials. This is often done with an onsite glass crusher to reduce volume.

In addition, there is glass collected through container deposit depots and allied return routes. The commingled material is sent to material recycling facilities in capital city and regional centres where the glass is sorted from paper grades, plastics and metals.

The glass is in a mixed colour form with tops and labels included. This material is then sent to one of six beneficiation plants. These are:

- Visy – Adelaide and Melbourne
- SKM – Sydney and Melbourne
- Polytrade – Melbourne
- Brisbane Cullet (O-I) – Brisbane.

These plants also receive some loads sent and paid for by O-I from regional locations where freight costs are high. This includes glass into Adelaide from Western Australia and the Northern Territory, and into Melbourne from Tasmania. O-I pays these suppliers a rate that recognises the extra cost of freighting.

Much has been made in the media over the last few years of the stockpiled 'mountains' of glass. Some of these are historic and were created before state of the art optical sorting equipment was available in beneficiation facilities in each packaging production capital.

For most of the past twenty years, recyclable packaging has been collected at the kerbside in mechanised, bin-based, fully commingled systems. Many stakeholders have pointed out that, while this delivers collection efficiencies, mixing materials and compaction result in cross contamination and reduced quality of the material collected.

Of concern, is the impact of glass fragments on other materials, particularly paper grades. The glass itself is of much lower value when collected through commingled kerbside systems. This has prompted some stakeholders to suggest either a separate paper and cardboard collection or a separate glass collection. This would represent a significant shift in approach, and the costs and benefits would need to be assessed to inform the review of options.

The Northern Beaches municipality in Sydney collects paper grades separate from glass and other materials and may offer a model. In New Zealand, around 30% of the population is served by a system that collects glass at kerbside in a crate separate from other materials. This material is colour sorted and is of a higher quality than the material from fully commingled systems and therefore is more valuable. This approach also offers an option for consideration.

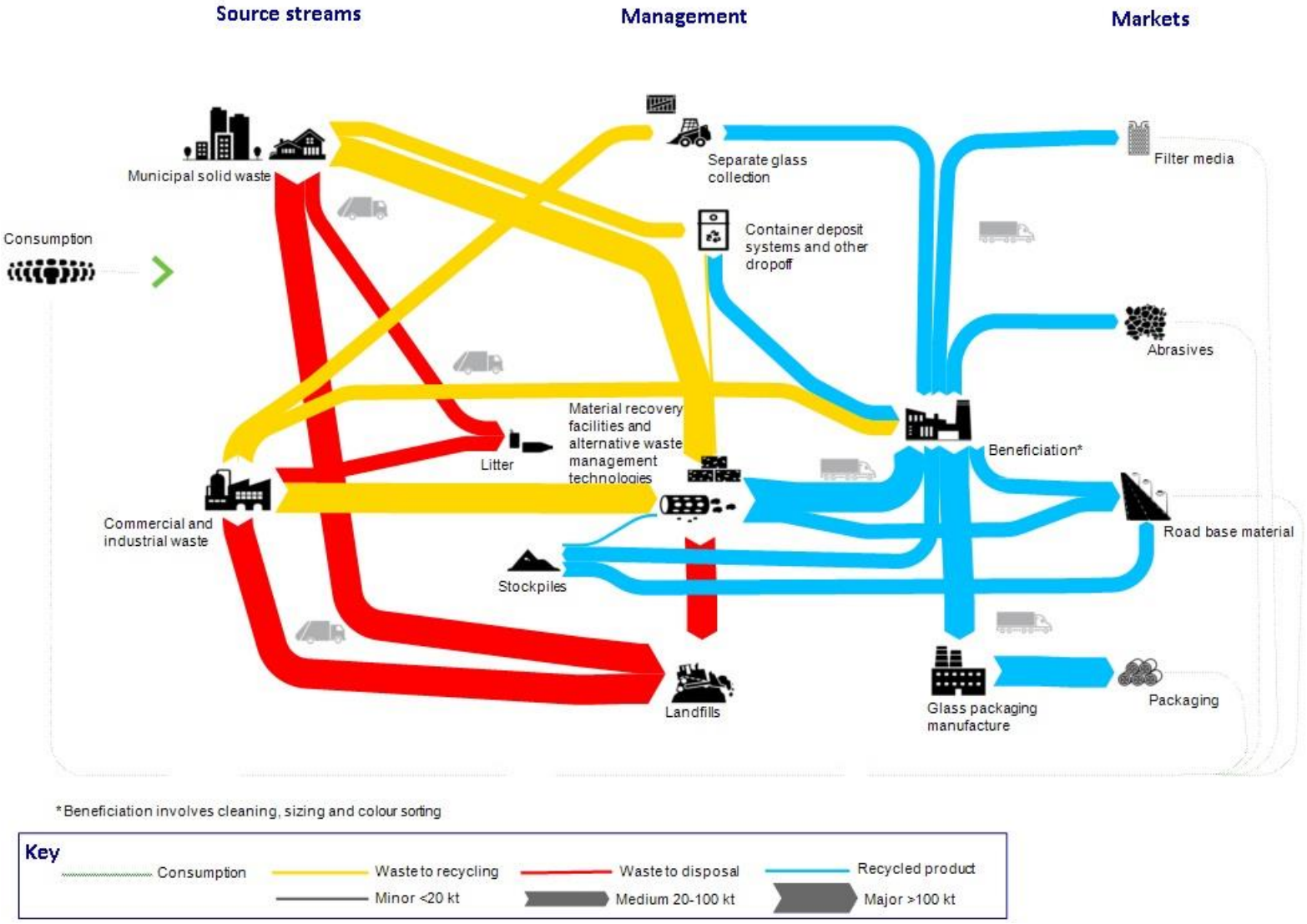
There is generally a gate fee to MRF operators for glass collected, to cover beneficiation costs. As the cullet contract price has not changed, any surge in price paid at the gate would appear to be opportunistic or the result of poorer quality material being received. Some of the same companies (Visy, SKM, Polytrade) operate MRFs and beneficiation in some capital cities.

Glass collected from kerbside recycling is recycled back into glass packaging at O-I plants in Brisbane, Sydney, Melbourne, and Adelaide. Glass from NT and Tasmania is shipped to Adelaide or Melbourne. However, glass collected in WA is almost entirely used in civil construction projects such as in road base applications.

O-I receives the glass cullet from beneficiators in each city. The price paid for the glass cullet by O-I to beneficiators has remained largely unchanged in recent years. Green glass is in oversupply in Sydney and Melbourne so some of it is shipped to Adelaide for wine bottle production. The price of green cullet has reduced in Sydney and Melbourne but not significantly.

The price that MRF operators get for glass delivered into beneficiators is not fixed. There have been additional beneficiators offering processing in recent years and this brings increased competition. As there is competition, a fixed price for cullet and no limit on outlet, the price received by MRF operators should be stable or improving. However, the quality of collected glass and the relatively low price received for this material has been an issue in kerbside recycling collection, sorting and sale for many years.

4 GLASS PACKAGING FLOW DIAGRAM



5 RECYCLED PRODUCT TYPES AND MARKETS

Glass packaging is produced in three different colours; amber (brown), green and flint (clear). To produce new glass packaging from recycled cullet, there are restrictions on what colours can be blended. Amber packaging (used mostly for beer) can utilise flint and green cullet, green can use flint and green cullet, while flint glass packaging requires clear cullet. The demand for different colours varies around the country. There is much greater demand by the wine industry in South Australia for green glass so sometimes cullet needs to be shipped from other capitals to Adelaide.

Virgin glass is made essentially from a combination of silica and soda ash. Cullet can be blended with these materials in quite high proportions. Having cullet blended at over 60% is possible if the quality is good. Currently the cullet content is 39-40%, much lower than it could be.

Prices for glass from kerbside are currently low, and as a result this is not a major revenue source despite the significant quantities recovered through kerbside recycling. The price has been steady throughout the past year and is unaffected by Chinese import restrictions.

The price received for cullet is locked into 3–7-year contracts between glass producers and beneficiators. It is likely that the price for cullet is close to the long-term average of $72 /tonne. Currently cullet makes up 40% of the input to O-I glass manufacture. They are targeting 60% input and can accept an even higher ratio, particularly for amber and green production.

Based on quality and volumes, gate fee rates for MRFs sending material for beneficiation can vary. An average gate fee of $0 /tonne (EXW) has been assumed for this analysis, unchanged over 2017–18. It may be that some MRFs are being charged by beneficiators in the order of $40–$60 /tonne, but this is not verified and if it is occurring could be linked to the provision of poor quality of material.

Beyond taking glass packaging waste back into packaging production, there are a range of other secondary markets that can be used. The glass can be used as a filter media for water quality projects. This application is specialised and per tonne, does not offer a high market price.

Similarly, it can be used as an abrasive material in sandblasting of ships and similar targets. This has been tried but, competing with widely available sand, does not offer a broad market outlet.

Cullet can also be used in a range of road base and sub-base applications. This market is also low value. It has the advantage of being able to absorb large volumes of material, and a second advantage of not requiring the same quality of cullet, with ceramics and metals and mixed colours not a market barrier. For this reason, it is an outlet for stockpiles of glass that have contaminant levels higher than packaging production can tolerate.

Beyond packaging glass, there is sheet glass used in a range of application including automotive windows and windscreens and in windows and skylights for buildings. Glass is also used for household and commercial durable applications such as drinking glasses, plates, cookware, vases etc. These different forms of glass melt at different temperatures to packaging glass. Due to this, they are not compatible with packaging glass recycling systems. Active education programs are used in commercial and household settings to keep packaging glass free from these other glass forms. There are recycling systems operated by Potters Industries for the recovery and recycling of windscreen glass into road marking paint and some military applications.

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Challenges and opportunities for municipal recycling infrastructure in Australia

Improve provision of kerbside municipal waste collection and recycling services

The majority of Australians have access to kerbside municipal waste collection and recycling services. However much of remote and regional Australia has limited or no kerbside municipal waste collection.

Improving regional and remote kerbside collection services across Australia will improve waste management and increase opportunities for recycling in these areas. Major improvements in national recovery rates and recycling tonnages from municipal sources could be achieved through improved kerbside collection of organic (food and garden) waste.

Improve collection and processing infrastructure to process all forms of waste

Existing collection and processing infrastructure is generally equipped to process current volumes of Australia's recycled materials. However current infrastructure is not well equipped to process all forms of recyclable waste, particularly all forms of recyclable plastic and organic waste.

Opportunities exist to increase Australia's capacity to manage organic waste, including through provision of new infrastructure supporting kerbside collection of organic material, and processing those organics into compost and other products. There are also opportunities to develop infrastructure that enables alternative waste treatment options, such as removing organic waste from the landfill bin. Better management of organic waste will also reduce contamination in co-mingled bins and increase resource recovery rates.

Improve collection and processing infrastructure to better process co-mingled waste

Australia's waste management and recycling infrastructure is vulnerable to international markets for recycled materials. Collection infrastructure is generally designed for collection of co-mingled municipal waste. This presents significant challenges for sorting and processing infrastructure. Few sorting facilities are equipped to process co-mingled municipal waste in a way that enables assured, sorted flows of uncontaminated plastics, paper and cardboard.

A small number of large waste management and recycling operators have demonstrated that they are capable of responding to shifts in global prices for recycled materials. This has led to increased waste exports overall since China introduced restrictions on waste imports. However, most recycling collectors and downstream processors have not been able to meet new standards imposed by China on contamination limits of recycled materials.

Opportunities exist to improve the technical capacity of existing collection and recycling services processing co-mingled municipal waste, for example through investment in state of the art optical sorting equipment. Improving collection and processing infrastructure to better process co-mingled waste will reduce contamination in recycled materials and improve resource recovery rates. It would also improve the quality and value of recycled materials, and improve access to markets for recycled materials, including international markets.

Data on exports of Australian wastes

7 November 2018

Inquiries to joe.pickin@blueenvironment.com.au

Background

Exports of wastes came to public prominence after China made a series of four announcements during 2017 and 2018 that restricted the import of certain materials, mainly by specifying a threshold contamination rate of 0.5%. The restrictions have had global consequences, reducing prices for recycled commodities and causing market blockages, stockpiling and some instability in the provision of recycling collection services.

This analysis looks at exports of wastes from Australia to all countries. The export tonnages and values are Australian Border Force data obtained via the Australian Bureau of Statistics.

On a tonnage basis nearly all these exports are materials recovered from our waste streams for recycling or energy recovery, rather than for disposal fates such as incineration or landfill. For convenience, the term 'wastes' is used in this document to include these recovered materials.

Annual trends in waste exports

Figure 1 shows exports of waste from Australia to China by financial year (July to June) and type during the 12 years to 2017-18. Waste exports to China started to fall from 2008-09, primarily due to declining scrap metal exports. In 2017-18 the impact of the China restrictions is readily apparent – exports of waste metals fell by 23%; plastics by 78%; and paper and cardboard by 39%. Overall, between 2016-17 and 2017-18 waste exports to China decreased from 1.26 million tonnes (Mt) to 0.75 Mt, a decline of 41%.

Figure 1 Exports of waste from Australia to China by financial year and type

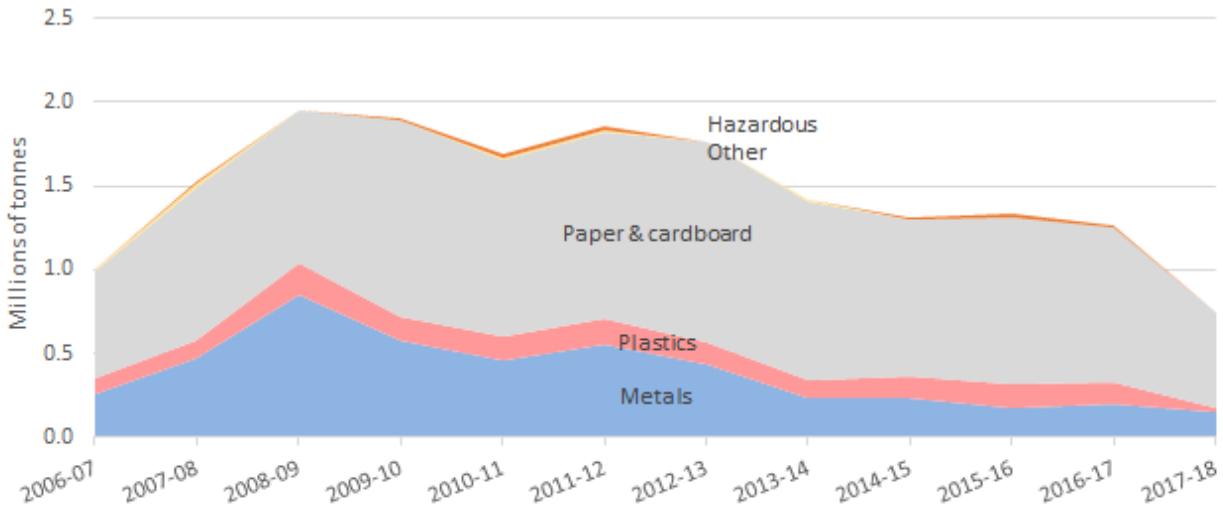


Figure 2 shows the value of exports of waste from Australia to China by financial year and type during 12 years to 2017-18. In line with tonnages, the value of waste exports to China has fallen since 2013-14, led mainly by decreases in the value of metals. Between 2016-17 and 2017-18 the value of waste exports to China declined by 30% for paper and cardboard and by 77% for plastics. The overall value for scrap metals increased by 12%, spurred by a 47% increase in the value of waste copper exports.

Figure 2 Value ($A) of waste exports from Australia to China by financial year and type

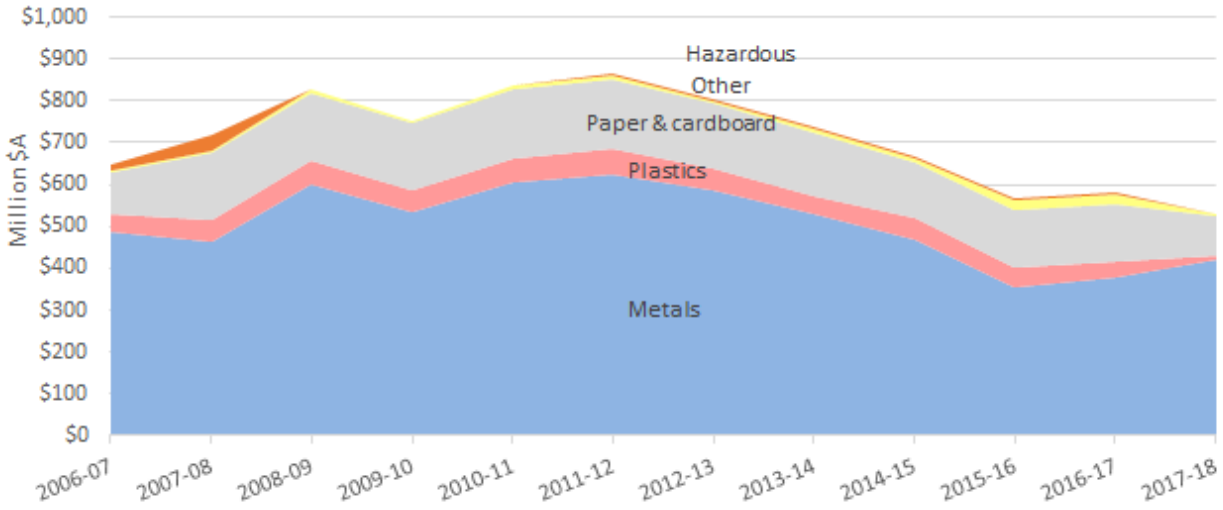
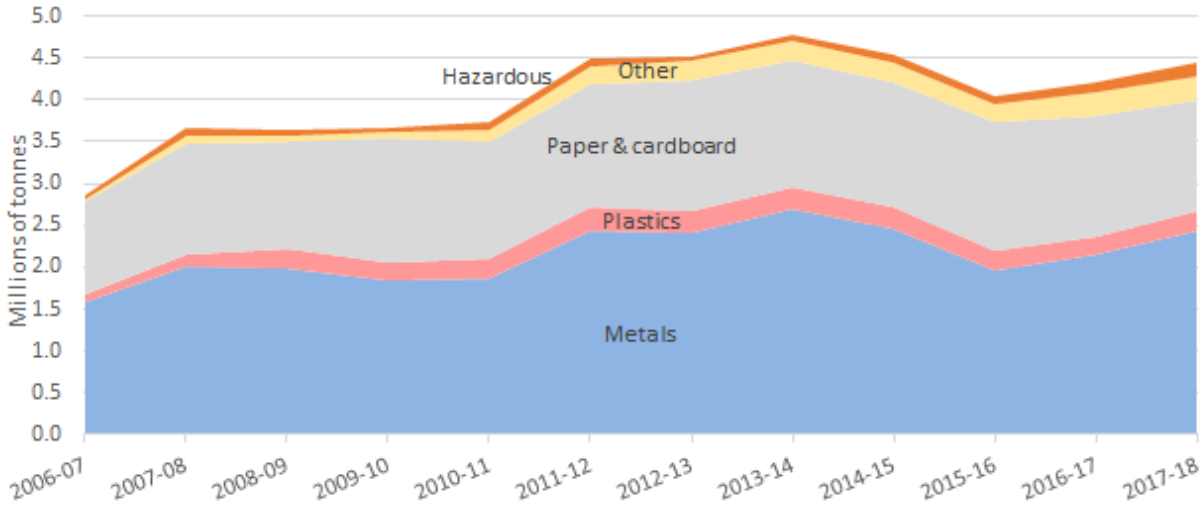


Figure 3 displays exports of waste tonnages to all destinations over the same time period. The effect of the China announcements is not visible in this chart. Rather, waste exports increased last year and the year before, consistent with the long-term trend. Between 2016-17 and 2017-18 exports of all wastes grew by 0.23 Mt (5%) to reach 4.44 Mt. There is some variability by material type – the years of highest export tonnages were for plastics 2011-12, for metals 2013-14 and for paper and cardboard 2012-13.

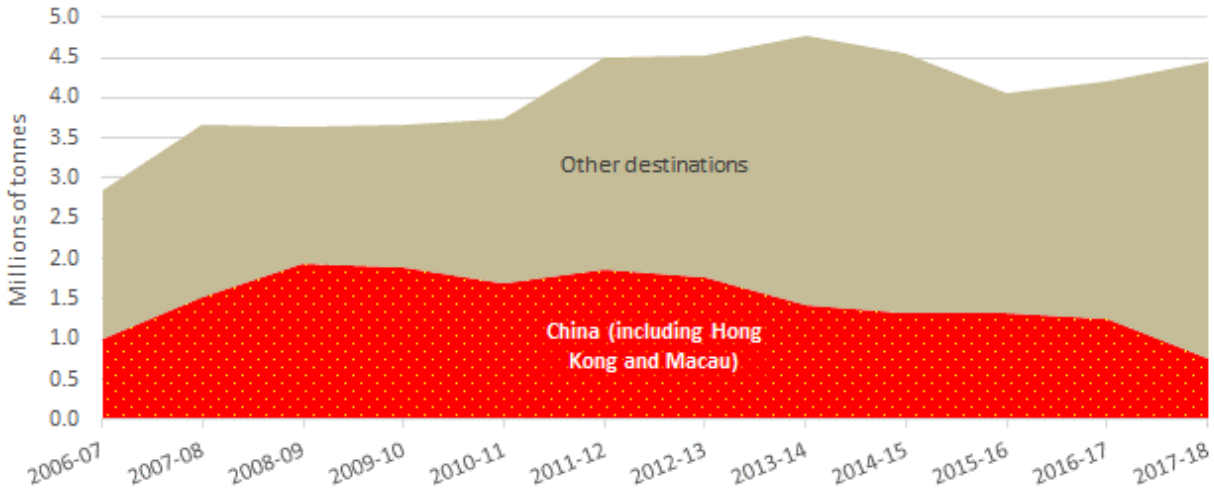
Figure 3 Exports of waste from Australia to all destinations by financial year and type



The value of 2017-18 waste exports were $A340 million (13%) higher than in 2016-17, despite a 2.7% rise in the average value of the Australian dollar against the US dollar, in which currency most trades occur. A similar rise was experienced between 2015-16 and 2016-17.

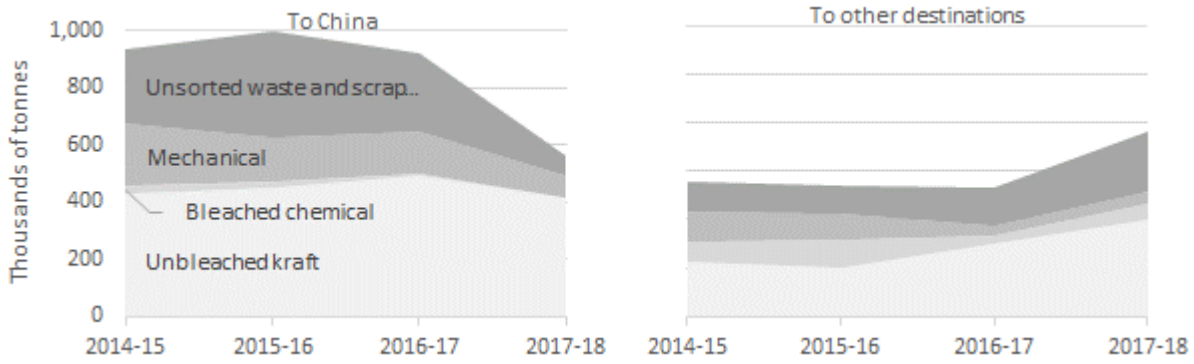
Figure 4 confirms that the decline in waste exports to China was more than offset by higher exports to other countries.

Figure 4 Exports of waste from Australia to China and other destinations by financial year



The waste type most affected by the China restrictions, in tonnage terms, was paper and cardboard. Figure 5 examines the trend in exports of paper and cardboard over the past four years. It distinguishes exports to China (on the left) from those to other destinations (on the right) and shows material grade. In 2017-18 exports of all grades to China dropped and other destinations received increased volumes of 'unbleached kraft' (comprising packaging and industrial grades including old corrugated containers) and 'unsorted waste and scrap' (primarily from household recycling bins). Exports of mechanical pulp (newsprint) to all destinations declined.

Figure 5 Exports of scrap paper and cardboard from Australia to China and other destinations by financial year



In proportional terms, exports of waste plastics were most affected by the China restrictions, declining 78% from 2016-17 levels. Figure 6 examines the trend in exports of plastics over the past four years, displaying exports to China on the left and to other destinations on the right, and showing the main export grades. In 2017-18 exports of the two main grades exported to China – polymers of ethylene and mixed plastics – fell markedly. For both, exports to other destinations increased. Overall exports of waste plastics increased by 2%, suggesting alternative destinations were found for lost Chinese export markets.

Figure 6 Exports of waste plastic from Australia to China and other destinations by financial year

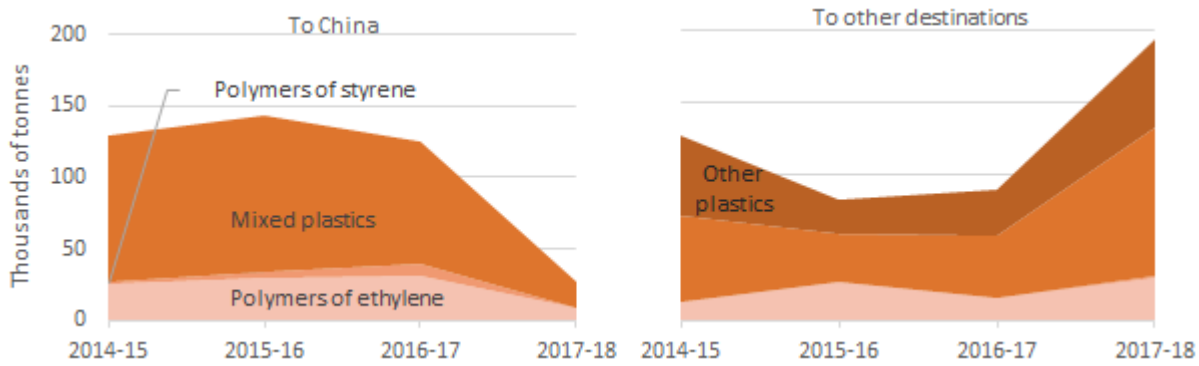
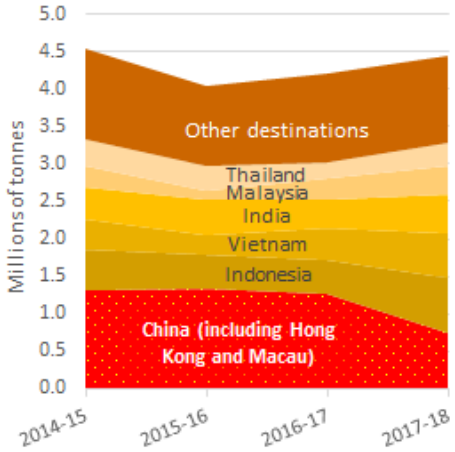


Figure 7 breaks down all waste exports by destination, ranking the six destinations that received the most materials over the past four years. China was the top ranked destination in each of these years. As its tonnages declined in 2017-18 there was no single substitute. Exports increased to each of Indonesia, Vietnam, India and Malaysia, as well as some other countries.

Figure 7 Exports of waste from Australia by financial year, showing the top six recipient destinations



2017-18 in focus

Figure 8 shows exports of waste to China by type and by month during 2017-18. Scrap metals exports declined in the early part of the year, spiked in February, then grew in the last quarter. Plastics shrank and remained weak. After significant falls, exports of waste paper and cardboard recovered strongly in the last quarter. The growth was across the various grades but mostly unbleached kraft.

Figure 8 Exports of waste from Australia to China by month and type, 2016-17

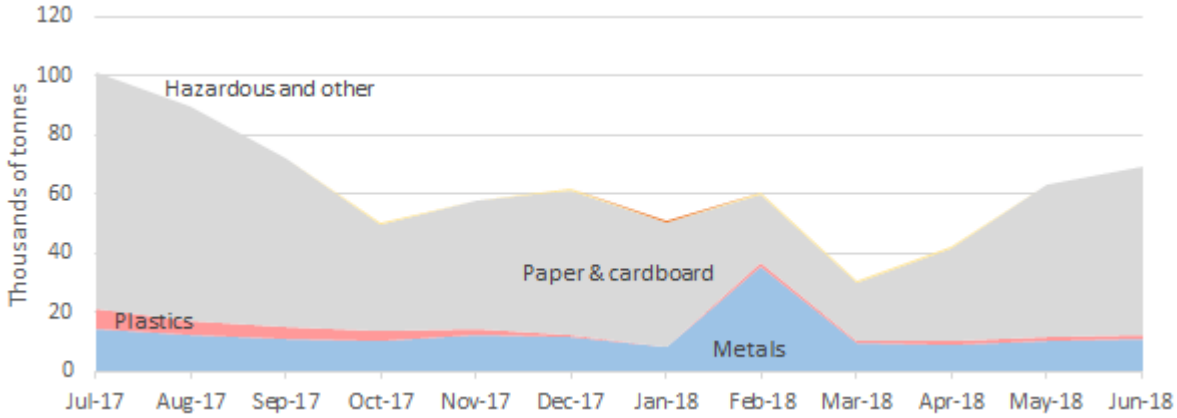
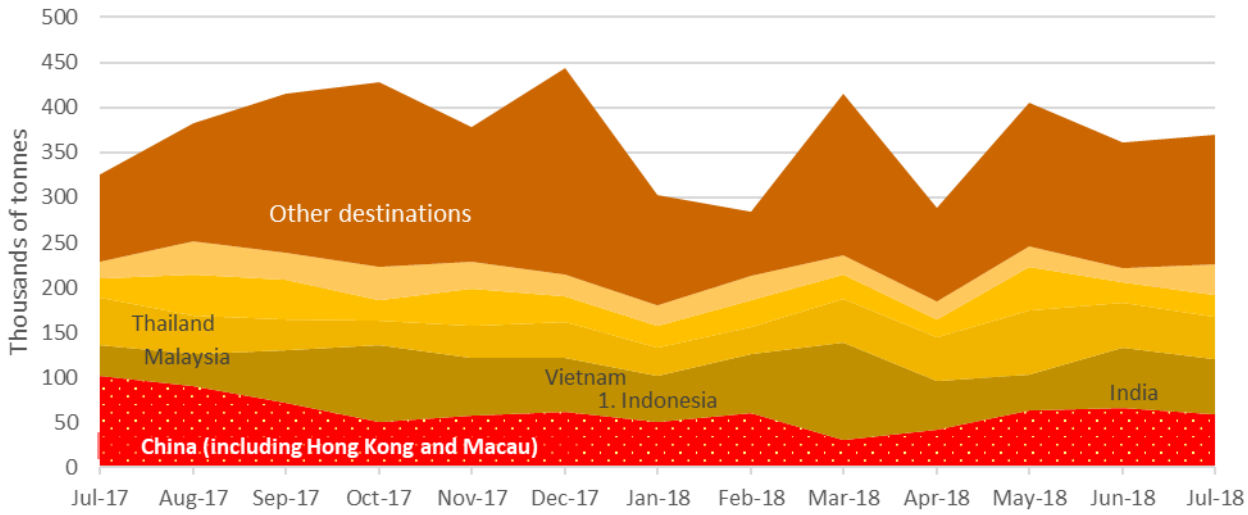


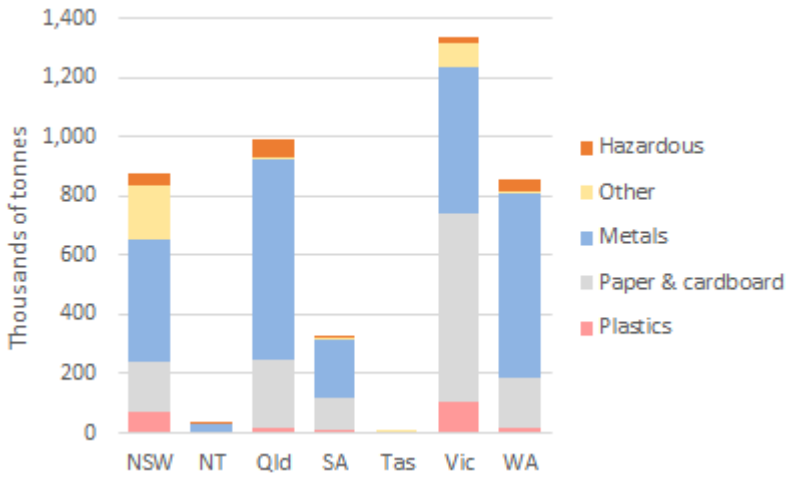
Figure 9 shows exports from Australia in 2017-18 by month, again ranking the six destinations receiving the most materials. China started the year as the top ranked destination and ended as the second ranked, but its share was falling for most of the year and in March it was ranked seventh. Again, there is no single obvious substitute destination for China – exports increased variably to each of the top destinations.

Figure 9 Exports of waste from Australia by destination and month, 2016-17



Australia's 2017-18 exports of waste materials were exported from ports in the jurisdictions shown in Figure 10. The fact that material was exported from a jurisdiction does not necessarily mean it was generated within that jurisdiction – it may have been transported from interstate.

Figure 10 Australian 2017-18 waste exports by jurisdiction of origin



Context – Australian waste exports compared with overall waste flows

The most recent published national data (2014-15) had Australia generating 64 million tonnes (Mt) of waste, sending 54% (35 Mt) to recycling, 4% to energy recovery and 42% to disposal in landfill and incineration. In 2017-18 Australia exported 4.44 Mt of waste (about 13% of national recycling and 8% of national waste generation) including 0.75 Mt to China (17% of all exports and 2% of national recycling). Table 1 compares quantities recycling in Australia with exports of waste materials, noting that nearly all exports are destined for recycling or energy recovery.

The table suggests that about half of recovered metals, plastics and paper and cardboard were exported in 2017-18. Nearly all other recovered materials were recycled in Australia. These encompass a wide range

of materials but the majority of the tonnes were demolition materials, organic wastes and fly ash from coal-fired power stations.

Table 1 Data comparing Australian exports and overall recycling of wastes

Waste material type	Quantity recycled in 2014-15 [1] *(thousands of tonnes)*	Quantity exported in 2017-18 *(thousands of tonnes & percent of 2014-15 recycling[2])*		Quantity exported to China[3] in 2017-18 *(thousands of tonnes & percent of all exports)*	
Metals	4,867	2,445	50%	156	6%
Paper & cardboard	3,294	1,317	40%	558	42%
Plastics	346	219	63%	27	12%
Other, incl. hazardous	26,846	448	2%	4	1%
All wastes	**35,353**	4,429	13%	750	17%

Notes:

1 *The most recent published national data set, taken from the National Waste Report 2016. Comprises materials entering recycling processes. The National Waste Report 2018 will be released by the end of this year, reporting 2016-17 data.*

2 *Individual values may not sum to the 'All wastes' total due to rounding.*

3 *Including Hong Kong and Macau.*

Analysis

The China restrictions delivered a major shock to the recycling sector, particularly operators of materials recovery facilities processing household recyclables. The waste products most affected are waste plastics and paper and cardboard, especially lower grade mixed products. Scrap metals exports have been less impacted because China was receiving a much smaller proportion of these materials prior to its announcements.

Notwithstanding the disruption, waste exports increased in quantity and value during 2017-18. The waste sector, it would seem, was able to find alternative export markets. These were largely Asian countries. Exports increased to each of the top five recipients of Australian waste products after China – Indonesia, Vietnam, India, Malaysia and Thailand.

Further, while exports to China tumbled during 2017-18 – reaching one third of their July 2017 quantity in March 2018 – they subsequently recovered strongly, mainly through growth in exports of paper and cardboard. Paper industry expert Tim Woods of IndustryEdge nominates three factors that may help explain this:

1. Some operators applied higher levels of sorting, particularly of existing inventories, to meet China's new 0.5% contamination limit. This is apparent in Figure 4, which shows the overall quantity of unsorted waste and scrap contracted while unbleached kraft and bleached chemical grades grew, suggesting some conversion between grades.
2. The China restrictions diverted demand towards higher grades, and some Australian operators were able to respond by redirecting higher grade materials to export and lower grades to their domestic production.
3. Chinese compliance efforts may have focused on waste imports from the USA.

Recent reports suggest that several Asian countries are reviewing their policies in relation to waste imports. If Malaysia, Vietnam and Thailand stopped waste imports, Australia would need to find substitute domestic or export markets for approximately 1.29 Mt (or $530 million) of waste a year, based on 2017-18 export amounts.

Helen Lewis Research

Overview of state waste infrastructure plans

Report to Department of Environment and Energy

FINAL

5 July 2018

CONTENTS

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EXECUTIVE SUMMARY

This report provides a summary of waste and resource recovery infrastructure support provided by state and territory governments. It includes waste and recycling strategies and financial assistance for infrastructure projects.

STRATEGIES

Most jurisdictions have a waste infrastructure plan but these vary in their level of detail and the extent to which they are up to date. Victoria and South Australia both released comprehensive infrastructure strategies in 2018 that focus specifically on infrastructure. Other strategies have a broader focus on waste and recycling, for example the ACT released its waste 'roadmap' in 2018 and Queensland released a 'directions paper' for consultation.

Some strategies are not as current as these, e.g. Northern Territory (2015), NSW (2014) and Tasmania (2009). Western Australia produced an infrastructure report in 2014 but it is not clear if this has been translated into strategy or policy. Because Tasmania does not have a current waste strategy, the report examines those prepared by the City of Hobart and the Northern Tasmania Waste Management Group.

PRIORITY MATERIALS AND EXCLUSIONS

Priority materials vary but most strategies have a common focus on organics: either all organics including timber (Queensland, Victoria, Hobart) or a specific focus on food and garden organics (NSW, ACT, Northern Tasmania). This is generally driven by waste reduction and recycling targets but may also be linked to other government policy goals such as industry development (Queensland's investment in 'biofutures' industries) or greenhouse gas abatement (Victoria).

Other priorities include materials collected from kerbside, particularly plastics, paper/cardboard and glass (most jurisdictions), e-waste (Victoria), household hazardous wastes or 'problem' wastes (NSW, SA) and packaging covered by a container deposit scheme (NT). Most strategies exclude liquid and hazardous wastes.

INFRASTRUCTURE GRANTS

NSW, Victoria, SA and Northern Tasmania have existing grants for infrastructure funding, while Queensland has announced its intention to provide significant funding following introduction of the landfill levy.

Various types of infrastructure are eligible for funding depending on state and regional priorities. Examples include equipment that improves sorting of recyclable materials including MRF upgrades; new resource recovery or recycling facilities; kerbside collection bins; drop-off facilities for recyclable materials; organics recycling facilities; weighbridges; sheds or temporary cover for short term storage of recyclable materials; landfill consolidation and/or new/upgraded transfer stations; equipment to help businesses collect or recover their own waste; civil infrastructure projects that utilise recycled materials; and waste to energy facilities.

RESPONSES TO CHINESE IMPORT RESTRICTIONS

Victoria and NSW updated some of their grants programs in 2018 in response to pressures imposed by the Chinese import restrictions. The Victorian Government announced on 3 July that it will provide more money for its Resource Recovery Infrastructure Fund and will establish a new market development grants program, although no details have yet been published.

NSW is providing funding for:

- upgrades to MRFs to improve the quality of output, reduce contamination or increase throughput
- improvements to recycling facilities e.g. to increase capacity or improve sorting

- equipment to help product manufacturers use more recycled plastics, glass, and mixed paper/cardboard
- civil construction projects that incorporate MRF outputs including glass.

OVERVIEW BY JURISDICTION

The most recent state and territory government waste infrastructure plans and associated grants programs are summarised below.

TABLE 1: OVERVIEW OF INFRASTRUCTURE PLANS AND ASSOCIARED GRANTS PROGRAMS

Jurisdiction	Strategy	Infrastructure priorities		Exclusions	Grant programs
		Type	Materials		
Queensland	Transforming Queensland's Recycling and Waste Industry: Directions paper (2018)	Infrastructure to support waste levy e.g. weighbridges Resource recovery infrastructure upgrades	Organic wastes as feedstock for 'biofutures' industries		To be developed
NSW	Waste Avoidance and Resource Recovery Strategy 2014-2021	New or enhanced infrastructure for recovery of MSW and C&I materials Permanent drop-off facilities for household problem wastes	Food and garden organics (FOGO) 'Problem wastes' including household hazardous waste	Many grant programs exclude asbestos, contaminated waste, gaseous and liquid waste	Numerous programs under Waste less recycle more including the new Product Improvement Program
Victoria	Statewide waste and resource recovery infrastructure plan Victoria (2018), supported by seven regional plans	Kerbside collection of FOGO Collection facilities for e-waste Waste and resource recovery hubs Improved sorting at MRFs	Organics, e-waste, plastics, tyres, glass fines, concrete and aggregates	Hazardous waste – will be addressed in the next update of the SWRRIP	Resource Recovery Infrastructure Fund; E-waste Infrastructure Support Program; Recycling Industry Transition Support Grants; Waste to Energy Infrastructure Fund
South Australia	South Australia's Waste and Resource Recovery Infrastructure Plan (2018)	Wide range of infrastructure including kerbside collection, drop-off facilities, MRFs, reprocessing including waste-to-energy (WTE)	No priorities identified. Scope includes all MSW, C&I, C&D, hazardous waste	Replacement or upgrades of existing waste and resource recovery facilities New cells in existing landfills	Recycling infrastructure grants – industry and local government Loan scheme for local government & industry
Tasmania	Northern Tasmania Regional Waste Management Strategy (2017-2022)	Kerbside FOGO collection Regional C&D recovery facility Upgrading transfer stations to increase recovery, incl. colour sorting glass Collection facilities for household hazardous and problem wastes E-waste collection	Organics C&D waste Household hazardous wastes e.g. batteries, paint, gas bottles Problem wastes e.g. e-waste, glass	None mentioned	Resource Recovery Grants Program

	City of Hobart Waste Management Strategy (2015-2030)	Green waste kerbside collection, followed by food waste Organics processing Regional C&D sorting facilities	Organic waste C&D materials Glass	None mentioned	
Western Australia	Infrastructure Plan Investigation Report (2014) – expected to be the first stage of the planning process	Mixed putrescible waste processing for materials or energy Waste facility precincts / co-location	Municipal solid waste, C&I, C&D	Liquid, hazardous, clinical or radioactive waste Regions outside Perth metropolitan and Peel regions	Better Bins Program ($20m)
Northern Territory	Waste management strategy for the Northern Territory (2015-2022)	Consolidate recycling infrastructure in regional locations Rollout of CDS scheme Improved landfill operation Asbestos disposal	All wastes including solid waste, problem wastes (liquid, hazardous, asbestos, clinical, batteries etc)		Container deposit scheme infrastructure grants Strategic local government infrastructure fund
Australian Capital Territory	ACT waste management strategy (2011-2025) – will be updated to reflect waste feasibility study and roadmap (below)	Mixed commercial waste MRF Residual waste MRF (household and possible wet commercial waste) Waste to energy facilities Hume Resource Recovery Estate (co-location of recycling activities)	Commercial waste Organic waste Residual waste	None mentioned – strategy covers all wastes	None identified
	Waste feasibility study roadmap and recommendations (2018)	Food and garden organics (FOGO) composting facility FOGO kerbside collection service Modified C&I collection service to improve processing outcomes Process engineered fuel (PEF) plant	Organics including FOGO, timber Recyclable materials in residual waste	None mentioned – strategy covers all wastes	None identified

INTRODUCTION

This report provides a summary of waste and resource recovery infrastructure support provided by state and territory governments. The review covers:

- state-wide strategies and funding programs
- any infrastructure support including buildings, associated civil works and equipment
- projects relating to collection, recovery (sorting, consolidating, aggregating), reprocessing and disposal of waste materials
- waste generated in all sectors (commercial and industrial (C&I), construction and demolition (C&D) and municipal waste) and all materials.

OVERVIEW

STRATEGIES

Victoria and South Australia both released comprehensive infrastructure strategies in 2018 that focus specifically on infrastructure. Other strategies have a broader focus on waste and recycling. The ACT released its waste 'roadmap' in 2018 and Queensland released a 'directions paper' for consultation. Other strategies are not as current, e.g. Northern Territory (2015), NSW (2014) and Tasmania (2009). Western Australia produced an infrastructure report in 2014 but it is not clear if this has been translated into strategy or policy. Because Tasmania does not have a current waste strategy, the report examines those prepared by the City of Hobart and the Northern Tasmania Waste Management Group.

Infrastructure plans vary widely depending on a range of factors including:

- **Availability of funding**: e.g. the NSW waste levy generates enough income for multiple infrastructure grants programs; Queensland's levy will only commence in 2019; Tasmania does not have a state-wide levy but councils in northern Tasmania collect and manage their own levy
- **Links to other government policies**: e.g. Victoria is supporting e-waste collection infrastructure to support a ban on e-waste to landfill, Queensland has a focus on recovery of organics to support their 'biofutures' industry development strategy, while the ACT is focusing on organics and waste to energy to meet an ambitious waste diversion target.

PRIORITY MATERIALS AND EXCLUSIONS

While priority materials vary, most strategies have a common focus on organics: either all organics including timber (Queensland, Victoria, Hobart) or food and garden organics (NSW, ACT, Northern Tasmania). This is generally driven by waste reduction and recycling targets but may also be linked to other government policy goals such as industry development (Queensland) or greenhouse gas abatement (Victoria).

Other priorities include materials collected from kerbside, particularly plastics, paper/cardboard and glass (most jurisdictions), e-waste (Victoria), household hazardous wastes or 'problem' wastes (NSW, SA) and packaging covered by a container deposit scheme (NT).

Most strategies exclude liquid and hazardous wastes. There are a few exceptions:

- the SA strategy includes all waste including hazardous materials
- NSW and Northern Tasmania include household hazardous waste
- Victoria plans to include hazardous waste in the next update of its infrastructure strategy.

INFRASTRUCTURE GRANTS

NSW, Victoria, SA and Northern Tasmania have existing grants for infrastructure funding, while Queensland has announced its intention to provide significant funding following introduction of the landfill levy.

The types of infrastructure eligible for funding vary according to the needs and priorities in each jurisdiction. Examples include (although this is not comprehensive):

- equipment that improves sorting of recyclable materials including MRF upgrades (NSW, SA, Victoria, Northern Tasmania)
- new resource recovery or recycling facilities (Queensland, NSW, Victoria)
- kerbside collection bins (WA)
- drop-off facilities for recyclable materials, e.g. container deposit collection points (NT), community recycling centres (NSW), e-waste (Victoria), public place recycling / C&I / C&D materials (Northern Tasmania)
- organics recycling facilities (NSW, Victoria)
- feasibility studies for innovative resource recovery and waste management projects (Queensland)
- weighbridges (Queensland, NSW)
- sheds / temporary cover for short term storage of recyclable materials (Victoria, NSW)
- landfill consolidation and/or new/upgraded transfer stations (NSW, Northern Tasmania)
- equipment to help businesses collect or recover their own waste (NSW)
- civil infrastructure projects that utilise recycled materials (NSW)
- waste to energy facilities (NSW, ACT, Victoria).

There appears to be an increasing focus on waste to energy (WTE) although this is not across the board. Target materials include residual waste (NSW, ACT) or targeted organics (Victoria). Victoria is the only jurisdiction to target waste to energy facilities through a dedicated grants program. The ACT government is planning to invest in a process engineered fuel (PEF) plant. SA's infrastructure plan includes WTE for non-recyclable materials in its scenario planning but WTE technologies are currently excluded from grants programs.

RESPONSES TO CHINESE IMPORT RESTRICTIONS

Victoria and NSW updated some of their grants programs in 2018 in response to pressures imposed by the Chinese import restrictions. The Victorian Government announced on 3 July that it will provide more money for its Resource Recovery Infrastructure Fund and will establish a new market development grants program, although no details have yet been published.

NSW is providing funding for:

- upgrades to MRFs to improve the quality of output, reduce contamination or increase throughput
- improvements to recycling facilities e.g. to increase capacity or improve sorting
- equipment to help product manufacturers use more recycled plastics, glass, and mixed paper/cardboard
- civil construction projects that incorporate MRF outputs including glass.

The SA Government announced it would provide grants to support market development for recycled materials and recycled content products, but eligible activities do not appear to cover infrastructure.

FUNDING CRITERIA

Examples of the types of criteria used for assessing infrastructure grant applications include:

- alignment with relevant state or regional infrastructure plans

- a strong/credible business case
- sources of raw material and/or end markets identified and secured
- suitability of the project/effectiveness of technology for the application
- compliance with relevant planning and environmental regulations
- minimum quantity of materials to be diverted
- recovery of priority materials, e.g. those affected by Chinese restrictions
- reduction in waste to landfill
- benefits that extend beyond the immediate project, e.g. social/economic benefits, jobs, greenhouse gas savings, knowledge transfer
- sound project planning
- minimum co-contributions from the applicant or other project partners
- value for money, e.g. measured as cost per tonne diverted / jobs created
- completion by a specified end date.

SUMMARY BY JURISDICTION

A summary is provided for each jurisdiction below.

QUEENSLAND

The Queensland Department of Environment and Science is currently updating the state's resource recovery and waste management strategy to include a landfill levy, funding for infrastructure and a policy to promote 'safe and sustainable' waste to energy technologies for residual waste. Submissions have been invited on a Directions Paper.

STRATEGY

Strategy	Infrastructure priorities		Exclusions	Grant programs
	Type of infrastructure	Materials		
Transforming Queensland's Recycling and Waste Industry: Directions paper (June 2018) – consultation paper for proposed new resource recovery and waste management strategy	Infrastructure to support collection of new waste levy (planned for 2019) including landfill weighbridges & security fences. Resource recovery infrastructure upgrades and market development (details still to be developed) Infrastructure in 'key regional areas' to create markets and jobs	Organic wastes as feedstock for 'biofutures' industries (fuels, plastics, chemicals), e.g. food waste		Levy will be used to fund (from 2019) grants for local govt. waste disposal infrastructure upgrades and grants and loans for industry resource recovery infrastructure upgrades & market development

GRANT PROGRAMS

There is no detail on the infrastructure grants and loans anticipated in the Directions Paper. The paper identifies the following priorities:

- Local government: 'waste disposal infrastructure upgrades'
- Small business and industry: 'grants and funding programs…that can assist the resource recovery sector to upgrade infrastructure and develop new markets for recovered materials' and to stimulate investment in 'expanded and innovative technologies that process residual waste and support local processing facilities in regional areas'

The budget announced a $100m resource recovery program with funding available from late 2018.

Program name	**Priorities**		**Exclusions**	**Detail / status**
	Types of infrastructure	**Materials**		
Resource Recovery Industry Development Program ($100m)	Infrastructure or machinery up to $5m New large-scale facilities Advanced feasibility studies for innovative resource recovery and waste management projects	Details not available	Details not available	Will open late 2018

NEW SOUTH WALES

STRATEGY

Strategy	**Infrastructure priorities**		**Exclusions**	**Grant programs**
	Priority infrastructure	Priority materials		
Waste Avoidance and Resource Recovery Strategy 2014-2021	New or enhanced infrastructure for recovery of MSW and C&I materials Permanent drop-off facilities for household problem wastes	Food and garden organics (C&I, MSW) 'Problem wastes' including HHW – paint, gas bottles, fire extinguishers, motor and cooking oils, car and household batteries, fluorescent tubes	No general exclusions although many grant programs exclude asbestos, contaminated waste, gaseous and liquid waste	Resource Recovery Facility Expansion and Enhancement Program Major Resource Recovery Infrastructure Program Weighbridge Fund Landfill consolidation and environmental improvements

		and globes, and smoke detectors		Bin Trim rebates Circulate Recycling innovation grants fund Community recycling centre infrastructure grants Organics Infrastructure (Large and Small) Organics infrastructure Fund and Program: Organics collection grants program

GRANT PROGRAMS

The Waste less recycle more package ($337m over 4 years) includes a wide range of grant programs. Some target infrastructure specifically while others have an infrastructure component.

In response to the China Sword Policy, in 2018 the Government announced a $47 million support package funded by the Waste Less, Recycle More Initiative to ensure kerbside recycling continues and to promote industry innovation. This includes:

- the new Product Improvement Program to help industry identify new uses and markets for recyclable materials, and to develop local processing and remanufacturing capability to help ensure recycling services are maintained in future years ($4.5m)
- Changes to Round 3 of the Circulate, Industrial Ecology Program to include projects that deal with municipal waste materials impacted by China's National Sword Policy – it was previously limited to C&I waste only ($2.5m)
- Changes to Round 1 of the Civil Construction Market Program to broaden the range of source materials to include glass, paper, cardboard and plastics from MRFs ($2.5m).

Program name	**Priorities**		**Exclusions**	**Detail / status**
	Types of infrastructure	**Materials**		
Waste and Recycling Infrastructure Fund: Resource Recovery Facility Expansion and Enhancement Program ($8m)	Improvements to recycling infrastructure at existing licensed recycling facilities to increase recovery, e.g. to improve sorting or expand capacity	Reuse/recycling of materials from households and business, e.g. paper, glass, metals, tyres, rubber, wood/timber, plastics, cardboard and consumer packaging, e-waste,	Asbestos and contaminated waste Food and garden organics New facilities Upgrades where primary purpose of the project is to convert waste to energy	Available to private sector, not-for-profit, councils Not currently open (round 5 recipients announced 5/18)

Program name	Priorities		Exclusions	Detail / status
	Types of infrastructure	Materials		
		plasterboard and other C&D wastes Residual waste	Projects that don't recover additional material	
Product Improvement Program ($4.5M)	Equipment upgrades or process improvements to an existing MRF to increase the quality of output materials, reduce contamination or increase capacity e.g. optical sorters Equipment to improve the quality of outputs from MRFs or reprocessors e.g. shredding, washing, pelletising, or to improve storage, e.g. sheds, temporary cover Equipment to help product manufacturers use more recycled material	Waste generated by households and C&I but will give preference to projects that prioritise glass and materials affected by China's National Sword policy; i.e., mixed paper/ cardboard and plastics	New MRFs (covered by Major Resource Recovery Infrastructure grants program – see below) Food and garden organics (covered by Organics Infrastructure Fund – see below) Waste to energy	Round 1 now open (closes 23/7) Available to MRFs, reprocessing and secondary reprocessing facilities, product manufacturers using post-consumer material
Major Resource Recovery Infrastructure Program $25m)	Investment in major new waste and recycling infrastructure facilities Processing, stabilisation and energy recovery of residual waste Facilities based on priorities in Regional Waste Strategies for household waste	Reuse/recycling of materials from households and business, e.g. paper, glass, metals, tyres, rubber, wood/timber, plastics, cardboard and consumer packaging, e-waste, plasterboard and other C&D wastes Residual waste	Asbestos and contaminated waste Food and garden organics Existing facilities	Available to private sector, not-for-profit, councils. Up to 50% of capital costs. Currently closed: will open for round 4 later in 2018.
Waste and Recycling Infrastructure Fund:	Installation of weighbridges at waste and recycling facilities in the waste levy areas and licensed	No restrictions apart from on type of facility	Facilities that received >5000 tonnes of waste last year	Open for applications

Program name	Priorities		Exclusions	Detail / status
	Types of infrastructure	Materials		
Weighbridge Fund ($0.5m)	landfills outside the waste levy area		Facilities for clinical & related waste, liquid waste, hazardous or restricted solid waste; slags or virgin excavated natural material; ceramic works, composting, container reconditioning, contaminated soil treatment, or paper or pulp production facilities; facilities licensed only for metallurgical activities	
Local Government Waste and Resource Recovery Program – Landfill consolidation and environmental improvements ($5m)	Landfill consolidation and closure, building and upgrading transfer stations Aims to address current issues facing regional & rural landfills including end of life, minimal cover, site security and access and overall supervision	All	Metropolitan councils	Available to councils in regional & rural areas
Business recycling program: Bin Trim rebates ($12.5m)	Provides small and medium-sized businesses with rebates for small-scale, on-site recycling equipment Examples: balers, compactors, glass crushing machines, commercial worm farms, composters, recycling bins etc	Must divert priority materials including paper, cardboard, plastic (including expanded polystyrene), food, organics and wood/timber, however, other materials will also be considered	Garbage compaction units	Available to businesses with up to 400 FTE employees, and facility managers and small-scale recyclers responsible for managing the waste of small to medium-sized businesses Applications are open

Program name	Priorities		Exclusions	Detail / status
	Types of infrastructure	Materials		
Business recycling program: Circulate ($5.46m)	Supports industrial ecology initiatives that reduce waste to landfill, which may include recycling equipment	C&I, C&D	MSW, liquid or gaseous waste, asbestos, waste-to-energy	Application open Under the response to the China National Sword, eligibility has been expanded to support new uses for recycled materials
Recycling innovation grants fund ($5m)	Includes funding for 'new recycling infrastructure solutions'	'Problematic' materials not captured under other programs, do not have existing markets or are contaminating other waste streams	Non-target materials	Program currently being reviewed Available to industry, councils, not-for profit, tertiary/research organisations
Household problem waste program: Community recycling centre (CRC) infrastructure grants ($3m)	Upgrades to existing CRC (drop-off) facilities or the construction of new facilities in target areas: buildings, concrete slabs, receptacles etc	'Problem wastes' e.g. paint, gas bottles, fire extinguishers, motor and cooking oils, car and household batteries, fluorescent tubes and globes, and smoke detectors	CRCs in non-target areas Receptacles for some products e.g. paint, to be supplied by collector Land purchase, operating expenses etc	Available to councils, not-for-profits, private sector Currently closed
Organics infrastructure Fund and Program: Organics Infrastructure (Large and Small) ($14M)	Infrastructure and equipment to reuse or recycle source separated food and garden waste that would otherwise be landfilled; infrastructure that will improve product quality and consistency	Food and garden organics	Non-source separated organics, sources other than MSW or C&I; waste that would not have previously been disposed to landfill, stockpiled or burnt at a waste facility	Currently closed Available to councils & businesses

Program name	Priorities		Exclusions	Detail / status
	Types of infrastructure	Materials		
Organics infrastructure Fund and Program: Organics collection grants program ($10M)	Funding to support new or enhanced collection services for garden or food organics from households or businesses (two separate funding streams). Covers a % of costs for trucks, bins, lifters etc	Food and garden organics	Various including liquid food injection	Currently open Available to councils and businesses
Civil Construction Market Program ($2.5M)	Projects that reduce or recover C&D materials. Applies to publicly owned construction projects in NSW. E.g. using recycled materials in road construction	Source materials broadened in response to China Sword to include post-consumer materials from MRFs e.g. glass		Available to business, not for profit organisations, councils, industry bodies, product stewardship groups Currently open – available until funds exhausted or June 2020

VICTORIA

STRATEGY

Strategy	Infrastructure priorities		Exclusions	Grant programs
	Types of infrastructure	Priority materials		
Statewide waste and resource recovery infrastructure plan (SWRRIP) Victoria (2018), supported by seven regional plans	Council kerbside collection of food and garden organics Collection facilities for e-waste at resource recovery and transfer stations Waste and resource recovery hubs (consolidation and aggregation	Organics (including timber), e-waste, plastics, tyres, glass fines, concrete and aggregates Regional plans prioritise food organics to achieve recovery of organics, and some additional priority materials	Hazardous waste (prescribed industrial waste) – will be addressed in the next update of the SWRRIP	Resource Recovery Infrastructure Fund E-waste Infrastructure Support Program Recycling Industry Transition Support Grants Waste to Energy Infrastructure Fund

	for further sorting and processing) Improved sorting at MRFs			

GRANT PROGRAMS

On 3 July 2018 the Government announced details of its $37 million package to support recycling in response to the disruption caused by the China Sword policy. This includes a commitment to support markets for recycled products through government procurement and a community education campaign. Infrastructure projects include an additional $8.3m for the Resource Recovery Infrastructure Fund, $4.5m for market development and $800,000 for improvements to kerbside collections.

Program name	**Priorities**		**Exclusions**	**Detail/status**
	Types of infrastructure	**Materials**		
Resource Recovery Infrastructure Fund ($13.6m + additional $8.3m in response to China Sword)	New infrastructure or upgrades that lead to improved recovery Projects aligned with goals and priorities in the SRRIP and/or addressing opportunities in Regional Waste Management Plans	Food organics, rigid and soft plastics, and e-waste Priority materials identified in regional plans	Disposal infrastructure, operational costs	Applications open (closes 31 July) Available to councils and businesses located in and servicing Victoria
E-waste Infrastructure Support Program ($15m)	Fixed or semi-permanent e-waste infrastructure (including signage) upgrades for compliant collection and storage of e-waste, at 'primary and secondary sites' identified in the Victorian E-waste Infrastructure Network (VECN) Assessment Report	Electrical or electronic equipment with a power cord or battery and its parts that have been discarded by the owner as waste without the intention of re-use	Infrastructure upgrades at sites not identified within the VECN Non-permanent infrastructure or e-waste collection units	Currently open Available to local and state government organisations

Recycling Industry Transition Support Grants ($1m)	Infrastructure, equipment and process upgrades at MRFs to support greater sorting and decontamination Infrastructure and equipment upgrades to reprocess PPC to a commercial grade Storage and consolidation infrastructure for short-term storage of PPC	Plastics, paper, cardboard (PPC)	Hazardous waste	Currently closed – no advice on next round Available to recovery and reprocessing operators
Waste to Energy Infrastructure Fund ($2.38m)	New or upgraded waste-to-energy (WTE) infrastructure resulting in an increase in greenhouse gas abatement, including anaerobic digestion and thermal treatment of waste	Organic and 'other materials'		Currently closed (last round closed April 2017) Victorian Government is developing its WTE policy
Market development grants ($4.5m) - new	No details available			

South Australia

Strategy

Strategy	Infrastructure priorities		Exclusions	Grant programs
	Types of infrastructure	Priority materials		
South Australia's Waste and Resource Recovery Infrastructure Plan (2018)	Wide range of infrastructure including kerbside collection, drop-off facilities, MRFs, reprocessing including WTE Includes regional plans	No priorities identified. Scope includes all MSW, C&I, C&D, hazardous waste, 'specialised and problematic waste streams'	Replacement or upgrades of existing waste and resource recovery facilities New cells in existing landfills	Recycling infrastructure grants – industry and local government Loan scheme for local government & industry

GRANT PROGRAMS

Program name	Priorities		Exclusions	Detail/status
	Types of infrastructure	Materials		
Recycling infrastructure grants – industry and local government ($5.8m)	New or upgrading infrastructure and/or equipment to enable value adding of targeted materials for local use Projects which improve sorting and/or processing to enhance quality through reduced contamination	Paper, cardboard, glass and plastic Materials affecting the financial viability of MRFs such as glass fines Materials banned from landfill	Waste to energy C&D wastes Landfill	Currently open Available to industry, local government
Loan scheme for local government & industry ($5m)	Projects with large capital requirements which can have an immediate effect to increase local remanufacturing /reprocessing of targeted waste streams, including equipment that reduces contamination and improves the quality and volume of kerbside and/or C&I recyclable materials	Paper, cardboard, glass and plastic Materials affecting the financial viability of MRFs such as glass fines	Waste to energy C&D wastes Landfill	Currently open Available to recycling businesses and local government

TASMANIA

STRATEGY

Strategy	Infrastructure priorities		Exclusions	Grant programs
	Types of infrastructure	Priority materials		
Tasmania Waste Management and Resource Recovery Strategy (2009)	Facilitate the development of infrastructure and best practice facilities to meet Tasmania's waste & resource management needs Infrastructure for the management of controlled waste	None mentioned	Biosolids	

Northern Tasmania Regional Waste Management Strategy (2017-2022)	Kerbside organics collection (FOGO) Regional C&D recovery facility Upgrading transfer stations to increase recovery, incl. colour sorting glass Collection facilities for household hazardous and problem wastes E-waste collection	Food and garden organics (FOGO) C&D waste Household hazardous wastes e.g. batteries, paint, gas bottles Problem wastes e.g. e-waste, glass	None mentioned	Resource Recovery Grants Program
City of Hobart Waste Management Strategy (2015-2030)	Green waste kerbside collection, followed by food waste Organics processing Regional C&D sorting facilities	Organic waste C&D materials Glass	None mentioned	

GRANT PROGRAMS

Program name	Priorities		Exclusions	Detail/status
	Types of infrastructure	Materials		
Northern Tasmania Waste Management Group Resource Recovery Grants Program ($70K)	Collection facilities, upgrades to MRFs or transfer stations, collection facilities for C&I or C&D waste, pubic place recycling	No priorities mentioned	Hazardous waste including asbestos	Currently closed

WESTERN AUSTRALIA

STRATEGY

Strategy	Infrastructure priorities		Exclusions	Grant programs
	Types of infrastructure	Priority materials		
Infrastructure Plan Investigation Report (2014) – expected to be the first stage of the planning process	Mixed putrescible waste processing for materials or energy Waste facility precincts / co-location	Municipal solid waste, C&I, C&D	Liquid, hazardous, clinical or radioactive waste Regions outside Perth metropolitan and Peel regions	Better Bins Program ($20m)

Western Australia Waste Strategy: Creating the Right Environment (2012) – currently being reviewed	Public purchase of strategic sites and buffers throughout the State Systems that achieve best practice outcomes Collection of problematic wastes	Municipal solid waste, C&I, C&D	Nuclear waste, mining spoil, agricultural wastes or industrial wastes managed onsite under license	

GRANT PROGRAMS

Program name	Priorities		Exclusions	Detail/status
	Types of infrastructure	Materials		
Better Bins Program ($20m)	Investment in best practice kerbside recycling systems (new or retrofitted bins), paid as an incentive payment per household	Household waste (general waste, recyclable waste, green waste/organics)	None mentioned	Currently closed

NORTHERN TERRITORY

STRATEGY

Strategy	Infrastructure priorities		Exclusions	Grant programs
	Types of infrastructure	Priority materials		
Waste management strategy for the Northern Territory (2015-2022)	Consolidate recycling infrastructure in regional locations Rollout of CDS scheme Improved landfill operation Asbestos disposal	All wastes including solid waste, problem wastes (liquid, hazardous, asbestos, clinical, batteries etc)		Container deposit scheme infrastructure grants Strategic local government infrastructure fund

GRANT PROGRAMS

Program name	Priorities		Exclusions	Detail/status
	Types of infrastructure	Materials		
Container deposit scheme infrastructure grants	Equipment or infrastructure for CDS collection depots or points	Packaging covered by CDS legislation		Currently open Available to councils, businesses, community etc

Strategic local government infrastructure fund	Examples include 'Waste management sites establishment/upgrades'			Grants invited annually Available to councils

Australian Capital Territory

Strategy

Strategy	Infrastructure priorities		Exclusions	Grant programs
	Types of infrastructure	Priority materials		
ACT waste management strategy (2011-2025) – will be updated to reflect waste feasibility study and roadmap (below)	Mixed commercial waste MRF Residual waste MRF (household and possible wet commercial waste) Waste to energy facilities Hume Resource Recovery Estate (co-location of recycling activities)	Commercial waste Organic waste Residual waste	None mentioned – strategy covers all wastes	None identified
Waste feasibility study roadmap and recommendations (2018)	Food and garden organics (FOGO) composting facility FOGO kerbside collection service Modified C&I collection service to improve processing outcomes Process engineered fuel (PEF) plant	Organics including FOGO, timber Recyclable materials in residual waste	None mentioned – strategy covers all wastes	None identified

Grant programs

None identified.