NSW Waste Sector
Volume II: Situational Analysis

NSW Environment Protection Authority

April 2019

pwc

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INFRASTRUCTURE PARTNERS

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1 Introduction

1.1 Background

The Environment Protection Authority (EPA) is the primary environmental regulator for New South Wales. It partners with business, government and the community to reduce pollution and waste, protect human health, and prevent degradation of the environment.

The EPA is working with Infrastructure NSW to outline a scope and concept for the development of a 20Year Waste and Resource Recovery Strategy for NSW. The purpose of the Strategy will be to set a 20 year vision and directions to reduce waste to landfill, driving sustainable recycling markets and identifying and improving the state and regional waste infrastructure network.

As part of this work, the EPA has engaged PricewaterhouseCoopers (PwC) and Sphere Infrastructure Partners (Sphere) together, the "Advisers' to prepare a situational analysis and demand projections for the NSW waste sector, and to benchmark the NSW waste sector against international or domestic best practice to identify innovation and areas of improvement.

This Report provides a situational analysis of the waste sector in NSW, including identifying long term challenges, risks and opportunities.

The Report is subject to the restrictions of use set out in the Important Notice at the front of this Report. This Report has been prepared by the Advisers for the EPA pursuant and subject to the terms of engagement with the EPA.

1.2 Approach and Methodology

The Report has been prepared in accordance with the following methodology:

- analysis of EPA data;
- analysis of independent research;
- consultation with the NSW Government;
- consultation with representatives from stakeholders involved in the NSW waste industry;
- analysis of waste policies and practices implemented by the NSW and other Governments domestically and internationally.

1.3 Scope of works

This Report considers the current state of the waste management and resource recovery sector in NSW, including identification of factors which currently influence demand and associated risks, challenges and opportunities.

The focus of this Report is on the solid wastes from the following waste streams in NSW:

- Commercial & industrial (C&I) - waste from commercial and industrial businesses;
- Construction & demolition (C&D) - waste from construction and demolition activities;
- Municipal Solid Waste (MSW) - municipal solid waste, from households and public places.

Waste from additional waste streams such as mining, forestry and agriculture are not specifically considered within this Report. This Report primarily focuses on solid waste, rather than liquid or gaseous waste.

The Report also briefly considers hazardous waste, e-waste and liquid trade waste as significant and particularly challenging components of the three core waste streams.

The scope of work comprised:

Situational analysis (Volume II) and demand projections

a) review available material (provided by the NSW EPA) and undertake any further research (of publicly available information) to analyse the waste sector in NSW covering:
    - generation, sorting, distribution, storage, recovery, resource recovery destinations/ markets, and disposal located domestically and internationally disaggregated by:
        - Construction and Demolition waste, Commercial and Industrial waste and Municipal solid waste
        - waste types, including e-Waste
        - waste recovered, and waste disposed
    - rates of waste generation, distribution, recovery, storage and disposal
    - synopsis of waste market and participants in the waste market
    - macro and micro factors that positively and negatively affect the waste market including (but not limited to):
        - household attitudes and behaviour, and consumer demand
        - the role of government
        - markets (including product and waste markets)
        - regulatory, policy and contractual frameworks
        - the extent, nature and hierarchy of the waste infrastructure network and industry structure
        - spatial issues and implications (for the State and interstate and international supply chains as well as within and between metropolitan and regional areas)
        - innovation
        - initiatives or arrangements to avoid or minimise waste generation

International benchmarking (Volume III)

Based on jurisdictions agreed with NSW EPA and subject to availability of information:

b) review available material, undertaking any further research and taking necessary soundings to analyse the current NSW waste sector. This includes understanding the factors that affect the generation and management of waste, the avoidance, of waste, use of recovered materials and the role of the waste industry
c) undertake research of best practice domestic and global leaders in the waste sector in an agreed number of jurisdictions, which includes (but is not limited to) investigating:
    - household attitudes and behaviour, and consumer demand
    - the role of government, markets (including product and waste markets)
    - regulatory, policy and contractual frameworks
    - the extent, nature and hierarchy of the waste infrastructure network and industry structure
    - spatial issues and implications (for the State and interstate and international supply chains as well as within and between metropolitan and regional areas)
    - innovation frameworks
    - initiatives or arrangements to avoid or minimise waste generation
    - lessons learnt from policy failures and market impediments
d) incorporate the latest thinking, research and evidence from policy and civil society institutions or from the academic community.

e) develop outcomes-focused objectives and criteria to support benchmarking analysis

f) benchmark NSW with best practice jurisdictions

g) develop draft and final reports to report on findings of benchmarking exercise and proposed areas of innovation and for improvement. These areas must explore:
   - the conditions for waste market investment attraction and retention
   - the competitiveness of the waste market
   - consumer behaviour change
   - waste system regulation, policy, monitoring and reporting
   - the choices available to use a range of government levers
   - the conditions for when and how government levers are exercised

h) develop a set of overarching directions and complementary recommendations in relation to these findings for inclusion in the draft and final reports. These recommendations must consider levers available to the State Government and could include levers beyond State-based environment protection legislation. The Service Provider may also make observations about the use of Commonwealth and local government levers too.

The nature and extent of the procedures undertaken by the Advisers in respect of the scope of works were subject to the availability of information and any revisions to the Adviser's approach and analysis, agreed with NSW EPA during the course of the engagement.

1.4 Data

The generation, disposal and recycling data presented in this Report has been primarily provided by the EPA and reflects reporting by licensed waste recovery and disposal facilities (in the regulated areas or receiving waste from a regulated area) through the Waste Avoidance and Resource Reporting Portal (WARRP).

The nature of the data collected is considered to be more comprehensive than the data collected prior to FY16 and is considered by the EPA to provide a more robust assessment of waste flows in NSW and the state's performance against targets under the Waste Avoidance and Resource Recovery (WARR) Strategy 2014-21. In this regard, reporting during the period FY16-FY18 is not considered to be on a comparable basis with FY15 and prior years, limiting any direct comparison of data between these periods. As a result, data reported in this Report primarily focusses on FY16-18. Where beneficial to the situational analysis, the Report commentary does consider comparable data in prior periods to aid the analysis.

FY16 was the first year in which licensed facilities were required to report into WARRP, and the first time that recovery facilities were required to report to the EPA. Implementation of the new reporting regime resulted in a number of errors and quirks in data reported by licensed facilities. The EPA has reviewed the data submitted and made adjustments for reporting errors / quirks for calculation of the FY16-18 datasets. Where a facility was required to report in FY16 but did not do so, FY17 data has been included as a proxy for FY16.

Whilst the WARRP provides a useful insight to waste flows in NSW, it does not capture all relevant information. Further the EPA acknowledges the need to make simplifying assumptions to address gaps in information captured by WARRP. Further analysis of data limitations is contained in Appendix A.

1.5 Sources of information

The information, statements, statistics and commentary contained in the Key Findings Report (Volume I), the Situational Analysis (Volume II) and the Benchmarking Review (Volume III) have been prepared by the Advisers based on material provided by the NSW EPA, consultation with overseas stakeholders and from other public data sources external to the Advisers and the NSW EPA. The content reflects a synthesis of the Advisers' analysis and the

views and facts provided by the underlying sources, but the Advisers are not responsible for any errors arising from the underlying sources and the Advisers' use of those sources.

Where the report summarises overseas policy and regulation or findings from other adviser reports, reasonable efforts have been made to attribute the content to the relevant source at the commencement of the relevant section

1.6 Timing of Work

PwC was engaged in January 2019. Our work was completed during the period January 2019 to March 2019, with the Report finalised in April 2019.

The Report has not been updated for any information or market developments that occurred post March 2019.

The Report is based on data available at that time (included data provided by the NSW EPA) and has not been updated for any new data which may now be available or for amendments to data previously provided.

1.7 Structure of the Report

The Report comprises three volumes:

- Volume I: Key Findings provides a summary of the key findings, observations and recommendations arising from the Situational Analysis and the Benchmarking Review;
- Volume II: Situational Analysis;
- Volume III: Benchmarking Review.

This Volume II: Situational Analysis report is structured as follows:

- Section 2 introduces the policy and regulatory framework for the waste management and resource recovery sector in NSW;
- Section 3 provides an overview of the sector;
- Section 4 introduces the three core waste streams (municipal solid waste, commercial and industrial waste and construction and demolition waste);
- Section 5 provides an overview of the waste management industry in NSW, including consideration of waste management and resource recovery infrastructure and facilities;
- Sections 6-10 analyse the flow of particular waste materials through the sector, from generation (section 6), collection and transfer (section 7) and resource recovery (section 8), through to end markets for recycled products (section 9) and disposal (section 10); and
- Section 11 highlights issues in respect of waste infrastructure.

2 Policy and regulatory context

2.1 Introduction

The regulation of waste management and resource recovery activities is primarily the responsibility of state and territory governments, whilst the Federal Government provides a national framework for waste and resource recovery in Australia.

The Federal Government sets national legislation, strategies and policy frameworks for waste, particularly those which give effect to Australia's roles and responsibilities in relation to international agreements and obligations. The Commonwealth's National Waste Policy outlines the roles and responsibilities for collective action by businesses, governments, communities and individuals.

National and state legislation and policies addressing all waste streams (municipal, commercial & industrial, and construction & demolition) set the framework that local and regional government activities must reflect.

The NSW Government is responsible for legislation, policies and programs in relation to waste management.

Climate change

Projections for NSW predict that temperatures across the state will rise by 0.7°C by 2030 and will continue to rise by 2.1°C by 2070.[1] The projected change in climate holds a number of potential implications for NSW, including:

- a likely renewed emphasis on reducing the amount of waste to landfill and improving capture of landfill gas as a means of reducing greenhouse gas emissions (for example, the Australian Government's Emissions Reduction Fund already includes support for projects related to alternative waste treatment and landfill gas capture);
- a potential renewed interest in alternative energy sources, including energy from waste;
- increased impact of extreme weather events and natural disasters and a need to manage the waste created by them;
- consideration of the impacts of climate change on infrastructure, environmental and strategic planning decisions[2]; and
- increased community awareness and concern around environmental issues and management.

Long term strategies for the waste management and resource recovery sector in NSW will need to take these considerations into account. This may also include consideration of the ability to monitor changing climate impacts and their interaction with the sector.

Sustainable Development Goals

In 2015, the United Nations General Assembly passed resolution 70/1, 'Transforming our World: the 2030 Agenda for Sustainable Development.' The sustainable development goals

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1 NSW and ACT Regional Climate Modelling Project (NARCliM). *Climate Projections for NSW*. Sourced from: https://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW

2 See for example the recent decision of Chief Judge Preston of the NSW Land and Environment Court rejecting an application for the construction and operation of the Rocky Hill Coal Mine – the first time an Australian court has made a planning decision in reliance of climate change impact: Gloucester Resources Limited v Minister for Planning (2019) NSWLEC 7.

(SDGs) are a blueprint of actions and targets to achieve by 2030 with the intention of creating a more sustainable future for all.

The SDGs address 17 global challenges, including those related to poverty, climate change, inequality, environmental degradation, prosperity, peace and justice. The SDGs that are relevant for jurisdictions to consider in relation to waste management include:

- Goal 2 – Zero Hunger: avoiding food wastage;
- Goal 9 – Industry, Innovation and Infrastructure: repurposing and reusing materials;
- Goal 12 – Responsible Production and Consumption: recycling paper, glass, plastics and aluminium;
- Goal 14 – Life Below Water: Avoiding soft plastics and keeping our oceans clean.[3]

Certain jurisdictions utilise the Sustainable Development Goals as a platform for transformation of their waste management sector and to communicate the necessity of change to the public. As a UN resolution, the SDGs must be adopted by a UN member state and then ratified domestically to come into force.

2.2 Commonwealth Government

2.2.1 Legislative Framework

At the Federal level, the central piece of legislation affecting waste management is the *Environment Protection and Biodiversity Conservation Act*, which provides a legal framework for the protection and management of nationally and internationally important flora, fauna, ecological communities and heritage places. It provides an overarching legal framework for the management of the environment impacts of waste and resource management.

The Australian Government's role in waste is focused on ensuring its international obligations are met, supporting global environmental outcomes through cooperation and international engagement, and providing effective national leadership and coordination.

The Australian Government promotes innovation, develops standards for products and materials, addresses national market failures and provides national data and reporting.

The Commonwealth Government's role in waste is focused on:

- national legislation, strategies and policy frameworks for waste management;
- implementing measures that give effect to obligations under international agreements (such as the Basel Convention);
- supporting global environmental outcomes through cooperation and international engagement and providing effective national leadership and coordination;
- promoting innovation, developing standards for products and materials, addressing national market failures and providing national data and reporting; and
- acting as a potential source of funding.[4]

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3 The United Nations. (2019). *Sustainable Development Goals*. Sourced from: https://www.un.org/sustainabledevelopment/sustainable-development-goals/

4 For example, the Clean Energy Finance Corporation supports the 'reduce, reuse, recycle' recommendations of the international waste hierarchy and focuses on projects that seek to make a material reduction to Australia's waste-related carbon emissions.

This gives the Australian Government a leadership and coordination role, as well as being a potential source of funding, information and guidance.

2.2.2 Policy Framework – National Waste Policy

The Commonwealth Government recently released the 2018 *National Waste Policy (Less Waste, More Resources)* which provides a framework for collective action by businesses, governments, communities and individuals until 2030.

The *National Waste Policy* incorporates the waste hierarchy (see Section 2.3.3), with a focus on high order uses, while building on the idea of continually reusing, recycling and reprocessing materials.

The *National Waste Policy* adopts a 'circular economy' framework.[5] Applying circular economy principles to waste management will require:

- changes to product design, production, use and reuse, recycling and disposal;
- accounting for the full cost and life-cycle of materials;
- approaches that will help to minimise reliance on virgin materials and maximise the economic value of resources.

Following the waste hierarchy, the *National Waste Policy* is underpinned by the following strategies:

- avoiding waste generation by:
  - prioritising waste avoidance, encourage efficient use, reuse and repair;
  - designing products so waste is minimised, they are made to last and materials can be more easily recovered;
- improving resource recovery:
  - improve material collection systems and processes for recycling;
  - improve the quality of recycled material we produce.
- increasing use of recycled material and building demand and markets for recycled products;
- better management of material flows; and
- improving information to guide investment and support informed consumer decision making.

The NSW Government participated in the development of the 2018 *National Waste Policy* and supported the *National Waste Policy* presented on 7 December 2018, although NSW has expressed a desire for more Commonwealth funding and stronger leadership on delivering consistent regulation across jurisdictions to encourage investment and the right behaviours.[6]

The 2018 *National Waste Policy* did not contain any specific targets in respect of the policy focus areas. Rather, Ministers have agreed, by their next meeting, to the development of a

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5 A circular economy approach involves considering waste as a resource, and taking efforts to reuse, recycle and reprocess materials and retain the value of materials within the economy for as long as possible.

6 NSW EPA. (2018). *NSW calls for National leadership on waste*. Sourced from: https://www.epa.nsw.gov.au/news/media-releases/2018/epamedia181207-nsw-calls-for-national-leadership-on-waste

national action plan that includes appropriate funding, targets and milestones to implement the 2018 National Waste Policy.

Ministers also agreed to strengthen the national action plan to address Environment Ministers' waste priorities. These include:

- reducing plastic pollution;
- supporting industry development;
- increasing demand for recycled materials through procurement; and
- a national approach to waste policy and regulation, which may include a unified approach to the cross-border transportation of waste, consideration of proximity principles, and a coordinated approach to waste levies.

Environment Ministers are next due to meet in the first half of 2019. Ministers have also agreed to annually review the future targets and milestones to ensure that priority actions stay focussed on the issues most important to effectively manage waste.

Considerations for the 20-year waste strategy

The development of the 20-year waste strategy will need to incorporate actions that align with key areas for action under the National Waste Policy, as well as any targets, specific actions or funding arrangements subsequently agreed to with the Commonwealth.

Consideration will need to be given to the process by which the EPA will review and update targets under the 20-year waste strategy to align with any amendments to future targets and milestones arising from the national review process.

A national approach to a circular economy will be beneficial to managing any potential risks to NSW in pursuing such a strategy alone. A national approach may also provide access to funding for innovation and infrastructure development, including investment in regional areas. Such programs will need to be agreed with the Commonwealth.

2.2.3 Product Stewardship and Extended Producer Responsibility

Product stewardship is an approach that acknowledges that those involved in producing, selling, using and disposing of products have a shared responsibility to ensure those products or materials are managed in a way that reduces their impact, throughout their lifecycle, on the environment and on human health and safety.

The *Product Stewardship Act 2011* (PSA) provides the framework to effectively manage the environmental, health and safety impacts of products, and in particular those impacts associated with the disposal of products and their associated waste.

The objectives of the PSA include reducing the impact that products and substances contained in them have on the environment and people by encouraging or requiring manufacturers, importers, distributors and other persons to take responsibility for those products throughout their lifecycle, including by taking action that relates to:

- avoiding generating waste from products;
- reducing or eliminating waste from products;
- reducing or eliminating hazardous substances in products and in waste from products;
- managing waste from products as a resource;
- ensuring that products and waste from products are reused, recycled, recovered, treated and disposed of in a safe, scientific and environmentally sound way;

The PSA supports mandatory, co-regulatory and voluntary product stewardship schemes:

- **Voluntary product stewardship:** accrediting voluntary arrangements designed to further the objects of the PSA in relation to products, and authorising the use of product stewardship logos in connection with such arrangements;
- **Co-regulatory product stewardship:** requires some manufacturers, importers, distributors and users of products (called liable parties), who have been specified in the regulations, to be members of co-regulatory arrangements approved by the Minister. These arrangements must have outcomes, specified in the regulations, which are designed to further the objects of this Act. Administrators of approved co-regulatory arrangements are required to take all reasonable steps to ensure those outcomes are achieved in accordance with the regulations;
- **Mandatory product stewardship:** involves enabling regulations to be made that would require some persons to take, or not to take, specified action in relation to products.

There are currently no mandatory schemes under the PSA.

The only co-regulatory scheme in operation is the National Television and Computer Recycling Scheme (NTCRS), established through the *Product Stewardship (Televisions and Computers) Regulations 2011*. Under the NTCRS, the television and computer industry funds the collection and recycling of end-of-life televisions, printers, computers, computer parts and peripherals.

There are currently two accredited voluntary arrangements under the PSA:

- **MobileMuster**: the product stewardship program of the mobile phone industry (accredited by the federal government) that is voluntarily funded by all of the major handset manufacturers and network carriers to provide a free mobile phone recycling program in Australia.

  MobileMuster is administered by the Australian Mobile Telecommunications Association (AMTA). Its participants are members of AMTA and include handset manufacturers and Network carriers. Through the arrangement, the participants fund the collection and recycling of mobile phone components including handsets, batteries and accessories.[7]
- **FluoroCycle**: this scheme aims to increase the recycling of lamps that contain mercury. FluoroCycle provides a national, voluntary scheme which businesses, government agencies and other organisations can join as signatories.

  FluoroCycle is administered by Lighting Council Australia. Its participants are commercial end-users of lighting products, such as institutions, government agencies, property managers and other businesses, which commit to recycling their mercury-containing lamps. Other participants play a facilitating role, through education, promotion of the scheme and collection and recycling of mercury-containing lamps. [8]

Other voluntary product stewardship arrangements, that are not currently accredited under the PSA but may seek this accreditation in future include:

- **National Tyre Product Stewardship Scheme**: voluntary scheme whereby any stakeholder in the tyre supply chain, including tyre and vehicle importers, retailers, fleet

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7 Review of the Product Stewardship Act 2011, including the National Television and Computer Recycling Scheme. Sourced from: https://www.legislation.gov.au/Details/F2011C00912

8 Review of the Product Stewardship Act 2011, including the National Television and Computer Recycling Scheme. Sourced from: https://www.legislation.gov.au/Details/F2011C00912

operators, local governments, collectors, recyclers and the mining industry, may apply to become a participant in the voluntary scheme. Participants commit to play their part in ensuring end-of-life tyres go to an environmentally sound use. The scheme is funded via a levy imposed on participating tyre importers, including for market development and research. The levy does not directly fund the collection and recycling of end-of-life tyres.

A 2017 report reviewing the scheme stated that, whilst the scheme has materially contributed to improving the environmental outcomes of end of life of tyres, there are issues with the scheme, chiefly pertaining to performance against targets, reporting and data collection.[9]

- **Mattresses:** a voluntary scheme has been established by the big four bedding manufacturers, leading retailers and supply chain manufacturers as founding members. A not-for-profit organisation (Soft Landing) has been appointed to oversee the operation of the scheme (fees are charged by Soft Landing to collect and process mattresses). 1.25 million mattresses end up in landfill in Australia each year, equating to around 20,000 tonnes of steel, wood and foam. 75% of materials in a mattress can be recycled. The scheme is presently challenged by a lack of a long-term funding model.[10] Discussion with stakeholders indicated the program suffered from a lack of collection points with a primary focus on metropolitan areas.
- **Paintback:** an industry-led voluntary scheme to increase recovery and minimise the environmental, health and safety footprint of waste architectural and decorative paint in Australia.

Under the NTCRS the Environment Minister maintains a list of those products being considered for accreditation or regulation under the PSA. Among others, the Environment Minister's Product List includes the following problematic items:

- Plastic microbeads and products containing them: national phase-out (voluntary approach). At the meeting for Environment Ministers in July 2017, Ministers reasserted their position that if the current industry-led approach does not effectively phase out microbeads by mid-2018, governments will move to implement a ban;
- Large energy storage batteries: development of a product stewardship scheme;
- Photovoltaic systems: development of a product stewardship scheme by 2019. A photovoltaics working group has been established. The working group is currently undertaking material flow analysis and stakeholder mapping activities to inform the scope and requirements of future product stewardship work;[11]
- Electrical and electronic products: the government is considering options to include other products under the National Television and Computer Recycling Scheme. e-waste is one of the fastest growing waste streams (see Key Finding 14);
- Plastic oil containers: The Australian Institute of Petroleum and its members established a voluntary recycling scheme in 2004. Due to a number of its members withdrawing funds for the scheme (essentially becoming 'free-riders'), the operation ceased on 31 December 2016. Members of the scheme expressed an interest in the scheme coming

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9 Dwyer, G, Clarke, M & Kinrade, P. (2017). *Review of the Tyre Stewardship Scheme and Tyre Stewardship Australia*. https://www.accc.gov.au/system/files/public-registers/documents/AA1000409%20-%20Tyre%20Stewardship%20Australia%20Limited%20-%20Annexure%203%20-%20Appendix%20A%20-%20Review%20of%20TSA%20Scheme%20-%2005.12.17%20-%20PR.pdf

10 France and a few states in the United States have established mandatory schemes.

11 Review of the Product Stewardship Act 2011, including the National Television and Computer Recycling Scheme. Sourced from: https://www.legislation.gov.au/Details/F2011C00912

under the regulated levy-benefit Product Stewardship Oil scheme. This will be considered as part of the *Product Stewardship (Oil) Act 2000* review in late 2018;

- Plastic bags: voluntary, national action by retailers to phase-out the use of heavier plastic department store or 'boutique' bags;
- Tyres: implement a National Market Development Strategy for Used Tyres 2017-22;
- Packaging: administration of the Australian Packaging Covenant;
- Container deposit scheme: implementation of State and Territory Governments' container deposit schemes (already implemented in NSW);
- Batteries: work with battery industry to develop a voluntary Product Stewardship scheme for power tools and other hand-held rechargeable batteries.

In interviews with stakeholders, energy storage batteries were a regular subject of concern with the importance of a solution for this particular waste type highlighted.

PSA Review

The PSA is currently subject to a review by the Department of the Environment. The department has sought input from industry, governments, and the general public to ensure the ongoing effectiveness of the Act. Consultation closed on 29 June 2018 and we understand the department is currently compiling submissions and will publish them soon.

The major criticism of the PSA is that existing programs are voluntary, whilst effective product stewardship schemes in other jurisdictions around the world have contained mandatory requirements. Some stakeholders expressed concern about mandatory schemes because of the impact they can have on business in terms of cost of compliance or availability of solution to achieve targets. In addition, the schemes created under the PSA focus on recycling, rather than avoidance through practices like planned obsolescence.

Considerations for 20-year waste strategy

The 20-year waste strategy will need to take into account any endorsed recommendations arising out of the review of the PSA and in particular whether the scope of application of the PSA and targets set under the PSA (including timeframes for their achievement) are consistent with the targets established under the 20-year waste strategy.

The 20-year waste strategy should consider actions to work with Commonwealth to modify the approach to producer responsibility and product stewardship schemes to drive further short-term gains (e.g. next 3-5 years) in waste avoidance and reduction. Key actions that may be considered are considered further in Key Finding 5.

The WARR Act gives the EPA the authority to introduce state-based product stewardship schemes (e.g. Container Deposit Schemes). In the event the PSA does not align with the NSW 20-year waste strategy, consideration may need to be given to implementing additional state-based stewardship scheme requirements. Such an action may be necessary for example to align waste recycling targets or to support any circular economy strategies implemented in NSW.

2.2.4 Australian Packaging Covenant

The Australian Packaging Covenant is the principal national instrument focused on the reduction of the impacts of consumer packaging in Australia. It is underpinned by *the National Environment Protection (Used Packaging Materials) Measure 2011*, requiring companies that produce or sell packaging and packaged products to reduce environmental degradation arising from the disposal of used packaging by encouraging waste avoidance and encouraging the use of more recyclable, compostable or reusable packaging.

Under the Covenant, signatories agree to work together to implement and promote the principle of product stewardship for packaging. Through this commitment, responsibility for

the environmental impacts of packaging is shared by companies throughout the packaging supply chain - including raw material suppliers, packaging manufacturers and suppliers, brand owners and retailers, consumers of packaged products, and all levels of government—Australian, state, territory and local. Waste service providers and recyclers are also an important part of the packaging supply chain but are not signatories to the Covenant.

In April 2018, Australian Environment Ministers endorsed a target of 100 percent of Australian packaging being recyclable, compostable or reusable by 2025, to be delivered by the Australian Packaging Covenant Organisation (APCO).

Following from that, in September 2018, the Federal Minister for the Environment and industry announced Australia's 2025 National Packaging Targets, namely:

- 100% of all Australia's packaging will be reusable, recyclable or compostable by 2025 or earlier;
- 70% of Australia's plastic packaging will be recycled or composted by 2025;
- 30% average recycled content will be included across all packaging by 2025;
- problematic and unnecessary single-use plastic packaging will be phased out through design, innovation or introduction of alternatives.

These targets are consistent with those proposed internationally, such as the UK Plastics Pact (considered below).

Australian Packaging Covenant signatories agree to work together to implement and promote the principle of product stewardship for packaging. Signatories to the Australian Packaging Covenant must:

- apply the Sustainable Packaging Guidelines to all new packaging; and
- commit to review all existing consumer packaging within a reasonable timeframe in accordance with the guidelines.

Brand Owner Signatories are required to take certain actions, including the development of public action plans to achieve the key performance indicators and targets specified in the Covenant, support materials recovery systems and infrastructure used for reprocessing used packaging materials and meet reporting obligations.

In November 2016, Environment Ministers endorsed the new Australian Packaging Covenant and five-year strategic plan developed by APCO in consultation with Australian, State and Territory governments, and endorsed by the National Environment Protection Council.

The 2017-2022 Strategic Plan, delivered by APCO, focuses the work of the Covenant on improving resource efficiency through sustainable packaging design, diverting packaging from landfill through consumer education and packaging disposal labelling and improving packaging sustainability performance through research and sharing of knowledge across industries.

APCO is currently developing a national roadmap for how Australia can deliver on the recently announced revised targets and has recently released a list of priority projects in support of the targets.

Stakeholder Feedback

Feedback from stakeholder consultations conducted by the Advisers identified a strong desire for the scheme to be mandatory with a requirement for manufacturers to use domestically recycled materials in production. Such an approach would:

- support the development of domestic end markets for recycled plastics;
- support the recycling of a broader range of plastics compared to current practices (which are currently focussed on PET and HDPE);

- support improved infrastructure to reduce the level of contamination in plastics; and
- reduce the volume of plastics being sent overseas.

Stakeholders consulted also indicated a need to provide further guidance by what is meant by compostable. Some compostable packaging products in the Australian market are still being sent to landfill, as they cannot be processed by organics plants as they require more time and a higher temperature to compost relative to the composting practices currently utilised by industry. Some facilities are also not permitted to receive compostable packaging. Businesses using compostable packaging may also not have the appropriate collection services in place to divert this packaging to the appropriate facility.

Industry led action – United Kingdom

As an alternative to direct government action, the UK Plastics Pact is transforming the way the UK makes, uses and disposes of plastic. 68 members who are responsible for 80% of all UK plastic packaging sold in UK supermarkets and 50% of all plastic packaging placed on the market have committed to a series of targets aimed at:

- *eliminating single use packaging through redesign, innovation or reuse;*
- *achieving 100% of packaging being reusable, recyclable or compostable;*
- *achieving 70% of plastic packaging being effectively recycled or composted; and*
- *achieving 30% average recycled content across all plastic packaging by 2025.*

Members of the Plastics Pact include Procter and Gamble, Veolia, Highland Spring, Asda, and Innocent drinks.

The Plastics Pact has developed a roadmap which provides a framework for all businesses, including members to deliver the agreed targets.

The roadmap documents key outcomes to be achieved by the end of year 1 (April 2019), end-2022 and end-2025. Four work streams (collaborative action groups) have been initiated, focusing on:

- ***Measurement and reporting** – agreeing how to report characteristics of plastic packaging placed on the UK market by members, from a 2017 baseline.*
- ***Recyclability** – defining criteria and guidance for recyclable, reusable and compostable plastic packaging and agreeing what is 'good' in terms of packaging design choices (e.g. polymer and decoration choices). Also, considering how to embed this across businesses and inspire good practice.*
- ***Problematic & unnecessary single-use plastic items** – developing criteria for 'problematic & unnecessary' and considering how these problems could be solved e.g. through elimination, reuse models, design, recycling infrastructure, education etc.*
- ***Film & flexibles recycling** – films comprise 26% of all consumer plastic packaging by weight. This group will focus on (i) front of store collections; (ii) kerbside collections; and (iii) end markets. WRAP has initiated trials to identify markets for recycled PE/PP film.*

Source: wrap.org.uk

Considerations for 20-year waste strategy

The 20-year waste strategy will need to take into account the revised targets established under the Australian Packaging Covenant and the work being undertaken by APCO on the key actions required to achieve their stated objectives.

Consideration may need to be given to:

- the current level of NSW participation in the Australian Packaging Covenant;

- any policy, regulatory, infrastructure, market development or funding requirements identified as being critical to the realisation of the Australian Packaging Covenant, which can be considered as part of the 20-year waste strategy; and
- reporting required under the Australian Packaging Covenant and the extent to which this can be leveraged to improve the EPA's plastics data reporting (including the identification of any additional information that may be sought directly from participants or through APCO).

These recommendations are considered further in Key Findings 5, 7, 8 and 10. Overseas jurisdictions, including the UK and Germany, have adopted alternate approaches to reducing packaging waste. The UK is pursuing an industry led program while Germany's approach is supported by legislative requirements.

Government led action – Germany

Germany's new Packaging Act enters into force on 1 January 2019. Under the new act, minimum recycling requirements have been established for a range of packaging wastes including an initial target of 58.5%, which is to be increased to 63% in 2022.

The act applies to all distributors who put packaging into commercial circulation on the German market for the first time. Without proper registration, producers or retailers must not offer the packaging (and therefore the products contained therein) for sale in Germany. Failure to register the packaging, can result in fines and a prohibition on the sale of the underlying product.

Distributors pay a fee beforehand for the disposal of the packaging. Fees are calculated using the weight of packs, material type used and the volumes of product produced per annum.

These licensed distributors can then add the Green Dot logo to their package labelling. This packaging is placed into the separate yellow waste collection bins by households for collection and sorting by the system operator. The system operator delegates the collection and processing of used packaging.

Source: Packaging Europe. (2019). Getting ready for the German Packaging Law. https://packagingeurope.com/getting-ready-for-the-german-packaging-law/

2.2.5 National Food Waste Strategy

The National Food Waste Strategy provides a framework to support collective actions to reducing the volume of food waste by 50% by 2030.

The strategy adopts a circular economy approach and the waste hierarchy to prioritise initiatives that seek to capture food waste as a resource, so it is not sent to landfill.

At a high level, the strategy outlines the following four priority areas:

- policy support, including monitoring, identifying areas for target investment, and enabling legislation across national, state and territory governments;
- business improvements, including identifying areas for improvement, support technology adoption, encouraging collaboration and normalising food waste considerations into business practices (for example through certification and rating systems);
- market development, including identifying food waste composition and nutritional value to develop new markets, encourage innovation, and connect food waste generators to potential end users;
- behaviour change focused on changing consumer behaviours and engaging industry to minimise food waste.

The strategy's primary target is to halve food waste by 2030. The Australian Government is responsible for developing a common methodology and indicators to measure food waste.

It will be important that the 20-year waste strategy complements this national agenda. The NSW Government has already implemented the Love Food, Hate Waste program to reduce food waste (see Section 2.3.6).

2.3 NSW State

2.3.1 Legislative framework

There are two key pieces of legislation, and associated regulations, which provide the regulatory settings for waste management in NSW:

- the *Protection of the Environment Operations Act 1997* is the central piece of environmental protection legislation in NSW and is administered by the EPA. It provides enforcement provisions, a licensing framework and other tools with a focus on protecting human health and the environment from inappropriate use of waste. The Act enables the EPA to regulate scheduled and non-scheduled activities, grant licences and set licence conditions, issue environment protection notices, offences and penalties, conduct investigations and implement economic regulatory measures for environment protection;
- the *Protection of the Environment Operations (Clean Air) Regulation 2010* provides regulatory measures to control burning activities by imposing obligations to prevent or minimise emissions, by prohibiting the burning of certain articles and requiring approval for certain incinerators;
- the *Protection of the Environment Operations (Waste) Regulation 2014*, which provides the legislative framework for the NSW waste levy (discussed in detail below), includes thresholds for environment protection licences, imposes requirements on brand owners and retailers to recover, re-use and recycle packaging, and makes it an offence to apply residue waste to land that is used for the purposes of growing vegetation;
- the *Waste Avoidance and Resource Recovery Act 2001*, which provides the legislative framework for the NSW state-wide waste strategy, sets out the waste hierarchy, and seeks to encourage the efficient use of resources and to reduce environmental harm in accordance with the principles of ecologically sustainable development.

The planning approval pathway for waste or resource management facilities is provided for in the *State Environmental Planning Policy (Infrastructure) 2007* (the SEPP). The SEPP sets out a number of considerations that must be taken into account in assessing a development application for the purpose of the construction, operation or maintenance of a landfill for the disposal of waste, including putrescible waste, including:

- whether there is a suitable level of recovery of waste, such as by using alternative waste treatment or the composting of food and garden waste, so that the amount of waste is minimised before it is placed in the landfill;
- whether the development:
  - adopts best practice landfill design and operation; and
  - reduces the long-term impacts of the disposal of waste, such as greenhouse gas emissions or the offsite impact of odours, by maximising landfill gas capture and energy recovery;
- if the development relates to a new or expanded landfill:
  - whether the land on which the development is located is degraded land such as a disused mine site; and
  - whether the development is located so as to avoid land use conflicts, including whether it is consistent with any regional planning strategies or locational principles;
- whether transport links to the landfill are optimised to reduce the environmental and social impacts associated with transporting waste to the landfill.

2.3.2 NSW Waste Levy

The waste levy is the principal economic regulatory measure used in NSW to discourage waste to landfill by making it more expensive that recycling. The levy aims to reduce the amount of waste being sent to landfill and thereby promote recycling and resource recovery.

The NSW waste levy is provided for in the *Protection of the Environment Operations (Waste) Regulation 2014*. Associated Waste Levy Guidelines contain the specific legal requirements which must be met by occupiers of scheduled waste facilities. The levy is applied to all waste that is received at:

- scheduled waste disposal facilities (EPA-licensed landfills); and
- scheduled waste facilities that are not scheduled waste disposal facilities (for example, EPA-licensed waste processing, storage or resource recovery facilities) which are in a regulated area or receive waste from a regulated area.

Scheduled waste facilities required to pay the levy must submit a Waste Contribution Monthly Report to the EPA for each reporting period.

The 'regulated area' refer to councils within the metropolitan levy area (MLA) and the regional levy area (RLA). The regulated area comprises the Sydney metropolitan area, the Illawarra and Hunter regions, the central and north coast local government areas to the Queensland border, as well as the Blue Mountains, Wingecarribee and Wollondilly local government areas.

The levy liability for scheduled waste facilities is extinguished once the waste is sent offsite for lawful recycling, re-use or disposal. The levy becomes payable for these facilities if waste is stockpiled unlawfully or if waste transported from the facility is unlawfully disposed of.

The 2018-19 NSW waste levy rates were $141.20 per tonne in the MLA, which is the highest landfill levy in Australia (the higher figures for the ACT also include gate fees), and $81.30 in the RLA. Waste levy rates escalate annually by the Consumer Price Index.

Table 1: Waste levy prices in Australia (2018-19 rates)

Jurisdiction	Waste levy ($ per tonne)
Australian Capital Territory	$90.55 per tonne (MSW) $146.20 per tonne (C&I) $199.20 per tonne (mixed C&I waste with <50% recyclable material)
NSW	$141.20 per tonne (MLA) $81.30 per tonne (RLA)
Northern Territory	No current waste levy
Queensland	No current waste levy. Proposed waste levy rates (coming into effect on 1 July 2019): $75 per tonne (MSW, C&I, C&D) $155 per tonne (regulated waste category 1) $105 per tonne (regulated waste category 2)
South Australia	$100 per tonne (Metropolitan Adelaide) $50 per tonne (Non-metropolitan Adelaide)
Tasmania	No state levy (voluntary levy of $0-5 per tonne)
Victoria	$64.30 per tonne (MSW/C&I, MLA, PLA) $32.22 (MSW RLA) $56.36 (C&I RLA)
Western Australia	$70 per tonne (putrescible waste)* $105 per cubic meter (inert waste)*

*applies to waste generated in the Perth metropolitan region which is disposed in either landfill in Perth or elsewhere in the state.

In NSW, the waste levy is attached to the disposal of waste. It has been suggested (for instance, in submissions to the NSW Parliamentary Inquiry into Energy from Waste Technology[12]) that the levy should be attached to the generation of waste, rather than disposal, to recognise the environmental costs of waste generation and to help encourage waste avoidance. This issue was also raised through industry consultation where it was proposed that significant reductions in the volume of waste being generated would not be achieved until there was a transparent environmental cost attached to packaging and other waste materials.

Effectiveness of waste levy

Submissions to the NSW Parliamentary Inquiry into Energy from Waste agreed that the levy was meeting its objectives, with a number highlighting the higher recycling rates in NSW compared to jurisdictions with no levy or a very low levy. Overall, submissions suggest it is generally accepted that the waste levy has been effective in meeting its objectives of reducing the amount of waste being sent to landfill and promoting recycling and resource recovery. In its submission, the EPA suggested that the levy has helped to increase recycling rates in NSW from 45% in 2002-03 to 63% in 2014-15.[13]

The impact of the waste levy on waste volumes is more direct in the C&D waste stream. Marginal changes in the cost of sending material to landfill will have a direct flow on effect on the C&D material diversion rate. The industry operates on the basis of the most cost-effective method of disposal, which has in part contributed to waste being diverted interstate (see below).

Recyclers/ sorters are not always the preferred destination for the C&D material. The fact that the least cost option is not always followed suggests there may be other factors driving decision making in this market segment. Possible issues could be a lack of information about disposal options, or reluctance in the C&D market to take up new approaches. In such circumstances it may be more appropriate to also focus on non-price-based methods to drive change (e.g. education programs).

Commercial arrangements between landfill operators and waste collection and transportation and material processors may influence where residual wastes are ultimately landfilled.

Diversion of waste

Feedback from stakeholders has been that the waste levy has been effective in diverting waste from landfill, however, the lack of a comparable levy in Queensland has seen waste shifted to Queensland landfill operations (see section 4.3.5).

Industry has advised that waste to be disposed will generally be delivered to the lowest cost option. This will largely reflect the cost of transport plus the relevant landfill rates. The Queensland Government is proposing to implement a waste levy from 1 July 2019.[14] Stakeholders have advised that waste will continue to be transported to Queensland as long as it is more cost effective to do so.

Use of waste levy

The waste levy is paid to the EPA and then remitted to the State's Consolidated Fund. The waste levy generated around $720 million in 2017-18.

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[12] NSW Parliament. (2018). 'Energy from waste' technology. Portfolio Committee No. 6 – Planning and Environment. Sydney, NSW. Sourced from: https://www.parliament.nsw.gov.au/lcdocs/inquiries/2436/Final%20-%20Report%2028%20March%202018.pdf

[13] Ibid

[14] Ibid

Table 2: Waste levy revenue and expenditure on environmental programs (2012-13 to 2016-17)

Item/Program ($m)	2012-13	2013-14	2014-15	2015-16	2016-17
Revenue					
Total waste revenues	483.3	503.6	568.5	692.1	695.5
Program expenditure					
Waste and Regulatory programs	61.7	76.9	111.1	100.0	91.0
Other environmental programs	61.5	90.0	95.9	90.1	88.8
Total expenditure	123.2	166.9	207.0	190.1	179.9

Source: NSW Parliamentary Inquiry into Energy from Waste Technology

A portion of the waste levy was used to fund specific waste initiatives, such as the Waste Less, Recycle More program. The initial WLRM initiative (2012-16) received $465 million in funding. The initiative has since been extended with a further $337 million over four years to 2021 (see Section 2.3.4).[15]

Table 2 indicates around 19% of waste levies were re-invested in waste programs. It was recommended in the NSW Parliamentary Inquiry into Energy from Waste Technology and again in stakeholder interviews, that a greater proportion of the funds raised through the waste levy be hypothecated for waste management activities or used to invest directly in waste infrastructure.[16]

Considerations for the 20-year waste strategy

The findings of this Report contain a number of observations where further investment is required to either support reductions in the volume of waste generated or sent to landfill or to increase volumes recycled. Specific programs will also need to be developed to support the transition to a circular economy for waste. Funding of these initiatives may pose a major challenge and support for the release of a greater proportion of levy proceeds to fund such initiatives would help overcome this challenge.

2.3.3 Waste Avoidance and Resource Recovery Strategy 2014-21

The Waste Avoidance and Resource Recovery (WARR) Strategy 2014-21 sets out the NSW Government's preferred approaches for efficient resource use and the framework for achieving waste management goals.

The WARR Strategy was prepared on a basis consistent with the 'waste hierarchy' (Figure 1). The waste hierarchy is a set of priorities for the efficient use of resources; this underpins the objectives of the Waste Avoidance and Resource Recovery Act 2001. The hierarchy outlines approach in order of most to least preferable, beginning with avoiding and reducing waste, through to disposal. The waste management hierarchy is a tool enshrined in waste management strategies and legislations globally.

[15] NSW Parliament. (2018). 'Energy from waste' technology. Portfolio Committee No. 6 – Planning and Environment. Sydney, NSW. Sourced from: https://www.parliament.nsw.gov.au/lcdocs/inquiries/2436/Final%20-%20Report%2028%20March%202018.pdf

[16] Ibid.

Figure 1: Waste management hierarchy

The WARR strategy has the overarching objectives of:

- avoiding and reducing waste generation;
- increasing recycling;
- diverting more waste from landfill;
- managing problem wastes better;
- reducing litter;
- reducing illegal dumping.

The WARR Strategy included the following targets under its overarching objectives:

- avoiding and reducing the amount of waste generated per person in NSW;[17]
- increasing recycling rates to:
  - 70% for municipal solid waste;
  - 70% for commercial and industrial waste;
  - 80% for construction and demolition waste;
- increasing waste diverted from landfill to 75%;
- managing problem wastes better, establishing 86 drop-off facilities and services across NSW;
- reducing litter, with 40% fewer items (compared to 2012) by 2017;
- combatting illegal dumping, with 30% fewer incidents (compared to 2011) by 2017.

The WARR Strategy was supported by Waste Less, Recycle More, a NSW Government initiative funded by the waste levy, providing funding for waste and recycling improvements across NSW, detailed below.

[17] Trends will be monitored using 2012-13 as a starting point

The WARR Strategy also set the direction for other related programs, policies and plans directed at minimising the impact of waste on the environment and human health, including:

- education to encourage behaviour change;
- economic mechanisms like the waste levy that encourage resource recovery over landfill disposal;
- enforcement of the waste regulations; and
- incentives to encourage investment, innovation and improvement in environmental practices.

Initiatives under the strategy have been implemented through funding provided under the Waste Less, Recycle More funding program.

A February 2015 final report of an Upper House Inquiry into the EPA recommended that the WARR strategy help:

- identify appropriate locations for waste infrastructure;
- facilitate new infrastructure;
- enable the circular economy; and
- create markets for secondary materials.

2.3.4 Waste Less, Recycle More

The Waste Less, Recycle More (WLRM) initiative aims to improve waste and recycling behaviours in the community.

Waste Less, Recycle More provides grant funding for business recycling, organics collections, market development, managing problem wastes, new waste infrastructure, local councils and programs to tackle illegal dumping and litter.

Initial funding of $465.7 million for waste and recycling initiatives was provided for the 2013-2017 period. This has been extended with a further $337 million over 4 years from 2017-21.

Program monies were distributed between eight funds providing financial support for a range of programs. Each fund comprised a collection of programs, priorities and grants targeted at a specific area of waste reduction and recycling, including:

- $1.4m, **Contaminated Land Management** program: eligible Regional Organisations of Councils (ROCs) and groups of councils will be provided with funding to employ a Council Regional Capacity Building Officer to improve contaminated land planning, policies, procedures and practices.
- $22.5 million, **Business Recycling Grants** including:
  - $12.5 million Bin Trim grants (to boost business recycling and reduce waste to landfill) and small scale equipment rebates (fund up to half the purchase price of onsite small-scale recycling equipment;
  - $5 million for industrial ecology networks in the commercial and industrial and construction and demolition sectors throughout NSW;
  - $5 million for other business initiatives;
  - Circulate, EPA Industrial Ecology grants fund projects that enable waste from one company to be used as an input for another; and
  - a Civil Construction Market Program to improve resource productivity, reducing the costs of coordination and minimising the risks involved in making waste from one civil construction project a useful input into another civil construction project.

The Australian Packaging Covenant also co-funds infrastructure to recycle packaging and make its use more sustainable.

- **Local Government Waste and Resource Recovery** Program ($70 million):
  - $39 million for the Better Waste and Recycling Fund and $8 million for funding voluntary regional waste groups;
  - $5 million for regional landfill consolidation and environmental improvements;
  - $4.5 million for regional coordination and strategy for the Greater Sydney Region; and,
  - $4 million to empower Aboriginal communities in waste management and $9.5 million for education and support.
- **Illegal Dumping Prevention and Waste Enforcement Fund** ($65 million):
  - $52 million for proactive enforcement compliance programs;
  - $9 million to create and support Regional Illegal Dumping (RID) squads and RID online; and,
  - $3 million for clean-up and prevention and $1 million for the Aboriginal land clean-up and prevention program.
- **Household Problem Waste** ($57 million):
  - $37 million for community recycling centre receptacles and processing;
  - $9 million for household chemical collection and processing (partnership program with local councils to support mobile collection services for safe disposal of household chemical products); and,
  - $3 million for community recycling centre infrastructure grants and $8 million for education, training and support for problem waste collection.
- **Waste and Recycling Infrastructure Fund** ($48 million) - three main programs providing funding for new recycling facilities or upgrades to existing facilities:
  - Product Improvement Program provides industry an opportunity to identify new uses and markets for recyclable materials, and to develop local processing and remanufacturing capability to help ensure services are maintained in future years;
  - $25m for Resource Recovery Facility Expansion and Enhancement Program for enhancing existing council and private sector facilities; and,
  - Major Resource Recovery Infrastructure Program for new council and private sector facilities.

  Through this fund, $25 million has been allocated for major resource recovery infrastructure grants; $14.5 million for auditing, education and support; and $8 million for resource recovery expansion and enhancement grants and $0.5 million for weighbridges.
- **Organics Infrastructure Fund and Program** ($35.5 million): the fund supports programs that will educate people to avoid food waste, expand collection and processing, increase food donation, and develop new markets, including**:**
  - $14 million for organics infrastructure grants and $10 million for local government organics collection grants;
  - $4.5 million for organics market development including $3 million in grants;
  - $7 million for food waste avoidance, including $1.6 million in Love Food Hate Waste grants.
- **Litter Prevention and Enforcement Fund** ($30 million)

  - $4 million for local government litter grants and $1.5 million for community litter grants;
  - Litter prevention programs, including the Hey Tosser! Campaign.
- **Recycling Innovation Fund**: $15 million for Recycling Innovation Fund grants.
- **Heads of Asbestos Coordination Authorities** programs: $4 million for the education and coordination activities of the Heads of Asbestos Coordination Authority (HACA).

Effectiveness of WLRM

In 2018, the EPA undertook a review of the "effectiveness, efficiency, appropriateness and sustainability of each fund and identified areas of potential improvement for the future of the initiative".[18]

The key findings of the review are summarised in Appendix B.

The review found at 30 June 2017, funds spent by WLRM totalled $327.5 million (72% of the initial $456.7 million program allocation). Key outcomes achieved included:

- 5 existing resource and recovery facilities were expanded or enhanced;
- 10 major resource recovery facilities are being built and 15 facilities in the process of being expanded or enhanced;
- 87 new community recycling centres built, of those 60 have been formally opened in FY17. The EPA has advised 87 were operational in FY18;
- 43 local councils have used EPA funding to upgrade their litter infrastructure, including new bins, and have installed signage discouraging littering;
- Landfill consolidation and environmental improvements under the Landfill Grants program which supported councils to close landfills and establish transfer stations;
- Better Waste and Recycling funded 112 infrastructure projects, including infrastructure and equipment to divert waste from landfill, new and upgraded education facilities, weighbridges, new litter and recycling bins and works to prevent illegal dumping;
- 30 organics infrastructure projects funded. [19]

The EPA also supported 18 charity or community organisations to increase their capacity to re-distribute edible food. Grants funded the infrastructure and equipment required to receive, store and make surplus food available to those who need it.

The review determined:

- the amount of waste to be diverted (per annum, as stated on applications at the end of 2016/17) is 2,041,280 tonnes (once construction of additional infrastructure is complete). It was also estimated that an additional 1.3 million tonnes of waste will be diverted from landfills each year;
- CRCs in operation safely disposed of 3,171.4 tonnes of problem waste;
- once all projects are completed, 70% of householders in NSW will be able to access a garden or combined food and garden service, and an additional 400,000 tonnes of capacity to recycle organic waste will be added to the system;

[18] Internal unpublished report procured by the EPA (2018)

[19] Internal unpublished report procured by the EPA (2018)

- the EPA has funded waste experts who directly engaged with and assessed 22,114 businesses between 2013 and 2017 and business waste going to landfill has been reduced by at least 72,000 tonnes annually; and,
- a 19% reduction in litter volume has been achieved.

In consultations undertaken by the Advisers, stakeholders expressed the view that:

- the CRC program had been effective;
- a greater proportion of the waste levy needed to be allocated to the overall WLRM program; and
- a greater focus needed to be put on larger value programs.

Infrastructure

As of June 2017, seven existing resource recovery facilities had been expanded or enhanced and were operating as a result of WLRM funding, and a further 13 were in the process of being expanded or enhanced. At June 2018, three new major resource recovery facilities were operating and seven were under construction.[20] The waste industry and local government has invested $110 million into the construction of these new facilities. Once operational, the new facilities have predicted that an additional 1 million tonnes of waste will be diverted from landfill each year in addition to existing capacity.

Two-thirds of the new major resource recovery facilities are being built by the private sector and most will process, stabilise or recover resources from residual business and household waste.

The WARR Branch is continuing to track actual performance as facilities come on line.

A challenge of the program, however, has been the timeliness of infrastructure projects, with many projects taking longer than anticipated to become operational. Particular challenges for infrastructure projects have included dealing with delays caused by the impacts of planning and consent processes, environmental licence requirements delaying projects, low interest from councils in expanding or enhancing waste infrastructure, and a lack of market for recycled materials.[21]

Potential solutions to these challenges could include ensuring the NSW Government provides an overarching strategy for the development of waste infrastructure to provide guidance and certainty to councils and industry with regard to demand, planning approvals processes and licensing requirements. It will also be important to provide certainty to industry that there is demand for recycled materials to encourage infrastructure investment.

2.3.5 Circular economy

A circular economy revises a waste management system from a linear model to one that is circular, redefining growth and product design, focussing on positive society wide benefits.[22]

Underpinned by a gradual transition to entirely renewable energy sources, the circular model builds economic, natural and social capital. The model designs out waste and pollution, keeps products and materials in use and regenerates natural systems.

Research of international best practice indicates that there is a global trend towards adopting 'circular economy' principles in approaches to material re-use, recycling and waste

[20] Internal unpublished report procured by the EPA (2018)

[21] Internal unpublished report procured by the EPA (2018)

[22] Ellen MacArthur Foundation. (2019). *Circular Economy*. Sourced from: https://www.ellenmacarthurfoundation.org/circular-economy/concept

management. In 2015, the European Commission adopted an ambitious Circular Economy Action plan, which included measures to transition Europe to a circular economy model.

Countries who have adopted a circular economy strategy talk about 'closing the loop' on waste production. There are three general objectives to a circular economy model:

- design out waste and pollution;
- keep products and materials in use;
- regenerate natural systems.[23]

While NSW has developed a draft Circular Economy strategy,[24] this was largely focused on means of addressing the challenges associated with China National Sword and domestic and export markets for recyclables. There is an opportunity to expand this approach and ensure that the circular economy principles underpin the 20-year waste strategy, including recognising the need for long term commitment and adoption of short and long term strategies and milestones for implementation.

Circular Economy – Scotland, the Netherlands and Ontario

Scotland, the Netherlands and the province of Ontario in Canada have recently released their Circular Economy strategies. These strategies outline the actions that will be undertaken to achieve a fully circular economy and zero waste by 2050.

Ontario's strategy includes a number of interim targets such as a 30% diversion goal by 2020, which increases to 50% by 2030 and 80% before 2050. The strategy includes objectives that will transition the current model to a circular economy, including enhancing provincial direction and oversight, creating conditions to support sustainable end-markets, enabling efficient and effective recovery systems and increasing waste reduction and resource productivity (Ontario 2018).

The Dutch circular economy strategy outlines the transition in three stages. The current state of a linear economy will move to a 'reuse' economy that improves recycling and gradually eliminates non-recyclable waste by changing product design. The final stage is the circular economy, where no non-recyclable waste is produced.

The Scottish strategy prioritises four areas for action to focus the transition to a circular model. These priority areas include: food and drink, as well as the broader bio economy, re-manufacturing and repairing products, construction and built environment and energy infrastructure.

These strategies, whilst containing subtle differences, including interim targets around waste diversion, make commitments to re-design products for recycling and re-use, and reconsider the use of raw materials from production to end-of-life.

2.3.6 Love Food Hate Waste

Love Food, Hate Waste is a program under the EPA's Waste and Resource Recovery Strategy, and is funded by the waste levy. It is based on and licenced from the UK's own Love Food, Hate Waste program, and aims to educate households and businesses about the environmental, economic and social impact of food waste in NSW.

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[23] Ellen Macarthur Foundation 2019. *Circular Economy: building blocks*. Sourced from: https://www.ellenmacarthurfoundation.org/circular-economy/concept/building-blocks

[24] NSW EPA 2018. *Circular Economy Policy Statement: Too Good to Waste*. Sourced from: https://engage.environment.nsw.gov.au/38561/documents/88956

The program focuses on implementing behavioural changes to reduce waste generation, by giving people the skills to make better purchasing decisions, improving food storage techniques, using leftovers so that food is eaten rather than thrown away and saving money.

The program provides grant funding and works with partners to deliver programs to households and businesses in the community.

With 35% of residual MSW and C&I waste going to landfill comprising food organics, any significant reduction in food waste will have a significant impact on landfill volume.[25] Food organics are estimated to comprise approximately 25% of total landfill volume.[26]

2.3.7 Premier's Priority

One of the 12 Premier's Priorities is to 'keep our environment clean' by reducing the volume of litter by 40% by 2020, from a 2013-14 baseline. Specific initiatives under the priority have included:

- implementation of the 'Return and Earn' Container Deposit Scheme, discussed in detail below;
- education and awareness campaigns, including the 'Don't be a Tosser!' campaign; and
- Council and Community Litter Prevention Grants under the Waste Less, Recycle More initiative, including the allocation of $8.3 million to councils, Regional Waste Groups and community groups to fund litter bins, cigarette butt bins, litter signs, enforcement of litter laws, litter education and community engagement initiatives about the impacts of littering.

The most recent 2017-18 National Litter Index result shows a 37% reduction from the 2013-14 baseline.

2.3.8 NSW Container Deposit Scheme

The NSW container deposit scheme (CDS) was announced in 2015. Roll out of the finalised scheme (Return and Earn) across NSW commenced on 1 December 2017. Features of the scheme in NSW are as follows:

- most NSW beverage containers between 150 millilitres and 3 litres in volume are eligible for a 10-cent refund;
- beverage suppliers (manufacturers, importers, wholesalers or retailers) that first supply eligible drink containers in NSW are responsible for funding refunds and associated Scheme costs;
- more than the planned 500 collection points will be established by the Network Operator, TOMRA Cleanaway, across the State;
- at full scheme rollout, collection points will include more than 800 reverse vending machines, and may also include local shops, depot sites and recycling centres.[27]

The rollout of the CDS will have a considerable impact on kerbside recycling, as CDS revenues are much larger than underlying commodity values[28] and potentially provide a very large

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[25] Organics comprised 1.704Mt of FY17 MSW and C&I waste to landfill – see Table 32 in Section 10.2.1.

[26] Based on 1.704Mt of organics per Table 32 in Section 10.2.1 and total waste to landfill of 6.74Mt per Table 31 in Section 10.2.1.

[27] NSW EPA. (2019). *Return and Earn*. Sourced from: https://www.epa.nsw.gov.au/your-environment/recycling-and-reuse/return-and-earn

[28] For example, aluminium has a value of over $6,000 per tonne from the CDS, compared to a value of $1,250 per tonne as a commodity – CIE: Revenue sharing arrangements between MRFs and councils from the Container Deposit Scheme. (2018). Sourced from:

source of additional revenue for councils, who are required to enter into revenue sharing agreements with MRFs for the proceeds of the CDS revenues.[29]

Negotiation of the sharing of CDS revenues is being undertaken by councils individually and is therefore influenced by the term remaining under existing waste contracts as well as their relative experience in negotiating contracts. Feedback from councils has indicated that a lack of data on the cost and revenue profiles of MRFs has negatively impacted on the ability of councils to negotiate the revenue sharing arrangement.

MRFs are utilising the CDS revenues to offset the loss of commodity revenues following China Sword (see Section 9.1). At the same time MRFs are also seeking gate fee increases from councils. The lack of data transparency limits a council's ability to assess whether MRFs are over recovering the loss of revenues from China Sword.

This issue may be considered as part of any future work streams under the 20-year waste strategy as the implementation of a uniform approach to CDS revenue sharing (as part of standardised waste contracts) may create additional revenues for councils to invest in waste avoidance, reuse and recovery strategies.

The change in waste values due to China's implementation of the National Sword policy and the combination of the CDS and NSW Waste levy means there is a highly financially viable kerbside recycling system in the state.[30] The full impact of the CDS may not, however, flow through for some time. [31]

The EPA will need to monitor the impact the CDS will have on waste streams and recovery rates. For example:

- a high take up containers in the CDS will reduce the volume of containers in kerbside recycling and a loss of revenue to MRFs[32];
- removal of glass from kerbside dry recycling may reduce the level of contamination of waste paper from glass shards;
- Separation of PET bottles and glass out of kerbside recycling may reduce the level of contamination of these recyclate, which may increase the amount of these wastes that may be recycled.

https://www.olg.nsw.gov.au/sites/default/files/CIE%20APC%20Final%20Report_NSW%20OLG_Container%20Deposit%20Scheme%20-%2028032018%20.pdf

29 Internal unpublished report procured by the EPA (2018)

30 Internal unpublished report procured by the EPA (2018)

31 Comparisons are made between the NSW and the South Australian scheme, which has been in operation since 1977 and the benefits that the SA scheme has achieved were realised over an extended period. Volumes to date, however, have exceeded expectations.

32 This loss of revenue may been offset to some degree through the revenue sharing agreements entered into with councils.

Consultation with industry has indicated that:

- regional take-up of the program has been "extraordinary";
- there is now a number of applications by landlords to host a vending machine in recognition of the associated business opportunities it creates for them by having people visit their site to deposit waste;
- the volume of containers covered by the CDS is significantly greater than had initially been estimated;
- the CDS has created a significantly cleaner waste stream which is highly desirable to the waste recyclers and is creating export opportunities with improvements in the value being realised; and
- the removal from containers from the kerbside is reducing the volume of recyclables collected, with existing contamination in the dry recyclables bin increasing as a percentage of waste.

2.3.9 Energy from Waste policy

In 2015, the EPA published the *NSW Energy from Waste Policy Statement*. The policy set out the requirements for facilities seeking to recover energy by thermally treating waste, or materials derived from waste.

The role of energy from waste technologies in NSW was the subject of a recent NSW Parliamentary Inquiry, where participants debated whether there was a place for energy from waste facilities in managing residual waste once higher order waste management techniques were exhausted.

Feedback from stakeholders, both at the Inquiry and as part of the Advisers' consultations, was that energy from waste has an important role to play in the future strategy for waste in NSW, but that there is significant uncertainty at present as to whether waste from energy was a viable option. Feedback provided included:

- uncertainty as to whether industry would be able to meet the requirements of the policy statement, particularly where new technologies were being proposed;
- issues with securing project sites close to waste sources and transport infrastructure, whilst recognising the challenges of urban encroachment;
- uncertainty over whether the EPA was supportive of energy from waste, despite its inclusion on the waste hierarchy;
- the lack of new waste to energy projects in NSW;
- the significant cost associated with developing such projects and the risk of the project not obtaining regulatory approval.

The Parliamentary Inquiry acknowledged that there was significant concern amongst some stakeholders about energy from waste, particularly around whether the available technologies, specifically combustion technology, pose an undue risk to human health and the environment. However, the Parliamentary Committee supported energy from waste in some circumstances and made a number of recommendations aimed at strengthening the regulatory framework for such facilities.

Stakeholder consultations undertaken by the Advisers in developing this Report indicated that energy from waste (including alternative fuels manufacturing e.g. as undertaken at ResourceCo and Cleanaway's Wetherill Park facility) has an important role to play in the NSW market, particularly as existing landfill becomes exhausted. Industry has indicated a willingness to invest in such infrastructure (for processing of waste where alternate recovery options have been exhausted), however:

- industry felt that the EPA was not supportive of the option and therefore obtaining approval carries a significant level of risk at potentially high cost;
- challenges existed with meeting some of the existing requirements of the *NSW Energy from Waste Policy Statement* or that there was uncertainty as to the statement's interpretation and how compliance could be demonstrated;
- industry requires regulatory certainty which it believes has been eroded by recent events in the organics industry (which will make financing of such infrastructure significantly more uncertain).

Councils consulted indicated a willingness to ensure appropriate waste supply for new energy from waste facilities.

Considerations for the 20-year waste strategy

Under circular economy principles, the use of Waste to Energy facilities, should only be contemplated when all other options have been exhausted and the proposed treatment represents a better environmental outcome than landfilling.

In regional or remote areas where reuse or recycling options are not economically viable, there may be a need to consider the merit of small scale Waste to Energy facilities.

Industry would benefit from a better understanding of:

- the EPA's view of the role to be played by energy from waste, within the context of a Circular Economy policy and the waste hierarchy – for instance whether it may play an interim role in the transition to a circular economy or has a place as a long-term solution;
- what needs to be demonstrated in new investment proposals, or whether new proposals would only be considered where the EPA has specifically requested submissions;
- the EPA's comfort levels with the different types of technology;
- the direction and EPA's interpretation of the NSW Energy from Waste Policy Statement.

The EPA may wish to undertake a review of the existing policy and assess the need to refine or clarify the application of the statement to new investment proposals.

Energy from waste is discussed further in Section 8.10.2.

2.3.10 Resource recovery orders and exemptions

Under the *Protection of the Environment Operations (Waste) Regulation 2014*, the EPA has the power to grant exemptions to license and levy requirements for resource recovery activities. Resource recovery orders apply to generators and processors of waste materials and include conditions which must be met to supply waste material for resource recovery activities. Resource recovery exemptions apply to consumers of the waste material and include requirements around how the waste can be re-used, as well as record keeping, reporting and other requirements.

2.4 Local Government

Local councils have the statutory ability to provide domestic waste management services under the *NSW Local Government Act 1993*.

Local governments are primarily responsible for the management of municipal waste programs in their jurisdictions, including kerbside collections, hazardous waste programs, public place waste management and provision of recycling and disposal infrastructure.

Businesses in council areas are generally required to source their own waste solution.

Services provided vary by local government and region (metro vs regional and remote). Kerbside collection, transportation and sorting services may be provided directly by the

council or through the use of third-party contractors. The majority of metropolitan councils outsource kerbside collections services, although some councils such as Newcastle still utilise their own fleet of trucks to deliver this service at what is believed to be a more than competitive rate.

Many regional and remote councils still own and operate landfill operations. Strategies are in place to increase the environmental safety and performance of these resource recovery centres. This has resulted in the closure of some small landfills.

2.4.1 Contracting Models

Stakeholder consultations have indicated:

- councils tend to enter into long term (7-10 years or longer) contracts for waste collection and processing services;
- existing contract terms tend not to provide the flexibility to modify service approaches to match changing council policies and attitudes towards waste reduction and diversion. Where they do, there are often cost implications which are not manageable for councils;
- councils would benefit from contracts that provided a greater level of flexibility in service delivery. This will be particularly important to ensure new actions developed through the 20-year waste strategy are able to be pulled down into council collection, transfer and processing arrangements;
- older style contracts tended not to have specific KPIs around meeting minimum recycling or diversion rates or requirements for the specific treatment of waste, although some councils have already included or are seeking to introduce such requirements to align with council and state strategies;
- councils tend to receive insufficient data with respect to waste recycling and diversion, with any data provided often reflecting the waste processing facility average rather than council specific data;
- council objectives in contracting services have, at times, been historically focussed on contracting services that meet minimum service delivery specifications, with a strong focus on cost minimisation. A broader set of objectives aligned to the 20-year waste strategy may need to be developed for inclusion in waste service contracts;
- councils tend to be sensitive to the impact on ratepayers of any strategies that, while beneficial to waste outcomes (e.g. recycling rates), would negatively impact on council rates. Regional and remote locations have demonstrated a much higher level of sensitivity, as have councils with challenging socio-economic profiles;
- councils may be capital constrained and not have the financial capacity to fund significant waste infrastructure;
- consolidation of the waste industry is impacting on the level of competition in the market and creating issues with access to waste infrastructure. One council raised the issue that at contract end, councils were losing their waste capacity at existing infrastructure as operators had contracted the capacity to other councils or organisations prepared to accept higher rates;
- there is often limited, or no, competition for contracts. Concentration of the ownership of critical infrastructure and vertically integrated organisations may be reducing the level of competition in tender processes (see Section 5);
- some concerns were raised that where critical waste infrastructure (including new purpose built facilities to meet a council's needs) is owned by the private sector and where there are no competing facilities in close proximity, pricing realised may not fully benefit

from the impact of competition and this may also create incumbency issues if other waste service providers were unable to gain access to that infrastructure.

Considerations for the 20-year waste strategy

- Councils consulted were keen for a waste infrastructure strategy or the 20-year waste strategy to explore alternate infrastructure ownership and funding models for critical infrastructure to support increased contestability e.g. public private partnerships; joint ventures; step in rights or the creation of an essential infrastructure fund (funded by the waste levy) to own critical infrastructure (but operated by the private sector);
- Councils consulted were keen for the EPA to work with councils to develop a set of guidance on a standard set of terms to be included in new waste services contracts (by all councils, across all waste services and different contracting models) to ensure that those councils with contracts expiring in the near term (e.g. next 3 years) did not enter into agreements that prevent councils from modifying arrangements to benefit from new strategies under the 20-year waste strategy;
- Councils expressed interest in working with the EPA and councils to develop a set of a standard set of KPI's or performance targets (aligned to the 20-year waste strategy) to be included in all new waste services contracts. Some councils felt their negotiating positions did not support the inclusion of such terms, but a whole of industry approach would be beneficial to achieving greater transparency.

2.4.2 Strategic Planning

Some councils consulted indicated a shift in waste planning practices, with planning for service delivery and in particular strategic planning for waste infrastructure being done in conjunction with other councils, through regional or joint organisations.

Feedback indicated that many councils saw the benefit in a regional approach to infrastructure planning, particularly with respect to identifying capacity constraints and presenting a consolidated view to the private sector when trying to attract infrastructure investment. However, industry lamented the fact that many new large scale developments (and even the Western Sydney Aerotropolis) are not planned and approved with waste considerations in mind, including the treatment of waste generated during construction, as well as waste separation and collection services, post completion. Industry believe insufficient consideration is given to opportunities for circular economy or precinct style solutions, as well as truck movements and access to waste infrastructure (both onsite considerations and more broadly).

The benefit of such a regional planning approach has not, however, fully extended to the procurement of waste services, with councils wishing to maintain their operational independence (through separate contracts) even though operational and financial benefits may be realised though optimising collection and transportations strategies (by ignoring council boundaries).

The feedback indicated that some councils (and not just larger councils who have critical waste volume mass by themselves) whilst members of regional organisations are less committed to coordinated approaches. In some cases, this has resulted in a failure to implement waste collection and diversion strategies as they were not viable on a standalone basis (although the economics could have improved by engaging with bordering councils).

2.5 Intergovernmental cooperation

Policy and regulatory inconsistencies between state and territory governments, and the Australian Government, creates additional challenges for long term waste management and resource recovery planning for both government and industry.

Particular challenges to address include:

- inconsistency of landfill levies between jurisdictions, encouraging waste disposers to seek less costly disposal locations;
- policy and regulatory inconsistency between jurisdictions reduces the waste industry's confidence, potentially constraining future capital investment decisions;
- extended producer responsibility schemes not being applied uniformly across jurisdictions and compliance not being mandatory; and,
- a national government body to bring together all stakeholders to monitor progress against the National Waste Policy.

3 The waste sector in NSW

3.1 Overview

The waste management industry in NSW is diverse and includes large and small operators participating in activities from waste collection and transportation, material recovery, and landfill ownership and operation. A combination of private sector, not for profit, local councils and government funded businesses collectively participate in the key areas of activity in the NSW waste industry, namely:

- waste generation;
- waste collection and transfer;
- sorting of waste;
- recycling and reuse; and
- the final disposal of residual waste.

Waste comprises items disposed of by households, businesses and industry and includes solid waste (putrescible and non-putrescible), liquid and hazardous. Waste is generally grouped into three categories, reflecting the source of generation:

- Construction and Demolition (C&D)
- Commercial and Industrial (C&I)
- Municipal solid waste (MSW).

3.2 The waste market

The Australian waste and resource recovery sector managed about 55 Mt of waste in 2016-17, including about 32 Mt through recycling and most of the rest through landfill. As of 2018, the waste management sector makes up approximately 0.8% of Australia's gross domestic product (GDP). In 2017, the waste management sector in NSW was worth approximately $4 billion.[33] The sector directly employs almost 50,000 people (full time equivalent terms), accounting for about 0.5% of total employment in Australia. About 20% of waste related activity is undertaken by local government.[34]

After a long-term trend towards consolidation (see Section 5.2), a number of large businesses, including some multinationals, have come to dominate segments of the market. Consolidation has brought efficiencies and higher levels of expertise. In NSW, the large operators include Cleanaway, Remondis, Suez, and Veolia and Bingo. Each of these companies operate collection operations for both commercial and domestic waste in NSW and also own landfills or other waste infrastructure. Visy remains a major operator in recycling and paper and cardboard reprocessing. Cleanaway, with its recent purchase of Toxfree, is Australia's largest operator in hazardous waste management. Some operators specialise in particular markets, such as composting or skip bin operation, or work in particular jurisdictions or regions. In

[33] NSW EPA. (2018). *Too Good To Waste: Discussion paper on a circular economy approach for NSW*. Sourced from: https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/recycling/18p1061-too-good-to-waste-circular-economy-discussion-paper.pdf?la=en&hash=4217537474E04FA7DD4A2D3191FFBD1A78433FD2

[34] Department of the Environment and Energy. (2018). *Australian National Waste Report 2018*. Sourced from: http://www.environment.gov.au/system/files/resources/7381c1de-31d0-429b-912c-91a6dbc83af7/files/national-waste-report-2018.pdf

metropolitan areas, collection businesses with small and medium-sized fleets provide competitive options for commercial and industrial waste sources.

In addition to the operators, there are a large number of local charities, consultants and developers who also operate in the waste sector. Further analysis is included in Section 5.

3.3 Waste tonnages

In 2017-18 NSW generated 21.41 million tonnes (Mt) of waste including 12.77 Mt from C&D, 4.40 Mt from C&I and 4.24 Mt from MSW.

Total waste tonnages grew by 14% between FY16 and FY18. This result is distorted by strong growth in C&D tonnages (FY18: 20% increase). MSW tonnages declined by 3% between FY16 and FY18, whilst C&I tonnages grew by 5.7% over the same period.

C&D accounted for over 56% of waste tonnages across FY16-FY18, increasing from 54% in FY16 to 60% in FY18.

Table 3: NSW Waste Generation Tonnages

Waste stream	2015-16	2016-17	2017-18
Waste tonnages (Mt)			
MSW	4.37	4.36	4.24
C&I	4.17	4.47	4.40
C&D	10.16	10.61	12.77
Total (Mt)	**18.70**	**19.44**	**21.41**
Change in waste tonnages to previous year (%)			
MSW	n/a	-	(3)
C&I	n/a	7	(1)
C&D	n/a	4	20
Total (%)	**n/a**	**4**	**10**
Waste stream as % of total waste tonnage			
MSW	23	22	20
C&I	22	23	21
C&D	54	55	60
Total (%)	**100**	**100**	**100**

Source: EPA data

3.4 Waste per capita

The NSW population grew by 3.1% between FY16 to FY18, an average of 1.5% per annum. 94% of population growth occurred in the MLA, with 4% in the RLA and 1.8% in the NLA.[35]

[35] NSW EPA waste generation, disposal and recycling data

NSW waste per capita grew by 11% between FY16 to FY18, the result distorted by the approximately 20% growth in C&D tonnages (see Section 4.3). Further analysis of total waste tonnages on a per capita basis is considered to be misleading as C&I and C&D volumes are influenced by other factors (see Section 3.9).[36]

Analysis of MSW waste tonnages per capita indicated a 7.0% decline between FY16 and FY18, largely influenced by a 4.3% decline in FY18 (FY17: 1.7% decline). The decline in MSW per capita largely occurred in the MLA, with a 3.7% decline in FY17 and 5% in FY18.

Table 4: NSW waste generation (tonnes per capita)

NSW Waste	2015-16	2016-17	2017-18
Levy area (tonnes per capita)			
Metropolitan Levy Area	2.61	2.65	2.86
Regional Levy Area	1.18	1.25	1.32
Non-levied area	2.33	2.44	2.77
Total	**2.42**	**2.48**	**2.69**
MSW (tonnes per capita)			
Metropolitan Levy Area	0.53	0.51	0.48
Regional Levy Area	0.52	0.57	0.57
Non-levied area	0.82	0.83	0.80
Total	**0.57**	**0.56**	**0.53**
MSW (tonnes per capita % increase / decrease)			
Metropolitan Levy Area		-3.7	-5.0
Regional Levy Area		10.4	-0.6
Non-levied area		0.1	-3.0
Total		**-1.7**	**-4.3**

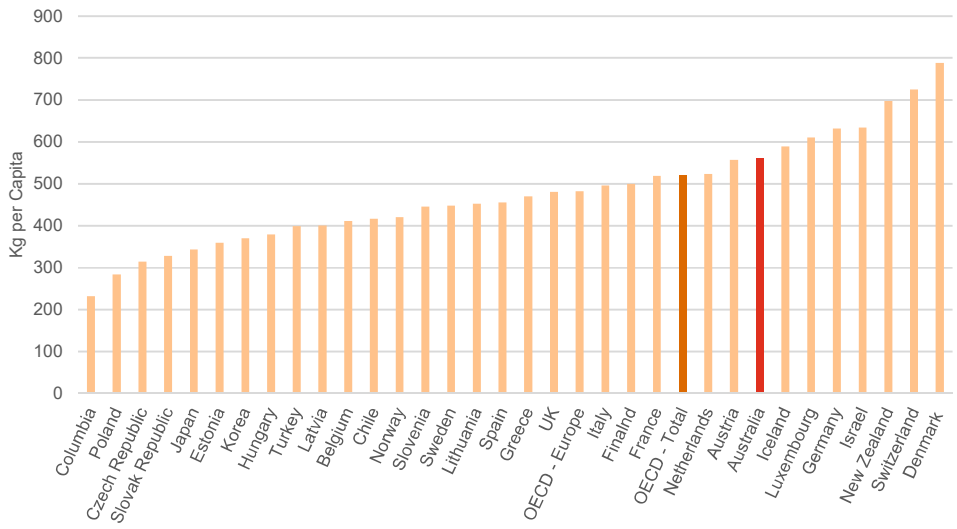
Source: EPA Data

With waste processing and recovery activities occurring predominantly outside of metropolitan areas, continued population growth in metropolitan areas will place further pressure on existing waste collection and transportation infrastructure as there has been a lack of new infrastructure being built in densely populated metropolitan areas.

As shown in Figure 2, Australia's (and NSW's) waste generation per capita is relatively high in comparison to the rest of the OECD. However, these statistics should be treated with some caution given the differing methodologies used to calculate waste per capita.

[36] NSW EPA waste generation, disposal and recycling data

Figure 2: Annual MSW waste generation per capita [37]



3.5 Waste generation

82% of total waste generated over FY16-18 was from the MLA, which covers the Sydney metropolitan region, including the Central Coast and the Illawarra (but excluding the Blue Mountains and the upper Hunter region, which are considered part of the RLA). Approximately 76% of the NSW population lived in the MLA during this period.

Table 5: Waste Generation by Levy Area

	2015-16	2016-17	2017-18
Waste tonnages (Mt)			
Metropolitan levy area	15.35	15.89	17.48
Non-levied area	2.40	2.53	2.86
Regional levy area	0.95	1.02	1.07
Total tonnes	**18.70**	**19.44**	**21.40**
Waste tonnages %			
Metropolitan levy area	*82%*	*82%*	*82%*
Non-levied area	*13%*	*13%*	*13%*
Regional levy area	*5%*	*5%*	*5%*

Source: EPA Data

3.6 Waste composition

The composition and drivers of waste volumes differ by waste stream. Analysis of waste composition by material type is considered in Section 6 and waste drivers by waste stream is considered in Section 4.

[37] OECD Environment Statistics, Data 2015, Sourced from: https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics/municipal-waste_data-00601-en (NB Data included is from 2015 as Australia did not provide 2016 data to the OECD)

3.7 Waste recycling rates

3.7.1 Summary observations

Table 6 below summarises the waste recycling rates by waste stream.[38]

Table 6: Waste recycling rates

	2015-16	2016-17	2017-18
Waste to Landfill (Mt)			
MSW	2.52	2.53	2.45
C&I	2.18	2.25	2.09
C&D	2.21	1.96	2.94
Total	**6.91**	**6.74**	**7.48**
Waste generated (Mt)			
MSW	4.37	4.36	4.24
C&I	4.17	4.47	4.40
C&D	10.16	10.61	12.77
Total (Mt)	**18.70**	**19.44**	**21.40**
Recycling rates (%)			
MSW	42	42	42
C&I	48	50	52
C&D	78	81	77
Total	**63**	**65**	**65**

Source: EPA Data

The overall recycling rate increased from 63% in FY16 to 65% in FY17, staying at this level in FY18. The MSW recycling rate remained at 42% over FY16-FY18. The C&I recycling rates has improved from 48% to 52% between FY16 and FY18, while the C&D recycling rate fluctuated from 81% to 77%.

The WARR Strategy included the following targets for 2021 under its overarching objectives:

- increasing recycling rates to:
  - 70% for municipal solid waste;
  - 70% for commercial and industrial waste;
  - 80% for construction and demolition waste;
- increasing waste diverted from landfill to 75%;

The FY18 recycling rates are tracking well below the WARR Strategy targets, except for the C&D target.

Factors that are negatively impacting on diversion rates are included in:

- MSW (Section 4.1);
- C&I (Section 4.3);
- C&D (Section 4.4).

[38] Recycling rate, as defined in the WARR Strategy, pertains to the proportion of all recycled materials compared to the total amount of waste generated – and does not include energy from waste.

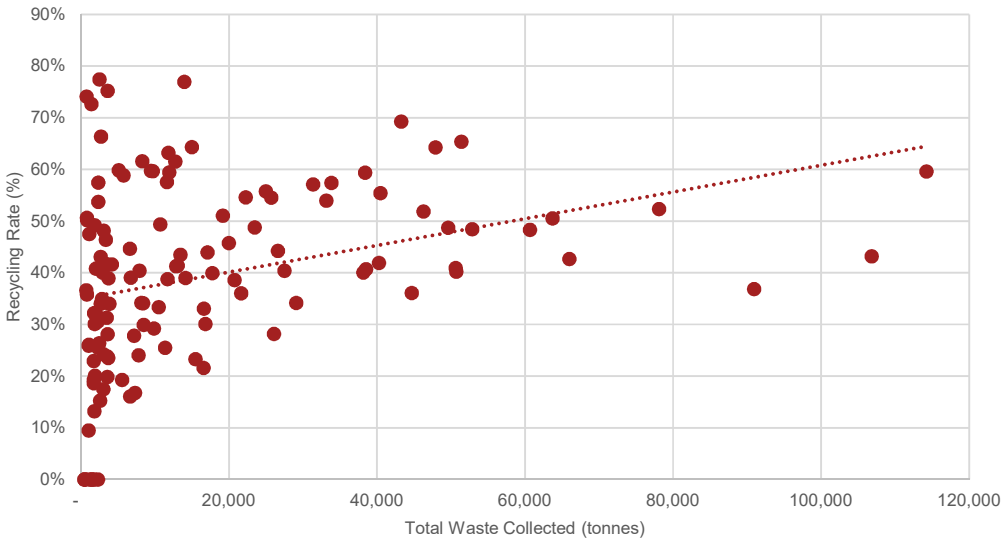
3.7.2 Local government recovery rates

Analysis of 2016-17 local government self-reported recycling data indicates:[39]

- 92 out of 128 councils (72%) have a recycling rate below 50%;
- 26 out of 128 councils (20%) have a recycling rate below 25%;
- 8 out of 128 councils (6%) do not have a reported recycling rate;
- 17 out of 128 councils (13%) have a recycling rate at or above 60%, with the highest rate being 77%.

As shown in Figure 3, there is no consistent relationship between the amount of waste generated and the recycling rate.

Figure 3: Councils waste generated and recycling rate



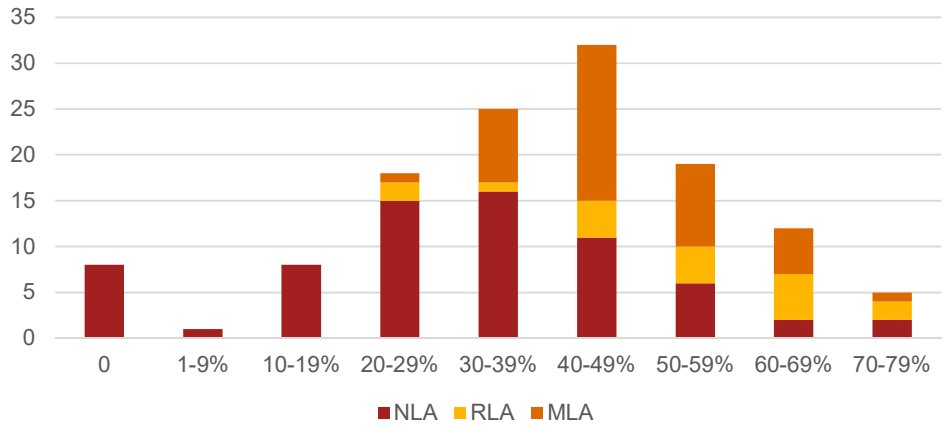
Source: EPA Data

As shown in Figure 4, those councils with higher recycling rates tend to be in levied areas. All of those councils with a recycling rate of below 20% were in the non-levied area (NLA).

Data derived from WARRP reporting for 2016-17 indicated that per capita MSW generation in the MLA was the lowest rate at 0.48 (see Table 4) tonnes per annum, followed by the RLA (0.57) and the NLA (0.80).

[39] 'NSW Environment Protection Authority (forthcoming), Local Government WARR Survey 2016–17'

Figure 4: Council recycling rates (%) by waste levy area (number of councils)



Source: EPA Data

Figure 5 illustrates the breakdown of councils between the NLA, RLA and MLA by bin system, based on the following five systems:

1 General waste only

2 General waste and dry recycling

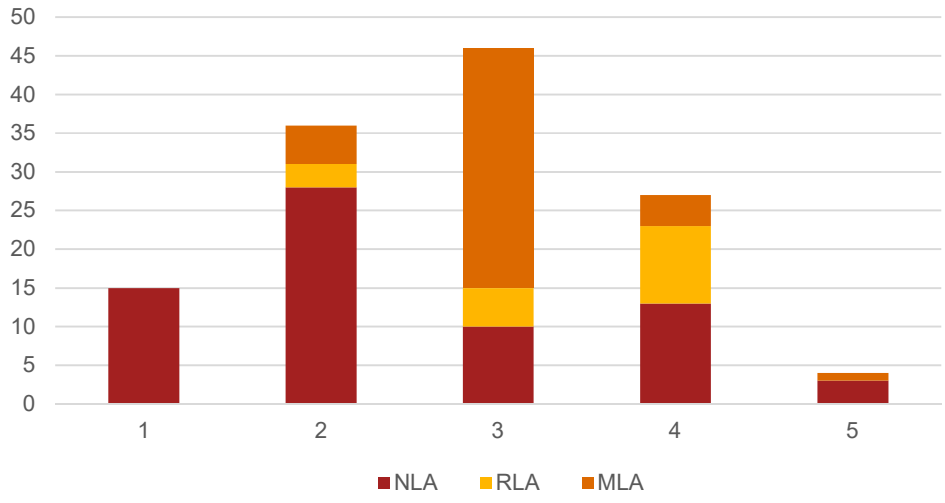
3 General waste, dry recycling and garden organics

4 General waste, dry recycling and food organics

5 General waste, dry recycling, garden organics and food organics.

As can be seen, most councils within levied areas had a bin system three or four, with a handful having a bin system two. Of the four councils with bin system 5, four were in the NLA.

Figure 5: Council bin system by waste levy area (number of councils)



Source: EPA Data

Analysis of the highest and lowest performing councils in terms of recycling rates shows that, of the 17 highest performing councils:

- Only four are outside the levied area;

- 15 councils (88%) had either a 3 (residual waste, dry recycling and garden organics) or 4 (all of the above plus FOGO) bin system with the majority (10 or 59%) having bin system four;
- the associated regions had populations ranging between 3,000 and 350,000;
- metropolitan, metropolitan fringe, regional town/city, large rural and rural classifications are all represented in the higher performing group;
- 7 of the 17 councils (41%) have waste processed at AWTs (2015-16);
- 10 of the 17 councils (59%) collect food and garden organics; and
- 13 have kerbside clean up services (76%) and 15 have drop off services (88%), this is higher than the NSW average on both counts (59% and 80% respectively).[40]

Of the 19 lowest performing councils:

- none are in a levied area;
- most of the 19 had either a 1 bin system (12/19 councils, residual waste only) or a 2 bin system (6/19 councils, residual waste and dry recycling), with only one 3 bin system in the group;
- the councils had populations ranging from 1,800 to 26,000, with an average of 7,140 people and 10% recycling rate;
- rural, large rural and regional town/city classifications are represented in the group;
- none of the councils have waste processed at AWTs (2015-16);
- 4 have kerbside clean up services (21%) and 15 have drop off services; and
- none have a FOGO service.

3.8 Waste to landfill

The total tonnage of waste going to landfill was 7.48Mt in FY18, an increase of 8.3% over the FY16-FY18. This result is distorted by the increase in C&D volumes. Excluding C&D, total MSW and C&I waste tonnages declined by 5% in FY18 and 1.7% in FY17.

C&D was the largest contributor of waste going to landfill in FY18, 2.94Mt, an increase of 50% over FY17. As noted in Section 2 total C&D tonnages have increased significantly in recent years driven by large construction and infrastructure projects across NSW.

MSW tonnages comprised 22% of total waste tonnages across FY16-FY18, but accounted on average for 35% of waste going to landfill over this same period, reflecting its comparatively lower diversion rate relative to C&D and C&I (see Section 4.1).[41]

[40] High performing councils in the 2016-17 data include some with materials processed by AWT facilities which, as of 2018, would be landfilled after the retraction of the Mixed Waste Exemption by the NSW EPA.

[41] For example, the FY18 contribution of MSW to total waste volumes going to landfill would be 5% higher in the absence of the C&D volume increase in FY18.

Table 7: NSW Waste to landfill

	2015-16	2016-17	2017-18
Waste to Landfill (Mt)			
MSW	2.52	2.53	2.45
C&I	2.18	2.25	2.09
C&D	2.21	1.96	2.94
Total	**6.91**	**6.74**	**7.48**
% of total tonnage to landfill			
MSW	36	38	33
C&I	32	33	28
C&D	32	29	39
Total	**100**	**100**	**100**

Source: EPA Data

3.9 Drivers of waste generation

Growth in waste generation is influenced by a large number of factors including changes in population, economic conditions, consumer behaviours, changes in technology and other factors that influence our lives.

3.9.1 Population

Waste generation (particularly MSW), is closely linked to population size. Generally, the greater the population the greater the waste generation.

The population of NSW at the end of FY18 was 7.97 million and is expected to grow to 9.9 million people by 2036. This growth is expected to increase the amount of waste to 159% higher than waste levels in 2002.[42]

Population change will have a significant impact on waste generated across NSW, regardless of changes in per capita waste generation.

Key issues impacting waste generation include:

- overall population growth in NSW, both as a result of natural population growth and interstate and international migration;
- intrastate migration; changing regional profiles and the increasing number of people living in high density accommodation and in metropolitan areas;
- closely related to the impact of growing urban areas, is the impact on infrastructure construction and expanding commercial and industrial activities.

3.9.2 Economic conditions

Waste generation has a positive relationship with economic development. Increased wealth tends to result in increased waste generation (across all waste streams) due to increases in the consumption of materials, increased infrastructure development (which impacts C&D waste generation) and changes in consumption patterns with a shift towards convenience and time-saving (which largely impacts on MSW generation).

[42] New South Wales Department of Planning and Environment. (2019). *2016 NSW State and Local Government Area Population Projections*. Sourced from: https://www.planning.nsw.gov.au/Research-and-Demography/Demography/Population-projections

Manufacturing, retail and mixed small business are the largest generators of C&I waste.[43] Waste volumes growth in the C&I sector will be closely linked to activity levels in these industry sectors.

NSW has experienced a strong period of economic growth, with a four-year economic growth above trend of 2.5% per annum to FY18.[44] Household consumption, public infrastructure, dwelling construction and service exports have been the key drivers. The NSW economy is forecast to continue to perform well in the short term (to FY20), with gross state product (GSP) increasing by 2.75% annually. Growth drivers are shifting from dwelling construction and household consumption, towards business investment and more broad-based strength in exports.[45]

NSW's significant infrastructure program and its spill over into private investment has contributed to its strong economic growth but has also contributed to an increase in waste generation (particularly in C&D). Strengthening global and national economies are expected to boost exports, spurring businesses to lift investment and employment. With a further $87 billion spend on infrastructure pipeline over the next four years, the 20-year waste strategy will need to take into consideration the short and longer term impact these projects are likely to have on waste generation and transportation volumes; its immediate impact on C&D volumes and the flow on effects to C&I and MSW volumes.[46]

The labour market is experiencing strong momentum, with employment growth of 3% forecast in 2017-18. This has fostered near record workforce participation, which combined with above-trend population growth is expected to see the unemployment rate stabilise at nearly 5% over the forward estimates.[47]

The strong economic performance has also contributed to strong jobs growth boosting household income and consumption and can also be linked to changes in the business activities of generators of waste (such as manufacturing and food services); growth in the construction sector (including infrastructure projects, commercial and residential buildings and demolition activity resulting from urban renewal and post-natural disaster construction).

3.9.3 Housing density

Higher density housing is an emerging trend in Australian housing, with a growing proportion of Australians living in multi-unit developments (MUDs). The 2016 Census of Population and Housing found that 10% (2,348,434) of all people in Australia spent Census night in an apartment. Over the past 25 years, the number of occupied apartments (including flats and units, excluding townhouses) in Australia has increased by 78% to 1,214,372 dwellings at the 2016 Census. The growth in apartment living is primarily an urban phenomenon, concentrated within Australia's major capital cities.[48]

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[43] NSW EPA. (2015). *Disposal-based Audit Commercial and Industrial Waste Stream in the Regulated Areas of New South Wales*. Sourced from: https://www.epa.nsw.gov.au/~/media/EPA/Corporate%20Site/resources/warrlocal/150187-disposal-audit-overview.ashx

[44] NSW Treasury. (2018). *Economic outlook*. Sourced from: https://www.treasury.nsw.gov.au/nsw-economy/about-nsw-economy/economic-outlook

[45] Ibid

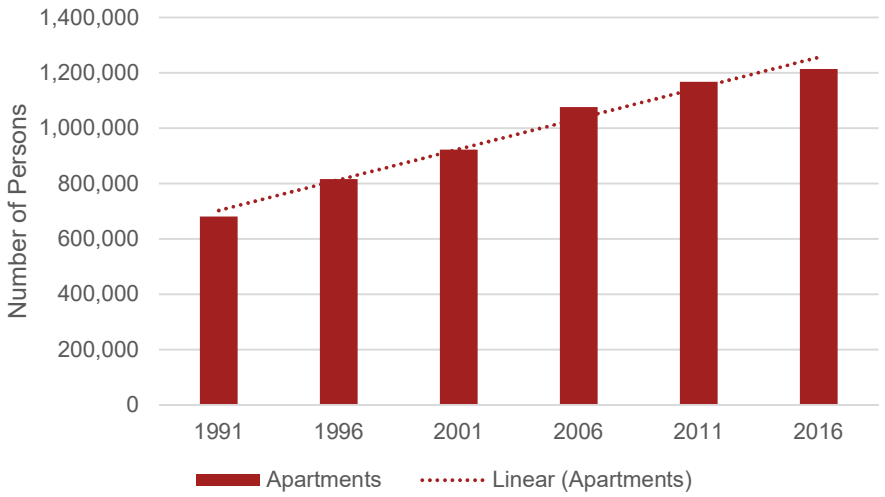
[46] NSW Government. (2018-19). *Infrastructure Statement 2018-19*. Sourced from: https://www.budget.nsw.gov.au/sites/default/files/budget-2018-06/Budget_Paper_2-Infrastructure%20Statement-Budget_201819.pdf

[47] Ibid

[48] Australian Bureau of Statistics. (2017). *2071.0 - Census of Population and Housing: Reflecting Australia - Stories from the Census, 2016*. Sourced from: http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/2071.0~2016~Main%20Features~Apartment%20Living~20

Of the 1,214,372 occupied apartments in Australia in 2016, nearly half (47%) were in New South Wales, followed by 23% in Victoria and 17% in Queensland. New South Wales also had the highest proportion of apartments relative to all occupied private dwellings (at 21%).[49] As shown in the figure below, there has been an increase in the number of persons living in apartments in Australia over the past three decades from 1991 to 2016.

Figure 6: Persons living in apartments in Australia 1991-2016



Source: ABS 2017, Census of Population and Housing – Stories from the Census 2016 – Apartment Living

Due to the higher rate of occupancy and density, effective waste management and recycling in MUDs presents a greater logistical challenge than standard housing. Given the trend in increased housing density and the waste management challenges presented by MUDs, it is important for property developers, state governments and local councils to embrace best practice in MUD waste management from the design through to the operational phase.

Changes in household size and composition

Declining household occupancy levels will also impact on waste consumption per capita. Drivers of lower occupancy include an aging population, increasing divorce rates, the rise of single-person households and an overall decline in the number of children per household.[50] Smaller households tend to produce less waste than larger ones. The amount of waste generated per capita decreases with increasing household size.[51]

3.9.4 Technology

Changes in technology, innovations in the nature of materials used by industry and changes in consumer behaviour will influence not only waste generation but the mix of waste. This has flow on consequences for the efficiency and effectiveness of waste collection and recovery practices, the contamination levels in waste streams and ultimately the tonnage and type of waste that ends up in landfill.

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[49] Australian Bureau of Statistics. (2017). *2071.0 - Census of Population and Housing: Reflecting Australia - Stories from the Census, 2016*. Sourced from: http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/2071.0~2016~Main%20Features~Apartment%20Living~20

[50] AIFS. (2019). *Population and households*. Sourced from: https://aifs.gov.au/facts-and-figures/population-and-households

[51] Schanes, K et. al. (2018). 'Food waste matters - A systematic review of household food waste practices and their policy implications'. *Journal of Cleaner Production*. Vol. 182. Pgs. 978-991.

Specific emerging issues to be considered include:

- growth in e-waste e.g. higher penetration of mobile phones, portable electronic devices, laptops; televisions, lighting and other electronic equipment (e.g. toys, leisure and sporting equipment- see Key Finding 14);
- growth in waste from the energy generation sector e.g. solar panels and associated photovoltaic system equipment;
- shift away from fibres and metals to complex plastics;
- growth in battery usage - for household energy storage systems.

Options to manage the increasing influence of technology may include increased controls over the growing use of non-recyclable materials in the development of new technologies, and increased producer responsibility or stewardship obligations (see Section 2.2.3). This could include voluntary or mandatory schemes, with positive obligations to establish infrastructure to recover waste materials and establish access to end markets.

New technologies may also bring new opportunities to improve the processing of waste materials, and the re-use of recycled materials. This could present an opportunity to increase diversion of waste materials from landfill decrease the level of contamination in recyclates as technologies continue to develop (discussed in further detail at Section 8.11).

3.9.5 Social change

Social changes can impact on consumer behaviour and consumption patterns, which can have a significant impact on waste generation and the mix of waste. International consumer and business concerns over the impact of waste on the environment and the tonnage of waste being sent to landfill has seen social change:

- impact the tonnage of waste being generated (e.g. through food waste and other avoidance) and sorted through kerbside recycling and ultimately diverted from landfill;
- place pressure on retailers to improve the recovery and recyclability of materials included in their products;
- produce a shift in purchasing patterns towards goods with higher recyclable material content or goods which are longer-lasting (reduction in single-use goods);
- result in greater transparency and information over the extent to which products may be recycled and what support the manufacturer or relevant industry is providing to reduce waste going to landfill.

The profile of waste and related issues is experiencing significant coverage in social media and local council forums. Consumer attitudes are starting to exert greater influence over business and purchasing decisions. The recent success of the ABC TV program “The War on Waste” demonstrated this, with governments and businesses taking action with problem waste streams such as food, lightweight plastic bags and coffee cups. The power of social media in effecting change and impacting decision-making was also raised in interviews of stakeholders undertaken by the Advisers.

Social change – San Francisco

Social change has been central to the success of San Francisco's Zero Waste policy. In 2003, in response to considerable constituent pressure, the city set the ambitious goal of achieving zero waste by 2020. To achieve this, San Francisco introduced a number of significant policies to change behaviour, including:

- *prohibiting the use of Styrofoam and Polystyrene foam in food service;*
- *mandatory recycling for construction debris;*
- *ban of plastic bags in drugstores and supermarkets; and*
- *implementation of mandatory recycling and source separation of organics for residents and businesses.*

San Francisco also launched a number of education campaigns to change behaviours. Door-to-door communications campaigns were developed, in multiple languages to educate citizens about mandatory recycling and composting. By 2010, the city had achieved a 75% diversion rate.

Source: US EPA. (2019). Zero Waste Case Study: San Francisco. https://www.epa.gov/transforming-waste-tool/zero-waste-case-study-san-francisco

3.10 Considerations for the 20-year waste strategy

In order to improve waste reduction, diversion and recycling rates, future waste policy needs to:

- address the waste hierarchy (i.e. have a greater focus on avoidance and reuse strategies) and the adoption of circular economy principles;
- consider not only the current tonnages and mix of waste but changes in patterns of waste generation now and over the next 20 years, and the capacity/capability of waste infrastructure to respond to potentially changing needs;
- consider options to support the greater use of materials which are recyclable and/or discourage the use of single-use materials;
- be undertaken in a coordinated manner through all levels of waste flow (generation; collection, transportation, recovery, landfill) within the state and across borders to reduce the risks of waste diversion across borders (e.g. landfilling interstate);
- consider policy initiatives specific to individual problem waste materials (e.g. plastics) as well as any potential unintended consequences of policy decisions (e.g. a decrease in food waste to landfill may reflect food waste going to sewerage);
- consider the end markets for recycled materials:
  - domestic and export markets;
  - economic competitiveness of recycled vs virgin materials;
  - capacity to create circular economies for individual materials;
  - barriers and opportunities for greater levels of waste avoidance, reuse and recycling.

4 NSW Waste Streams

4.1 Overview

This section considers the sources, composition and particular challenges associated with the MSW, C&D and C&I waste streams.

4.2 Municipal solid waste

MSW comprises:

- solid waste collected by local councils through local kerbside collection (covering general waste; dry recyclables (paper, card, glass and plastics); organic waste and in some locations combined food and organics);
- waste collected by councils from municipal parks and gardens;
- street sweepings and public council bins;
- waste from community collection centres;
- hazardous and other waste collection programs coordinated by councils (e.g. e-waste, paints);
- specific kerbside collections through council clean-up programs or requests by residents.

MSW waste generation is influenced in part by:

- economic factors (including disposable incomes; employment; number of dependents);
- consumer preferences and social change;
- population demographics (also see Section 3.9.1).

4.2.1 MSW waste generation

70% of MSW in FY18 was generated in the MLA, with a further 11% in the RLA and 20% in the NLA.

Table 8: MSW waste generation

	2015-16	2016-17	2017-18
MSW generation (Mt)			
Metropolitan levy area	3.11	3.04	2.95
Non-levied area	0.85	0.86	0.83
Regional levy area	0.42	0.46	0.46
Total (Mt)	**4.37**	**4.36**	**4.24**
MSW generation (tonnes per capita)			
Metropolitan levy area	0.53	0.51	0.48
Non-levied area	0.82	0.83	0.80
Regional levy area	0.52	0.57	0.57
Total	**0.57**	**0.56**	**0.53**

Source: EPA Data

Total MSW waste decreased by 3% between FY16 and FY18 from 4.37Mt tonnes to 4.24Mt tonnes. The largest decline occurred in the MLA (155,000 tonnes – 5%), whilst the RLA reported a 44,000 tonne (11%) increase.

Waste generation per capita declined by around 7 per cent between FY16 and FY18, with a 9 per cent decline in the MLA, a 2 per cent decline in the NLA and a 10 per cent increase in the RLA.

4.2.2 Generators of MSW waste

The general factors driving MSW waste generation are outlined in Section 3.9.

4.2.3 MSW waste composition

The composition of the MSW waste stream in NSW has been identified through audits of kerbside collections. The analysis is based on the results of the 2011 kerbside audit covering councils from the Sydney Metropolitan Area (SMA), Extended Regulated Area (ERA) and Regional Regulated Area (RRA) which carried out household waste (66 councils) and recycling bin (54 councils dry recycling and 20 councils green bins) audits as part of the Waste and Sustainability Performance Improvement Payment (WaSIP) program. This analysis is supplemented by more recent kerbside audits for individual councils (see Section 4.2.4).

Table 9 indicates the composition of waste contained in the residual waste bins, as per the 2011 audit report. An uptake in organics collections and changing packaging and consumption trends will have influenced the composition of MSW waste since this audit.

'Other' materials include hazardous waste, building waste, earth based materials, e-waste and miscellaneous items.

Table 9: MSW residual waste bin composition

Material %	SMA[52]	ERA	RRA	Total
Paper and paper products	21.2	16.3	17.5	19.6
Organics	53.2	56.0	53.4	53.8
Glass	3.3	4.3	4.5	3.7
Plastics	10.4	10.3	11.0	10.5
Ferrous materials	2.1	2.3	2.5	2.2
Non-Ferrous materials	0.6	0.7	0.9	0.6
Other	9.3	10.3	10.4	9.6
Total	**100**	**100**	**100**	**100**

Source: NSW EPA Data

The 2011 analysis indicated that the MSW stream contained a significant portion of materials that could be recycled.

[52] The SMA and ERA have since been combined into what is now known as the Metropolitan Levy Area, and the RRA is now known as the Regional Levy Area.

Table 10: Potential recoverable materials in the kerbside residual waste bin

Recoverable Material %	SMA	ERA	RRA	Total
Dry recyclables	21.6	22.4	24.0	22.1
- Paper	-	-	-	8.2
- Plastic	-	-	-	8.4
- Glass	-	-	-	3.2
- Metals	-	-	-	2.3
Garden and vegetation	6.8	17.2	11.9	9.7
Food organics	38.5	29.1	30.2	35.3
Sub-total	**66.9**	**68.7**	**66.1**	**67.1**
Non-recoverable waste	33.2	31.2	34.0	32.9
Total	**100**	**100**	**100**	**100**

Source: NSW EPA data

The kerbside audit determined that up to 67.1% of residual waste (red bin) could be diverted from landfill.

Dry recyclables

Contents of the dry recyclables was found to be primarily paper and paper products (55%), followed by glass (30%) and plastic (8%).

The remaining contents included ferrous and nonferrous materials, e-waste, small amounts of hazardous waste and other miscellaneous waste materials.

The 2011 audit concluded that the dry recyclable bins contained on average 92.7% of recyclable materials and 7.3% of contamination (including non-recyclable paper, glass, plastic and metals, organic compostable materials).

The high level of contaminants in the dry recyclables can have a significant impact on the ability of processors to recover recyclable materials.

Organic materials

97.9% of waste in the organics bin was found to be garden and vegetation waste. The remaining 2.1% included other organic materials and non-recyclables which were considered contamination.

Summary

The 2011 audit highlighted that:

- a significant portion of the residual waste comprises recyclable materials that need not go to landfill;
- dry recyclables contain a high level of contamination that reduce the volume of recyclate that could be recovered and reused or processed into alternate products;
- certain contaminates may damage processor equipment.

The above findings may reflect:

- a lack of understanding by householders on what can be recycled through kerbside vs other council recycling programs;
- a lack of commitment to effective recycling practices;
- a lack of understanding of the damage that can be done to processing equipment through the inclusion of inappropriate materials in recycling;
- a lack of understanding that contamination can result in waste loads being sent to landfill.

Since 2011, the EPA has implemented a number of programs to address the identified issues (see Section 2).

4.2.4 Council kerbside audits

A review has been undertaken of a sample of kerbside audits undertaken by individual councils or regions since 2011.

Regional Organisation of Councils 2015 kerbside audit[53]

The 2015 kerbside audit key findings included the following observations:

- total waste (general waste, dry recyclables and organics) increased by 4% since 2011, reflecting a 48% increase in organics, a 3% increase in general waste and a 15% decline in dry recyclables;
- electrical items /peripherals and dry cell batteries were the most common hazardous wastes. Smaller numbers of toner cartridges, other batteries, computer equipment, mobile phones, gas bottles and car batteries were found in waste;
- e-waste and metals remain at 1% of residual waste;
- single-unit dwellings (SUDs) produce more waste (12kg) than Multi-unit dwellings (MUDs -7kg). Both SUDs and MUDs had an average of 17% of dry recyclables in their general waste, compared to the average of 22% in 2011;
- loose food in residual waste (36%) has not changed, but containerised food (5%) has increased;
- paper has declined from 54% of recyclate to 44% (reflecting the shift to on-line news and correspondence). This has flown through to a 15% reduction on the volume of recyclate;
- the volume of plastic and textiles wastes in general waste is increasing;
- 84% of waste is presented in bags (such waste needs to be processed through bag openers in an MRF in order to capture recyclates; bagged waste in an organics facility or AWT would be treated as a contaminant and removed to landfill);
- 3% of recyclables are presented as bagged (up from 1%). Bagged recyclables are generally treated as a contaminant and sent to landfill);
- stringy items that can interfere with waste processing equipment makes up 0.7% of general waste and 0.9% of co-mingled recyclables; [54]
- contamination in the recycling increased from 13% to 16%, a combination of bagged materials in recycling and reduced paper volumes;
- contamination levels were consistent between MUDs and SUDs;
- organics waste volumes (in the green bin) had increased from 2.5kg per week to 4.1kg;
- organics contamination had declined from 3% to 2%;
- recovery of recyclables (in recyclables bins) increased from 79% to 83%. SUDs achieved 86% compared to MUDs 69%. Under-performing materials (relative to the average)

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53 Sourced from the consultants review of 2015 kerbside audits (2016).http://ssroc.nsw.gov.au.s223791.gridserver.com/wp-content/uploads/2018/01/2015-SSROC-Regional-report_final_no-council-names_17_6_16.pdf

54 Rope, string, hoses, cables, cords, textiles, plastic film, wiring etc.

included plastics (PET/HDPE) at 62-64%, other plastics (25%), aluminium (36%) and liquid paperboard (49%);

- SUDs and MUDs recover less than half of all steel, aluminium and non-PET/HDPE plastics;
- 46% of waste was diverted from going directly to landfill (up from 41%) through processing by AWT's (Rockdale and City of Sydney facilities);
- if all recyclable paper and containers were placed in dry recycling, diversion rates would increase to 52%;
- if all organics were placed in the green recycling bin, landfill diversion rates would increase to 54%;
- diverting 60% of all food wastes in the general waste bin would increase the landfill diversion rates to 65%;
- diverting 60% of other organics in the general waste bin would increase the landfill diversion rates to 73%, which would achieve the NSW state diversion target of 70%

City Council 2013 kerbside audit[55]

The key findings from this City Council 2013 kerbside audit included:

- a higher yield of food was found in the 2013 audit (at 2.20kg/hh/wk or 23.94% of the stream) compared to 2011 (at 1.77 kg/hh/wk or 24.42% of the stream);
- a lower yield of organics was found in the 2013 audit (at 2.01kg/pp/pw or 21.93% of the stream) compared to 2011 (at 2.89 kg/hh/wk or 39.72% of the stream);
- the proportion of mobile garbage bin (MGB) recyclable and potentially recyclable were both up on 2011 figures at 13.25% and 1.49% respectively (as opposed to 11.64% and 0.44% respectively in 2011);
- the amount and proportion of MGB non-recyclable was considerably higher in the 2013 audit (2.84 kg/hh/wk or 30.91%) than in the 2011 audit (1.39 kg/hh/wk);
- total waste levels were higher in the 2013 audit (at 9.19 kg/hh/wk) than in the 2011 audit (at 7.26 kg/hh/wk);
- the fully commingled recycling contamination rate was higher was 11.37 %, up from 6.76% in 2011 audit;
- the overall resource recovery rate proportion (in the recycling week) was lower in the 2013 audit (at 87.03%) than in the 2011 audit (at 91.33%);
- each household presenting a bin generates the following per week:
  - 9.19 kg/hh/wk of residual waste compared to 7.26 kg in 2011;
  - 4.61 kg/hh/wk (9.21 kg per fortnight) of fully commingled recycling material which is a lower yield from 4.78 kg/hh/wk (9.55 kg per fortnight) in the 2011 audit;
- across miscellaneous waste types, the 2013 audit had a higher yield than 2011 in food, wood/timber, textile/rags, plastic bags, ceramics, dust, dirt, rock, inert, ash material and 'other' materials;

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55 Information sourced from a report produced for the City Council http://doc.shoalhaven.nsw.gov.au/Displaydoc.aspx?Record=d14/64846(2013)

- 2013 had a higher proportion of both hazardous waste (1.63%) and E-waste (2.10 %) compared to the 2011 audit (at 0.37% and 0.80% respectively).

Audit Recommendations[56]

- 17% of materials (containers, paper and organics) in the residual waste should be in the recycling or garden organics stream. Household education to motivate residents to divert recyclables could lift recovery and diversion rates;
- contamination rates are increasing. Education programs should focus on the main contaminants bagged material and contaminated paper and newspapers/magazines wrapped in plastic;
- removing containerised food/liquid before recycling and clarifying exactly which plastics are accepted in the recycling stream will reduce contamination. Councils should work more closely with their waste collection contractors to identify households where contamination occurs regularly;
- implement trials of combined weekly food and garden organics collections, with an associated reduction in general waste collection to fortnightly;
- promote the various free e-waste drop-off days or permanent e-waste collection points offered by councils;
- consider increasing the frequency of e-waste collection events;
- promote use of recycling centres for hazardous wastes and promote battery recycling through new product stewardship schemes;
- lobby on a regional basis for more extended producer responsibility schemes for hazardous materials, user-friendly locations for drop-off centres established through such schemes, and future landfill bans of hazardous materials;
- investigate resource recovery options for residual waste including centralised collection such as clothing bins, household chemical recovery and e-waste recovery;
- investigate centralised processing technologies such as FOGO or AWT.

Comparison with 2017 kerbside audits[57]

Analysis of 2017 kerbside audits from five NSW Councils were broadly consistent with the results seen previously. Notably, the audits found:

- high levels of co-mingled recycling contamination with rates between 10 and 20 per cent contamination but low rates of contamination for organics with rates between 1 and 5 per cent;
- organic materials made up the majority of the general waste composition for all councils, with rates between 37 and 51 per cent;
- the majority of hazardous waste identified in the audits was composed of e-waste such as batteries and electrical items.

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56 Sourced from the consultants review of 2015 kerbside audits (2016).

57 Internal unpublished report procured by the EPA (2017)

4.2.5 Research into household behaviours

Better Waste and Recycling has funded 307 education projects and awareness campaigns. The EPA undertook a study in 2014 on 1200 NSW residents to uncover their knowledge, attitudes and behaviour around waste and recycling. [58]

The findings of this research are important within the context of understanding why MSW diversion rates have plateaued at 42%. The findings should be considered in light of the 2011 kerbside audit findings and subsequent audits undertaken by councils on their MSW.

The findings may also be considered in designing effective strategies to improve MSW waste reduction, diversion, recycling rates, and options to reduce waste going to landfill.

1. Attitudes towards recycling are generally supportive

The majority of residents are concerned about the environment and take actions to minimise their environmental impact. However, testing revealed:

- only 55% of respondents try to minimise the amount of packaging on purchased items;
- recycling practices were found to be over-simplistic or out-of-date. In practice, some general waste items were being placed in recycling bins (increasing contamination levels), whilst some recyclate is being placed in general waste;
- testing on the recyclability of range of problematic waste items identified a significant number were allocated to the wrong stream by a high proportion of residents;
- residents with food and garden waste (FOGO) collection services are often unsure or incorrect about which items can be recycled in this stream, however, 88% agreed that a recycling bin for organic waste (i.e. food and garden waste) was a good idea;

The EPA has advised that other surveys have found:

- almost all of those with a new FOGO service agree that it is easy to use (91%);
- almost all of those with a FOGO service agreed that it is good for the environment (90%);
- almost all of those with a FOGO service liked that they like that they can now recycle more of their organic waste (88%);
- two-thirds agree that it made them think more about their other recycling habits (65%); and
- only one-fifth say it took them a while to adjust to it (20%).

2. Ease of recycling

Residents (particularly those in MUDs) who do not consistently use an in-home receptacle for recyclables may be less inclined to set materials aside for recycling.

The distance to council bins (and the number of flights of stairs) from the dwelling influences recycling. Disposing of recyclables in the in-home general waste bin was considered an easier option compared to carrying them by hand to the council bin.

Separate feedback provided by councils indicated building planning requirements also did not contain specific obligations with respect to the design of waste facilities for new MUDs. A large number of waste management plans were also found to be deficient and not completed by individuals with requisite experience. Common problems noted:

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[58] NSW EPA. (2015). *Waste Less, Recycle More Initiative: Community benchmark study*. Sourced from: https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/wastestrategy/150194-community-benchmark.pdf

- insufficient consideration of ease of access of bins or use of chutes or on-floor waste rooms (for dry recyclables);
- poor design limiting access for waste contractors to collect waste by automated means;
- insufficient consideration of the number and size of bins and frequency of their collection.

Councils noted that the larger property developers tended to undertake waste planning to a higher standard relative to other developers.

Research indicated a number of Australian councils are experiencing comparatively lower recycling rates in MUDs relative to SUDs (see Section 4.2.6). Strategies to improve recycling outcomes in MUDs may include:

1. Culturally and linguistically diverse community education program and materials be developed with input from community members to understand cultural sensitivities;
2. A database of MUDs with five or more dwellings should be prepared and a targeted direct feedback/visual inspection program be developed;
3. Inside/outside recycling bin stickers could be provided as a cost-effective means of reducing illegal dumping and contaminated recycling bins;
4. Future projects should consider the inclusion of segregation audits where measurement of resource loss rates is a desired outcome;
5. Continue building relationships with real estate agents and strata management to discuss opportunities to work together, opportunities could include:
    a) Lease inclusions (for misuse of the waste services);
    b) Bond reductions (for tenants who leave hard waste);
    c) Waste services inductions (run by either council and/or building management);
    d) Rent reductions (for tenants who manage the bins and hard waste bookings).
6. The research also indicated the need to review the design and ease of access and use of infrastructure within MUDS. This extends from infrastructure than can be provided within individual units to support source separation, to on-floor chutes and recycling options through to the design of waste storage and collection areas including:
    a) the number and size of recycling bins;
    b) options for in-home source separation (e.g. temporary storage receptacles for dry waste; kitchen cadies for organics);
    c) minimum design considerations for new builds (chute systems for recyclables; on-floor dry- recyclable collection systems; storage areas for source separated dry recyclables).

3. In-home recycling systems

In-home recycling systems employed by residents influence recycling behaviour. Use of containers in or close to kitchen (or laundries) to collect organics or dry recyclables are likely to support a higher recycle rate including the recycling of smaller items.

4. Bin capacity and timing of collections

58% of respondents advised their bins sometimes become so full they cannot fit any more into them before collection. Some councils have undertaken reviews and recommended revisions to the number and size of bins, including changes in the number of recycling bins compared to general waste bins.

Stakeholder consultations identified that some councils that had introduced a weekly organics collection service had also implemented a shift in general waste collection from weekly to fortnightly leading to increased contamination levels in the dry recyclables.

5. FOGO systems

Residents are positive towards FOGO collection services and feedback from councils who have recently introduced such systems confirm this experience. However, barriers to uptake need to be considered to optimise recycling outcomes. Issues include:

- perceptions with respect to potential smell and pests (cockroaches, rats);
- frequency of bin collection.

Considerations for the 20-year waste strategy

Recommendations from the research undertaken include:

- General messaging relating to the environmental benefits of recycling may not be required to encourage engagement;
- Messaging should focus on encouraging behaviours to maximise recovery of recyclate, including examples of high volume recyclate not currently being recovered. Messaging should be broadened to align with the waste hierarchy to promote waste avoidance and reuse and other waste reduction strategies[59];
- Messaging to ensure that recycling efforts are not wasted (e.g. items being placed in the wrong bin) may be valuable;
- Messaging should focus on challenging knowledge about items which are commonly placed in the incorrect bin;
- Messaging should encourage residents to engage in reflective cognition, rather than relying on automatic processes when making decisions about which bins waste items should be placed in;
- Implement education programs to tackle wastes that are contaminating dry recyclable (e.g. food) and organic waste streams and hazardous wastes appearing in the general waste stream (e.g. e-waste, batteries);
- Both names and images should be included when providing information on which items should go in each stream;
- More detailed guidance may be required for some labels and names to make it clear to residents which items are included and how they should be treated;
- Use of waste caddies (potentially provided by council to source separate waste in the dwelling (e.g. kitchen);
- Government approaches to encouraging recycling in MUDs (e.g. planning requirements) should consider the higher levels of time and effort required for residents to recycle in MUDs.

Implementation of recommendations from the waste audits should also be undertaken in conjunction with improvements in the labelling of packaging materials to indicate whether or not packaging can be recycled (see Section 6.1).

[59] Love Food, Hate Waste is example or messaging that is targeting the avoidance of food waste.

4.2.6 Love Food Hate Waste Tracking Survey

In 2017, the EPA undertook research into NSW residents' knowledge, attitudes and behaviours towards food waste.

The research objectives of this study was to:

- measured attitudes to and awareness of environmental issues, with a particular focus on food waste;
- measured levels of food waste avoidance behaviours and possible barriers to reducing food waste in the household;
- explored the influence of food waste in the media in encouraging new habits and norms of behaviour in terms of food waste avoidance strategies.

The research identified:

- 38% of respondents care only a little (or less) about environmental problems;
- the proportion of households engaged in food waste avoidance behaviours has declined and is now on par with 2012 levels;
- 50% of respondents believe they throw away very little uneaten food, yet food wastes account for a significant portion of waste in residual waste bins;
- Awareness of the food waste has risen, with 91% of respondents identifying packaging (58%) or food (33%) as the largest waste item in residual waste bins.

The research also indicated that those who were aware of seeing food waste in the media were more likely to adopt more food waste avoidance behaviours than those who were not. This suggests that keeping the food waste issue front of mind through a sustained media presence may influence behaviour.

The research also indicated that the groups who wasted the most food (based on estimated volumes) included:

- residents aged 18–34 (6.6 L per week 21% higher than the average NSW resident);
- households with gross annual incomes above $100,000, especially those in the $150,000+ bracket (6% higher);
- families with children (15% higher).

The research should be used to:

- develop initiatives that reduce the volume of food waste generated and disposed of at the household level; and
- influence new habits and norms of behaviour with a shift towards more efficient approaches to food purchasing, storage, preparation and consumption.

Key actions identified in the Report include:

- increasing community knowledge about the environmental, social and economic impacts of food waste;
- increasing community awareness of the amount of food waste generated and sent to landfill;
- increasing knowledge and skills in best household practices in food purchasing, storage, preparation and use of leftovers;

- promoting behaviours that support avoidance of food waste in the home (such as menu planning, shopping from a list, correct portion sizes and more effective food storage techniques), as well as what to do with food waste;
- supporting institutional and intergenerational transfer of knowledge and skills in more efficient food purchasing, preparation and consumption;
- providing a platform for increased knowledge and awareness of food waste in business.

4.2.7 Research into improving MSW recycling rates

A number of councils have experienced low recycling rates for MUDs and have undertaken specific programs to improve recycling outcomes with mix success.

1. Fairfield MUD recycling program

In 2015, Fairfield City Council (FCC) received EPA funding to target low recycling and high contamination rates in MUDs. This program included bin audits, relationship building with strata managers, community education programs and targeted materials for culturally and linguistically diverse (CALD) communities.[60]

WSROC reported the program delivered a 5-10% reduction in recycling contamination across MUDs in the two years since the project started. Whilst this is a positive outcome, FCC's recycling rates remained comparatively lower than the state average at 30.5% in FY15-16 (up from 28.5%).

WSROC noted that the high turnover of residents living in MUDs meant that the program needed be maintained in order to deliver sustained improvement in recycling rates. Fairfield officers continue to educate residents on correct waste practices via on-site bin inspections, door knocking, school visits, and through community groups across the LGA.

The council also worked with strata managers to improve bin bay layout, size and usability. Other key learnings from the program included:

- Build relationships with strata managers and real estate agents;
- Present where and when residents are available;
- Keep it simple, keep it visual;
- Face to face contact is preferable to written materials;
- Keep interactions as positive as possible.

These learnings are discussed in further detail in Appendix C.

2. Southern Sydney Regional Organisation of Councils (SSROC)

SSROC recently undertook a project across 75 buildings across five SSROC region councils to reduce the contamination in the dry recycling bin and leakage of recyclables (into the general waste bin) in MUDs through improving the availability of waste infrastructure and directly engaging with residents to educate residents within these dwellings.

UTS analysis of the project was unable to detect any impact of the interventions on recycling behaviour.[61]

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[60] WSROC. *Case Study: Fairfield MUD recycling program*. Sourced from: www.wsroc.com.au/images/Waste/Case_Study_-_Fairfield_MUDs_education_web.pdf

[61] UTS. (2018). *Improving waste management in multi-unit dwellings*. Sourced from: https://www.uts.edu.au/research-and-teaching/our-research/institute-sustainable-futures/news/improving-waste-management

A number of factors have been cited as potentially contributing to the outcome, however, the SSROC experience mirrored feedback provided by WSROC that a number of councils have experienced difficulties in achieving sustained improvement in recycling rates at MUDs. WSROC indicated written education programs were generally ineffective and other programs consumed significant time and resources without necessarily achieving sustained improvements. The high turnover of residents in MUDs is also considered to be a contributing factor.

3. City of Yarra and City of Melbourne

Both the City of Yarra and City of Melbourne have high proportions of MUDs which deliver lower recycling rates than single dwellings. The councils undertook a joint project in 2014 to increase recycling capacity, improve education and engagement with residents and trial innovative solutions in both privately and publicly owned and operated MUDs.

Residents covered by the project covered a broad range of people, including low-income earners living in public housing, dedicated student accommodation and individuals living in high-end private developments. These residents also represented a range of attitudes to recycling.[62]

The project implemented a number of actions including:

- removing over allocated general waste bins and replacing with recycling bins;
- education was timed to match changes to waste infrastructure on what can and cannot be recycled;
- messaging focused on celebrating the positive;
- educating residents of how easily materials are recycled and what they come back as;
- explaining how hard to recycle materials can be recovered, through Recycling Drop Off Points and Community Resource Recovery Hubs and not through the kerbside bin;
- direct tenant engagement backed up with recycling workshops and information sessions on selected mornings using a coffee cart;
- development of waste champions to promote and monitor recycling;
- use of recycling officers to visit high rise buildings to assess infrastructure and education and work with building representatives to make changes to waste infrastructure, provide better signage and education, supported by follow up visits;
- working with contractors to monitor the recovery of hard waste collected and advising building managers of their service entitlements.

The project was undertaken across 20 private MUD buildings and 6 MUD precincts in Yarra and 70 buildings (11,849 apartments) in Melbourne.

Key project outcomes:

Melbourne: drop in contamination rates from 41% to 25%; drop in recyclate in general waste from 29% to 26%; reduction in bagged recyclate (which were going to landfill) from 27% to 12%.

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[62] Metropolitan Local Government Waste and Resource Recovery Fund. (2016). *Improving Resource Recovery with Residents at Multi-Unit Dwellings*. Sourced from: https://www.mwrrg.vic.gov.au/assets/resource-files/MUDs-MFR3-Final-Report-MelbYarra.pdf

Yarra: drop in recyclate in general waste in public housing MUDs from 54% to 26%; drop in recyclate in private MUDs from 53% to 36%; bagged recyclate (which were going to landfill) dropped from 27% to 26% in public housing MUDs and 26% to 13% in private MUDs .

While the Victorian experience was effective in reducing the level of contamination in recycling and did deliver a small increase in the volume of dry recyclables, the program delivered only a small improvement in the overall recycling rate.

Source Separation – Slovenia and San Francisco

- *The success of source separation as a technique to improve recycling and recovery rates is evident in the case of Slovenia. Citizens separate up to 8 different types of waste, including glass, paper, plastic, household hazardous waste, metal, electrical and electronic, kitchen and garden waste, making the composition of waste entering treatment facilities heterogeneous and reducing the likelihood of contamination. In 2016, Slovenia boasted a MSW recycling rate of 58%, 35 percentage points higher than in 2010. The landfill rate in 2016 was just over 4%.*[1]
- *San Francisco also practices source separation. Similar to Slovenia, San Francisco has made rapid progress in improving rates of recycling and recovering, and diverting waste from landfill. San Francisco has implemented a 'fantastic three' kerbside collection program. This program includes separate collection of comingled recyclables, compostable materials and any remaining waste. The cost of refuse collection is dependent on the type of waste and the size of bin. Waste for landfill is the most costly in regards to collection, incentivising citizens to recycle and recover more waste.*[2]

[1]*Republic of Slovenia Statistical Office. (2017). Waste Indicators, Slovenia, 2016. Sourced from:* https://www.stat.si/StatWeb/en/News/Index/7099

[2]*US EPA. (2019). Zero Waste Case Study: San Francisco. Sourced from: https://www.epa.gov/transforming-waste-tool/zero-waste-case-study-san-francisco*

4.2.8 Behavioural and other barriers to greater levels of recycling

Based on the research undertaken, there are a broad range of factors than negatively impact on the levels of recycling. These include:

- a lack of sufficient incentive for households to recycle;
- a lack of education on what materials can be recycled;
- a lack of understanding of contamination and its consequences in terms of cost; ability to recycle and resultant landfill volumes;
- a lack of understanding on options to deal with problem waste materials;
- no direct link between poor recycling practices and the resulting negative consequences (beyond indirect landfill costs which are not always readily apparent), particularly in MUDs in NSW where nearly 60 per cent of occupiers are renters (as opposed to 21 per cent of SUDs)[63];
- deficiencies in the waste infrastructure to support greater levels of source separation in MUDs;
- a lack of a consistent solution (across all LGAs) for the recovery of food wastes and other organic materials (see Section 8.9);

[63] Australian Bureau of Statistics. (2018). *Apartment Living*. Sourced from: https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/2071.0~2016~Main%20Features~Apartment%20Living~20

- a lack of focus on waste avoidance and the use of waste avoidance strategies (see Section 6.1);
- a lack of consistent processing of MSW across all LGAs to remove recyclates prior to landfilling;
- weaknesses in the development of end markets for recyclates and the lack of any pull effect this may have on recycling levels (see Section 9);
- a lack of progress in producer responsibility schemes and the pull effect this may have on recycling levels (see Section 2.2.3);
- the levels of single use materials in general waste;
- the high cost of processing relative to using virgin materials.

4.2.9 Considerations for the 20-year Waste Strategy

Research indicated a number of Australian councils are experiencing comparatively lower recycling rates in MUDs relative to SUDs (see Section 4.2.4). With the significant growth that has occurred in MUDs, industry would benefit from clearer guidance and enforcement of minimum waste infrastructure requirements for new builds.

Diversion rates are the outcome of a broad range of factors through the waste cycle from generation to processing and recovery. The diversion rate has stalled, despite various initiatives implemented by state and local governments to:

- try to reduce the MSW waste generation;
- improve the level of infrastructure available to support source separation and recovery of recyclable materials in the generate waste; and
- influence householder behaviours to ultimately improve recycling rates, the diversion has still stalled.

The 20-year waste strategy will need to consider waste stream-specific initiatives (e.g. organics) in combination with broader, integrated strategies to drive improvements in MSW, including:

- educating households with a focus on key waste issues, waste avoidance, re-use and recycling to influence consumer behaviour;
- focusing on MUDs with a view to strengthening planning and review processes, implementing inspection programs and building relationships with real estate agents and strata management to drive improved recycling and reduced contamination;
- working with industry to improve processing of MSW;
- examine alternate tariff structures and contracting models to incentivise waste reduction and greater levels of source separation.

Considerations for the 20-year waste strategy are discussed in further detail in Key Finding 7.

4.3 Construction and Demolition

C&D is the largest source of waste (at 12.77Mt in FY18 – see Table 11) accounting for 60% of waste generation volumes in FY18. It also had the highest recycling rate at 77% (see Table 11).

4.3.1 Generators of Waste

C&D wastes are generated through the demolition and construction of residential, civilian and commercial buildings and infrastructure (e.g. roads). Construction and demolition activities can generate a wide range of different waste materials, including:

- excavated material such as rock and soil;
- waste asphalt, bricks, concrete, plasterboard, glass, metals, timber and vegetation (including from land clearing operations);
- asbestos and contaminated soil.[64]

The C&D recycling industry is considered to be mature and consistently delivers high recycling rates, although currently below the WARR target of 80% and international benchmarks (see Volume III: Benchmarking Review). C&D statistics by levy area for FY 2016-18 are detailed in Table 11. The largest quantity of C&D waste comes from the MLA (at 11.52Mt in FY18), which has the highest levels of construction and demolition generation activity.

Table 11: C&D waste statistics

Waste stream	2015-16	2016-17	2017-18
Waste generation (Mt)			
Metropolitan levy area	9.27	9.66	11.52
Non-levied area	0.64	0.68	0.89
Regional levy area	0.26	0.26	0.35
Total	**10.16**	**10.61**	**12.77**
Waste to landfill			
Metropolitan levy area	1.74	1.42	2.23
Non-levied area	0.40	0.45	0.59
Regional levy area	0.08	0.10	0.13
Total (Mt)	**2.21**	**1.96**	**2.94**
Recycling rates (%)			
Metropolitan levy area	81%	85%	81%
Non-levied area	37%	35%	34%
Regional levy area	71%	63%	64%
Total	**78%**	**81%**	**77%**

There was a significant increase in waste tonnages over FY16-18, which has seen generation volumes increase by approximately 26% over the period. It is likely that NSW's significant infrastructure program and its spill over into private sector investment has contributed to this growth.

Tunnelling spoil was raised in stakeholder consultations as a waste stream likely to increase over the coming years in the Sydney region, given the extensive tunnelling being undertaken as part of major infrastructure programs.

4.3.2 Composition of waste

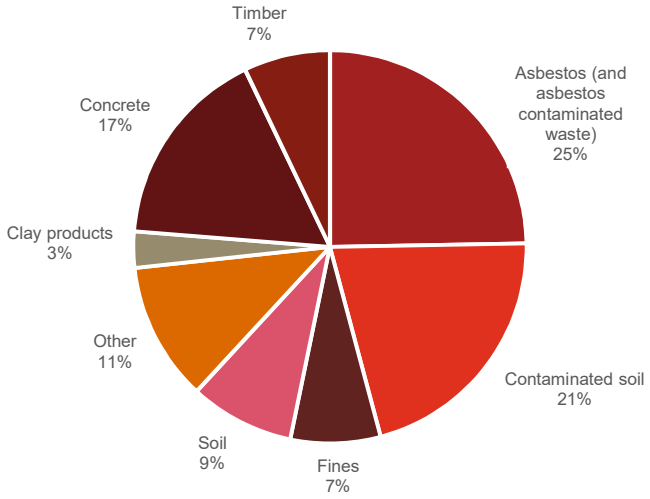
C&D wastes are primarily metals and inert masonry materials (uncontaminated soil, bricks, aggregate, road base, ballast, bricks, concrete, ceramics and tiles) and non-inert masonry materials (timber and plasterboard). Lower volumes of ferrous metals (1.7%) and organics (1.9%) are also generated. The mix of C&D waste volumes is influenced by the nature of the

[64] NSW EPA. (2017). *Construction and demolition waste*. Sourced from: https://www.epa.nsw.gov.au/your-environment/waste/industrial-waste/construction-demolition

projects and the extent which materials can be reused. Table 12, indicates metals comprised 5% of C&D waste generated in FY18 vs 1.9% based on the 2000-05 audit.

Limited data is available on the composition of C&D waste to landfill. A 2000-05 compositional study of C&D waste disposed to landfill in the Sydney Metropolitan Area found waste to C&D landfill by weight primarily comprised asbestos contaminated waste, contaminated soil, concrete and soil (see Figure 7).

Figure 7: Composition of C&D Waste Disposed to Landfill by weight, 2004-05[65]



Source: NSW Department of Environment and Climate Change 2007, Report into the Construction and Demolition Waste Stream Audit 2000-05

4.3.3 Sorting of waste

The sorting of waste on site at the point of generation in the C&D stream perhaps represents the most effective method of increasing recycling rates of any waste category. It has been noted in the ACT that when construction and demolition (C&D) waste is sorted onsite (i.e. at the point of generation), virtually all of the material can be recovered.[66] Although on-site sorting of C&D waste has been shown to improve material recovery, there is currently minimal on-site sorting of C&D waste in NSW. The wide-spread introduction of onsite C&D waste sorting would likely increase resource recovery and reduce the incidence of contamination and the subsequent landfilling of reusable materials.

In the European Union, a non-binding protocol on construction and demolition from the European Commission (the *EU Construction & Demolition Waste Management Protocol, 2016*) focuses on source separation as a key component of effective C&D waste management for the maximisation of resource recovery.[67] The protocol also includes guidelines for waste audits before demolition and renovation works of buildings. As with source separation, the aim of the guidance is to facilitate and maximise the recovery of materials and components

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65 Fines consist of all material from mixed C&D waste that are less than 4.75mm in size. There was no compositional analysis of this material.

66 Commonwealth of Australia. (2018). *Never waste a crisis: the waste and recycling industry in Australia*. Environment and Communications References Committee. Sourced from: https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Environment_and_Communications/WasteandRecycling/~/media/Committees/ec_ctte/WasteandRecycling/Report/report.pdf

67 European Commission. (2018). *EU Construction and Demolition Waste Protocol and Guidelines*. Sourced from: https://ec.europa.eu/growth/content/eu-construction-and-demolition-waste-protocol-0_en

from demolition or renovation of buildings and infrastructures for beneficial reuse and recycling.[68]

In NSW, minimum standards for C&D waste facilities were recently introduced which will come into effect on 15 May 2019.[69] While they do not directly address onsite sorting, the standards require licensed construction and demolition waste facilities to inspect, sort, recover and responsibly handle C&D waste, with additional requirements for C&D waste from the MLA to be properly processed before being landfilled. All C&D waste that is received and is not required to be isolated (after a two-point inspection of contents for unpermitted waste) must undergo a sorting process, in the following order:

- physically sort the waste at the facility to separate recoverable materials, including any soils, masonry and ceramics;
- if any contaminant or asbestos waste is discovered, it must also be isolated in a dedicated area;
- sorted waste must be put in the dedicated storage areas for that type of material (including any material processed to meet a resource recovery order); and
- wastes must not be mixed with any other material at the facility, except in order to process it to meet a resource recovery order at the time the waste leaves the facility.[70]

4.3.4 Recycling rates

Total tonnes going to landfill declined from 2.21m tonnes in FY16 to 1.96m tonnes in FY17. In FY18, landfill tonnes increased 50% to 2.94m tonnes. It should be noted that a portion of C&D waste is reused between construction sites and is not captured in the EPA data. Diversion rates are therefore higher than indicated in Table 12.

Table 12: C&D waste diversion rates

C&D Materials (Mt)	2015-16	2016-17	2017-18
Diverted materials			
- Masonry materials	6.82	7.21	8.02
- Metals	0.58	0.58	0.69
- Organics	0.08	0.1	0.12
- Other recyclables	0.46	0.76	1.00
Landfilled materials	2.21	1.96	2.94
Total (Mt)	10.15	10.61	12.77
Recycling Rate	**78%**	**81%**	**77%**

Source: EPA waste generation, disposal and recycling data

Diverted masonry materials increased by 383kt between FY16 and FY17, primarily due to a 323kt increase in soil. The 810kt (11.24%) increase between FY 17 and FY18 in masonry

[68] European Commission. (2018). *EU Construction and Demolition Waste Protocol and Guidelines*. Sourced from: https://ec.europa.eu/growth/content/eu-construction-and-demolition-waste-protocol-0_en

[69] NSW EPA. (2019). *Waste management reforms commence on 16 November 2018*. Sourced from: https://www.epa.nsw.gov.au/your-environment/waste/industrial-waste/construction-demolition/construction-and-demolition-waste

[70] NSW EPA. (2018). *Standards for managing construction waste in NSW*. Sourced from: https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/wasteregulation/18p1270-standards-for-managing-construction-waste-in-nsw.pdf

materials recycled was due to an additional 600kt in aggregate recycled in the MLA. Both year on year increases are likely attributed to large NSW infrastructure projects.

Diverted materials included soil and VENM increasing from 21% of totalled diverted materials in FY16 (1.4Mt) to 23% in FY18 (1.86Mt).[71]

4.3.5 Barriers to recycling

Whilst the cost of landfill in NSW and the scrap value of certain materials (e.g. ferrous metals) provides a strong incentive to recycle C&D waste, a number of barriers still remain that may impact on the ability to improve upon current recycling rates:

- interstate leakage: the comparatively higher waste levy in NSW saw approximately 830,000 tonnes of waste transported to Queensland in 2016-2017, largely C&D waste (see Section 10.6). While this volume may decline following the proposed introduction a Queensland Levy, the market will determine whether transporting to Queensland remains a more cost effective waste disposal solution (after transport costs, and relative to NSW);
- difficulties in being able to source separate materials on site (e.g. non-ferrous metals);
- a lack of markets for certain materials;
- contamination of materials through comingling;
- certain materials are unable to be recycled (e.g. contaminated soil; treated timber);
- a lack of knowledge and the cost of separating recyclable materials on smaller building sites;
- a lack of planning to optimise waste recovery construction and demolition activities;
- low value / low volume products tend to be landfilled rather than being stored for recycling as it is uneconomic.

Excluding contaminated soil, Mixed C&D waste represents the majority of C&D waste that is to landfill. Improving on site separating and processing will support improved diversion rates and reduced contamination.

Longer term improvements in waste diversion and reuse may also be realised through:

- designing products and structures for their eventual deconstruction to support resource recovery or energy conversion;
- reducing contamination of waste in their capture and separation at their on-site source.

4.3.6 Considerations for the 20-year waste strategy

Stakeholder feedback raised concerns around the behaviour of some industry participants. A distinction was drawn between the 'ethical' and 'less ethical' companies and individuals. There was some concern that there is an uneven playing field for these players, with compliance efforts targeted at the larger, more visible companies. In the same vein there was commentary around penalties being an insufficient deterrent for some, given the benefit they could obtain from flouting the rules and the low likelihood of sanction. This observation led to concerns that there is a risk that the recovery rates may be overstated (if, by way of example, contaminated fill is being disguised as clean fill).

The 20-year waste strategy may present an opportunity to review compliance programs and the interface between 'carrot' and 'stick' approaches. A key opportunity for improving the rate of re-use and recycling of C&D waste and the reduction of contamination lies in the on-site

[71] EPA waste generation, disposal and recycling data

sorting of waste. The strategy should consider approaches like those in the EU, where audits and source separation are emphasised for improved rates of resource recovery.

Other considerations are provided under Key Finding 9, and include:

- designing products and structures in a way that supports future resource recovery;
- improving monitoring and compliance with plans and audits of actual waste recovery outcomes;
- encouraging the uptake of recovered materials through state and local government procurement, and incorporating targets in contractual arrangements;
- defining quality standards and materials specifications to provide guidance for the use of recycled materials.

4.4 Commercial and Industrial

Commentary in the following sections is largely influenced by the results of a 2014 audit, commissioned by the EPA, of 2,000 loads and 300 garbage bags (totalling 3,950 tonnes) across 14 landfill and transfer stations. Whilst the sample size is small and carries a high risk of sampling error, the audit is one of the few information sources that provides insights into the nature of C&I materials that are being sent to landfill.

4.4.1 C&I Waste Generation

68% of the FY18 C&I waste was generated in the MLA, with 6% generated in the RLA and 26% derived from the NLA.

Table 13: C&I waste generation

	2015-16	2016-17	2017-18
C&I generation (Mt)			
Metropolitan levy area	2.97	3.18	3.00
Non-levied area	0.91	0.99	1.14
Regional levy area	0.28	0.29	0.26
Total (Mt)	**4.17**	**4.47**	**4.40**
C&I generation (tonnes per capita)			
Metropolitan levy area	0.50	0.53	0.49
Non-levied area	0.89	0.96	1.10
Regional levy area	0.34	0.36	0.32
Total	**0.54**	**0.57**	**0.55**

Source: EPA Data

4.4.2 Generators of C&I waste

An audit of the C&I waste stream indicated that the majority of waste (c.70%) is generated from a wide range of small to large businesses, including manufacturing (25%); mixed small businesses (17%); shopping centres and retail (18%); healthcare and social assistance (7%) and accommodation and food services (5%).[72]

In addition to the general factors noted in Section 3.9, additional factors that drive C&I waste generation include:

[72] NSW EPA. (2015). *Disposal-based audit Commercial and industrial waste stream in the regulated areas of New South Wales*. Sourced from: https://www.epa.nsw.gov.au/~/media/EPA/Corporate%20Site/resources/warrlocal/150209-disposal-audit.ashx

- changes in manufacturing processes including raw material inputs, manufacturing technologies, production yields and changes in product design and new product / service innovation can all lead to changes in the volume and mix of C&I waste;
- multinationals, listed corporations businesses that have social objectives and industries that are subject to pressure from their clients on environmental performance are increasingly developing policies and targets aimed at reducing their waste generation, increasing material recycling and reuse and reducing their impact on the environment. As noted in section 3.9.5, consumer attitudes are expected to exert greater influence over business and purchasing decisions, with businesses needing to be seen as supporting improved environmental outcomes;
- the extent to which businesses operate in industries that are the subject of product stewardship schemes (Section 2.2.3);
- the extent to which waste materials are a significant cost or factor of operations and the opportunity to reduce operating costs and/or earn a revenue from waste streams;[73]
- across small to medium enterprises (SMEs), environmental outcomes is becoming a more important factor for some businesses, influencing decision making, however, this remains subject to financial considerations;

In the absence of overriding company objectives (e.g. environmental objectives), businesses generally seek the most cost effective production option which can influence the nature and volume of waste generated and options for its subsequent disposal. In the absence of other priority objectives, this factor will exert the greatest influence on the volume of waste generated.

SME Behaviours

The following observations are based on research undertaken by the EPA:[74]

- nearly all SMEs claim to be currently engaged in recycling activities of some form;
- SMEs link reducing waste and increasing recycling, to becoming a sustainable and ethical business;
- most SMEs firmly believe they have done all they can to minimise waste and maximise recycling (reducing the likelihood of SMEs modifying existing practices);
- motivators for further action to reduce waste and enhanced recycling come from a desire for a competitive edge, motivating staff and being able to promote that they recycle and minimise waste to their customers;
- there is a real or perceived lack of space to keep the bins needed to recycle effectively;
- only one third of the SMEs believed they were very well informed about the information, assistance and support that is available to help them manage waste and to control their waste. Most SMEs seek information directly from waste service providers. Local government was also seen as a useful information source;
- waste is a relatively small cost of an SMEs business, which does not provide any motivation to improve waste outcomes;

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73 For example Woolworths decision to convert its 3L milk bottles to lightweight bottles delivered both an operating cost saving and an improved waste outcome (see Section 6.1)

74 NSW EPA: Social Research on Small to Medium Enterprises (SME) Waste and Recycling

- waste generators require incentives, either behavioural or economic, to motivate behaviour change towards recycling.

4.4.3 Composition of C&I Waste

C&I waste is generally a mixture of putrescible and non-putrescible materials. The 2014 audit of C&I waste indicated:

- 68% of waste arriving at the disposal point arrived in mixed waste loads;
- 32% arrived as single material loads.[75]

Analysis of the C&I waste sample indicated that 28% was delivered in garbage bags, which had not been subject to any sorting processes and was likely to be sent directly to landfill from the generator. Apart from bagged waste, the balance of the waste comprised:

- 18% fines (such as residue from waste processing), shredder floc and pulp;
- 14% wood;
- 12% masonry;
- 7% plastics;
- 7% paper and cardboard;
- 4% textiles;
- 2% food; and
- a further 2% metals and glass.

Analysis of a sample of garbage bags indicated 26% of the waste comprised food, with a further 31% paper and cardboard and 21% plastic.

Redistributing the contents of the garbage bags indicated 51% of the C&I waste in the regulated area comprised degradable organic materials.

[75] A single material load comprises a waste load where one material comprises more than 90% of the total load)

Table 14: C&I waste composition in the regulated areas of NSW[76]

Material	Sydney Metropolitan Area (SMA) [77]		Extended Regulated Area (ERA)		Regional Regulated Area (RRA)		Total	
	Tonnes per year	% of waste stream	Tonnes per year	% of waste stream	Tonnes per year	% of waste stream	**Tonnes per year**	**% of waste stream**
Cardboard	80,420	*5.7*	10,710	*4.2*	7,170	*6.7*	**98,300**	***5.5***
Electrical	6,620	*0.5*	430	*0.2*	330	*0.3*	**7,380**	***0.4***
Food	127,590	*9.0*	28,250	*11.2*	15,480	*14.5*	**171,320**	***9.7***
Garden organics	74,160	*5.2*	6,900	*2.7*	3,110	*2.9*	**84,170**	***4.7***
Glass	19,510	*1.4*	4,210	*1.7*	2,540	*2.4*	**26,250**	***1.5***
Masonry	123,990	*8.8*	82,360	*32.6*	11,600	*10.9*	**217,960**	***12.3***
Metals	36,180	*2.6*	6,480	*2.6*	2,820	*2.7*	**45,480**	***2.6***
Paper	147,810	*10.4*	19,840	*7.9*	12,600	*11.8*	**180,250**	***10.2***
Plastic	181,860	*12.8*	29,660	*11.7*	17,010	*16*	**228,530**	***12.9***
Rubber	8,100	*0.6*	2,190	*0.9*	830	*0.8*	**11,110**	***0.6***
Textiles	79,120	*5.6*	9,630	*3.8*	5,620	*5.3*	**94,360**	***5.3***
Wood	205,790	*14.5*	34,330	*13.6*	16,100	*15.1*	**256,210**	***14.4***
Other	324,420	*22.9*	17,570	*7*	11,340	*10.6*	**353,340**	***19.9***
Total	**1,415,560**	***100***	**252,550**	***100***	**106,540**	***100***	1,774,650	***100***

Analysis of C&I waste material by industry sector indicated:

- almost one third of waste disposed by the manufacturing sector is processing residuals;
- half of the waste from mixed small businesses is masonry materials and wood;
- the retail sector disposes mostly plastic; paper, food and wood;
- waste from the healthcare and social assistance sector is mostly wood, plastic, food and textiles; and
- e-waste, predominantly office based electronics; small household appliances; computers and peripherals (annual estimated tonnage of 6,840 tonnes).

Analysis of recycling technologies available at the time of the audit (or likely to become available in the future through better source separation and /or emerging technologies) indicated that around 55% of the C&I waste not being diverted (and not presented in garbage bags) could be recovered. This figure increases to 83% if it is assumed that the contents of the garbage bags can be accessed.

76 EPA 2015. *Disposal based audit: commercial and industrial waste stream in the regulated areas of NSW*. Sourced from: https://www.epa.nsw.gov.au/~/media/EPA/Corporate%20Site/resources/warrlocal/150209-disposal-audit.ashx

77 Since the audit was conducted, the SMA and ERA have been combined into what is now known as the Metropolitan Levy Area, and the RRA is now known as the Regional Levy Area

Changes in waste mix

The composition of C&I is largely influenced by changes in manufacturing and packaging processes. Price substitution to cheaper materials; changes in technology and innovation therein; and changes in product specifications can all influence the nature and volumes of waste. Emerging trends that may influence the composition of waste in the future include:

- Changes in service delivery models and consumer behaviours such as the growth in food home delivery and online shopping may see a shift in packaging materials from the C&I stream to MSW and a change in the composition of wastes;
- An aging population and the preference to 'age in place' is expected to see a change in service delivery models and an increase in health related wastes in MSW;
- Shifts away from longer life assets to assets with more short term profiles will influence consumption habits.

4.4.4 Sorting of C&I Waste

C&I waste is collected in various types of containers, depending on the type and quantity of waste material. The most common bin type is a front lift bin which is usually used to collect general waste and recyclables, provided there is sufficient room for the collection vehicle to manoeuvre to collect. Otherwise it is collected by rear lift bins. C&I bins tend to be on wheels.

There is minimal processing of residual C&I waste and sorting of C&I waste is largely dependent on separation at the source unless delivered to an MBT or AWT. There are a number of reasons for this, including:

- minimal dedicated infrastructure for processing mixed C&I residual waste, and the infrastructure that is available are often small, dedicated facilities with limited processing capacity;
- few and volatile end markets for recycled materials, addressed in greater detail in Section 9;
- no obligation on businesses to separate waste at the source, meaning it is often easier for businesses to dispose of all their waste in one bin. While the NSW Waste Levy provides an economic incentive to do so, this incentive is generally only significant enough (based on volume of waste) for large waste generators;
- introducing an additional recycling system can be time consuming and costly for SMEs, and often means negotiating with different providers or negotiating with the incumbent provider to provide an additional service (who may have a bargaining advantage due to existing familiarity with the SMEs waste);
- many and varied individuals are responsible for sorting waste, and so education programs are often needed to improve source separation, which is again time consuming and costly for SMEs;
- often it is the building owner or agent who makes decisions on waste programs and not the individual business tenancies;
- in certain circumstances, it is not economic for a waste provider to do two (or more) collections and the SME has little choice in the matter. Similarly, there may be no facility nearby to take the recyclables to.

Efforts have been made by the EPA to increase the sorting of C&I waste at source by SMEs who have been the target of the EPA's Bin Trim program.

Bin Trim Program

The Bin Trim program, through WLRM funding, provided SMEs with financial assistance (through a refund) to purchase recycling equipment that supports the avoidance, reuse or

recycling of waste in the workplace. There have been two rounds of the program. Round two of the programs commenced in September 2015 and finished in March 2017. The program allocated $6.87 million to 26 grantees who engaged with SMEs across the state.[78]

In both round one and two, there was an increase in the waste diversion levels. However, assessors noted there were still significant quantities of recyclable material ending up in general waste, even after a waste action plan had been implemented.[79] Data from round three of Bin Trim was not available at the time of this Report.

A recent evaluation of the program found that it made a direct contribution to the aims of increasing the recycling of C&I waste. Opportunities were identified to improve the program, including more targeted marketing of rebates, additional oversight and technical training for assessors, improved monitoring of waste bins for composition and volume, independent advice and improved communications with participants.[80]

Whilst the Bin Trim program has demonstrated a degree of effectiveness in improving recycling rates the size of the gains being realised are insufficient to achieve significant improvement in diversion rates at a whole of state level. Further the program targets individual businesses, rather than influencing SMEs on a broader scale.

4.4.5 Diversion rates

The WARR Strategy 2014-21 has a recycling target of 70% for C&I. Whilst improvements have been realised in the level of recycling, the rate of improvement (2% per annum) is unlikely to deliver the 2021 target, with the C&I recycling rate at 52% in FY18.

Table 15 shows the C&I recycling rate experienced small annual increases from 48% in FY16 to 52% in FY18.

The recycling rate in the MLA was just below the total C&I average for FY18. However, it had increased from 43% in FY16 to 49% in FY18.

Of all levy areas, the NLA had the highest diversion rate at 64% in FY18, however, this result may be distorted by the manner in which data is reported and not all businesses are required to report.

Table 15: C&I waste volumes

	2015-16	2016-17	2017-18
C&I volume (Mt)			
Metropolitan levy area	2.97	3.18	3.00
Non-levied area	0.91	0.99	1.14
Regional levy area	0.28	0.29	0.26
Total (Mt)	**4.17**	**4.47**	**4.40**
C&I volume diverted (%)			
Metropolitan levy area	43	46	49
Non-levied area	60	62	64
Regional levy area	56	51	46
Total (%)	**48**	**50**	**52**

Source: NSW EPA data

[78] Internal unpublished report procured by the EPA (2017)

[79] Internal unpublished report procured by the EPA (2017)

[80] Internal unpublished report procured by the EPA (2018)

A particular focus of the WLRM grants program has been on encouraging the development of new resource recovery infrastructure. Several major C&I resource recovery facilities were proposed for the Sydney region with grant funding through the WLRM program, including three very large C&I processing facilities.

Of these three, two facilities (owned by ResourceCo in Weatherill Park and Dial-a-Dump in Eastern Creek) are operational, while the third is not yet constructed (proposed by Veolia in Camellia).

Early analysis predicted that together, these WLRM funded facilities would have the potential to divert over 390,000 tonnes per year of C&I waste from landfill, from a total of 1.6 million of throughput capacity.[81] However, there are a number of risks to this C&I capacity being realised, including:

- Facilities prioritising processing of MSW over C&I, limiting their capacity to meet C&I demand;
- Facilities not meeting their estimated maximum build capacity;
- Facilities not securing their maximum feedstock capacity due to existing and complex contractual arrangements and sector competition;
- Performance, technology and management issues.

4.4.6 Barriers to recycling

Businesses, and in particular small businesses, are unlikely to implement comprehensive approaches to recycling. Factors that inhibit or prevent recycling may include:

- the size of the potential gains vs the additional cost (both financially and operationally in terms of time and hassle);
- an inability to secure the commitment from stakeholders to implement source separation, particularly where it involves multiple stakeholders (e.g. property owners; multiple tenants; cleaners; waste contractors) or there is a lack of a recycling 'champion';
- infrastructure constraints that inhibit source separation e.g. lack of space for multiple bins or insufficient access for waste collection vehicles;
- the economics of waste collection practices - minimum volume requirements are required to adjust waste collection routes. As a result, the waste industry tends to focus on larger organisations with greater waste volumes;
- the cost of educating and training staff initially and then ongoing, particularly when there is high turnover or a transient staff workforce;
- lack of access to recycling facilities, particularly in regional and remote locations;
- lack of access to end markets for recycled materials in regional and remote locations;
- the comparatively smaller cost of waste for some businesses relative to salaries, rent or utilities.

The majority of resource recovery in the C&I stream is a result of source separation at site, rather than processing post-collection. Analysis [82] has highlighted a number of barriers to recycling waste within the C&I stream, including:

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[81] Internal unpublished report procured by the EPA (2016)

[82] Internal unpublished report procured by the EPA (2016)

- C&I waste is highly mixed, making it difficult to separate and recover individual materials;
- much of the C&I waste is disposed of in garbage bags, making it difficult to identify and recover recyclable materials;
- the high presence of putrescible food waste increases the regulatory and compliance burden and contamination risk, for facilities not licensed to process putrescible waste;
- there is a high portion of treated timber in C&I waste, which is unable to be recycled due to the presence of toxic chemicals;
- C&I is lighter than C&D, meaning the waste levy provides less of a financial incentive to increase recovery;
- energy from waste is not widely available as an alternative diversion solution.

Responsibility for C&I waste – Scotland

In Scotland, the management of C&I waste is largely the responsibility of business to arrange with their local waste service provider. Edinburgh Council used to contract collection services for commercial and industrial waste, however, due to the increasing volume of MSW that the Council needed to manage, it was decided that responsibility would be left with businesses to manage. Zero Waste Scotland, in partnership with the Scottish Government, provides comprehensive support and guidance for businesses to reduce their waste generation, however, no assistance is provided with the collection of waste produced. However, all businesses are still required to separate their waste for disposal and recycling or recovery, as per the Waste Scotland Regulations (2012). Businesses are not required to report waste volumes to the Scottish Environment Protection Agency, so data on C&I waste is received from operators of licensed and permitted waste management sites. The exception to this situation is food waste. The Waste Scotland Regulations (2012) state that any business that keeps or produces food over 5kg per week must take all reasonable steps to ensure separate collection of food waste. Local authorities are required to provide a collection service or arrange for the provision of a collection for food waste from premises within the area if requested to do so.

4.4.7 Considerations for the 20-year Waste Strategy

Analysis conducted on the C&I sector[83] identified a number of strategic intervention points to improve recycling rates, including:

- Reducing waste generation by:
  - Supporting and implementing programs aimed at the avoidance of waste generation;
  - Encouraging businesses to recycle and re-use waste;
  - Support for councils and collection operators to provide more recycling services.
- Encouraging resource recovery by:
  - Implementing source separation of higher volume recyclable materials;
  - Planning to support and promote the appropriate siting and development of new C&I processing facilities;
  - Supporting research and innovation into recycling for difficult waste streams;
  - Introducing extended producer responsibility schemes (including funding for collection and processing);

[83] Internal unpublished report procured by the EPA (2016)

  - Supporting development of end markets for recycled materials;
  - Supporting industry to invest in new resource recovery infrastructure to improve recovery rates and reduce contamination;
  - Supporting local council; private sector or NFP initiatives that repair and reuse products.
- Discouraging landfill disposal. Options may include:
  - Banning landfilling of unsorted C&I waste, or other material specific landfill bans[84] (as has been implemented in overseas jurisdictions. See Volume III);
  - Applying planning constraints to new landfill development.

Given the estimate that 51% of the C&I waste comprises degradable organic materials (see Section 4.4.3), the EPA may wish to explore an organics-specific solution for C&I customers (as has been implemented in international jurisdictions, see Volume III: Benchmarking Review).

The gains being achieved through existing C&I programs and feedback from program assessments indicated a need to consider a more holistic approach to improving C&I diversion rates taking into consideration all elements of the waste management hierarchy.

SME research indicates that a number of entrenched beliefs and a lack of financial incentive (unless addressed) is likely to act as a deterrent to improving C&I recovery rates.

[84] The use of bans in support of other policy instruments can be effective in reducing waste sent to landfill. Bans may extend beyond unsorted wastes to specific materials e.g. bans on materials that may be recovered under a circular economy policies (e.g. Canada – Nova Scotia) such as plastics or organics; or wastes covered by producer responsibility schemes (e.g. Canada – Nova Scotia); combustible residual wastes (e.g. Denmark, Belgium); organic waste (Finland, Germany)

5 Industry structure

5.1 Waste flow

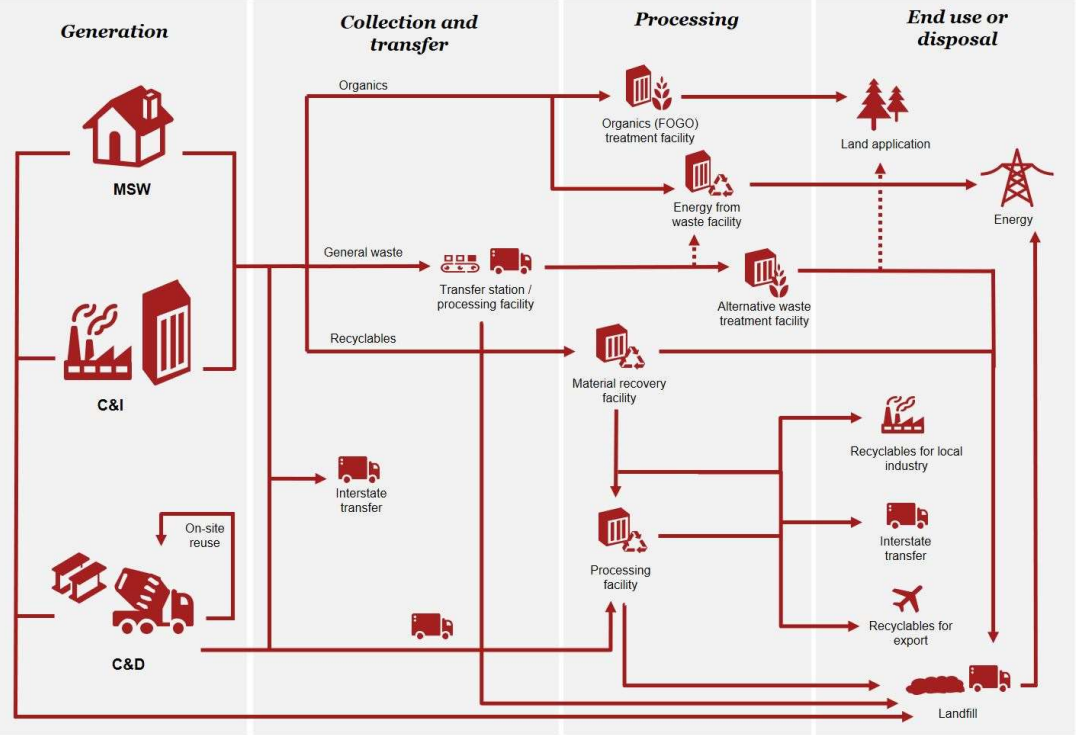
Once generated, certain wastes, particularly those generated within the MSW and C&I streams, may be sent to transfer stations. Some temporary storage, sorting and separation may occur at transfer stations, with extensive processing occurring later in the waste cycle.

For processing, waste is transported by collection or transfer services and delivered to waste management infrastructure – such as material recovery facilities (MRFs), composting facilities and alternative waste treatment (AWT) facilities. The nature of the waste, as well as the stream in which it is generated, will determine the waste process and the type of facility in which it is processed. Once processed, residuals and non-recovered recyclable materials are disposed to landfill or sent interstate for disposal. Not all MSW and C&I waste is subject to sorting and recovery processes.

Recovered materials are recovered for re-use in domestic and/or international markets or exported for further processing or disposal.

The figure below illustrates the waste management industry structure as well as examples of waste flows through the structure.

Figure 8: Industry structure and waste flows[85]



[85] NB dotted lines represent processes that do not currently occur in NSW (i.e. land application of AWT output, and energy from waste using general waste)

5.2 Waste industry in NSW

The structure of the industry in NSW is reflective of the wider Australian industry which is concentrated due to acquisition activity taking place over the last five years.[86] Within solid waste collection services in Australia, the largest four companies are estimated to account for over 40 per cent of industry revenue, and within waste treatment and disposal services, the largest four companies are estimated to account for just under 50 per cent of total industry revenue.[87] As these figures indicate, market concentration varies across collection, treatment and disposal, waste stream and, in some cases, material type.

For example, Cleanaway's subsidiary Tox Free Solutions is estimated to account for 17.3% of the medical waste collection and disposal services revenue in Australia.[88]

Like the wider Australian market, the waste industry in NSW is comprised of private firms and government enterprises, and some not-for-profit organisations and social enterprises. C&I and C&D waste management services tend to be provided by private companies, who are contracted directly by commercial and industrial businesses.

Local governments typically manage waste collection and transfer for MSW and may provide landfill facilities (particularly outside Sydney). Local governments tend to outsource these activities to the private sector where it is cost-effective to do so.

This also reflects a risk management approach where the private sector is generally better placed to manage risks such as commodity price fluctuations and evolving international markets. In many regional locations, however, local governments continue to provide these services directly due to the lack of waste volumes associated with waste collection and the inability of the larger waste service providers to deliver a cost effective solution.

In some regional and remote locations, the volume of waste and the collection area does not support a kerbside collection service. In these areas, the local council may offer a kerbside service only within the immediate town area. Collections may be limited to a one or two bin service. Feedback provided indicated, source separated collections my not be effective in some locations due to a lack of proximity to end markets; the high cost of transport (relative to volumes and values in the underlying materials). The 20-year waste strategy may wish to examine options to promote greater level of recycling waste materials in regional and remote locations.

Consistent with the wider Australian market, the market in NSW is experiencing increasing levels of concentration in recent years, largely due to acquisitions made by larger companies. In its deliberation of Bingo's proposed acquisition of Dial-a-Dump in November 2018, the ACCC found that Bingo's share of Sydney non-putrescible landfill post-acquisition would be in

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[86] IBISWorld. (2019). *Solid Waste Collection Services: Competitive Landscape*. Sourced from: http://clients1.ibisworld.com.au/reports/au/industry/competitivelandscape.aspx?entid=5023

[87] IBISWorld. (2019). *Solid Waste Collection Services: Competitive Landscape*. Sourced from: http://clients1.ibisworld.com.au/reports/au/industry/competitivelandscape.aspx?entid=5023
IBISWorld. (2019). *Waste treatment and Disposal Services: Competitive landscape*. Sourced from: http://clients1.ibisworld.com.au/reports/au/industry/competitivelandscape.aspx?entid=5024

[88] It should be noted that the above estimate was made before the acquisition of Tox Free by Cleanaway. IBISWorld. (2019). *Waste treatment and Disposal Services: Competitive landscape*. Sourced from: http://clients1.ibisworld.com.au/reports/au/industry/competitivelandscape.aspx?entid=5024

the order of between 15 and 25 per cent of annual capacity.[89] In the same deliberation, and indicating variations in the concentration of the market across waste streams, the ACCC indicated that Bingo's combined share of C&D collections was claimed to be 24 per cent, with some market participants estimating the share to be as high as 70 per cent in NSW.[90] Further discussion of the concentration of the waste management market in NSW is addressed in Section 5.2.2 below.

5.2.1 Contracting framework

Current contracting and subcontracting arrangements between private operators and local governments across the waste management flow (from collection, transfer, sorting, recycling and disposal) are complex. By way of summary:

- *Collection contracts (from Councils)* - these contracts tend to be at least 7 years to factor in the investment needed to buy new trucks. Operators under these contracts focus on optimising the efficiency of the collection service, including the frequency of collection; the distance and cost of transportation; use of transfer stations to compact and consolidate waste; and the size of collection and transportation vehicles.

  Historically these contracts:

  - may have seen ownership of waste transfer to the service provider, with a rebate or revenue share provided to the Council (based on the volume of recyclates collected), however, these types of arrangements have ended post China Sword;
  - may have been integrated with a waste processing service (either by the same provider or a back to back arrangements with a MRF);
- *Collection and disposal contracts (from businesses)* - these tend to be combined contracts that are for 2-3 years, that in the past have included a rebate for recyclate (e.g. paper);
- *Processing contracts to MRFs (Councils)* - these contracts tend to be shorter term service contracts;
- *Processing/disposal contracts for MBTs (Councils)* - tend to be long-term (15 years plus) reflecting the capital cost of the infrastructure / fact that they are usually project financed. Councils are usually the anchor waste supplier for new facilities, whether merchant or PPP;
- *Processing /disposal contracts for organics* – these contracts are variable - some garden waste contracts are short service-style contracts; FOGO tends to be longer term underpinning specific waste infrastructure;
- *Processing/disposal contracts for landfills (Councils)* – these contracts are much more variable; with short and longer term arrangements, again dependent on whether the contract is underpinning new infrastructure or not.

Some contracts are "take or pay" style where the counterparty is agreeing to provide a certain amount of waste or pay the difference. Others are more "throughput" where the contractor is paid for waste processed. For contracts between waste companies (for example, a waste company that collects waste and a waste company that treats/disposes of the waste) the gate fee is usually on a discounted scale (they pay less the more waste they provide).

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[89] ACCC. (2018). *Bingo- proposed acquisition of Dial-a-Dump*. The Australian Competition & Consumer Commission. Sourced from: https://www.accc.gov.au/public-registers/mergers-registers/public-informal-merger-reviews/bingo-industries-limited-proposed-acquisition-of-dial-a-dump-industries-pty-ltd

[90] ACCC. (2018). *Bingo- proposed acquisition of Dial-a-Dump*. The Australian Competition & Consumer Commission. Sourced from: https://www.accc.gov.au/public-registers/mergers-registers/public-informal-merger-reviews/bingo-industries-limited-proposed-acquisition-of-dial-a-dump-industries-pty-ltd. The ACCC accepted Bingo's acquisition of Dial-a-Dump in February 2019, on the condition that Bingo divest its Banksmeadow waste processing facility to an ACCC-approved purchaser.

At present, the EPA is provided with insufficient data to identify and track the flow of waste. Current reporting supports the identification of volumes processed by certain facilities (e.g. MRF's, landfills and other processors), and the data can identify the waste stream (MSW, C&I or C&D), however, it does not identify where the waste came from (e.g. LGA) or where the waste was sent to.

The present data collection does not support an assessment of the relative markets shares of competitors at each step of the waste flow or the efficiency of waste flows (including the distances waste is being transported, or whether movements are consistent with the proximity principal).[91]

Additional data is held within the EPA but is not readily accessible. As such, in the absence of reviewing individual licenses, the EPA is unable to readily identify the nature of the service provided by each waste facility that reports to the EPA and the materials processed.

In addition to the data limitations identified, the complex contracting framework means that there is limited visibility of the flow of waste between providers and limited ability to monitor and evaluate performance against outcomes. This limits the ability of waste service commissioners to engage providers, monitor performance and choose from a competitive market of providers.

There are a number of potential benefits to a contestability approach to contracting, including:

- increased commissioner market oversight and stewardship, enabling informed purchase decisions with flow on impacts for competition, service quality and price;
- increased ability to structure contracts in a way that drives performance against desired outcomes;
- increased incentives for providers to adopt innovative solutions to deliver against outcomes, rather than simply delivering specified services;
- more flexible contracts, which allow for innovation during the term of the contract in line with changing best practices, rather than constraining change.
- a more detailed analysis of the current level of contestability in the market should be undertaken as a project to help inform the interventions that might be warranted in the adoption of a contestability approach. This should include a comprehensive understanding of:
  - ownership of assets | businesses through the waste chain to understand the extent of vertical integration;
  - understanding of the services provided at each facility and the waste streams they service;
  - the location of specialty recyclers and from where they are drawing materials;
  - an understanding of the flow of materials between the various service providers;
  - an understanding of the contracted parties under LGA arrangements and the end date for current contracts;
  - an understanding of the contracted terms and the KPI's under which services are provided.

[91] Proximity principal: waste should be managed and disposed of as close as practicable to where it is generated

Considerations for the 20-year waste strategy

At present, the business models for the waste sector has in large part assumed continued growth in the production of waste. As part of the 20-year waste strategy it may be appropriate to review this model and to consider options to change the focus to support the transition to a circular economy. For example, the waste industry could become more involved in collection, consolidation and redistribution services in support of a circular economy rather than just collection for ultimate recovery or disposal. This would likely require a shift in approach away from regulating waste and treating it as a commodity and reviewing the regulations that apply (in particular, the underlying theme that once something is a waste it is always a waste, even if repurposed).

Other considerations are explored further in Key Finding 21, including:

- expanding the roles of service providers to include monitoring of waste contamination;
- restructuring fee arrangements to align with circular economy objectives (increased recycling and minimising residual waste);
- a standard set of KPIs around meeting minimum recycling or diversion rates for inclusion in all contracts;
- feedback on the effectiveness of source separation and contamination levels;
- options to provide greater levels of consistency of revenue sharing arrangements and gate fees across LGAs.

5.2.2 Competition

In 2017, the waste management sector in NSW was worth approximately $4 billion.[92] The sector directly employs almost 50,000 people (full time equivalent terms), accounting for about 0.5% of total employment. About 20% of waste related activity is undertaken by local government.[93]

Prior to 2010, Waste Services NSW (WSN) was owned by the NSW Government. WSN operations included 11 facilities for waste recycling, processing and disposal across Sydney, and offered kerbside collection, transport and disposal services. WSN held a dominant competitive position due to the fact that there were limited approved sites for waste infrastructure in NSW. SITA Environmental Solutions (now Suez) was successful in acquiring WSN in 2010.

Post the sale of WSN, the industry has undergone a period of consolidation, bringing cost and operational efficiencies and access to global expertise. The larger organisations run collection operations for both commercial and domestic waste and often also own landfills and other waste infrastructure. Access to critical infrastructure or close proximity to target markets offers potential operating cost and competitive advantages.

Concentration tends to be high in specific markets and regions and also varies across waste collection, waste treatment and disposal, waste stream and in some cases, material type. It is generally uneconomical to transport waste for disposal across long distances and, therefore, proximity and access to infrastructure is critical to competition. As a result, the level of competition is not consistent across the state. Stakeholders have advised that establishing new facilities can be difficult due to environmental regulations and real estate prices. A lack of

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92 NSW EPA. (2018). *Too Good To Waste: Discussion paper on a circular economy approach for NSW*. Sourced from: https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/recycling/18p1061-too-good-to-waste-circular-economy-discussion-paper.pdf?la=en&hash=4217537474E04FA7DD4A2D3191FFBD1A78433FD2

93 Department of the Environment and Energy. (2018). *Australian National Waste Report 2018*. Sourced from: http://www.environment.gov.au/system/files/resources/7381c1de-31d0-429b-912c-91a6dbc83af7/files/national-waste-report-2018.pdf

surety of supply of waste materials (which may be already contracted to other, less cost effective providers) can be a significant deterrent to new investments. As a result, there are generally few large treatment and disposal facilities in a localised area within transport range. These facilities tend to account for a high proportion of industry revenue.

Smaller operators may specialise in specific markets, such as skip bin operations or hazardous waste collection and treatment, or work in particular regions. For example, Cleanaway's subsidiary Tox Free Solutions is estimated to account for 17.3% of the medical waste collection and disposal services revenue in Australia.[94]

Waste operations in regional and remote locations are generally more challenging, with lower volumes and financial constraints impacting on the extent to which investments can be made in modern infrastructure. The comparative cost of recovering and transporting recyclate makes landfilling a more cost effective solution.

Local governments tend to play a larger role in service delivery and ownership of waste infrastructure assets in regional and remote locations. Operating costs are recovered though council rates, service fees and gate fees.

While concentration tends to be high in specific markets and locations, continued consolidation of the industry is starting to be a concern to regulators. While it has not opposed Bingo's proposed acquisition of Dial-a-Dump, the ACCC raised concerns regarding the merger. This included concerns regarding competition at three different levels of the industry: processing, landfill and collections. The ACCC stated that *'these three levels in the supply chain are closely linked, as competition in landfill can affect competition at the processing level, and competition at the processing level can affect competition at the collections level'*.

In February 2019, the ACCC announced that it would not oppose the acquisition following Bingo's undertaking to divest its Banksmeadow processing facility in order to maintain competition for building and demolition waste processing in Sydney's Eastern Suburbs and inner Sydney.[95]

However, specific concerns that were considered throughout the investigation include:[96]

- *Sydney building and demolition (B&D) waste processing services*: whether the acquisition would substantially lessen competition by removing Bingo's most substantial competitor, leading to increased waste processing rates, particularly in the Eastern Suburbs and Western Sydney. The ACCC also assessed whether the acquisition would increase Bingo's ability to impose exclusive processing contracts to the detriment of competition in processing;
- *In relation to landfill*:
  - whether the proposed acquisition would substantially lessen competition in the market for the supply of non-putrescible landfill services in Sydney, leading to higher prices. It was noted that the proposed acquisition may remove future

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94 It should be noted that the above estimate was made before the acquisition of Tox Free by Cleanaway. IBISWorld. (2019). *Waste treatment and Disposal Services: Competitive landscape*. Sourced from: http://clients1.ibisworld.com.au/reports/au/industry/competitivelandscape.aspx?entid=5024

95 Australian Competition and Consumer Commission (2019). *Bingo's acquisition of Dial-a-Dump not opposed, subject to divestiture undertaking*. Sourced from: https://www.accc.gov.au/media-release/bingo%E2%80%99s-acquisition-of-dial-a-dump-not-opposed-subject-to-divestiture-undertaking

96 Australian Competition and Consumer Commission (2018). *Statement of Issues: Bingo – proposed acquisition of Dial-a-Dump*. Sourced from: https://www.accc.gov.au/system/files/public-registers/documents/Bingo%20Dial-a-Dump%20-%20Statement%20of%20Issues%20-%20Public%20Register%20-%2029%20November%202018.pdf

competition between Dial-a-Dump's Eastern Creek landfill and Bingo's proposed Patons Lane landfill; and

  - if rivals have limited alternative options for non-putrescible landfill, whether the proposed acquisition would also lessen competition in B&D processing services, as processors need access to landfill.

- *In respect of B&D waste collection services in Sydney*: competing B&D waste collectors require access to processing facilities at competitive rates in order to be able to compete with Bingo. If rivals have limited options in the acquisition of B&D waste processing services, it was noted that the proposed acquisition may also substantially lessen competition in the supply of B&D waste collection services; and
- *Whether increased vertical integration will substantially lessen competition at the collections level*: if there were limited alternatives to a combined Bingo-Dial-a-Dump at the landfill level, the proposed acquisition would substantially lessen competition at the processing level. If there were limited alternatives at the processing level, the proposed acquisition would substantially lessen competition at the collections level.

The ACCC comments demonstrate how the transition to a vertically integrated model can substantially reduce competition. The shift to a circular economy for waste could reduce the reliance on landfill and disrupt the competitive landscape. However, the risk is that ownership and control of processing facilities would substantially replace landfill as the critical and controlling piece of infrastructure in the waste flow.

A perceived lack of competition has been raised by some participants in stakeholder consultations. Concerns were also raised as to the future ownership of critical infrastructure, including new builds that may strengthen a service provider's position relative to the rest of the market.

Stakeholders expressed the need for careful consideration to be given to the future ownership of infrastructure; ongoing access to the assets by local councils and the wider market; and whether alternate ownership models for new infrastructure should be considered (see Key Finding 8).

5.3 Waste facilities in NSW

5.3.1 Intermediary facilities

Analysis of the EPA data[97] shows that:

- There were 148 active intermediary facilities (that is, a scheduled waste facility that is not a disposal facility and which may act as either a recovery facility or a transfer facility) operating in NSW in 2016 which, combined, received 13.8Mt of waste during the year across MSW, C&D and C&I waste streams;
- There were 166 active intermediary facilities operating in NSW in 2017 (an increase of 18 facilities or 12% overall from 2016) which, combined, received 15.44Mt of waste during the year (an increase of 1.6Mt or 12% from 2016) across MSW, C&D and C&I waste streams;
- There were 156 active intermediary facilities operating in NSW in 2018 (a fall of 10 facilities or 6% overall from 2017) which, combined, received 13.18Mt of waste during the year (a fall of 2.26Mt or 15% from 2017) across MSW, C&D and C&I waste streams;

[97] This data refers only to the intermediary facilities which report into the WARRP and does not encompass all NSW intermediary facilities; it primarily includes facilities in the MLA and RLA, as most facilities in the NLA are not required to report.

- 22 (14%) of the intermediary facilities that were active in 2018 were in the RLA, with the remaining 134 facilities being located in the MLA;
- No intermediary facilities operating in the non-levied area reported data in 2018.

Feedback from stakeholder consultations is that regional areas are underrepresented in terms of infrastructure investment, in part due to the prioritisation of the metropolitan area by industry. However, industry recognises that there is opportunity to build infrastructure in regional areas as a potential solution to the challenges being faced in trying to process waste in metropolitan areas (as is the case with Veolia's Woodlawn facility). This approach will also create employment in regional areas which is consistent with Commonwealth and State policies. The key challenge with this approach is finding an efficient way to get waste to the facility (for example, by rail). Regional locations with access to transport infrastructure may play an important role in new waste processing or waste recycling.

5.3.2 Infrastructure

The NSW Government no longer owns any waste infrastructure.

Analysis of the EPA's Waste Infrastructure Asset Register indicates that there are 221 separate active facilities across NSW. However, it should be noted that this data is expected to be somewhat inconsistent with the EPA's data, as the infrastructure register relied on self-reported surveys and estimates.

Of the 373 activities undertaken by the 221 separate active facilities in the Infrastructure Asset Register sample, 22% (82) were disposal, 1% (5) were energy recovery and 77% (286) were sorting/treatment.[98]

Specific considerations related to infrastructure are explored in further detail in Section 11.

Table 16: Waste infrastructure facility capacity (tonnes)

Processing type	Sum of tonnes received (WARRP 2015-16)	Sum of Technical Capacity
C&D Waste Processing	5,509,155	9,510,926
Energy from Eligible Fuels	-	40,000
Energy Recovery Facility	-	1,562,500
Garden Organics Processing	1,066,421	1,340,937
Material Value-Adding	64,550	1,561,049
Mixed Waste Treatment	791,240	1,689,010
Non-putrescible Landfill	2,113,444	Not provided
Non-putrescible Waste MRF	1,265,703	4,787,560
Packaging MRF	536,190	1,552,802
Putrescible Landfill	3,161,583	775,000
Putrescible Organics Processing	255,398	1,169,900

Source: EPA Data
Note: The figures above are totals for all facilities within the dataset including facilities other than those classified as 'active'

[98] Although there were only 221 separate active facilities identified as operating in NSW in the period, between these facilities there were 373 specific capabilities, meaning that some of the facilities had multiple processing and/or disposal capabilities.

6 Waste generation and avoidance

This section analyses waste generation data, while also highlighting successes, opportunities and initiatives for the avoidance and reuse of individual waste streams.

6.1 Avoidance, minimisation and reuse

Avoidance and minimisation are key components of the waste hierarchy. Within these elements, the focus is on reducing waste generation through education and improved production processes, rather than improving technological processes for the treatment of waste. Maximising the use of resources and reducing the amount of waste disposed is also a key element of a circular economy approach.

A number of jurisdictions included in the Benchmarking Review have implemented specific policies that target a reduction in the production of waste materials, including the objective of achieving separation between the rate of GDP growth and the volume of materials consumed.

The sharing economy has contributed initiatives to the avoidance or minimisation of waste and reuse of materials before they are wasted. Car and ride sharing businesses, food kits and clothes hire businesses are all examples of businesses who have centred their businesses around sustainability objectives as well as social and economic considerations. The servicing economy also promotes practices that minimise waste generation, namely through the repair and reuse of goods.

The not for profit sector has a key role to play in the reuse sector. There are many charities which operate to collect items from households and businesses which are surplus to requirements but can be sold or donated to another person who requires it (in some cases after some repairs have been completed). Examples of goods that can be donated include clothing, kitchenware, books and furniture, amongst others.[99]

Support for initiatives such as those outlined above as well as broader waste reduction initiatives (such as education programs aimed at behaviour change) should be an important consideration for the 20-year waste strategy.

For industry, changes in product design to reduce virgin material consumption and removal of certain waste streams have been a key component driving waste reduction. For example, in 2018, Woolworths supermarkets reduced the waste generated by their milk bottles through initiatives such as converting 3L milk bottles to lightweight bottles (removing nearly 400 tonnes of plastic from circulation per year) and condensing the information on milk labels so there is only one label per bottle, rather than two (reducing about 50 tonnes of material weight a year).[100]

[99] NACR. (2019). *About*. Sourced from: https://www.nacro.org.au/

[100] Woolworths Group. (2018). *Sustainability Report*. pg. 28 sourced from: https://www.woolworthsgroup.com.au/icms_docs/195398_2018-sustainability-report.pdf

6.1.1 Generator and consumer behaviour

It is generally accepted that recycling requires greater effort from waste generators (including both commercial and industrial operators, households and individual consumers) than simply disposing of waste, in terms of time, behaviour and waste processing costs.

Generators require incentives, either behavioural or economic, to motivate behaviour change towards recycling. As noted in previous sections, there are opportunities that may motivate change in relation to both recycling behaviours and purchasing decisions, including:

- greater focus on education to support consumers in making purchasing decisions which lead to waste avoidance (e.g. avoidance of single-use goods and materials);
- education to increase understanding of contamination and its consequences in terms of cost, ability to recycle and landfill volumes;
- education for generators around what materials can and cannot be recycled;
- programs for generators to modify existing practices to support the greater use of recycled materials in production;
- expansion of producer responsibility schemes (see Key Finding 5);
- incentives and penalties for generators that fail to meet minimum standards in relation to sorting or recycling;
- direct consequences for poor recycling practices, beyond indirect landfill costs (for example, refusal to collect contaminated waste; higher collection rates for general waste vs recycled materials);
- greater focus on education and information to support increase demand in end markets or recyclables, such as:
  - clear labelling on the content of recycled materials used in a product to allow consumers to exercise their preferences about recycled products;
  - education to support greater use of recycled materials.

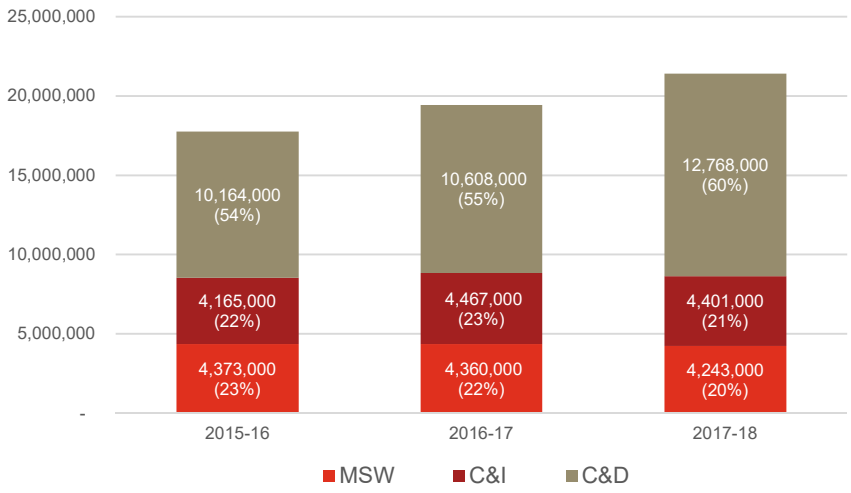
Many of these opportunities will require a coordinated approach across jurisdictions and all levels of government. For example, product specifications and quality standards would need to be consistent across all states and territories.

6.2 Generation

For the financial years in which data is available, total waste generation in NSW is increasing, as is the per capita generation rate. Total waste generation across all streams has increased from just under 18.7 Mt in 2015-16, to 21.4 Mt in 2017-18, while at the same time overall per capita generation has increased from 2.30 to 2.69 tonnes per capita.

As illustrated in Figure 9 below, the largest source of waste generation in NSW is C&D, followed by C&I and MSW.

Figure 9: Waste generated by stream in NSW (tonnes)



Source: EPA Data

The following sections consider the sources and amounts of major waste categories across the following waste material streams:

- Paper and cardboard
- Plastics
- Glass
- Metals
- Masonry materials
- Organics
- Timber
- E-waste
- Liquid waste
- Hazardous waste.

6.3 Paper and cardboard

Paper and paper products including cardboard, pulp and paperboard are produced in Australia, with key demand industries including:

- Meat processing;
- Paperboard container manufacturing;
- Corrugated paperboard manufacturing;
- Paper bag and other paper product manufacturing;
- Printing;
- Newspaper publishing; and

- Paper product wholesaling.[101]

The Australian paper industry directly employs 18,000 people with an annual sales income of over $9 billion from total production of around 3 million tonnes.[102] An estimated 1.7 million tonnes of paper is produced in NSW, with approximately 40% produced from recycled material.[103] The largest producer is the Visy Paper Mill at Tumut, which manufactures 800,000 tonnes of paper per annum from plantation sourced wood (75%) and recycled paper products (25%).[104]

In spite of large quantities of paper and paper products being produced in Australia and imported from international markets, paper and cardboard usage is in decline due in part to the digitisation of information and the consolidation of the printing and publishing markets. Overall, domestic industry revenue is expected to decline at an annualised 2.0% annualised rate over the five years through 2018-19, to $3.0 billion.[105]

In Australia, the paper, pulp and paperboard manufacturing industry is dominated by three major companies: Pratt Holdings (Visy), Paper Australia and Norske Skog Industries, which hold 28.6%, 19.4% and 13.7% of the market respectively.

NSW data from the 2016-17 financial year indicates that approximately 330kt of paper waste was sent to landfill from the MSW stream and 379kt was landfilled from the C&I waste stream.[106] In the same period, approximately 177kt of used paper was reprocessed from the MSW stream and 564kt was reprocessed from the C&I stream.

Of the 1.95 Mt of paper materials entering the NSW market in the 2016-17 financial year, approximately 13 per cent (262kt) was from imported materials (both virgin and recycled) and 87 per cent (1.7Mt) was NSW sourced materials.[107] Of the NSW made paper products and materials, approximately 650kt were exported in financial year 2016-17. It should be noted that this data pre-dates China's National Sword Policy, which significantly reduced the ability to export some recyclable materials (predominantly mixed paper and mixed plastic).[108]

6.4 Plastics

6.4.1 Overview

Globally, approximately 300 million tonnes of plastic waste are created every year.[109] Researchers estimate that more than 8.3 billion tonnes of plastic has been produced since the early 1950's.[110] Only 9% of all plastic waste ever produced has been recycled. About 12% has been incinerated, while the rest — 79% — has accumulated in landfills, dumps or the natural

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[101] Miller. T. (2019). *Pulp, Paper and Paperboard Manufacturing in Australia*. IBISWorld Industry Report. Sourced from: https://www.ibisworld.com.au/industry-trends/market-research-reports/manufacturing/pulp-converted-paper-product/pulp-paper-paperboard-manufacturing.html

[102] AFPA. (2019). *Pulp, paper and bioproducts*. Sourced from: https://ausfpa.com.au/about/pulp-paper/

[103] Internal unpublished report procured by the EPA (2018)

[104] Internal unpublished report procured by the EPA (2018)

[105] Internal unpublished report procured by the EPA (2018)

[106] Internal unpublished report procured by the EPA (2018)

[107] Internal unpublished report procured by the EPA (2018)

[108] Internal unpublished report procured by the EPA (2018)

[109] UN Environment. (2019). *Plastic Pollution*. Sourced from: https://www.unenvironment.org/interactive/beat-plastic-pollution/

[110] Ibid

environment.[111] The presence of plastics in the environment is an emerging pressure for governments and waste policy makers internationally.

Plastic waste consists of a variety of different plastic types:

- Polyethylene Terephthalate (PET)
- High-Density Polyethylene (HDPE)
- Polypropylene (PP)
- Polyvinyl Chloride (PVC)
- Low-Density Polyethylene (LDPE)
- Polystyrene (PS) or Expanded Polystyrene (EPS)
- Miscellaneous plastics (includes: polycarbonate, polylactide, acrylic, acrylonitrile butadiene, styrene, fiberglass, nylon, synthetic and natural rubbers and bioplastic).

The EPA engaged a consultant in 2018 to determine plastic generation and recycling volumes in NSW. Recycling was based on an annual survey of plastic recyclers and export data, while generation was based on a series of assumptions relating to import data.

Generation data was calculated on an Australia-wide basis and then allocated to each state using a per capita rate. The consumption data therefore does not account for variations of intensity of consumption across different jurisdictions.

6.4.2 Plastic generation

An estimated total of 295,000 tonnes of plastic is produced in NSW, including plastic from both virgin and recycled material.

Table 17: Plastic production in NSW

Material source	Volume
Manufactured from virgin material produced in NSW	170 000
Manufactured from recycled material	34 000
Total using NSW materials	204 000
Manufactured from imported plastic in primary form	91 000
Total	**~295 000**

Source: Internal unpublished report procured by the EPA (2018)

Total plastics consumption in NSW in 2017–18 is estimated at 1.09Mt, an increase of 15% over FY17, but an increase of only 8% since FY14.

The table below outlines the principal consumers of plastics in NSW across eight different application areas, as well as their estimated rate of recycling, in 2017-18.

[111] UN Environment. (2019). *Plastic Pollution*. Sourced from: https://www.unenvironment.org/interactive/beat-plastic-pollution/

Table 18: NSW plastics consumption and recovery[112] by application area in 2017-18 (tonnes)[113]

Application area (tonnes)	Recovery	Consumption	Recycling rate
Agriculture	900	29,100	3.1%
Automotive	0	70,300	0.0%
Built environment	1,400	185,300	0.8%
Electrical and electronic	3,600	60,400	6.0%
Packaging – municipal	48,300	252,800	19.1%
Packaging – C&I	13,300	97,300	13.7%
Other application area	14,300	267,900	5.3%
Unidentified applications	4,200	126,800	3.3%
Total	**86,100**	**1,090,000**	**7.9%**

Source: Envisage Works and Sustainable Resource Use 2018

32% of plastic volumes is generated by the packaging industry and 23% by the automotive and built environment sectors.[114]

Plastics used in longer life applications (e.g. automotive components) are not expected to be recovered in the same year they are generated and therefore recovery rates need to be viewed in this context.

6.5 Glass

Glass is a major packaging, utility and construction material. Industry revenues rose at an annualised rate of 2.6% over the five years through 2018-19. Industry revenue has grown at a slower rate than demand for glass and glass products during this period due to the loss of market share to imported products.[115] According to the 2018 National Waste Report, the overall domestic generation of glass fell by about 180,000 tonnes between 2006-07 and 2016-17, due to a loss of packaging market share to plastic and imported containers.[116]

Approximately 341kt of glass entered the NSW market in 2016-17 financial year, 80 per cent (274kt) was from NSW sourced materials (both virgin and recycled) and 20 per cent (67kt) was from imported materials (both virgin and recycled).[117] Of the NSW sourced materials, approximately 81 per cent is estimated to have come from reprocessed recyclables, with the remaining 19 per cent coming from NSW sourced virgin materials.[118]

The glass packaging segment of Australian manufacturing is dominated by two local firms, Owens-Illinois Australia and Orora Limited, which manufacture bottles and jars for packaging beverages and food products. Owens-Illinois (O-I) produces the majority of glass bottles that

[112] Note – these figures do not exclude contamination (and therefore the total recovery differs from the FY18 WARR dataset)

[113] Envisage Works and Sustainable Resource Use (2018). *2017–18 Australian Plastics Recycling Survey*. NSW EPA.

[114] Built environment includes pipes and cables; windows and doors; insulation; building fit-out; carpets and floor coverings.

[115] Kelly, A. (2019). *Glass and Glass Product Manufacturing in Australia*. IBISWorld Industry Report. Sourced from: https://www.ibisworld.com.au/industry-trends/market-research-reports/manufacturing/non-metallic-mineral-product/glass-product-manufacturing.html

[116] Department of the Environment and Energy. (2018). *Australian National Waste Report 2018*. Sourced from: http://www.environment.gov.au/system/files/resources/7381c1de-31d0-429b-912c-91a6dbc83af7/files/national-waste-report-2018.pdf

[117] Internal unpublished report procured by the EPA (2018)

[118] Ibid

are made in Australia, however, the company has seen a reduction in its permanent manufacturing footprint in Australia in recent years, and a loss of market share in wine and beer bottle manufacturing segments to Orora Limited.[119]

The largest local manufacturer in the flat glass segment is Viridian (CSR Limited), with the rest of the industry comprising many small to medium-scale glass fabrication firms. The industry comprises over 600 enterprises, although the vast majority of these employ fewer than 20 people.[120]

In Australia, the primary demand industries for manufactured glass include:

- Fruit and vegetable processing;
- Alcohol and beverage manufacturing;
- Aluminium door and window manufacturing; and
- Construction and glazing services.[121]

6.6 Metals

Metals are used in Australia for a wide variety of construction, consumer and commercial uses. Key demand industries of metals in Australia include:

- Food and beverage manufacturing;
- Plumbing services;
- Air conditioning and heating services;
- Private, commercial and industrial building construction; and
- Hardware and building supplies.[122]

Large quantities of imported metals and metal products are increasingly challenging domestic manufacturing markets. Fabricated metal products imports, for example, account for approximately 62 per cent of domestic demand. This is largely a result of the low cost of production of overseas manufacturers, particularly those based in nearby Asian economies, making Australian produced products uncompetitive in overseas markets.[123]

In the 2016-17 financial year, 89kt of metal waste was landfilled from the MSW stream and 113kt of metal waste was landfilled from the C&I stream.[124]

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[119] Kelly, A. (2019). Glass and Glass Product Manufacturing in Australia. IBISWorld Industry Report. Sourced from: https://www.ibisworld.com.au/industry-trends/market-research-reports/manufacturing/non-metallic-mineral-product/glass-product-manufacturing.html

[120] Kelly, A. (2019). *Glass and Glass Product Manufacturing in Australia*. IBISWorld Industry Report. Sourced from: https://www.ibisworld.com.au/industry-trends/market-research-reports/manufacturing/non-metallic-mineral-product/glass-product-manufacturing.html

[121] Ibid

[122] Cadwell. JP. (2019). *Sheet Metal Product Manufacturing in Australia*. IBISWorld Industry Report; Kelly. A. (2019). *Fabricated Metal Product Manufacturing in Australia*. IBISWorld Industry Report; Conley. D. (2019). *Structural Metal Product Manufacturing in Australia*. IBISWorld Industry Report.

[123] Cadwell. JP. (2019). *Sheet Metal Product Manufacturing in Australia*. IBISWorld Industry Report; Kelly. A. (2019). *Fabricated Metal Product Manufacturing in Australia*. IBISWorld Industry Report; Conley. D. (2019). *Structural Metal Product Manufacturing in Australia*. IBISWorld Industry Report.

[124] Internal unpublished report procured by the EPA (2018)

Metals represent some of the most highly-recycled and re-used materials, with most items on the market containing a mix of virgin and recycled material. Two of Australia's primary steel producers, BlueScope and Liberty OneSteel make extensive use of scrap steel.

Approximately 47% of the total steel produced at BlueScope is produced from scrap steel.

Liberty OneSteel Recycling handles approximately 1.2 million tonnes of ferrous scrap each year. This is sold to international markets or distributed to One Steel's mills in Sydney, Newcastle, Victoria and South Australia. During the 2015 financial year, recycled scrap composed 100% of steel produced at both Liberty's Sydney steel mill and Newcastle steel mill.[125]

While high levels of aluminium are recycled and reused internationally, very little post-consumer aluminium scrap is now recycled in Australia and all aluminium packaging, including beverage cans, are exported for recycling.

Overall, approximately 15% of metal materials used by NSW industry contain recycled or scrap metals.[126]

6.7 Masonry materials

Masonry includes aggregate, road base, ballast, bricks, concrete, ceramics, tiles, pottery, plasterboard, uncontaminated soil, and virgin excavated natural materials (VENM).

Masonry materials are recovered from most large demolition projects but less so from smaller projects. Smaller projects often generate mixed loads of demolition waste that are sent directly to landfill.

Masonry materials recycled represent the single largest waste category in Australia in 2016-17 at approximately one-third of all waste. Around 8Mt was recycled in NSW in 2017-18.

6.8 Organics

Organics include biosolids or manures, compost or mulches, food or kitchen wastes (including from agriculture and agricultural by-products), vegetation and garden waste, wood, trees or timber. Estimated organics waste generation in NSW in 2015-16 was 1.78 million tonnes for certain organic sources, including:

- garden organics (green waste) from arborist, land clearing or felling operations;
- kerbside garden organics;
- food organics and garden organics (FOGO);
- C&I food waste;
- organic outputs from MSW processing.[127]

There is also likely significant organic content in waste that goes to landfill in the general waste stream and is not captured in any data (see Section 8.9).

The volume of organics reported as recycled is based on the sum of:

- organics transported for lawful recovery by major composting facilities;

[125] Internal unpublished report procured by the EPA (2018)

[126] Internal unpublished report procured by the EPA (2018)

[127] Internal unpublished report procured by the EPA (2018)

- organics transported under a resource recovery order (RRO) by mechanical-biological treatment (MBT) facilities;
- organics transported under a RRO to an unspecified destination for lawful recovery by all other organic facilities;
- a mass loss adjustment[128];
- an estimate of organics processed at licensed facilities that did not report into WARRP.[129]

6.9 Timber

Wood has a high environmental impact and is one of the highest tonnages in landfill. Around 14% of C&I waste is made up of timber, most of which is treated timber.[130] It is unlawful for treated timber to be processed into mulch and applied to land, incinerated or used as a waste derived solid fuel combusted for energy.

6.10 Other recyclables

Other recyclables include ash, batteries, commingled recyclables, e-waste, mattresses, mixed waste, problem wastes, residues and rejects, textiles, tyres and other unidentified recyclable materials.[131]

The following tables provide information on the tonnage of these recyclable materials recycled for FY16-18.[132]

Table 19: Tonnes recycled of other recyclables by waste stream (2017-18)

Waste type	MSW	C&I	C&D	Total
Ashes	-	-	4,678	**4,678**
Batteries	476	5,018	107	**5,601**
Commingled recyclables	13,104	4,961	12,522	**30,587**
Dredging spoil	-	4	-	**4**
E-waste	1,886	654	648	**3,188**
Mattresses	1,765	393	244	**2,402**
Mixed waste	9,005	10,831	910,980	**930,816**
Problem waste	549	474	64	**1,087**
Residue or rejects	34,171	42,984	68,627	**145,782**
Textiles	51	2	-	**53**
Unknown	1	1	1	**3**
Tyres	164	49,410	119	**49,693**
Total tonnes	**61,172**	**114,732**	**997,990**	**1,173,894**

Source: EPA waste generation, disposal and recycling data

[128] See Appendix A

[129] See Appendix A

[130] Internal unpublished report procured by the EPA (2016)

[131] Only commingled recyclables sent interstate for processing and commingled recyclables transported for recovery by an NLA landfill are counted here; the majority of commingled recyclables are accounted for in the separated waste types (i.e. plastics, glass, paper/card, metals).

[132] Note – this data is not considered to fully encompass all waste recycled for some of these waste types, in particular batteries, e-waste, mattresses, problem waste, textiles and tyres. These waste types are often managed at small facilities which do not report to the EPA; no estimate was made within this data for waste managed outside of EPA-reporting facilities.

Table 20: Tonnes recycled of other recyclables by waste stream (2016-17)

Waste type	MSW	C&I	C&D	Total
Ashes	-	-	12,270	**12,270**
Batteries	480	4,157	81	**4,718**
Commingled recyclables	12,649	4,872	87,186	**104,707**
Dredging spoil	-	-	-	**0**
E-waste	1,951	651	459	**3,061**
Mattresses	1,351	234	236	**1,821**
Mixed waste	9,979	6,799	570,602	**587,380**
Problem waste	350	680	32	**1,062**
Residue or rejects	31,340	35,626	84,751	**151,717**
Textiles	182	1	-	**183**
Unknown	1	-	-	**1**
Tyres	242	53,578	2059	**55,879**
Total tonnes	**58,525**	**106,598**	**757,676**	**922,799**

Source: EPA waste generation, disposal and recycling data

Table 21: Tonnes recycled of other recyclables by waste stream (2015-16)

Waste type	MSW	C&I	C&D	Total
Ashes	-	89	12,197	**12,286**
Batteries	465	4,022	68	**4,555**
Commingled recyclables	12,672	10,838	69,186	**92,696**
Dredging spoil	-	-	-	**0**
E-waste	2,047	620	486	**3,153**
Mattresses	1,099	213	176	**1,488**
Mixed waste	1,924	4,883	298,271	**305,078**
Problem waste	230	979	22	**1,231**
Residue or rejects	1,768	2,540	84,875	**89,183**
Textiles	72	5	-	77
Unknown	270	21,632	-	**21,902**
Tyres	303	25,108	80	**25,491**
Total	**20,850**	**70,929**	**465,361**	**557,140**

Source: EPA waste generation, disposal and recycling data

As shown in the tables above, there has been an increase in other recyclables over the past three years. Of particular note:

- E-waste volumes have remained relatively stable over the past three years, despite the growth in e-waste volume (see Section 6.11);
- the volume of mixed waste has increased significantly each year (note – the C&D mixed waste is primarily waste reported as being transported interstate for recovery);
- the volume of tyres more than doubled between FY16 and FY17, before dropping 11% in FY18.

6.11 E-waste

Electronic waste or 'e-waste' is any item with a battery or plug that has passed its useful life. It is the fastest growing category of waste globally and features prominently in waste contamination in the MSW stream.

In Australia, e-waste is growing at three times the rate of general municipal waste. In NSW, total e-waste is projected to grow to about 200,000 tonnes per annum by 2025, an increase of more than 25% on the current level. E-waste contains resources, including precious metals, which can have significant market values.[133]

There are a number of subcategories of e-waste, including:

- Large household appliances (e.g. refrigerators, washing machines etc.);
- Small household tools and appliances (e.g. irons, toasters etc.);
- TVs, computers, other IT (e.g. computers, printers etc.);
- Telecom equipment (e.g. mobile phones etc.);
- Lighting (fluorescent lamps, LEDs etc.);
- Toys, leisure and sporting equipment (e.g. game consoles, hi fi equipment etc.);
- Professional tools and equipment (e.g. medical devices, automatic dispensers etc.);
- PV panels; and
- Batteries (all types).[134]

In 2016, e-waste generation in NSW was estimated to be about 150,000 tonnes. Of the nine subcategories, the largest contributors were (in order of largest to smallest contribution by mass):

- Large household appliances;
- Small household tools and appliances;
- TVs, computers, and other IT;
- Toys, leisure and sporting equipment.

Combined, these four categories made up more than 85% of e-waste by mass. The fastest growing categories of e-waste were lighting equipment, PV panels and flat screen TVs.[135]

Most councils have established hard waste collection services; community recycling centres and special e-waste collection programs that support the recovery of certain e-wastes, however, problem areas include batteries, cables, remote controls, mobile phones and other paraphernalia which appears in the MSW stream.

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[133] Internal unpublished report procured by the EPA (2018)

[134] Internal unpublished report procured by the EPA (2018)

[135] Internal unpublished report procured by the EPA (2018)

6.12 Liquid waste

Liquid waste includes waste from residential, industrial and commercial properties, and encompasses sewage, household liquid waste and trade waste. The focus in this Report, however, is on trade waste and household liquid waste, and its relationship to the broader waste management and disposal sector and excludes sewage. Hazardous liquid waste is encompassed within the hazardous waste section below.

Trade waste can be defined as non-sewage discharges from industrial and commercial premises. This excludes hazardous liquid waste but includes non-sewage discharges from hazardous waste treatment facilities.[136] Household liquid waste is defined as liquid waste disposed of into household bins or household chemical collection programs.[137]

A challenging aspect to measuring total liquid waste generation is the fact that liquids are also disposed of by households as part of food waste and sewage waste. Furthermore, the liquid content of 'solid' wasted food is included in the solid waste reporting earlier in this Report. The liquid content varies, but most food waste is putrescible and generates liquid as it decomposes.[138]

Some service industries and most manufacturing industries also dispose of trade waste to the sewerage system. Trade wastes are usually controlled by individual licence-type agreements between a company and the local water authority. Typically, the agreement sets out contaminant types and a maximum contaminant loading that can be discharged per unit volume of discharge from the premises, and often also sets a volume limit.[139]

The data in the table below was collated for the *National Performance Report 2009-2010 Urban Water Utilities* for the National Water Commission and includes sewage. This data should not be considered complete and is used as a guide only.[140]

Table 22: NSW sewerage system data (2009-10)

Liquid Waste type	Generation (ML)	Recycling (ML)	Disposal (treated effluent outfall, ML)	Energy Recovery (MWhrs)
Trade Wastes Volume (2009-10)	32,582	-	-	-
Sewage Including Residential and Non Residential (2009-10)	608,841	-	-	-
Total Sewage Collected (Inc. trade waste and sewage 2009-10)	641,423	62,391	578,969	45,520

Source: Australian Government (2010), National Performance Report 2009-2010 Urban Water Utilities, National Water Commission

Liquid food waste, comprising products such as drinks, stocks and soups, is a category of liquid waste which is largely landfilled in NSW. Liquid food waste is subject to the EPA's *Liquid Food Waste Exemption* (2014) which exempts a consumer of liquid food waste from

[136] Department of the Environment and Energy. (2018). *Australian National Waste Report 2018*. Sourced from: http://www.environment.gov.au/system/files/resources/7381c1de-31d0-429b-912c-91a6dbc83af7/files/national-waste-report-2018.pdf

[137] Ibid

[138] Ibid

[139] Ibid

[140] Ibid

certain requirements under the Protection of the Environment Operations Act 1997 (POEO Act) and the Waste Regulation in relation to the application of that waste to land. For the purposes of the Exemption, liquid food waste means liquid food waste from the manufacture, preparation, sale or consumption of food. The Exemption specifies that liquid food waste may only be applied to the land as a soil amendment and must be injected into the land to a minimum depth.[141]

A further major liquid waste category is used cooking oil (UCO). UCO is largely generated in the C&I stream, with collection usually taking place at the place of business and then transferred to aggregators or directly to treatment or disposal facilities. NSW generates approximately 26,226 tonnes of UCO per annum, the majority of which comes from food retailers, principally fast food chains, shopping centres and boutique food retailers.[142] UCO and associated waste types (such as grease trap waste, oil and oily waters) are often classified and treated as hazardous waste, as outlined below. UCOs can be effectively recycled through the production of bio fuels. For example, Biodiesel Industries Australia has a biodiesel manufacturing plant in Rutherford, NSW which produces biodiesel fuel from UCO.[143]

6.13 Hazardous waste

Almost all waste categories have the potential to contain hazardous materials. Hazardous materials are those which have properties that are a potential threat to public health or the environment. Hazardous waste includes:

- contaminated soils and asbestos from development and demolition projects;
- waste from the chemicals and heavy manufacturing industry;
- mining wastes, such as coal seam gas waste;
- waste with hazardous characteristics that arise from more everyday sources, such as tyres, oil, oily waters, grease trap waste, waste containing lead (such as acid batteries and leaded glass);
- used industrial catalysts and other residual waste contaminated with heavy metals.

The bulk of hazardous waste category comprises contaminated soils, asbestos and tyres. The volume of hazardous waste generated in Australia continues to increase each year, faster than the rate of population growth. Average annual growth in hazardous waste between 2010-11 and 2014-15 was estimated at 9% per annum.[144]

Between 2006-07 and 2016-17, the generation of hazardous waste increased by about 26% (5.0 to 6.3 Mt), while the recycling rate decreased from 34% to 27%. More than half the increase in the quantity of hazardous waste was due to greater quantities of material (mostly soil) contaminated with asbestos.[145]

In 2014-15, Australia produced around 5.6 million tonnes of hazardous waste, which is about 9% of all waste generated. NSW is the second-highest producer of hazardous waste after

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[141] NSW EPA. *The liquid food waste exemption 2014*. Sourced from: https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/waste/rre14-liquid-food.pdf?la=en&hash=FFFB41C8AEF6D812066C6FC74643ECED21377B28

[142] Information provided to PwC in consultation with industry

[143] Biodiesel Industries Australia. (2019). *Resources*. Sourced from: https://www.bioenergyaustralia.org.au/resources/

[144] Department of the Environment and Energy. (2017). *Hazardous Waste in Australia 2017*. Sourced from: http://www.environment.gov.au/system/files/resources/291b8289-29d8-4fc1-90ce-1f44e09913f7/files/hazardous-waste-australia-2017.pdf

[145] Department of the Environment and Energy. (2017). *Hazardous Waste in Australia 2017*. Sourced from: http://www.environment.gov.au/system/files/resources/291b8289-29d8-4fc1-90ce-1f44e09913f7/files/hazardous-waste-australia-2017.pdf

Queensland.[146] The majority of hazardous waste (as defined by the Australian Government) is sent to landfill (51% in 2014-15). In 2014-15, another 16% was recycled, 14% underwent specific treatment (to reduce or remove the hazard), and 13% was stored for accumulation and later release into management infrastructure.[147]

New hazardous wastes are continuing to emerge due to changes in technology, and increased recognition of hazards in already circulating materials. Particularly problematic is the emergence of new wastes in significant volumes with limited management infrastructure for treatment or disposal. Problematic waste types in this regard include:

- persistent organic pollutant (POP) wastes, including per and poly-fluoroalkyl substances (PFAS);
- new concerns about the contaminants in biosolids (due to upstream chemical use);
- changing battery technologies, and the increasing use of lithium-ion.[148]

The current treatment of hazardous wastes is considered in Section 10.3.

[146] Department of the Environment and Energy. (2017). *Hazardous Waste in Australia 2017*. Sourced from: http://www.environment.gov.au/system/files/resources/291b8289-29d8-4fc1-90ce-1f44e09913f7/files/hazardous-waste-australia-2017.pdf

[147] Ibid

[148] Ibid

7 Waste collection and transportation

Once waste is generated and separated (where this occurs), it is collected and transported either:

- to transfer stations for temporary deposit, waste aggregation or compaction prior to being loaded on special purpose, long-haul vehicles or freight containers for transport to processing facilities or landfill; or
- to waste processing facilities for extraction of recyclable materials, with the residual waste disposed of in landfill.

There are a large number of participants in the waste collection and transport industry, however, the large capital investment required and the economies of scale required to provide a cost effective and efficient service has seen significant consolidation, including vertical integration from waste collection through to processing and landfill. This is due in part to local government aggregating waste volumes (for tender processes) under multiple contracts as a way of attempting to streamline and optimise service and pricing outcomes. Councils will also put out joint contracts with other councils (or go to market together with separate contracts) in an attempt to attract better prices and/or to encourage the construction of new facilities.

7.1 Municipal solid waste

The collection and transportation of MSW is led by local governments – which are obligated under the *Local Government Act 1993* to provide waste collection services – and will do so by either managing the collection themselves or by outsource to a contractor.

For those councils that have a kerbside dry or organic recycling systems, some contract waste services for either or both collection and processing.

Councils currently contract waste services under different models, including:

- Separate collection and processing contracts, where councils separately contract with a waste collector and a MRF/resource recovery facility for the different waste streams. Under this model, the waste collector only provides a collection and transportation service and does not own the waste material at any point.
- Waste collection contract, where the collector is contracted to pick up and dispose of kerbside waste. Ownership usually transfers to the contractors upon collection. The operator may enter into a separate agreement with a MRF or use their own facilities to process the waste. This model can create additional challenges, as the council does not have a direct contractual arrangement with both service providers in the waste flow and existing contracts do not always provide the flexibility required to modify service approaches to match changing council or state policies and attitudes towards waste reduction and diversion (see Key Finding 10).

Commissioning waste services and potentially transitioning between waste service providers is costly and disruptive and as a result contracts are typically for 7+ years (and occasionally longer for contracts including disposal services) with multiple extension options.

Households pay for their waste collection services through their council rates. This is usually a flat fee, however, many councils offer services at different prices based on the number and size of bins. Nevertheless, the visibility of the service and its cost is limited, meaning that poor waste management practices (such as contamination of sorted waste or failure to separate recyclables) by householders does not have an immediate or visible financial or other impact for households.

The lack of an immediate cost impact or other mechanism means there is no financial or other incentive for householders to improve their waste management practices, for instance, by increasing their knowledge of what can be recycled or sorting their waste with care. Poor householder practices increases the volume of recyclable materials going to landfill, and the levels of contamination in MSW recyclate streams (see Section 4.2).

As a partial response to this issue, some councils have implemented waste collection arrangements that incentivise the service provider to achieve higher quality waste streams. Traditionally, council waste management KPIs have targeted aspects of waste management such as the percentage of bins collected, rather than the improvement of the quality of waste streams overall. Some councils, however, have begun to include these arrangements in their new contracts for both collection and processing of waste. Such approaches often place the onus on the service provider to influence householders, but in some cases, also include education to improve MSW sorting at the source. Some service providers have taken steps to recognise households who adopt good recycling habits.[149] The analysis undertaken has gathered anecdotal evidence of these changes. The 20-year waste strategy would benefit from a better understanding of the terms LGA's have actually been able to implement in new contracts and the service providers that have agreed to them.

Some larger waste management service providers appear to be withdrawing from the domestic collection market due to the limited profitability of collection activities coupled with significant occupational health and safety risks.

7.2 Commercial and industrial waste

While C&I waste comprises a similar waste profile relative to MSW, local governments are not directly responsible for its collection and management. This tends to be organised by direct contract between waste collection and transfer service providers and commercial and industrial businesses or facility owners (e.g. management companies or commercial and industrial property owners). However, there are some councils who have established their own commercial C&I waste business to deliver services where contractors are not present, or in competition with private operators.

In the C&I sector, collection of waste is usually charged per bin collection (lift), based on the volume of the bin (and therefore does not provide any incentive to reduce waste volumes). Collections are planned and scheduled to optimise available capacity in trucks and to minimise transport costs. Customers may be charged a premium for site specific requirements or where access to waste bins results in additional time being spent. Service provision usually requires a minimum waste volume and pricing usually reflects the operational efficiencies that can be realised by including additional sites into waste collection schedules. The structure of the industry (including being able to secure a steady stream of waste materials) and the pricing of the service delivery can be a significant inhibitor to an individual business electing to adopt improved recycling practices (e.g. source separation), or for new businesses to enter the market.

C&I customers that choose to have separate recycling streams, tend to produce better quality (lower contamination) recyclables. Large businesses are more likely to source separate wastes and have separate collection of recyclate due to the volumes they generate and the existence of relevant policy objectives (e.g. environmental goals). In the absence of a comparable requirement, SMEs are less likely to adopt comparable practices as the volumes they generate

[149] See, for example, Smiley Face Bin Tags, which are given to households after bin inspections by Hawkesbury Council. Source: Hawkesbury Gazette. (2017). *Hawkesbury Council inspectors will be conducting bin checks*. Sourced from: https://www.hawkesburygazette.com.au/story/4503520/will-your-bins-pass-the-test/

are likely to be too low for waste service providers to collect, transport and aggregate in a cost effective manner.

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

In NSW, Qld, Vic, WA and SA, hazardous waste transport within the jurisdiction's borders is subject to a tracking system. This requires that transporters, generators and receivers to verify the quantity and type of waste moved and report it to the regulator.

7.3 Construction and demolition waste

As C&D waste is comprised of significantly different materials to MSW and C&I, its collection and transportation differs significantly.

C&D waste is typically collected from building and construction sites, including demolition, excavation and construction sites. C&D contracts are usually 'one-off' or project-specific contracts as opposed to being term contracts and are usually between the builder and a waste collection company. Customers are usually provided with steel, open-face skips, and C&D waste is typically collected using a hook lift or Marrell truck. The skips and trucks used are more durable than those used for MSW and C&I, given the weight of waste they are designed to hold.[150]

C&D waste is distinguished as 'lights' and 'heavies' by those in the industry. 'Heavies' tends to refer to sand, bricks, tiles, concrete, rock, and plaster, while 'lights' refers to packaging, bags and glass. The cost of transport of 'heavies' generally makes it uneconomic to cart waste more than 50km. This requires location of infrastructure close to the end market. Certain C&D wastes are transported directly to landfill (e.g. VENM) or to other sites where it may be utilised (e.g. clean soil). The remaining waste is transported to processors for sorting and extraction of recyclables. In its recent statement of issues in consideration of Bingo's proposed acquisition of Dial-a-Dump (an acquisition which is subsequently approved), the ACCC recently observed that:

> "*it is not viable for [C&D] waste collectors to transport waste long distances from the customer premises (particularly in inner Sydney) due to traffic congestion, relatively small loads which result in high transport costs per tonne and opportunity costs incurred if a collector travels longer distances to a processing facility (i.e. the lost profits from other loads that the truck could be collecting). Therefore, skip bin collectors will typically transport waste to a processing facility that is near to the collection site, or on the route to their next pick-up location, or where the driver drops the truck off at the end of their shift and prices competitively.*"[151]

At present, a significant volume of C&D waste (generally the 'lights', not the 'heavies') is transported to Queensland (see Sections 4.3.5 and 7.6).

7.4 Travel distance considerations

Travel distances are a core component of the price of waste removal. In any area, a waste provider will seek to maximise the volume of waste in a truck and minimise the total distance the truck has to travel. This means, for example, that in higher density areas, commercial customers can benefit from using the same provider as a neighbouring business. Similarly,

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[150] Australian Competition and Consumer Commission 2018. *Bingo – proposed acquisition of Dial-a-Dump: Statement of issues*. Sourced from: https://www.accc.gov.au/public-registers/mergers-registers/public-informal-merger-reviews/bingo-industries-limited-proposed-acquisition-of-dial-a-dump-industries-pty-ltd

[151] Ibid

isolated runs can be uneconomic. This explains why there is a significant subcontracting culture in the industry: a business may contract with one provider to remove waste from all its stores, for example, but the provider then subcontracts some of its obligations for individual stores to another provider who is able to service the area more economically.

While a large majority of households in NSW have both landfill and recycling collection services, travel distances is a reason why it can be uneconomic for regional and rural councils to have kerbside organics collection, particularly in instances where organic waste is landfilled, composted or otherwise disposed of by the household, or in communities where source separation of organics is not well established.

7.5 Transfer and sorting

C&I, C&D and MSW streams are transported to resource recovery facilities, either directly or via transfer stations. Transfer stations are important consolidation points in the waste logistics chain and a potential bottleneck for waste movements.

While C&I and MSW streams will tend to be transferred and sorted by the same companies and facilities (as they comprise largely similar waste profiles), C&D transfer stations tend to be separate.

The scale, complexity and level of reporting of transfer stations vary greatly. Analysis of the EPA's Waste and Resource Reporting Portal indicates there were 148 active 'intermediary facilities' (meaning a facility which is not a disposal facility and may act as either a resource recovery or transfer facility) operating in 2016. Analysis conducted by GHD in 2011 estimated the number of transfer stations operating in NSW at 171.[152] Many small scale facilities have been established in regional and remote areas, often in lieu of a small landfill, where local communities without waste collection services can consolidate waste for bulk collection.

Following sorting, recovered recyclable materials may be further processed on site, forwarded to a material recovery facility (MRF) for processing, or stockpiled and sold domestically or internationally. Materials not recovered are disposed to landfill.

Some transport of aggregated waste is undertaken by rail. For example, Veolia has rail transfer terminals at Banksmeadow and Clyde in Sydney, which consolidates waste for transfer to Veolia's putrescible landfill at Woodlawn in southern NSW (near Goulburn). Other waste operators also transport aggregated waste by rail to Queensland.

The considerable benefits of transfer of waste by rail (the most significant one being the removal of trucks from the road) is muted by the key disadvantage – namely congestion of the rail network and difficulty in obtaining rail slots or rail siding space for the transfer of the waste.

7.6 Transport challenges

The transport of waste involves a number of challenges. Heavy machinery in the form of garbage trucks must traverse suburban and metropolitan streets to collect waste. This heightens the risks to other people (pedestrians and those in other vehicles) and presents a challenge with respect to ensuring urban amenity (odour and noise pollution reduction) while ensuring an efficient waste collection. Waste transporters endeavour to use data to optimise the routes they take to collect waste from different locations.

Industry feedback is that streets and developments are often not constructed with waste collection requirements in mind, this is particularly true of MUDs and high-density

[152] GHD. (2011). *Resource Recovery Infrastructure Needs Analysis: Background Report*. Sourced from: https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/wasteregulation/ghd-resource-recovery-needs-analysis.pdf?la=en&hash=F2778D1998C5566F89B1A3C3FD376704FF812E18

developments, which are increasing their share of total dwellings in NSW (see sections 3.9.3 and 4.2.5). As a result, significant manual handling is required by drivers, increasing occupational health and safety risks. Smaller waste trucks (which can carry less waste) are often required to be used in areas where larger trucks will not fit, this increases truck movements on roads, inefficiency in collection and thus increased costs. In turn, this increases the need for more transfer stations, particularly in metropolitan areas. Traffic congestion, especially in metropolitan regions, presents additional challenges to transporting waste between locations.

It will be important for the 20-year waste strategy to incorporate transport and planning considerations, including opportunities to leverage the transportation of waste by rail. For example, Veolia's Woodlawn facility has leveraged the rail network to transport waste by rail from metropolitan Sydney (namely transfer stations in Clyde and Banksmeadow) to regional NSW (Tarago near Goulburn). Investigation of existing rail lines between Sydney and other regional areas might assist in identifying areas where new infrastructure could be located. Some of the challenges of transportation of waste by rail include:

- identifying rail sidings in metropolitan areas appropriate for transfer station infrastructure;
- congestion of rail lines; and
- the economics of freeing up space for waste, versus the economic importance of other higher value commodities (e.g. coal).

Other transportation challenges include congestion on roads caused by trucks and optimising waste collection routes. Some stakeholders referenced the fact that it is sometimes more appropriate from a logistics perspective to collect MSW waste from areas that cross over LGA boundaries because it is more efficient. However, contracting is currently undertaken on a LGA basis. Consideration should be given to including ongoing obligations for contractors to optimise waste collection and transportation services during the term of contracts including through the use of subcontract arrangements (even where this crosses LGA boundaries).

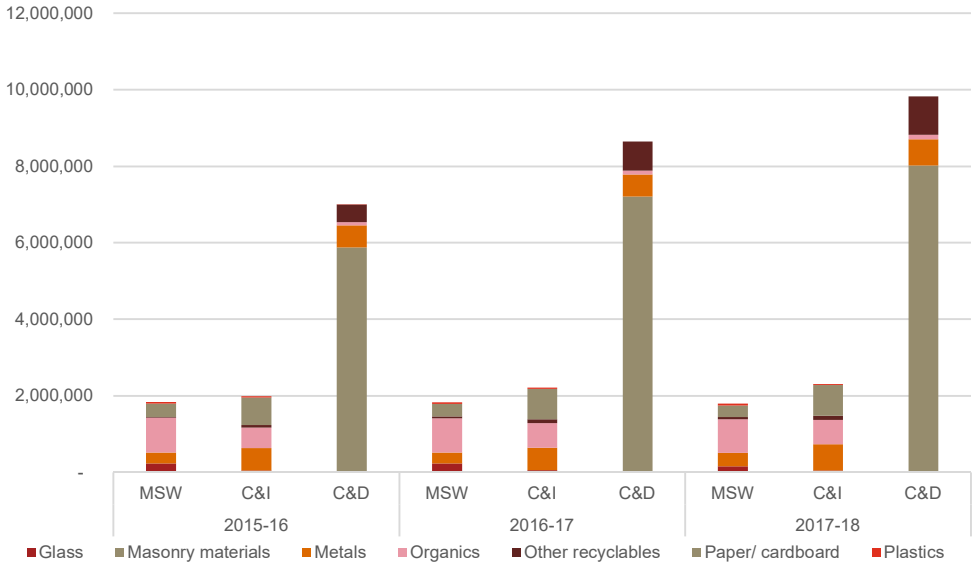
It would be appropriate to liaise with Transport NSW to identify traffic 'hot spots' that might require bespoke solutions.

8 Resource recovery

This section addresses various options for resource recovery, including material recovery for re-use and recycling, alternative waste treatment and energy from waste, which occur before residual waste is ultimately disposed.

The figure below illustrates the volume of recycled waste (tonnes) in NSW by material type and stream from 2015 to 2018. Masonry materials is the largest recycled material group.

Figure 10: Waste recycled by stream and resource type (tonnes)[153]



Source: EPA waste generation, disposal and recycling data

8.1 Material recovery

There are currently over 30 material recovery facilities (MRFs) operating in NSW. The majority are located in metropolitan locations, with the remainder located in regional areas. MRFs do not process putrescible waste.

Larger facilities tend to have technological capability to use a greater level of automation in the waste sorting process in comparison to smaller facilities. Regional facilities tend to be smaller in capacity (often less than 10,000 tonnes per annum), and more reliant on manual sorting processes. This likely impacts on the efficiency and effectiveness of waste recovery rates and the level of contamination in recovered materials.

Differences also exist in the range of materials recovered by MRFs:

- Some MRFs are currently limited to recovering mixed plastics only, while others can sort plastics into more refined and specialised plastics;[154]

[153] See section 6.10 for a breakdown of 'Other recyclables'.

[154] Improved sorting plastics will deliver downstream costs savings and increased yields, which will be beneficial to the cost competitiveness of domestic recycled plastic waste.

- Some MRFs can only recover commingled clear and coloured glass (which attracts a lower market price), while others are able to recover glass of different colours and sizes).

Differences in terms of size, location, technical sophistication and processing capabilities impacts on the efficiency of the waste industry in a number of ways:

- Some facilities forward certain waste materials to other MRFs for processing, incurring additional transportation charges;
- The transportation costs for certain MRFs to deliver recyclables to end markets makes it less economical to recycle particular waste streams under current market conditions;
- Some facilities do not have the capacity to produce recycled materials in sufficient quantities to secure arrangements with the end market and so they need to stockpile the materials or landfill them.

The following sections detail material recovery processes and challenges for specific waste materials. The availability of markets for recycled products is addressed in Section 9.

8.2 Paper and cardboard

8.2.1 Overview

Paper and cardboard are extensively recycled in Australia. Recycled white paper, such as shredded office paper is re-pulped and de-inked for use in premium recycled office and printing papers. Brown waste paper, such as cardboard is also sourced for use in recycled packaging papers and boards.[155]

It is estimated that NSW sourced recycled paper materials has made the greatest inroad in displacing the use of virgin materials. Analysis has estimated that recycled paper accounts for 50% of the paper (production) inputs used by NSW industry.[156] However, industry estimates tend to be higher.

8.2.2 Paper and cardboard recovery

Recycling quantities in NSW (Figure 11) have stayed relatively stable over FY 16-18, with an average rate of approximately 1.1 million tonnes per annum.[157]

The volume of paper and cardboard recycled includes:

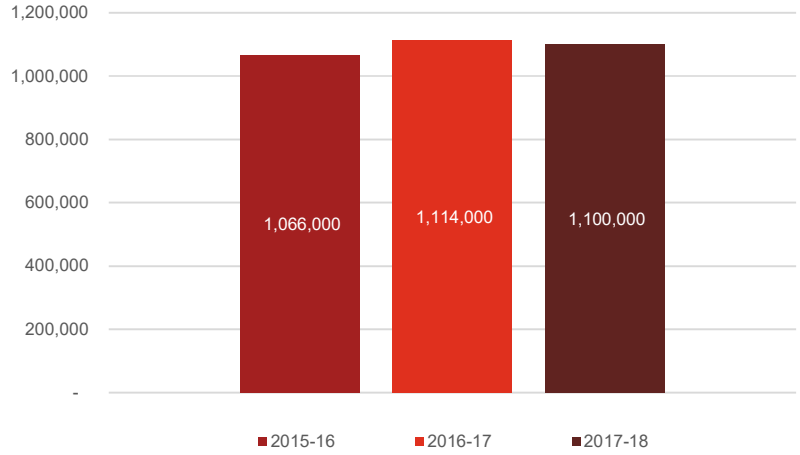
- Tonnes reported as being transported for recovery interstate and overseas by facilities that were not paper mills;
- Tonnes transported for recovery from paper mills;
- Tonnes transported for recovery under an RRO.

[155] Australian Paper. (2019). *Recycling*. Sourced from: https://www.australianpaper.com.au/environment-community/recycling/

[156] Internal unpublished report procured by the EPA (2018)

[157] Department of the Environment and Energy. (2016). *Australian National Waste Report 2016*. Sourced from: https://www.environment.gov.au/system/files/resources/d075c9bc-45b3-4ac0-a8f2-6494c7d1fa0d/files/national-waste-report-2016.pdf

Figure 11: Tonnes of paper and cardboard recycled in NSW (tonnes)



Source: EPA waste generation, disposal and recycling data

Figure 11 indicates that there has been no significant improvement in recycled volumes in recent years.

FY18 data indicated that 282,000 tonnes of paper was sourced from the NLA. The EPA have advised that the majority of NLA paper is likely from interstate sources. It is difficult to estimate the quantity of imported waste volumes and its impact on recovery rates.

Table 23 provides a breakdown of paper and cardboard recycled for FY18. Amounts recorded as recycled for paper and cardboard are the sum of tonnes reported as being received by paper mills and interstate and overseas export tonnes.

Table 23: FY18 Source and destination of paper and cardboard recycled in NSW (tonnes)

Facility type	Destination	Volume
Facility which is not a paper mill	Interstate	28,599
	Overseas	122,053
Paper mills	Intrastate	167,399
	Interstate	429,363
	Overseas	298,375

Source: NSW EPA

8.2.3 Barriers to recycling

There are physical and process limitations to paper recycling. Paper production requires the infusions of new virgin fibres because recycled fibres fray and shorten from repeated use. Contamination in paper recyclate is also an issue, with glass and plastic contamination particularly problematic.

Plastic contamination is resulting in approximately 10-20% of baled paper waste received being sent to landfill as it is unable to be used in production.[158]

Stakeholders also indicated that the comingling of paper with glass can result in fine shards and glass sands entering the paper waste stream. The incidence of glass shards may make the

[158] Source: stakeholder consultations

waste paper unsuitable for recycling, whilst glass sands may have a detrimental effect on processing equipment (e.g. pumps) increasing maintenance costs.

Contamination in paper also includes soiling of paper with food, grease, chemicals, or other noxious compounds, or the inclusion of inappropriate material for the intended paper grade. Food is a frequent contaminant in the dry recyclables bin.

8.3 Plastics

8.3.1 Overview

More than half of NSW's scrap plastics is processed overseas. In 2017-18, approximately 28% of recycled plastics was sent to Malaysia. Recent changes in China's waste quality requirements have resulted in a virtual ending of sales of unprocessed scrap plastics to Chinese based buyers across the second half of 2017 and across 2018. This has shifted the quantity and export destinations for scrap plastics out of Australia and NSW.[159]

According to the 2017-18 Australian Plastics Survey (the "Survey"), there were 17 processors identified as operating in NSW in the period. Total plastics consumption in NSW in the 2017–18 period was estimated by the Survey at 1.09Mt, with total plastics recovery of 86.1kt or 7.9 per cent. Consumption in 2017-18 was up significantly from 2016–17 (0.95Mt), due to jumps in both virgin resin imports and finished and semi-finished goods imports. The 2017-18 recovery rate (7.9%) was down from 2016-17 (9%).[160]

According to the results of the Survey, plastics recovery from municipal and C&I packaging sources dominated overall recycling in the 2017-18 period, making up 56% and 15% of the total weight recovered respectively. Recovery from all non-packaging related application areas makes up only 29% of total recovery.

Domestic demand generally remains strong for most processed scrap polymers, with good demand growth in the building sector.[161] Australia has a growing industry making use of recycled plastics. Uses include, but are not limited to, construction and infrastructure, furniture, sheeting and garden products.[162] However, challenges exist within certain plastic packaging materials and the supply of reprocessed materials far outstrips domestic demand in NSW.

8.3.2 Plastics recovery

Total plastics estimated to have been recovered in FY18 was 86.1kt (7.9% recovery rate), a small increase over FY17 (85.2kt - 9% recovery rate) and 94.6kt in FY16 (10.1% recovery rate).[163]

Local reprocessing held fairly steady from 2016–17, with approximately one third of overall NSW plastic recyclate processed within the State. However, the overall recycling rate of 7.9 per cent of plastic waste is low and demonstrates the need for improved plastics collection, sorting and reprocessing in NSW.[164]

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[159] Envisage Works and Sustainable Resource Use (2018). *2017–18 Australian Plastics Recycling Survey*. NSW EPA.

[160] Note that the 'recovery rate' used in the Survey is an approximation calculated by dividing plastics recovery for recycling in any given year, by consumption in that year.
Envisage Works and Sustainable Resource Use. *2017–18 Australian Plastics Recycling Survey*. NSW EPA.

[161] Envisage Works and Sustainable Resource Use. *2017-18 Australian Plastics Recycling Survey*. NSW EPA.

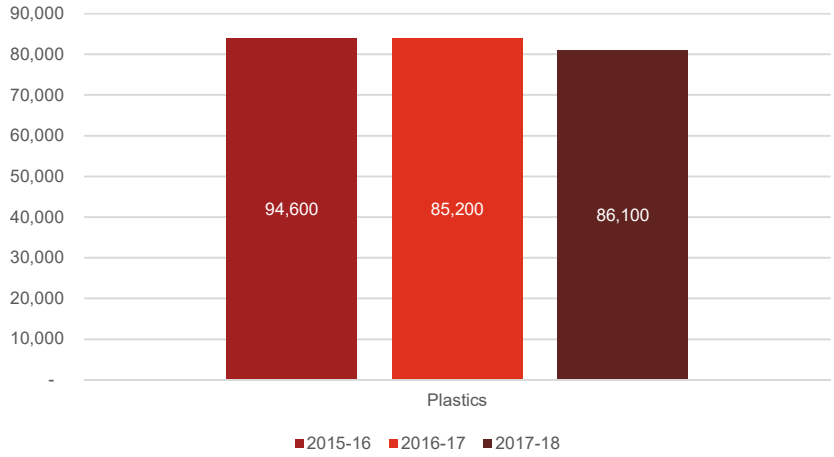
[162] Replas. (2019). *Products*. Sourced from: https://www.replas.com.au/about-replas/

[163] Envisage Works and Sustainable Resource Use. *2017–18 Australian Plastics Recycling Survey*. NSW EPA.

[164] Ibid

Plastic is a challenge to recycle, due to the variety of additives and blends used to manufacture the significant variety of products that are tailored to the specific industries and regulatory regimes they must comply with.

Figure 12: Volume of plastics recycled in NSW (tonnes)



Source: 2017–18 Australian Plastics Recycling Survey

56 per cent of recycled plastics were derived from the MSW waste stream and 37 per cent from C&I.

Of the 86.1kt recovered, 26.1kt tonnes (30%) was reprocessed locally in NSW, 56.8 kt (66%) appear to have been exported for reprocessing and the remaining 3.2kt was transported interstate for reprocessing.[165]

Analysis of tonnes export by country totalled 46.3kt.[166] Major export destinations were Malaysia (13kt); Thailand (10.4kt); Indonesia (6kt); and Vietnam (4.2kt).[167]

[165] Ibid

[166] Country totals do not equal to the estimated total exported (56,800 tonnes) due to quantities excluding worn clothing, the data for which was not available at the time of reporting.

[167] Envisage Works and Sustainable Resource Use. *2017–18 Australian Plastics Recycling Survey*. NSW EPA.

Table 24: NSW scrap plastics destination countries in 2017-18

Destination country	Export quantity (tonnes)
Malaysia	13,000
Thailand	10,400
Indonesia	6,000
Hong Kong (SAR of China)	5,800
Vietnam	4,200
China	2,500
Taiwan	1,600
Republic of Korea	1,300
Singapore	400
All other countries	1,000
Total	**46,300**

Source: Envisage Works and DFAT (2018)

Stakeholder feedback indicated that following China Sword, plastics have been exported to Thailand, Malaysia, Vietnam and Indonesia. These markets have started to tighten, with Thailand, Malaysia and Vietnam imposing tighter restrictions; revoking import licenses or banning certain wastes. Indonesia has also been taking regular shipments, however, none of these arrangements are expected to be sustainable and a domestic solution to plastic waste is necessary. India has also recently announced a complete ban on plastic waste imports.

As a result of the tightening export market and a lack of a developed domestic market, industry feedback indicates that stockpiling of mixed plastic is occurring.

Stakeholder feedback indicated that not all plastic wastes being exported are being recycled. Plastics are primarily exported as mixed plastics. Anecdotally, it is thought that a significant portion of the mixed plastic once hand sorted is residual waste that is not being recycled and is either being burnt or disposed of in the environment in the overseas jurisdiction.

8.3.3 Stakeholder feedback

Feedback from stakeholder consultations indicated:

- c.80-85% of recovered plastics comprise PET, Polypropylene (PP) and High-Density Polyethylene (HDPE);
- there is a limited market, both domestically and overseas, for soft plastic (film, packaging and wraps);
- Australia's higher cost structures (labour, electricity and lower yields from feedstock) reduce the competitiveness of domestic recycled plastics vs imported materials. Larger scale plants and better feedstock (lower contamination to driver better yields) would improve competitiveness;
- the competitiveness of recycled product vs virgin pricing is linked in part to oil prices. The cost of recycled plastic packaging is above virgin materials. Guidance was sought on the price competitiveness of local recycled materials vs virgin materials, however, this information was not provided. Understanding the gap between the costs of virgin vs recycled materials will be necessary to ensure end markets develop and the circular economy operates efficiently;
- China is rationalising its waste industry, building supersites (colocation of related industries) to process waste materials including plastics to optimise scale benefits and leverage labour and energy advantages. This will increase the risk of domestically recycled plastic resins being less cost competitive than imported product.

- existing plastics waste feedstock has significant contamination rates, with an average of only 50-70% yields being achieved, which further hurts the cost of production (note: product from South Australia has much less contamination and delivers an 85% yield);
- some plastic materials (e.g. bottle tops) could be re-used domestically to manufacture other products, however, no end markets have been developed and so domestic recyclers are paying for the scrap to go overseas;
- manufacturers use less than 20% recycled materials in production. Industry has the capacity to use a much greater level of recycled materials;
- there is no positive obligation on manufacturers to use recycled materials. APCO's 30% recycled content target for packaging is considered by industry to be aspirational;
- some manufacturers are importing recycled materials from Asia;
- plastic processors are paying for unprocessed wastes to be exported;
- there is a need for a more effective stockpile solution while long term solutions are found (for example, using former mine sites to temporarily store plastics until they can be recycled); and
- issues exist in respect of the intersection between food and health safety standards and plastic generation (for example, the high use of single-use plastics in hospitals and food manufacturers is in part driven by regulatory requirements). The transition to a circular economy will need to consider the extent to which existing regulatory requirements impose requirements on industry that represent an impediment to greater recycling and reuse. Mitigating these issues may require the redesign of products; substitution of alternate materials as well as reviewing existing regulations.

Industry feedback indicated there is a need to control the nature and volume of waste being generated and positive obligations are required to support the development of domestic markets and the innovation that will follow.

A 2016 report prepared by the EPA estimated that "in NSW two billion plastic bags are consumed each year, with only 14% being recycled".[168] Recent plastic bag bans by the major supermarket chains will reduced a significant amount of high density polyethylene (HDPE) single use plastic in the environment but in the absence of regulation, a significant number of other retailers continue to provide single use shopping bags. Stakeholder feedback indicated the need to move to a stronger policy position to reduce use and ensure materials used are fully recyclable (the Benchmarking Review indicated policy approaches range from complete bans, through to the imposition of taxes or the development of product standards to ensure multiple use and recyclability).

Avoidance measures should play an important role in the 20-year waste strategy. While plastic can be collected for recycling, some plastics are inherently unrecyclable, whilst there remains limited markets for some of the different types of recycled plastic. Some typical uses of recycled plastic are set out in the table below:

[168] NSW EPA. (2019). Sourced from: *Plastic shopping bags: Options paper*, https://www.epa.nsw.gov.au/~/media/EPA/Corporate%20Site/resources/waste/160143-plastic-shopping-bags-options.ashx

Table 25: Typical uses of recycled plastics in Australia

Polymer	Major uses of recycled polymer	Minor uses of recycled polymer
PET	Very high rates of recycling can be achieved with clean waste streams[169] e.g. beverage bottles and other takeaway containers	Timber substitutes, geo-textiles, pallets and fence posts, synthetic fibres and textiles
HDPE	Primarily used in milk and juice bottles and is often recycled into 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	Cannot easily be recycled. Can be used in 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
LDPE/LLDPE	Commonly used in grocery bags, bin liners, bread bags and other film (incl. builders' and agricultural film, concrete lining, freight packaging,), agricultural piping Not easily recycled.	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	Used in microwave meal trays, ketchup bottles, yogurt containers, medicine bottles. Can be difficult to recycle as few recycling centres can process these products. Recycled uses: crates boxes and plan 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	Used in foam trays as well as coffee cups and takeout boxes. Few recycling centres can process these products. Recycled uses: bar chairs and industrial spools	Office accessories, coat hangers, glasses, building components, industrial packing trays, wire spools and a range of extrusion products
EPS	Waffle pods for under slab construction of buildings	Synthetic timber applications (including photo frames, decorative architraves, fence posts), EPS/XPS (extruded polystyrene) insulation sheeting, and lightweight concrete
Acrylonitrile butadiene styrene (ABS)/ Styrene-acrylonitrile resin (SAN)	Injection moulded products	Automotive components, laminate edging, sheet extrusion, coffin handles, drainage covers, auto parts and a range of injection moulded products
Polyurethane (PU)	Carpet underlay	Mattresses, furniture, sealants, synthetic textiles (e.g.; imitation leather)

[169] High quality (low contamination rates) HDPE is now being produced from the NSW Container Deposit Scheme

Polymer	Major uses of recycled polymer	Minor uses of recycled polymer
Nylon	Injection moulded products, textiles	Furniture fittings, textiles, 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

Source: Envisage Works and Sustainable Resource Use (2017) Australian Plastics Recycling Survey National Report.

With export markets closing their doors to plastic recyclate new markets need to be found domestically and offshore. At present there is not a domestic solution for all types of plastic waste. A domestic recycler gave the example of plastic bottle lids and labels: both are recyclable – caps could be used as milk bottle crates and labels could be repurposed for underground manhole covers – but there is currently no commitment from anyone domestically to take them, so they are given at no cost to offshore processors.

The lack of markets internationally and domestically is also causing other issues. An oversupply of recyclate is starting to be observed by some local reprocessors. In February 2019, two facilities operated by SKM in Victoria were ordered by the Victorian EPA to stop accepting recyclate due to risk of fires in the stockpiles on site. Half of Victoria's recyclate is sent to SKM's three facilities, so the regulatory action was expected to cause significant challenges to the processing of recyclate.[170] Some Victorian Councils have subsequently admitted to having to send their recyclate to landfill as a temporary solution.

The Australian Packaging Covenant (see above Section 2.2.4) targets plastic waste avoidance with targets set to be in line with the Ellen MacArthur Foundation's New Plastics Economy Initiative[171], a project, with the following key visions:

- elimination of problematic or unnecessary plastic packaging through redesign, innovation, and new delivery models;
- application of reuse models to reduce the need for single-use packaging;
- ensuring all plastic packaging is 100% reusable, recyclable, or compostable and is in fact reused, recycled or composted in practice;
- decoupling the use of plastic from the consumption of finite resources;
- ensuring plastic packaging is free of hazardous chemicals, and the health, safety, and rights of all people involved are respected.

The 20-year waste strategy should understand the volume of different plastics currently being generated by the market and the capacity of these materials to be recycled. This understanding will provide a base for developing better informed policies to influence a shift away from the use of materials with a lower likelihood of reuse or recycling. Such information could be sought through a revised packaging covenant.

[170] Schelle, C. (2019). *Waste ban on fire-prone dumps could see recycling sent to landfill*. Sourced from: https://www.theage.com.au/national/victoria/waste-ban-on-fire-prone-dumps-could-see-recycling-sent-to-landfill-20190215-p50y5z.html

[171] Ellen Macarthur Foundation. (2019). *New Plastics Economy*. Sourced from: https://www.ellenmacarthurfoundation.org/our-work/activities/new-plastics-economy

8.3.4 Barriers to recycling

Research and stakeholder consultations have identified the following impediments to higher use of recycled plastic:

- in the MSW stream, householders need further guidance on what materials may be recycled. Plastic waste streams contain a significant level of contaminants, contributing to low yields in processing and high levels of mixed plastic waste that is not processed;
- plastic sorting plants using modern technology are required to improve sorting by plastics grade and colour. Some existing facilities are not able to distinguish between different plastic types;
- the domestic recyclate reprocessing capacity is small and would require an investment in new capacity;
- coloured PET (excluding light blue), used polystyrene (PS) packaging and PVC materials are not currently recycled as the cost of recycling is comparatively higher and there is no viable end market;
- there is no positive obligation on industry to use recycled materials – aspirational targets set by industry may not be effective or achieve the desired change in the timeframes required;
- the lack of data on the plastics industry inhibits investment and decision making;
- inclusion of mixed waste export volumes distorts the actual diversion and recycling rates being achieved;
- the lack of cost competitiveness of domestic recycled material and lack of domestic volumes has resulted in domestic manufacturers importing recycled materials from south east Asia;
- the primary concern for manufacturers in using recycled materials is the impact on the cost of production; surety of ongoing supply of the recycled materials and their suitability for use in production. Growing pressure through social media is expected to start influencing manufacturers' positions with respect to utilising recycled materials;
- many MRFs are using older and less efficient technology. Investment in modern or emerging technology (e.g. optical sorters; robotics) will improve processing yields, reduce contamination and increase recycling volumes (subject to there being an end market). Note, however, that a shift to source separation will reduce the need for significant investments in waste sorting and separation capability and reduce the risk potentially misaligned investment (see learnings from Scotland – Volume III, the Benchmarking Review);
- certain plastic products currently do not have alternate uses, whilst other products can be processed into lower value products such as strapping, however, there is a shift towards more organic based materials for these lower value products. Not all plastic wastes will have an end market and consideration may be given to phasing out such single use materials;
- the plastic packing industry needs to work with the recyclers to address issues with respect to the types of adhesives, coatings, inks and labels that are being used that drive high processing cost and contamination levels.

Government led action – European Union[1]

European Commissions Circular Economy Package requires 55% of all plastic packaging waste to be prepared for reuse or recycling by 2015.

European parliament has implemented a wide-ranging ban on single use plastics (e.g. straws; swabs; plates and cutlery), with the UK to adopt similar measures.

Government led action – United Kingdom Single-use Plastics Policy

- *single-use plastics will be removed from the government estate.*
- *A 5p plastic bag charge has been imposed on small retailers (charge has seen a successful 86% reduction in England since its introduction in 2015);[2]*
- *a tax on plastic packaging to be introduced (not due to come into force until April 2022.). Food and drink companies will be taxed on plastic packaging that does not include at least 30% recycled content;[3]*
- *established a £20 million Plastic Research and Innovation fund;*
- *the UK Government considered implementing a charge on disposable coffee cups to discourage their use (poly-coated paper cups are technically recyclable, but few UK facilities are capable of doing so).*

[1]The European Commission. (2019). Circular Economy: implementation of the Circular Economy Action Plan. Sourced from: https://ec.europa.eu/environment/circular-economy/

[2]Gov.UK. (2018). Plastic bag sales in 'big seven' supermarkets down 86% since 5p charge. Sourced from: https://www.gov.uk/government/news/plastic-bag-sales-in-big-seven-supermarkets-down-86-since-5p-charge

[3]Parliament.UK. (2019). Plastic food and drink packaging. Sourced from: https://publications.parliament.uk/pa/cm201719/cmselect/cmenvfru/2080/208006.htm

Gains being achieved in the UK and Europe are the product of manufacturers, retailers and recyclers coming together to develop and implement strategies supported by clear policy direction and targets.

Germany at a glance - Plastics

The push towards a more sustainable waste management system in Germany, with higher recycling rates, has been driven by a shortage of landfill capacity and the dual of objectives of recovering and preserving important resources for future usage and the protection of the environment. In order to meet these key objectives, successive German Governments since the 1990s have been focused on developing policies which enable a circular economy approach of waste and resource management.[1] The key driver of Germany's move towards a circular economy and increased levels of resource recovery has come through legislation and policy, some of the core elements of which are set out in the Circular Economy Act (KrWG), which entered into force on 1 June 2012. The Act outlines the legal basis and fundamental principles of the circular economy, beginning with the legal definition of waste, in particular, core principles including the 'polluter-pays' principle, the five-tier waste hierarchy, and the principle of shared public and private responsibility for waste management.[2]

While Germany is one of Europe's highest per-capita producers of waste, it also demonstrates relatively high recycling rates of 67 per cent for household waste, around 70 per cent for production and commercial waste, and almost 90 per cent for construction and demolition waste.[3] Despite these high rates, the German government has enacted new legislation in order to reduce overall quantities of packaging waste. As of 1 January 2019, the German Packaging Law (VerpackG) has replaced the German Packaging Ordinance, and involves mandatory registration in the Central Registry Packaging Regulation, participation in take-back systems and immediate reporting to the Central Registry of the data transmitted to the take-back system.[4] VerpackG applies to all participants (including online retailers and distributors who put packaging into commercial circulation on the German market for the first time), who bring packaged products, including padding material, onto the German market and which end up as waste with consumers.[5]

The Law sets targets for increased recycling rates, and new standards which define the extent that different types of packaging are actually suitable for recycling. In addition, provisions ensure that all businesses using packaging also pay for their collection and recycling. The system is one marked by market transparency, with the Central Packaging Registry, LUCID, enabling the public to check the extent to which manufacturers fulfil their product responsibility.[6]

Other than public accountability, the new Packaging Laws are backed by strong penalties for companies what are not compliant; fines of up to €200,000 and prohibition from selling goods on the German market may apply in some cases.[7]

[1] *Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. (2018). Waste Management in Germany. Sourced from:* https://www.bmu.de/fileadmin/Daten_BMU/Pools/Broschueren/abfallwirtschaft_2018_en_bf.pdf

[2] *Ibid*

[3] *Ibid*

[4] *Take back systems in Germany involve a number of providers who collect packaging materials from manufacturers who pay a license fee. License fee payers can then add logos to their package labelling to indicate that this package should be placed into the separate yellow bags or bins that will then be collected and emptied by provider-operated waste collection vehicles and sorted (and where possible recycled) in provider facilities.*

[5] *Packaging Europe. (2018). Getting Ready for the German Packaging Law. Sourced from:* https://packagingeurope.com/getting-ready-for-the-german-packaging-law/

[6] *Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. (2019). The Packaging Act has entered into force: Less packaging – more transparency and recycling. Sourced from:* https://www.bmu.de/en/pressrelease/das-verpackungsgesetz-ist-in-kraft-getreten-weniger-verpackungen-mehr-transparenz-und-recycling/

[7] *Packaging Europe. (2018). Getting Ready for the German Packaging Law. Sourced from: https://packagingeurope.com/getting-ready-for-the-german-packaging-law/*

8.3.5 Considerations for the 20-year waste strategy

In the 20-year waste strategy consideration should be given to methods to address improving the current rate of plastic recycling. Options to consider as part of consultations include:

- options to reduce the volume of plastics in packaging materials (which could be supported by R&D funding grants);
- R&D grant funding to support new product development or existing product redesign for recycled plastic materials;
- grant funding or a subsidised loan program for investment in new plastic waste infrastructure or technology upgrades and expanded processing and production capacity;
- the phasing out, and eventually the elimination of problem materials, such as a single use plastic;
- methods for reducing the use of plastics that are difficult to recycle, such as complex multi-material plastics, whether through the redesign of the plastic product or through substitution of alternate materials;
- stimulating the market for recycled products through measures such as: mandatory government procurement of recycled plastic (including in road works and other government infrastructure); minimum recycled content requirements (legislated or otherwise) in packaging materials or other defined products;
- working with the Commonwealth to modify the Australian Packaging Covenant to include mandatory funding arrangements to contribute to the recovery and recycling of plastic packaging wastes;
- incentive schemes for greater utilisation of recycled materials[172];
- social-media campaigns and education programs to encourage the purchasing of products that utilise recycled packaging; can be reused or are the subject of extended producer responsibility schemes;
- setting appropriate targets, guided by the Australian Packaging Covenant targets and Ellen MacArthur Foundation's New Plastics Economy Initiative; and
- different approaches for metropolitan areas to regional areas (e.g. micro-scale processing plants may have a role in the regions).

8.4 Glass

8.4.1 Overview

There are two main uses for recycled glass: glass cullet (used in bottle-making) and crushed glass (used as a substitute for sand).

Bottle-making requires larger pieces of glass, known as cullet. Kerbside glass is increasingly difficult to both recover and reuse, mainly as a result of increased compaction and mechanical sorting of co-mingled recycling, along with glass bottles becoming lighter and less durable. This has meant that glass sent to, and recovered from, MRFs tends to be broken into smaller pieces (which are more difficult to process) or are contaminated with other materials.[173]

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[172] Such a scheme may motivate retailers to insist on minimum recycled content and provide an opportunity to recover part of the cost of the Australian Packaging Covenant.

[173] Internal unpublished report procured by the EPA (2017)

With the introduction of the CDS, glass collected through the CDS offers a higher quality product relative to the MRFs. The market opportunities for MRF cullet may therefore decline.

Domestic glass bottle volumes are subject to increasing competition from plastics and imported products. This decline in demand led to the closure of Benedict Industries glass sand plant in Sydney and Owens-Illinois

closing two of its four glass bottle furnaces in Sydney, leading a number of MRFs to increase their glass sand production capacity, or to increase their stockpiling of glass.

Glass sand is produced by crushing glass into fines which are then used as a substitute for sand (for use in road base, pipe embedment and asphalt). Feedback suggests that potential end users of glass sand have concerns around the long-term effectiveness of the material, as well as concerns over the potential increased wear on capital equipment, compared to natural sand. Other impediments to the greater use of glass sand include concerns over the risk of asbestos in the product (which appears to stem from a single historical issue), issues with odours, leachate and other workplace health and safety concerns.[174]

Whilst there is a limited end market for recycled glass products (both bottles and fines/sand), the waste levy continues to ensure that it is more cost-effective for councils and MRFs to recycle glass than to dispose of it in landfill. This points to the importance of taking steps to facilitate end markets for recycled glass products in future. This could include consideration of procurement targets for the use of glass sand in government contracts, both to increase its uptake and demonstrate the long-term effectiveness of the material. Additional steps would also need to be undertaken to address any concerns end users have over the suitability of the product for end use in road and other projects.

8.4.2 Glass recovery

In Australia, glass has a potentially high recovery rate given the comparatively higher cost of virgin material. There is nonetheless a demand and supply imbalance – there is a greater supply of recovered glass than there is demand for recycled glass. Part of this is due to the volume of glass containers that are imported into Australia. Domestic consumption of glass in manufacturing is less than the total volume of glass in the system.

The total tonnage of glass recycled comprises:

- Glass transported for recovery to an unspecified destination intrastate (FY18: 0.14 Mt);
- Glass transported for recovery interstate and overseas;
- Glass transported under a Resource Recovery Order;
- Commercial glass received at a glass processing facility.

Waste disposed from the glass processing facility is excluded from total recycled volumes.

Total tonnes of glass comprise: glass recovered from intrastate (including glass bottle manufacture and glass recovered under an RRO) and glass transported for recovery interstate and overseas.

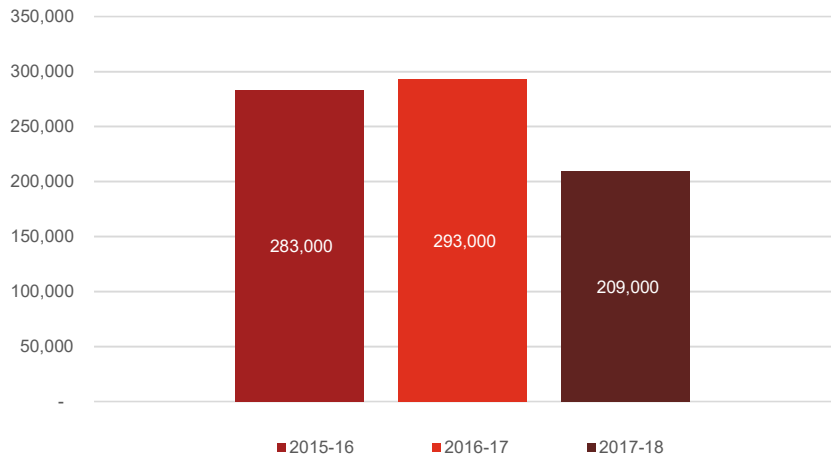
In NSW, a significant portion of recyclable glass is collected through the Container Deposit Scheme[175] and kerbside collections of MSW, and predominantly in the MLA. From FY16 to

[174] Internal unpublished report procured by the EPA (2017)

[175] The CDS commenced in December 2017

FY18, glass recycling in NSW was at an average of 260,000 tonnes per annum, with a high of 293,000 in FY17 and a low of 209,000 in FY18 (as illustrated in Figure 13 below).[176]

Figure 13: Tonnes of glass recycled in NSW (tonnes)



Source: EPA waste generation, disposal and recycling data

The EPA has indicated that there is some uncertainty over the accuracy of the reported tonnes in FY16-17. The EPA was required to estimate recycled tonnes for a processor that commenced operation in FY17. The EPA believes the tonnage may have been over-estimated, overstating glass recycling in FY16 and FY17.

Approximately 64 per cent of glass waste was diverted from landfill in 2016-17 (MSW: 72 per cent; C&I: 45 per cent). c.33%% of recovered glass waste was recycled into new glass products and c.46% was crushed into glass sand, with 8% stockpiled and 9% processed interstate and the balance exported (c.3%).[177]

As long as the landfill levy is in place, it will be cheaper to recover glass than to send it to landfill. This is leading to an increase in glass stockpiles. There is a need to focus on facilitating the market for crushed glass, rather than seeking to remove glass from the recycling system altogether. Glass as a substitute for sand could potentially utilise all recycled glass, however, existing impediments to the utilisation of glass sand will need to be addressed.[178]

8.4.3 Barriers to recycling

Research and stakeholder consultations have identified the following impediments to higher use of recycled glass:

- poor quality of kerbside collected glass due to contamination[179];
- the movement of materials across state borders, including the distribution of materials across metropolitan, regional and remote locations and recognition that the economics may prevent a state-wide uniform approach. High transport costs limit the economic

[176] EPA waste generation, disposal and recycling data

[177] Internal unpublished report procured by the EPA (2017)

[178] Internal unpublished report procured by the EPA (2017)

[179] New Zealand has a separate kerbside collection for glass only, leading to lower levels of contaminants. As a result glass containers manufactured in New Zealand contain 55-60% of recycled materials. At present Australian glass containers contain c. 35% recycled materials.

viability of sorting and transporting glass in many rural areas. In these areas landfilling glass locally is the preferred option;

- the lack of enforcement of product standards for the utilisation of glass sand as a substitute in road base or other commercial application;
- production limits on the use of recycled materials to 50% in clear glass and 70% in brown glass (i.e. to ensure the integrity of the end product);
- local and state government procurement policies do not support the procurement of glass sand or enhance the reputation of the product;
- reluctance and lack of a positive obligation to use crushed glass in road base and other commercial applications due to perceived inferior performance of glass sand, and potential contamination and asbestos concerns; and
- the potential inability of industry to deliver large volumes of glass sand based on project timetables and current stockpiling limits.

8.4.4 Considerations for 20-year waste strategy

Glass presents a good opportunity for domestic circular economy solutions given that it is uneconomic to transport it long distances, and the demand for end products, such as glass sand, is potentially high. It would be prudent for the 20-year waste strategy to focus on methods to improve the demand for recycled glass (including government procurement) and addressing the barriers to recycling.

Successfully addressing the barriers to recycling will likely result in the demand for glass exceeding the current NSW production capacity (existing capacity is less than when Benedicts was in operation).[180]

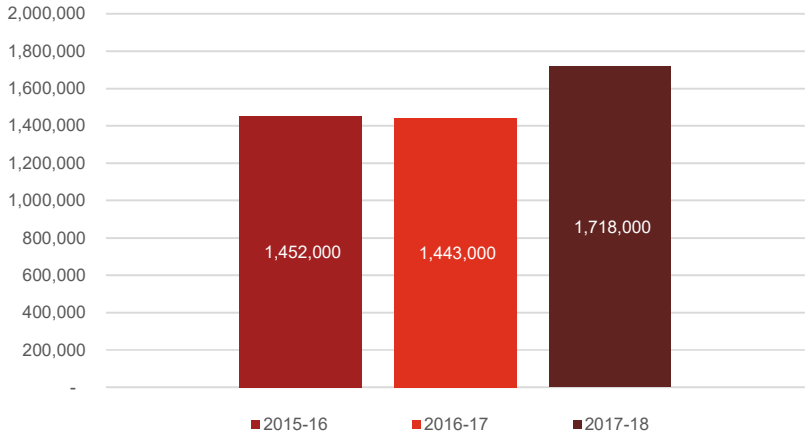
8.5 Metals

8.5.1 Metal recovery

Metal recycling, particularly steel, is well-established in NSW. However, recycling of non-ferrous metals is not. Recent unstable global prices have put financial pressure on the scrap metal industry which depends on export markets. Some toxic metals, such as cadmium and cobalt and rare and precious metals such as gold and palladium are landfilled in composite material products such as electronic waste.

[180] Internal unpublished report procured by the EPA (2017)

Figure 14: Tonnage of metals recycled in NSW (tonnes)



Source: EPA waste generation, disposal and recycling data

In NSW in 2017-18, approximately 1.7 million tonnes of metal was recycled in NSW, the majority of which was generated by C&I and C&D (both 687,000 tonnes) and within the MLA (approximately 1 million tonnes).

Scrap metal recyclers and processors are generally unable to identify the waste streams associated with metal waste volumes and so the EPA has allocated total metals recycled on the basis of 20% to MSW and 40% to both C&D and C&I.

Not all scrap metal processors are required to report waste tonnages; the EPA relies primarily on tonnages reported by the three major NSW scrap metal re-processors and ABS export volumes. Recovered metals comprises:

- Ferrous Metals
  - Waste transported interstate or overseas (excluding key recycler volumes captured below);
  - Waste transported for lawful recovery intrastate to an unspecified destination, interstate or overseas by key recyclers;
  - Differences between export tonnes report by the ABS and reported as exported in the WARRP;
  - Differences between tonnes reported to be received by scrap metal processors and volume reported as being transported to the processors.
- Non-Ferrous Metals
  - Waste transported for recovery intrastate to an unspecified destination intrastate;
  - Waste transported for recovery interstate and overseas;
  - Export tonnages (including differences between export tonnes reported by the ABS and reported as exported in the WARRP).

In terms of a circular economy flow, Australia's metal extraction capacity is much larger than local demand for metal bearing products and product manufacturing capabilities.[181] There is a lack of a market for secondary products, as well as complex supply chains and a paucity of data.[182]

Shifting towards a circular economy for metals will require a significant change to business models towards more circular material flows, across product design, disruptive technologies for manufacturing or material processing, and new consumption models.[183]

8.5.2 Considerations for 20-year waste strategy

Resource recovery practices are well established for the metals industry, however, the 20-year waste strategy may wish to consider:

- improvements could be made in respect of metals that remain in the residual MSW and C&I wastes;
- the future of the domestic metals industry and investments in technology that might support moves towards a circular economy and reduce the residual wastes generated by current metals recycling processes. Such an initiative could be undertaken in collaboration with industry; and
- new products and materials entering the market (in volume): strategies for their future recovery and end markets for the recovered materials.

8.6 Masonry materials

8.6.1 Overview

Concrete reprocessing involves the use of relatively uncomplicated and well-established crushing techniques. Where high landfill fees exist, there is a strong incentive to avoid weight-based disposal charges by recovering the heavy components of the C&D waste stream. Diversion also supports significant end markets for the recycled products in some metropolitan locations, where reprocessing sites can produce products that are commercially competitive with quarry products.[184]

There are good markets for recycled concrete aggregate for use as road base, aggregates and hardstand areas. The cement content in recycled concrete aggregate means that the aggregate 'packs down' well and forms a harder and more stable hardstand than pure virgin aggregate. There are also good markets for recycled bricks including for reuse in construction (when renovating older buildings to match the existing bricks) and when crushed into aggregate.[185]

The EPA has issued several resource recovery orders and exemptions to enable the lawful reuse of these recycled materials. Recycled materials may be used extensively in local roads,

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[181] Wealth from Waste Cluster (2017). *Australian opportunities in a circular economy for metals (2017)* (http://wealthfromwaste.net/wp-content/uploads/2017/11/Wealth_From_Waste_Report_WEB.pdf)

[182] Metal recovery is sourced from a number of data sources as disclosed in section 6.5, however, there is a lack of information on where the recycled materials ends up. Not all scrap metal facilities that exceed licensing thresholds currently comply with reporting obligations.

[183] Wealth from Waste Cluster. (2017). *Australian opportunities in a circular economy for metals*. Sourced from: http://wealthfromwaste.net/wp-content/uploads/2017/11/Wealth_From_Waste_Report_WEB.pdf

[184] The Department of Sustainability, Environment, Water, Population and Communities. (2012). *Construction and demolition waste guide-recycling and re-use across the supply chain*. Prepared by Edge Environment Pty Ltd for the Department. Sourced from: https://www.environment.gov.au/system/files/resources/b0ac5ce4-4253-4d2b-b001-0becf84b52b8/files/case-studies.pdf

[185] Department of the Environment and Energy. (2018). *Australian National Waste Report 2018*. Sourced from: http://www.environment.gov.au/system/files/resources/7381c1de-31d0-429b-912c-91a6dbc83af7/files/national-waste-report-2018.pdf

pavements and civil works. The EPA has set out a variety of uses for recycled aggregates, including:

- road base material suitable for a range of traffic conditions;
- select fill for improving sub-grade performance and also for raising site levels;
- bedding material suitable for use as a base layer for pavers; and
- drainage medium for backfilling drainage structures.[186]

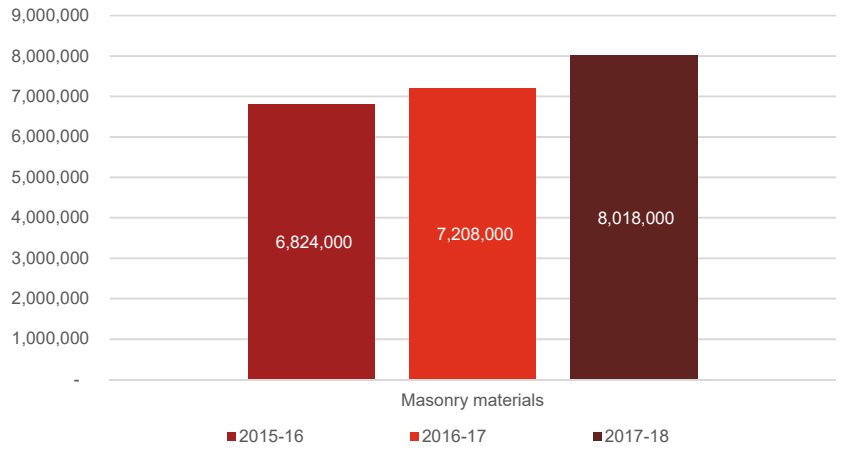
8.6.2 Masonry recovery

Total masonry materials recovered comprises:

- masonry materials transported to unspecified intrastate destinations for recovery;
- masonry materials transported interstate for recovery;
- materials transported under a resource recovery order;
- VENM received at major composting facilities; and
- an estimate of waste recycled at licenses facilities that did not report into WARRP.

VENM received at major composting facilities has been included in masonry materials and subtracted from the organics dataset. Masonry recycled has increased year-by-year, with approximately 6.8 Mt recycled in 2015-16 and 8 Mt in 2017-18. The vast majority of masonry materials are generated in the C&D stream.

Figure 15: Volume of masonry materials recycled in NSW (tonnes)



Source: EPA waste generation, disposal and recycling data

In view of the cost associated with transporting heavy C&D waste like masonry, processing facilities must be located in close proximity to both source and end markets. This makes it challenging to set up an independent C&D facility in most regional areas. While stakeholders expressed the view that it is possible to manage certain areas through a campaign-style methodology, they note that this would require stockpiling to make the process economically viable and the required stockpiling would likely exceed the timeframe currently permitted by regulations.

[186] NSW EPA. (2019). *Using recycled materials for pavements, earthworks and drainage*. Sourced from: https://www.epa.nsw.gov.au/your-environment/recycling-and-reuse/business-government-recycling/what-can-business-recycle/using-recycled-materials

While it is possible that recycled glass could disrupt the masonry market by being used as a natural sand replacement, the view of stakeholders was that there is still a number of hurdles to surmount with the EPA and the Roads and Maritime Service in respect of quality, appropriate standards and stockpiling limitations.

8.7 Timber

Timber, and particularly treated timber, poses a significant challenge for waste management and resource recovery, especially within the C&I waste stream.

Table 26: Composition of timber in single material C&I loads (2013-14)

Material	Tonnes per year	% of C&I wood waste
Wood – treated and/or painted	46,660	82.3
Wood – treated, pallets	4,740	8.5
Wood – untreated	2,990	5.4
Wood – untreated, pallets	2,090	3.8
Total	**55,460**	**100**

Source: EPA (2014) Disposal-based Audit

Markets exist clean and chipped untreated timber. However, it currently difficult to recycle treated or engineered timber due to the presence of preservatives and toxic chemicals. There is currently no good solution or diversion strategy for the treatment or recycling of treated wood. The 20 years strategy may wish to devote research funding to the development of a solution to address the current impediment.

8.8 e-Waste

8.8.1 Overview

In NSW in 2016, approximately 55% of e-waste was sent directly to landfill without any processing, with a further 9% disposed by e-waste and metal recyclers as secondary waste. The remaining 36% was recovered for recycling. Table 27 lists the major e-waste recyclers operating in NSW.[187]

Table 27: e-waste recyclers operating in NSW

Organisation	e-waste recycled
Private sector	
SIMS e-recycling	NTCRS equipment
MR E-Cycle Solutions	Most types
TesAmm	Most types
ToxFree (formerly PGM Refiners)	All types, including lighting and batteries
Enirgi Power Storage Recycling	Batteries
Reverse e-waste	NTCRS equipment
CMA Ecocycle	Lighting and batteries (mercury recovery)
Green Technology Recycling	Computer and IT equipment
Computersource Logistics	Computer and IT equipment
E-waste express	Computer and IT equipment

[187] Internal unpublished report procured by the EPA (2018)

Organisation	e-waste recycled
ACE Recycling Group	Computer and IT equipment
Buyequip	Computer and IT equipment
EWaste & Metal Recycling	Telecom equipment, also metals recycling
Ecycle Solutions	NTCRS computer and IT equipment
SRS Recycling	NTCRS equipment
Social enterprise	
Greenacres Wollongong	Computer and IT equipment
Endeavour Industries	NTCRS equipment
Kurrajong Recyclers	NTCRS equipment

Source: Internal unpublished report procured by the EPA (2018)

The National Television and Computer Recycling Scheme was established in 2011 to provide Australian households and small businesses with access to free industry-funded collection and recycling services for televisions and computers, including printers, computer parts and peripherals. Under the scheme, more than 1,800 collection services have been made available to the public and 230,000 tonnes of TV and computer e-waste have been collected and recycled. This has diverted hazardous materials away from landfill and enabled the reuse of valuable resources contained in e-waste, with more than 90% of materials recovered each year. The scheme is operated by federal government-approved administrators on behalf of industry.[188] Amendments to the National Television and Computer Recycling Scheme are currently being explored as part of the Commonwealth Product Stewardship Act review.

SIMS e-recycling, operate an advanced recycling plant in Villawood NSW, processing computers, printers and other e-Waste safely and responsibly whilst also extracting maximum materials for reuse (in some cases in excess of 99.8% by weight).[189]

8.8.2 Considerations for 20-year waste strategy

While most councils have established hard waste collection services; community recycling centres and special e-waste collection programs, a number of problem areas remain which lead to contamination in the MSW and C&I waste stream and potentially poses challenged for waste processing equipment. Many council collection services will also only accept NTCRS eligible items.

The 20-year waste strategy may wish to consider:

- improved education on the appropriate treatment of these wastes and the collection centres where wastes can be disposed will support a reduction in contamination rates and improved recovery and issues caused by contamination and inappropriate disposal;
- source separation of e-waste;
- options for e-waste repair and refurbishment, driving increase reuse including the implementation of an expanded NTCRS (see Key Finding 14);
- strategies focused on raising the profile (through education and social media) of the problem of e-waste; and the importance of its appropriate disposal;
- opportunities to expand existing e-waste collection and recycling services and product stewardship arrangements beyond those products currently within the scope of the

[188] Department of the Environment and Energy. (2019). *National Television and Computer Recycling Scheme*. Sourced from: http://www.environment.gov.au/protection/waste-resource-recovery/television-and-computer-recycling-scheme

[189] Internal unpublished report procured by the EPA (2018)

NTCRS. Singapore is similarly moving towards a producer responsibility approach to managing e-waste (see Volume III: Benchmarking Review);

- for new electronic and electrical products and materials entering the market (in volume): strategies for their future recovery and the development of end markets for the recovered materials.

E-waste requires specialised treatment and disposal services that often incur higher costs than treatment of other waste types. Continued growth in e-waste volumes and demands for higher recycling rates will place pressure on existing funding models and more sustainable arrangements may need to be considered across the full spectrum of e-waste materials.

8.9 Organics

8.9.1 Overview

Organics include biosolids or manures, compost or mulches, food or kitchen wastes, vegetation and garden waste, wood, trees or timber.

Organics processing facilities convert organic waste into specialist products including composts, mulches, garden soil and potting mixes, soil improvers and more.

There are 80 organic processing facilities in NSW, the majority (62) of which have an annual licensed capacity of 50,000 tonnes per annum. Research conducted for the EPA indicated that these facilities are at (or very near) their processing capacity (with current equipment). Changes to equipment to increase processing capacity would likely also necessitate a change to license limits.[190]

Table 28: Facilities by licensed processing capacity (2017)[191]

Licensed capacity (tonnes per annum)	Number of licensed facilities
5,000	15
50,000	62
220,000	2
Unknown	1
Total	**80**

Source: Internal unpublished report procured by the EPA

The volume of organics recovered is relatively low, with a large proportion of waste in landfills across Australia comprised of organics (see Key Finding 12).[192] Aside from the waste levy, there are no regulatory drivers encouraging the diversion of organics from landfill.

[190] Internal unpublished report procured by the EPA (2018)

[191] Internal unpublished report procured by the EPA (2018)

[192] There is some speculation as to the accurate number, with ~50% being the generally accepted figure, but audit data of specific areas showing significant ranges from 20-60%.

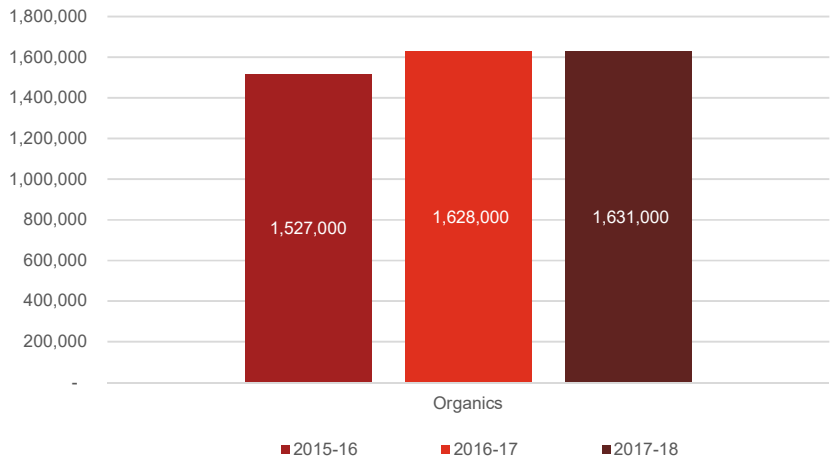
8.9.2 Organics recovery

Organic waste recycled in NSW in 2015-18 remained relatively stable year-by-year with an annual average of approximately 1.6 million tonnes (increasing from 1.53 million tonnes to 1.63 million tonnes from 2015-16 to 2017-17, or a growth rate of approximately 7 per cent over the period).[193] A 2018 report commissioned by the EPA indicated that the best estimate of total supply of organic material in 2015-16 in NSW is 1.78 million tonnes.[194]

Within the C&I stream, the wholesale and retail trade sectors are two of the principal contributors of food waste to landfill in NSW, generating approximately 236,000 tonnes of food waste each year. This represents around 6% of total food and organic waste per annum. Only 13% of wholesale and retail food waste is recycled, far lower than the average of 53% for food and organics across all streams in NSW.[195]

Research commissioned by the EPA in 2017–18 has indicated healthy demand and a high willingness to pay for quality recycled organic product. The report estimated an annual demand for 1.3 million tonnes of product, which can be met by the annual supply of 1.7 million tonnes of organic waste, even taking into account mass loss through the composting process.[196]

Figure 16: Volume of organics recycled in NSW (tonnes)



Source: EPA data

[193] EPA waste generation, disposal and recycling data

[194] Internal unpublished report procured by the EPA (2018)

[195] Lewis, H. Downes, J. Verghese, K. & Young, G. (2017). *Food waste opportunities within the food wholesale and retail sectors*. Prepared for the NSW EPA by the Institute for Sustainable Futures at the University of Technology Sydney. Sourced from: https://opus.lib.uts.edu.au/bitstream/10453/115674/1/Lewisetal2017EPA_Food_waste%20report_2017-08-23.pdf

[196] Internal unpublished report procured by the EPA (2018)

Organics presents significant opportunity for waste avoidance and reuse, increased recovery, rather than landfill application and for the application of circular economy principles. As highlighted in the National Food Waste Strategy, organic waste, and more specifically food waste, represents a huge proportion of waste generated:

> *"Globally, about one billion tonnes of food produced for human consumption is wasted each year. This wastage costs the global economy around US$940 billion, consumes nearly a quarter of all the water used in agriculture, and produces eight per cent of global greenhouse gas emissions."* [197]

For large generators of waste, such as supermarket groups, organic waste is a key focus of their sustainability and circular economy initiatives.[198]

8.9.3 Barriers to greater levels of avoidance, reuse and recycling

The key challenges that will need to be addressed to improve recovery rates include:

- succeeding in the education of households and businesses around food wastage and the options to reduce the quantities of waste that are produced and that go to landfill;
- challenges around food standards in respect of best before dates and transportation of food to charities for reuse;
- confirmation of policy objectives and requirements. As noted in Section 8.10.1, in October 2018, the EPA withdrew the mixed waste organics outputs exemption for AWT material (due to concerns over contamination and longer term environmental risks). Since then, organic outputs from mixed waste that might otherwise be applied to land have been landfilled; and
- significant organics remain in the residual MSW and C&I waste streams that are going to landfill. Waste collection and processing practices need to be reviewed to support a greater level of organics recovery (with minimal contamination – see the additional barriers noted in sections 4.2.8 and 4.4.6).

[197] Australian Government. (2017). *National Food Waste Strategy*. Department of the Environment and Energy. Sourced from: https://www.environment.gov.au/system/files/resources/4683826b-5d9f-4e65-9344-a900060915b1/files/national-food-waste-strategy.pdf

[198] See for example Woolworths Group 2018 Sustainability Report "Tomorrow Together" (https://www.woolworthsgroup.com.au/icms_docs/195398_2018-sustainability-report.pdf) at page 26 "Moving to a Circular Economy".

Reducing food waste – Scotland and the EU

Scotland[1]

The Scottish government has recently pledged to reduce all food waste by 33% by 2025. Including both avoidable and unavoidable food waste, this target focuses on prevention. The Waste (Scotland) Regulations were updated in 2016 requiring that all food businesses generating more than 5kg in non-rural areas recycle their waste. In addition, the number of anaerobic digestion plants is increasing across Scotland.

The Scottish government introduced the 'Good to Go' scheme, which tackles the 53,500 tonnes of food that is wasted by Scottish restaurants each year. Through the scheme, restaurants are required to provide diners with their leftovers as a matter of course. This challenges the culture around leftovers and saves food from the bin.

European Union[2]

The EU has established a target to halve per capita food waste at the retail and consumer level by 2030, and reduce food losses along the food production and supply chain. Kay actions undertaken included implementing a multi-stakeholder platform (EU Platform on Food Losses and Food Waste) involving both EU countries and businesses in the food chain in order to help define measures needed to achieve the food waste SDG, facilitate inter-sector co-operation, and share best practice and results achieved.

The EU Platform:

- *aids the identification and prioritisation of actions to be taken to prevent food losses and food waste;*
- *aims to identify opportunities for food waste prevention across the food production and consumption chain and facilitate inter-sector cooperation.*

The platform initially focussed on:

- *implementation and application of EU legislation related to waste, food and feed to ensure the highest value use of food resources (in line with a "food use hierarchy");*
- *facilitation of food redistribution;*
- *examining ways to improve the use of date marking by producers in the food chain and its understanding by consumers, in particular "best before" labelling.*
- *awareness, information and education campaigns;*
- *technological and social innovation;*
- *clarify EU legislation related to waste, food and feed and facilitate food donation and use of food no longer intended for human consumption in animal feed, without compromising food and feed safety*

Recommendations on food waste prevention initiatives are expected in mid-2019.

[1]*Scottish Government. (2010). Zero Waste Plan. Sourced from: https://www.gov.scot/binaries/content/documents/govscot/publications/publication/2010/06/scotlands-zero-waste-plan/documents/00458945-pdf/00458945-pdf/govscot%3Adocument*

[2]*The European Commission. (2019). EU Platform on Food Losses and Food Waste. Sourced from: https://ec.europa.eu/food/safety/food_waste/eu_actions/eu-platform_en*

8.9.4 Considerations for the 20-year waste strategy

The capturing and processing of organic materials represents a significant opportunity to reduce the volume of waste going to landfill. The 20-year waste strategy may consider options to address the barriers to a greater level of avoidance, reuse and recycling set out above, but also consider:

- options to support reductions in the volume of waste generated either through better planning and purchasing or through reuse (see Key Finding 7);

- future infrastructure requirements to process the higher levels of organic waste recovered (including the nature and size of facilities; their proximity to source feedstock; access to land and critical transport infrastructure) and the end markets for the product;
- technology solutions and education programs to reduce the level of contamination in organics waste streams;
- expansion of organics waste collection systems for households and businesses (recognising the potential need for differences in approach between metropolitan, regional and remote locations);
- opportunities to support greater use of recycled materials, including through local government use and access to householders for domestic use.

These options are considered further in Key Finding 12. Policies to address the collection and processing of organics have been implemented internationally. See discussion in relation to Scotland, Slovenia and San Francisco in Volume III: Benchmarking Review.

8.10 Recovery from mixed waste

This section refers to a range of activities where mixed solid waste that would have gone to landfill is processed into products such as compost, fuel or biogas, thereby increasing the recovery of resources. Technologies include:

- Mechanical Biological Treatment (MBT);
- Thermal energy from waste;
- Biological energy from waste.

8.10.1 Mechanical biological treatment

MBT facilities use mechanical and manual sorting processes to separate the organic materials, recoverable plastics and metals from residual waste. The separated products are then composted and further screened to remove as much of the remaining contamination as possible.

AWT facilities are able to divert as much as 70% of the waste destined for landfill. However, the quality of the outputs is highly dependent on the quality of the inputs and the level of contamination.

Contracts for MBT facilities are usually 20 or more years in duration and involve significant capital expenditure. In NSW such facilities are not eligible for funding under the Waste Less, Recycle More organics grants programs which are for source separated organics, but are eligible under the general waste infrastructure funding programs.

Given the higher cost of MBT facilities relative to traditional landfill, the key drivers for their construction are increased costs of landfill due to levies, or strong desire from governments to increase the quantities of residual waste diverted from landfill.

MBT is a process for managing general waste streams. It involves 15-20 year old technology and, in effect, composts the organic fraction from the waste. According to the most recent Waste and Resource Recovery Portal data, 15 Councils send their general waste to a MBT process in 2017-18.[199] There are five MBT facilities in NSW processing over 500,000 tonnes of mixed waste per year:

- Eastern Creek (Global Renewables Ltd (GRL))
- Woodlawn (Veolia)
- Coffs Harbour (Biomass)
- Kemps Creek (Suez)
- Raymond Terrace (Suez)

This has resulted in over 50% (by mass) diversion of the incoming waste from landfill through a combination of extraction of recyclables, moisture lost through the process and constructive use of the mixed waste organic output (MWOO).[200]

The main output from an MBT process is mixed MWOO. In contrast to FOGO, given MWOO involves the use of organic outputs from mixed waste, rather than from food and organic waste only, there is a higher level of contamination of MWOO.

Until October 2018, MWOO was used in NSW on mine sites, forestry and non-contact agriculture end uses, each with application rate limits, pursuant to the terms of a Resource Recovery Order (RRO).

An independent research program commissioned by the EPA concluded that there are limited agricultural or soil benefits from applying MWOO at the regulated rates, but potential physical contaminant and environmental risks were identified. In October 2018, the EPA withdrew the RRO Exemption. Since then, organic outputs that might otherwise be applied to land are being sent to landfill as a result of these restrictions. The impacts of the withdrawal are under consideration and further tests are being undertaken to determine whether, for example, certain product might be able to be used for mine rehabilitation.[201]

8.10.2 Energy from waste

The Protection of the Environment Operations Act 1997 ("POEO Act") defines "energy recovery from general waste" as "the receiving from off site of, and the recovery of energy from, any waste (other than hazardous waste, restricted solid waste, liquid waste or special waste)". Methods of energy recovery include thermal treatment (such as incineration facilities) and biological processes, such as anaerobic digestion.

Thermal treatment

Thermal treatment is defined in Schedule 1 to the POEO Act as "*the processing of waste by burning, incineration, thermal oxidation, gasification, pyrolysis, plasma or other thermal treatment processes*".

Energy from waste technologies may result in heat, electricity or fuel. Thermal treatment is the focus of the *NSW EPA Energy from Waste Policy Statement*.

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[199] EPA 2017-18 Waste and Resource Recovery Portal Data

[200] Internal unpublished report procured by the EPA (2019)

[201] See for example Woollahra Municipal Council update on use of mixed waste organic material dated 23 November 2018 (https://www.woollahra.nsw.gov.au/news/news/update_-_use_of_mixed_waste_organic_material)

Thermal treatment of waste is an alternative to landfill and is well established overseas. The process reduces the volume and mass of waste and the heat by-product is used to generate thermal and/or electrical energy. The plants are fitted with filters to control and minimise pollutant and carbon emissions. Metals can be recovered either before thermal treatment (using a front-end MRF) or after thermal treatment from ash residues. Bottom ash and slag, the by-product of the process can be recovered and used in the production of building materials, although it is often landfilled. Gasification and Pyrolysis technologies tend to require a more consistent feedstock stream than incineration technologies, necessitating more pre-processing at the front-end.

There are currently no operational thermal energy recovery facilities in NSW (as described in Part 4 of the Policy), although there have been development applications for various facilities. In July 2018, the Department of Planning formally refused a development application for a thermal waste to energy facility (using incineration technology) at Sydney's Eastern Creek. This was followed by a parliamentary inquiry into energy from waste technology (amongst other issues) in which the Committee, although supporting energy from waste in some circumstances, did not support the specific proposal due to uncertainty around the risks it may pose to human health and the environment.

Other development applications have been submitted for energy from waste facilities and stakeholders expressed the view that there is a place for energy from waste to play in reducing waste going to landfill and deriving more value from waste that is not otherwise reused or recycled. Energy from waste was a common theme in stakeholder interviews carried out by the Advisers as part of developing this Report – both waste generators and waste processors were of the view that thermal waste to energy has a role to play in NSW's future waste strategy. At present there is an operational plant in Wetherill Park, Sydney for the production of process engineered fuel for use in thermal facilities.

Biological treatment

This method of recovery of energy from waste refers to treatment such as anaerobic digestion technologies and energy derived from combustion of landfill gas capture.

According to the Clean Energy Finance Corporation, there are approximately 23 such energy from waste projects in New South Wales. Most of these facilities are relatively small-scale and have a nameplate capacity of less than 10MW.[202]

Anaerobic digestion (AD) technology is generally well accepted and has the advantage of being viable (technologically and economically) in a range of capacities / waste volumes. It is only viable for reasonably well separated sources of organic waste. As a result, it is a good solution for small scale, on-site, treatment of waste. AD may have a key role to play in regional or rural areas, given the proximity to sources of organic waste derived from agricultural areas.

Water authorities around the county have identified AD as a mechanism to attain energy self-sufficiency and have the benefit of mixing water treatment plant waste with food waste to increase energy output. For example, Yarra Valley Water in Victoria recently opened an anaerobic digestion facility which processes 30,000 tonnes of waste which in turn produces, through combustion of the gas produced by anaerobic digestion, 25% of Yarra Valley Water's energy requirements.[203] In NSW, Sydney Water has articulated a goal of using food waste to increase gas generation at its wastewater treatment plants (and is currently trialling processes

[202] Clean Energy Finance Corporation submission to the New South Wales Inquiry Into Energy From Waste (May 2017)

[203] Aquatec Maxcon. (2017). *Yarra Valley Water officially opens Waste to Energy Facility*. Sourced from: http://www.aquatecmaxcon.com.au/newsarchive/55-2017/301-yarra-valley-water-officially-opens-waste-to-energy-facility

at some of its facilities). Industries, like abattoirs, have developed circular economy, behind the meter solutions, using AD solutions to transform their waste into energy for their facilities.[204]

It is worth considering whether AD waste solutions may in the future be impacted by factors underpinning the MWOO ban referenced above, as anaerobic digestion processes produce a by-product which is often applied to land as a soil enhancer. In the same way that scientific testing identified a concern with contaminants in MWOO, it is potentially foreseeable that future studies may identify a similar concern with AD output (i.e. because of concerns around the waste input).

Energy from waste – Denmark[1]

Denmark is considered a world leader in energy from waste. Almost every city in Denmark has an incinerator that is publicly owned and around 55% of municipal waste is incinerated for energy recovery.

Denmark practices mixed collection. Waste used for incineration is not sorted. Denmark currently imports waste from other countries to support its waste to energy facilities. Incineration facilitates are not allowed to profit from their activities, to ensure reliability of energy prices. According to Zero Waste Europe, 20% of heat production and 5% of electricity in Denmark is generated from waste.

Denmark's high levels of waste generation per capita indicate high levels of resource use and environmental pressure. To address this problem, Denmark is moving away from incineration as its main strategy for waste management, recognising the need to reduce overall waste production and move towards a closed loop, or circular economy approach to waste management. The vested interests in maintaining waste incineration facilities at high capacity and competition for waste may make this move a challenging one. Denmark's strategy to reduce waste generation and move to a circular economy will be examined in further detail in Volume III: Benchmarking Review.

[1]Simon, JM. (2014). (The story of) Denmark's transition from incineration to Zero Waste. Sourced from: https://zerowasteeurope.eu/2014/01/the-story-of-denmarks-transition-from-incineration-to-zero-waste/

8.10.3 Considerations for the 20-year waste strategy

Across Australia, there is a lot of activity underway in this space at present. NSW would benefit from increased collaboration with other jurisdictions with a view to developing a nationally consistent strategy.

Options to consider as part of the strategy are discussed in Key Finding 17 and include:

- Developing processes to engage with community concerns around the broad topic of energy from waste. The development application process for the Eastern Creek facility referenced community concerns around the applicant's social license to operate a facility with the potential to cause environmental and health impacts if not adequately operated. A lack of understanding around the sophistication of some energy from waste technology contributes to this view and could be aided by an education campaign;

[204] For example, Southern Meat's Goulburn abattoir has partnered with ReNu Energy to build a $5.75 million biogas facility to reuse the waste generated by the abattoir as a fuel source. Latimer, C. (2018). *Abattoir goes offal the grid and turns rotting meat into electricity*. The Sydney Morning Herald. Sourced from: https://www.smh.com.au/business/the-economy/abattoir-goes-offal-the-grid-and-turns-rotting-meat-into-electricity-20180411-p4z90d.html

- Identifying preferred technology types. Although the EPA's practice is to be technology agnostic, this is not necessarily efficient given that preferences emerge through planning and financing in any case;
- Re-examining the eligibility of waste that can be used in energy recovery processes and confirming/adopting best practice emissions and safety standards;
- Establishing a policy for residue from thermal energy from waste facilities, such as bottom ash aggregate.

8.11 New technologies

New technologies are always emerging, with implications for the waste sector, across product design, waste collection and sorting, and recycling and reuse. In particular, over the next 20 years, innovation and new technologies are likely to increase the efficiency and effectiveness of recycling across all waste streams, significantly improve the capacities of facilities to process and divert waste from landfill.

New waste management technologies

In places such as Barcelona, Cascais and Cambridge, underground waste management systems have been installed. These systems include sensors that notify waste collectors when the bin is full, reducing the number of futile trips and keeping waste away from the street.

Internationally, there is also evidence of innovative waste treatment centres. RCERO is a treatment centre in Ljubljana Slovenia. The treatment centre processes one third of all waste in Slovenia, including both biodegradable and other waste. 80% is recycled into objects, compost or fuel. The centre is also self-sufficient in energy as it utilises the energy produced from the waste that is treated.

8.11.1 Lessons from previous experience

Government, in particular the EPA, has experience in the assessment of new technologies (for example MBT and Energy from Waste). Stakeholders within the EPA commented on the time and resources needed from the organisation when rebates and grants for on-site equipment were introduced. The EPA's dual role in managing the delicate balance between supporting innovation in resource recovery and protecting human and environmental health can result in concerns that technology is approved before all risks are understood. This is being felt currently in relation to the MWOO ban.

8.11.2 Valorising Waste – food and organics

Waste valorisation – the process of converting waste into more useful products – is another useful approach to address the management of waste materials that, like the examples above, has the potential to create new recyclate markets.[205] Basic valorisation strategies including composting, recycling and burning (for energy recovery) are known and largely accepted practises worldwide. These practices, however, are able to recover or convert less than 50 wt.% of the total waste processed into useful products.[206] Advanced valorisation strategies, on the other hand, are able to generate products with considerable practical, environmental and economic value. Food wastes in particular have been demonstrated to be valuable bio-resources that can be utilised to obtain a number of useful chemicals, materials and fuels.[207]

A valorisation initiative of note is AgriChemWhey, an EU-funded valorisation project in Ireland that is seeking to address the extensive food waste by-products from milk production. By converting the by-products whey permeate and de-lactosed whey permeate into lactic acid at their advanced bio-refinery, AgriChemWhey is able to tackle a key challenge of the dairy industry (namely, disposal of a key waste product) and establish a new value chain for industrial symbiosis with other local market participants. The process has enabled the creation of several added-value products for the global market including lactic acid, olylactic acid, minerals for human nutrition and bio-based fertilisers. Representing the first major industrial venture to convert residues from food processing, the flagship plant in Ireland will have the ability to valorise 25,000 tonnes per annum of dairy manufacturing by-product.[208]

Elsewhere, sugar cane producers in India are collaborating with leading UK universities and bioenergy companies to research and design new value streams for the extensive waste products produced by their industry. Of particular note are treatments to turn industry by-products into transportation fuels (bio-CNG and butanol) and chemicals including succinic and lactic acid. The impact of these technologies and value chains will be widespread, not just in the reduction of large quantities of waste, but also in the creation of new industries and advanced job opportunities.[209]

Given the extensive and well-established agricultural industry in NSW, as well as the high level of food and organics waste generated in the state, it is clear that valorisation industries such as those outlined above have the potential to be of great benefit to the state in both waste management and economic value.

8.11.3 Source Separation Education

Jurisdictions such as Slovenia, San Francisco, Ontario and Scotland mandate separation of waste types at source. To facilitate correct separation, and reduce contaminate, a number of cities and local councils have released various apps and websites that assist citizens to sort their waste into the correct bins.

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[205] Garcia-Garcia, G et.al. (2019). 'Opportunities for waste valorisation in the food industry – A case study with four UK food manufacturers'. *Journal of Cleaner Production*. Vol. 211. Pgs. 1339-1356. Sourced from: https://www.sciencedirect.com/science/article/pii/S0959652618336722

[206] Luque, R & Clark, JH. (2013). 'Valorisation of food residues: waste to wealth using green chemical technologies'. *Sustainable Chemical Processes*. Sourced from: https://sustainablechemicalprocesses.springeropen.com/articles/10.1186/2043-7129-1-10

[207] Ibid

[208] Food Technology. (2019). *Valorising waste in dairy processing the European way*. Sourced from: https://www.foodprocessing.com.au/content/processing/news/valorising-waste-in-dairy-processing-the-european-way-1440191832

[209] UK Research and Innovation. (2019). *Newton Bhabha Industrial Waste: Valorising Waste from Sugar Cane Industries via Innovations in Pretreatment, Biotransformation and Intensification*. Sourced from: https://gtr.ukri.org/projects?ref=BB%2FS011951%2F1

The City of Toronto has released the TOwaste App. This app provides residents with access to their collection schedule, as well as a Waste Wizard sorting tool and drop-off depot and donation locations on their phones.[210] Recology in San Francisco have a 'what bin' tool that allows citizens to search their specific waste material, and then clearly identify the most appropriate bin for that particular waste type. This includes disposal directions for materials that can be recycled and composted, what materials must be landfilled, and what materials require special disposal (including e-waste and hazardous waste) and where drop-off points for special waste can be located.[211] These simple tools have reduced the rate of waste contamination and work to increase the recycling rate.

Through user-friendly applications such as those outlined above which highlight to households what can and cannot be recycled (as well as what can be composted, what must be landfilled and, where applicable, proper treatment for hazardous and e-waste), source-separation may be more successful in the MSW stream and prevent contamination of recyclable materials. Stakeholders in Australia have commented on the complex and diverse recycling systems in NSW leading to high contamination rates (i.e. different rules for different councils and ambiguous directions for what is and what is not included in recyclable materials). Simple tools – such as a search function in the case of Recology – enable consumers to have greater clarity around what materials should be deposited in which bin, increasing the potential for source separation and decreasing the potential for contamination. Having a consistent approach across the city also support consistent messaging and education.

8.11.4 Smart Bins

Smart Bins are now commonly used in a range of cities across the world. Technology from Sotkon and SmartBin have revolutionised the ways that cities structure garbage collection. In the Cascais Municipality in Portugal, 400 Sotkon underground recycling bins have been installed. Reporting via cellular networks, Cascais control centre are able to monitor fill-levels and plan optimised collection routes for their drivers.[212] Adelaide in South Australia have installed CleanCubes, which are solar powered waste bins. These bins utilise cloud-based technology to optimise waste collection. Regular wheelie bins sit under a solar powered sensor that provides real-time data on the fill level. CleanCubes also contain a compactor which condenses the rubbish inside when it reaches a certain level.[213]

Smart bins also have immense potential to increase source separation. For example, Polish company Bin-E is developing a smart waste bin that uses a camera, sensors and artificial intelligence to automatically recognise, sort and compress waste into plastics, paper or glass before they are collected.[214] This technology has extensive implications for waste streams with poor source separation in most jurisdictions, in particular, MSW and C&I.

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[210] City of Toronto. (2019). *TOwaste App*. Sourced from: https://www.toronto.ca/services-payments/recycling-organics-garbage/towaste-app/

[211] Recology. (2019). *WhatBin*. Sourced from: https://www.recology.com/recology-san-francisco/what-bin/

[212] Smartbin. (2019). *Cascais Municipality*. Sourced from: https://www.smartbin.com/clients/cascais-municipality/

[213] City of Adelaide. (2019). *Smart Waste Bins*. Sourced from: https://www.cityofadelaide.com.au/city-business/business-responsibilities/waste-recycling/smart-waste-bins/

[214] AWRE. (2019). *The future of waste management is smart*. Sourced from: https://awre.com.au/waste-management-solutions/future-of-waste-management-is-smart/

8.11.5 Product Design

Beyond efficiencies in sorting, collection and management, innovations and technology relating to the waste sector have the potential to reduce the amount of waste overall. Innovative product design can result in products which do not just reduce the amount of waste going to landfill, but also utilise existing waste and by-products in their manufacture. For example, working in collaboration, Canadian companies Full Cycle Bioplastics, Elk Packaging and Associated Labels and Packaging make a compostable high-performance material from renewable materials, agricultural by-products and food waste which serves as a product-replacement for plastic. Similarly, the VTT Technical Research Centre of Finland has created a compostable multi-layer material from agricultural and forestry by-products.[215]

In order to reduce quantities of fresh food waste, California-based Company Apeel Sciences has created a post-harvest protection from edible plant extracts, which is used to coat fresh produce to extend shelf life.[216] The effect of this product design is twofold: firstly, it reduces the need for plastic wrap and coatings for food products; secondly, it has the potential to reduce overall quantities of food waste by extending product shelf life.

8.11.6 Artificial Intelligence and Robotics

Beyond source separation, efficient and effective separation of waste types at MRFs, recycling and waste processing facilities represents a key opportunity to increase recycling rates and reduce the quantities of waste being sent to landfill. Artificial intelligence (AI) and robotics innovations present key technological enablers for increased efficiency in waste separation. In 2011, Finnish company ZenRobotics was the first company in the waste management sector to introduce a waste sorter that utilised artificial intelligence (AI) to sort waste. ZenRobotics waste sorting robots are able to sort numerous waste types and various objects simultaneously in one spot, reducing the need for complex pre-processing of waste.[217] The success of robotic sorting technologies can be seen in their uptake by the waste management industry, with ZenRobotics having customers in the Netherlands, Sweden, Japan, Switzerland, China, Finland, Australia, France and Singapore, amongst others.[218]

The success of ZenRobotics has been mirrored by other companies and jurisdictions worldwide. For example, Sadako Technologies also released AI infused waste sorting system, which employs deep learning to scan the garbage visually, identify objects and robotic arms pick waste off conveyor belts. The first AI sorting robot in the UK was installed in Essex by Bulk Handling Systems UK. The MAX – AI Autonomous Quality Control unit sorts container streams following optical sorting. The robotic sorter employs a vision system to see material and make decisions, such as separating various materials such as thermoform trays, aluminium and fibre.[219] This technology reduces the potential for human labour, which is a significant challenge for MRF operators. Bulk Handling Systems own the MAX AI technology as well as providing solutions for all waste streams.[220]

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[215] Iles, J. (2018). *5 innovations that could end plastic waste*. Sourced from: https://www.greenbiz.com/article/5-innovations-could-end-plastic-waste

[216] Apeel Sciences. (2019). *Our Story*. Sourced from: https://apeelsciences.com/our-story/

[217] Zenrobotics. (2019). *Customer Cases*. Sourced from: https://zenrobotics.com/references/cases/

[218] Ibid

[219] Max AI. (2019). *BHS and NRT Introduce MAX-AI Technology*. Sourced from: https://www.max-ai.com/autonomous-qc/

[220] BHS. (2019). *Construction and Demolition (C&D)*. Sourced from: https://www.bulkhandlingsystems.com/solutions/construction-and-demolition/

AI and robotics have extensive implications for the waste management industry beyond the sorting of waste, including waste transportation and supply chain management. Whilst technology and uses of AI and robotics are still emerging, it is clear that further innovation in this area has the potential to greatly increase recycling rates and the overall efficiency and effectiveness of the waste management industry.

8.11.7 Considerations for the 20-year waste strategy

A long term strategy for the waste sector will need to recognise the increasingly significant role that new technologies will play in waste management and resource recovery in coming years. While to date, the EPA has not prioritised particular technologies, it will be important that NSW has a clear view of emerging technologies. This will help to ensure that government facilitates or supports the development of preferred capabilities in the state, and encourages investment certainty.

Options to consider as part of the strategy might include:

- using and sharing data to identify real problems in order to assist innovators to target their efforts toward particular issues in need of technologically innovative solutions;
- supporting innovation as a dedicated EPA function – for example through grants, such as the existing Recycling Innovation Grants Program; and
- developing pathways for innovators to work with government at concept stage to better understand drivers and concerns.

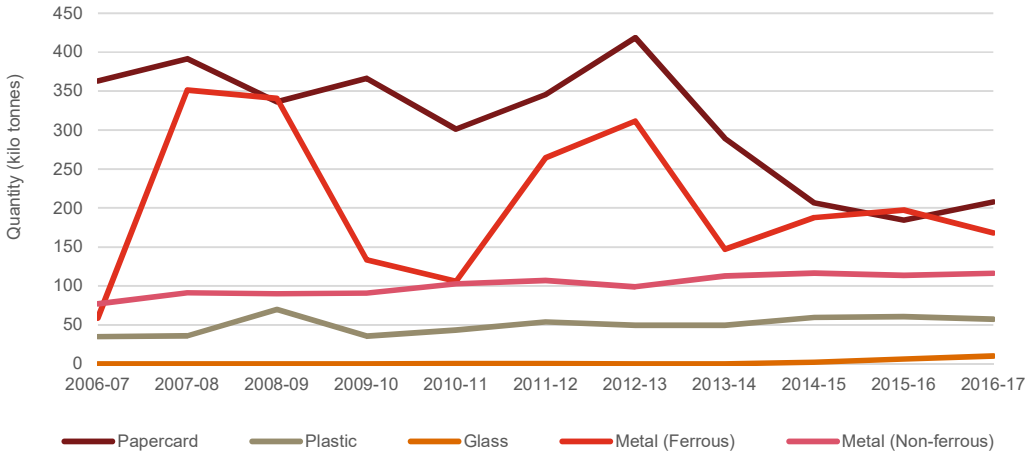
9 Recyclable materials

9.1 Export markets

A 2018 report prepared for the Australian Government found that the Australian recycling industry faces a demand problem, more than a supply one, where demand for recycled products is less than the supply of recyclable materials.[221] This is particularly so in the context of changing global export markets for recycled materials as a result of China's National Sword policy, with a risk that other importing countries will adopt a similar approach.

NSW has historically relied on export markets and in particular China, to export certain waste materials, especially plastics, paper and cardboard. Domestic markets for recyclable materials are relatively immature, and do not have the capacity to absorb the amount of recyclate available and so a large portion is exported for recycling.

Figure 17: NSW exports of recyclable materials (kt)



Source: NSW EPA trade data

China National Sword

China's decision to restrict its imports of recycled materials (China National Sword) has had a significant impact on waste export volumes and the average value realised. Prior to this policy change, the export of waste materials to China has been a low-cost option for many exporting countries.

China National Sword came into effect in January 2018. The restrictions place a 0.5% contamination limit on waste imports across 24 waste categories, including various plastics and unsorted waste paper.

[221] Internal unpublished report procured by the EPA (2018)

The impacts of the restrictions have been felt in Australia and NSW, including:

- A reduction in international prices for exported recycled materials;
- An increase in the cost of processing materials to meet China's regulatory requirements.[222]

Analysis[223] undertaken has estimated that China National Sword reduced the value of NSW waste exports by $11 million to $47 million per year ($4 to $16 per household).

The NSW waste system has responded by:

- Finding new global export markets, particularly in Southeast Asian countries;[224]
- Changing the composition of exports, with a higher proportion of lower quality materials being used in the domestic markets (particularly paper) and higher quality materials being exported;
- Increasing the stockpiling of recyclable materials.[225]

While new export markets have emerged, across Southeast Asia, the NSW recyclables sector remains vulnerable to any future tightening of regulation in these markets. Malaysia, for instance, has recently announced similar restrictions to China.[226]

Beyond changing regulations, broader market volatility is also an issue. As recyclables are sold into global commodity markets, values are affected by changing levels of global demand and supply. These factors demonstrate the importance of developing a domestic market for recycled waste materials to support waste diversion and the ability of the NSW resource recovery sector to withstand shocks resulting from unexpected changes in global markets and international policy and regulatory environments.

At present the demand for recycled materials in NSW is not sufficient to absorb currently exported recycled waste volumes. Analysis[227] undertaken has estimated that, if all plastic and paper export markets were to close, the financial cost of landfilling material currently exported would be around $50 million per year ($16 per household).[228] A large portion of this cost would be revenue to the NSW Government through the landfill levy. The cost of processing the material domestically, however, would be less than $50 million per year. Despite this position, there is currently limited demand for recycled materials in the domestic NSW market.

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[222] Many facilities are not able to meet these contamination level requirements due to quality issues with waste feedstock and limitations of technology or processes employed.

[223] Internal unpublished report procured by the EPA (2018)

[224] As noted in Section 6, the new markets identified are not considered sustainable in the longer terms, with some new markets already limiting or suspending the receipt of waste products.

[225] As noted in Section 6, industry feedback is that significant stockpiling is occurring in plastics and glass (although stockpiling of glass is not necessarily related to China National Sword).

[226] Massola, J & Rosa, A. (2018). *Malaysia bans waste imports as Australia battles recycling crisis*. The Sydney Morning Herald. Sourced from: https://www.smh.com.au/world/asia/malaysia-bans-waste-imports-as-australia-battles-recycling-crisis-20181019-p50atm.html

[227] Internal unpublished report procured by the EPA (2018)

[228] Internal unpublished report procured by the EPA (2018)

9.2 Domestic markets

While the recyclables system has responded relatively quickly to China National Sword and associated changing global market conditions, it is more difficult to respond quickly by increasing domestic processing capacity and markets. Increasing domestic markets is particularly challenging due to:

- A lack of short-term domestic recycling outlets for materials when global demand is low;
- Regulatory and planning processes which mean new facilities can take a long time to be approved, developed and become operational;
- Stockpile limits, which limit the ability of processors to hold material until old markets re-emerge or new markets are found, and;
- Uncertain regulatory environment for certain waste streams.

9.2.1 Glass

Domestic demand for recycled glass is particularly challenging, with both glass sand and glass cullet failing to find a stable and reliable market in NSW. In particular, the low cost of virgin sand and perceived quality risks of glass sand, as well as the poor quality of glass cullet, make recycled glass unattractive to domestic producers and users. These challenges are addressed in Section 8.4.

The two major glass manufacturers in Australia are Owens-Illinois and Orora.

Orora's glass production plant is based in South Australia.

An estimated 274,000 tonnes of glass is produced by Owens-Illinois at its Penrith facility each year, of which 39 per cent is produced from recycled material.[229] Owens-Illinois has a global objective of using 50% recycled materials in its glass products. The Australian operations are keen to achieve this goal, however, accessing sufficient cullet with low contamination levels has been a challenge despite obtaining the feedstock from MRFs who have separated the material. This position may change following the implementation of the CDS (see Section 2.3.8), which is not exposed to kerbside contaminants.

9.2.2 Plastics

There is an underdeveloped market for recycled plastics in NSW, with 20 plastic re-processors (including three tyre recyclers) reprocessing an estimated 45,200 tonnes of recycled plastic. Uses for re-processed plastics are detailed in the table below.

NSW re-processors receive material from NSW and interstate sources, with PET and Polyurethane comprising the majority of interstate recyclable plastic.[230]

[229] Internal unpublished report procured by the EPA (2018)

[230] Internal unpublished report procured by the EPA (2018)

Table 29: Users of recyclable plastics in NSW

Firm	Location	Polymer sources	Polymer uses
Astron Sustainability	Ingleburn	Commercial/industrial packaging	Construction, agricultural and industrial products
DGR (Aust) Pty Ltd	Moama	A range of C&I and post-consumer recylcate	Building, garden products
Dunlop flooring	Weatherill Park	Pre-consumer and post-consumer recyclate	Carpet underlay
Foamex NSW	Revesby	C&D materials	Waffle pods for concrete slabs
Hunter Pods	Thornton	Commercial/industrial packaging	Waffle pods for concrete slabs
IS Recycling NSW	Minto	Commercial/industrial packaging, C&D materials	Not reported
Key Plastics (Iplex)	Chipping Norton	C&D materials	Pipe and fittings
Polyfoam Australia P/L	Moorebank	Commercial/industrial packaging	Construction, packaging and other
RBM Plastics	Silverwater	Not reported	Not reported

Source: Internal unpublished report procured by the EPA (2018)

Domestic sales of recycled plastics in FY18 was c.26,100 tonnes. Total plastics consumption in NSW in 2017–18 is estimated at 1.09Mt.

Stakeholder feedback was that domestically recycled product was more expensive than imported materials, limiting domestic demand.

Certain plastic materials were also not being recycled either due to there being no end user of the recycled material (i.e. no domestic products or manufacturing requiring certain plastics) or certain products were not designed with recycling in mind (i.e. unrecyclable through existing facilities).

Certain plastics, such as food grade plastics films, could not be recycled for reuse in the same or comparable products and therefore had limited application unless product innovation occurs (e.g. creation of new products utilising recycled plastic).

Australia's higher cost structures (labour and electricity) reduce the competitiveness of domestic recycled plastics vs imported materials. Larger scale plants; increased automation and robotics and better quality feedstock (lower contamination to driver better yields) would improve the competitiveness of recycled materials, but further worked is required to develop domestic markets and uses.

9.2.3 Paper

An estimated 1.7 million tonnes of paper and pulp products is produced in NSW each year. Around 40 per cent of this is produced using recycled materials.

Nearly 50 per cent of all paper and pulp products is produced at the Visy Paper Mill in Tumut, which uses only virgin materials. Nevertheless, there is a good market for recycled paper materials, and opportunities to expand the use of recycled materials in existing factories.

Table 30: Volume of paper production in NSW

Firm	Location	Material sources	Volume (tonnes)
ABC tissue produces	Wetherill Park	Virgin materials	60,000
Orora B9 Botany Mill	Botany Bay	Recycled materials	400,000
Norske Skog	Albury	55% recycled	274,000
Visy Smithfield	Smithfield	Recycled materials	Not known Licence is > 150,000 In 2008 was 265,000
Visy Tumut Mill	Tumut	Recycled and virgin materials	800,000
Total			>1,684,000

Source: Internal unpublished report procured by the EPA (2018)

9.2.4 Metals – ferrous

The major steel producers in NSW are BlueScope and Liberty One Steel. During the 2015 financial year, 100% of steel produced at both the Liberty One Steel Sydney and Newcastle mills used 100% recycled materials. At the Sydney mill this was comprised of 91.8 per cent of post-consumer scrap, 1.2 per cent post-industrial scrap and 7.0 per cent internal mill scrap. At the Newcastle mill this was comprised of 81.5 per cent of post-consumer scrap, 0.3 per cent post-industrial scrap and 18.2 per cent internal mill scrap.[231]

Table 31: Volume of steel production in NSW

Firm	Location	Volume produced (tonnes)
BlueScope	Port Kembla	2,600,000
GFG Alliance Liberty One Steel	Sydney (Rooty Hill)	625,000
GFG Alliance Liberty One Steel	Newcastle (Waratah)	330,000
Total		**3,555,000**

Source: Internal unpublished report procured by the EPA (2018)

9.2.5 Metals – non-ferrous

In Australia, very little aluminium scrap is recycled domestically. All aluminium packaging, including beverage cans, are exported for recycling. There is only one aluminium smelter in Australia, located in Tomago, which uses 100 per cent virgin material.[232]

[231] Internal unpublished report procured by the EPA (2018)

[232] Internal unpublished report procured by the EPA (2018)

9.3 Increasing domestic demand for recycled materials

There is limited market demand for some recycled materials, and a lack of market certainty for others. This is due in part to the generally higher cost of recycled materials compared to virgin materials. The cost of recycled materials is being negatively impacted by contamination and a lack of scale. Virgin materials do not incorporate the costs of external environmental impacts. Both of these issues can be addressed through revised policies (see Key Finding 3).

The lack of end markets for recycled materials, it is also due in part to a perception among some end users (both commercial and industrial users and individual consumers) that products using recycled materials are of a lower quality.

There are a number of options to increase domestic demand for recycled materials. In converting to a circular economy it will be important to provide confidence to processors and investors to ensure recycling activities continue to increase in NSW. Similarly, strategies must be developed in conjunction with industry to develop domestic demand.

Opportunities to improve domestic markets may include:

- development | enforcement | promotion of Australian Standards for recycled materials or for the application of recycled materials to provide comfort that these products meet minimum acceptable standards, such as levels of contamination;
- greater use of domestically recycled materials in state and local government procurement, where appropriate;
- reducing regulatory barriers for the investment and development of recycling infrastructure to increase capacity and reduce cost of materials processing in NSW;
- support for end market development of recycled products, such as incentives for greater use of recycled materials or the development of new products using recycled materials;
- development of policies with respect to minimum use of recycled content;
- support of industry R&D pilot and commercial programs; and
- support for the development of alternate products using recycled materials.

10 Disposal

10.1 Overview

Disposal of waste is considered the least preferable approach to waste management. Almost all waste disposed of in Australia is sent to landfill, with the remainder comprising mostly thermal destruction of medical and other waste. Other methods of disposal include illegal dumping and littering. The interstate transfer of waste is also considered in this section, as it represents a method of disposal through which no re-use of waste materials is made within the NSW economy.[233]

Waste disposed comprises:

- waste received minus waste transported for annual-reporting to landfill facilities;
- waste received minus waste transported, minus waste deducted for an approved Operational Purpose for monthly-reporting landfills;
- waste transported interstate for disposal;
- waste reported as being transported for domestic recovery, but based on its nature (pharmacy, clinical, contaminated soil and asbestos) is reallocated to disposed.

A portion of some of the wastes reported as being exported or sent interstate for recovery are likely to end up in landfill, however, the EPA does not have sufficient data to quantify this.

10.2 Landfill

10.2.1 Waste to landfill - overview

100% of reported disposal comprises waste sent to landfill.

C&D fluctuated from 29% of total waste going to landfill in FY17 to 39% in FY18. The fluctuations were in part caused by fluctuations in contaminated soil and asbestos waste tonnages (an additional 1Mt was landfilled in FY18).[234]

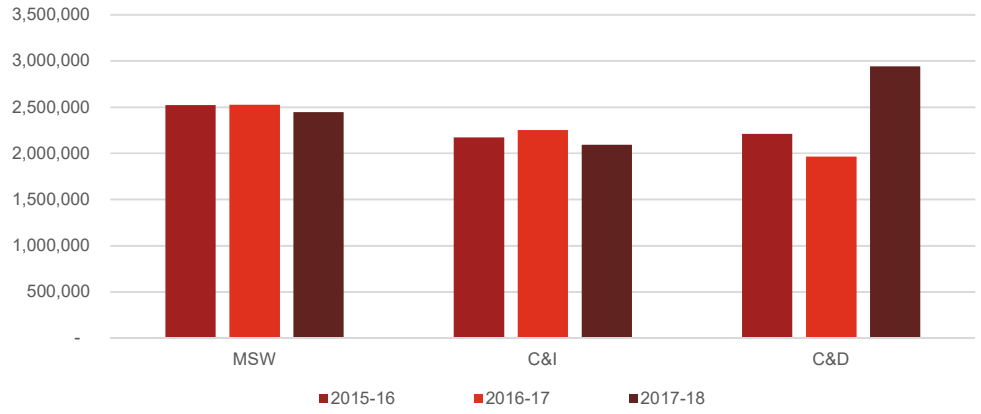
C&I waste to landfill fluctuated between 2.25Mt (33%) in FY17 to 2.09MT (28%) in FY18, 33-28% of total waste to landfill.

MSW waste volumes going to landfill have declined from 2.52Mt in FY16 to 2.45Mt in FY18. This is a decline from 37% of waste to landfill in FY17 to 33% in FY18.

[233] As noted in Appendix A, waste currently being sent to Queensland is assumed to be going to landfill. All others wastes that are sent interstate or overseas is assumed to be diverted from landfill.

[234] See Section 4.3.

Figure 18: NSW volumes of waste to landfill by waste stream (tonnes)



Source: EPA waste generation, disposal and recycling data

Table 32: NSW volumes of waste to landfill by stream (Mt)

Year	MSW	C&I	C&D	Total
2015-16	2.52	2.18	2.21	6.91
2016-17	2.53	2.25	1.96	6.74
2017-18	2.45	2.09	2.94	7.48

Source: EPA waste generation, disposal and recycling data

10.2.2 Waste to landfill – composition

Landfill operators do not maintain data on the mix of wastes entering landfill, however, an estimate can be made based on audits undertaken historically:

- EPA 2015, Disposal based audit – C&I waste stream in the regulated areas of NSW;
- EPA 2011, Domestic kerbside waste and recycling in NSW: Results of the 2011 waste audits.

A comparable analysis was undertaken based on FY17 C&I and MSW waste volumes, taking the total volume sent to landfill and apportioning this to materials types based on the results of the 2011 and 2014 audit.[235] The outcome of this analysis is summarised in Table 32.

[235] Internal unpublished report procured by the EPA (2018)

Table 33: Material composition of FY17 landfill[236]

Material type to landfill	MSW %	C&I %	MSW tonnes ('000)	C&I tonnes ('000)	Total tonnes ('000)
Glass	3.7	3.1	95	70	164
Paper	12.9	16.7	330	379	709
Metal	3.5	4.9	89	113	202
Plastic	10.9	16.9	278	384	662
Organics	53.8	14.4	1,376	328	1,704
Masonry	-	12.4	-	283	283
Timber	-	14.9	-	340	340
Residuals from waste processing	-	15.6	-	355	355
Other	15.2	1.1	390	26	26
Total	**100.0**	**100.0**	**2,558**	**2,277**	**4,835**

Source: Internal unpublished report procured by the EPA (2018)

As noted in Section 4.2.1 (Table 10) the 2011 kerbside audit determined that up to 67.1% of residual waste could be diverted from landfill. This data is dated and needs to be refreshed as the impact of the CDS and waste reduction programs are likely to have impacted on the volume of recoverable wastes that remains in the residual MSW going to landfill. None the less, the findings of kerbside audits (see Section 4.2.4) indicated a significant portion of MSW going to landfill could be diverted.

Section 4.4.3 noted that 55% of the C&I waste not being diverted (and not presented in garbage bags) could potentially be recovered. This figure increased to 83% if it is assumed that the contents of the garbage bags can be accessed.

With 61% of landfill currently derived from the MSW and C&I waste streams, a significant reduction in waste to landfill could be achieved if present barriers could be addressed through initiatives developed under the 20-year waste strategy.

10.2.3 Landfill Infrastructure

According to the EPA's most recent Waste and Resource Reporting Portal (WARRP) data, there are 327 active landfill facilities operating in NSW. The majority (293, or 90%) of these are owned by a council, with the remainder (34, or 10%) owned by private operators.

As shown below, the majority of these (252, or 77%) are in the non-levied area. The remainder are in the MLA (42, 13%) and the RLA (33, 10%).

Table 34: Landfills by ownership and levy area

Levy area	Council	Private	Total
Metropolitan	16	26	42
Regional	32	1	33
Non-levied	245	7	252
Total	293	34	327

Source: EPA data

[236] It is recognized that with the rollout of organic waste collection programs, the organic component of waste entering landfill is likely to be lower than identified in Table 32. Due to difficulties in measuring total waste volumes, these totals differ from waste totals in Table 32.

There are only two landfill sites serving Sydney that can take putrescible waste. One facility is operated by Suez at Lucas Heights, accessible by road. The second facility is operated by Veolia at Woodlawn, near Goulburn. Sydney waste is currently railed to Woodlawn. We understand that the rail access arrangements have reached capacity. Sydney's third putrescible waste landfill operation at Eastern Creek ceased operations in 2017.

Consultation with industry raised concerns around the lack of contingency planning for Sydney's putrescible landfills – noting that there are only two facilities in operation for the region (Veolia's Woodlawn and Suez's Lucas Heights), and uncertainty over what would happen if one was not available. It would be prudent for the 20-year waste strategy to address contingency planning.

In regional areas some landfills have a lot of airspace remaining, while others are approaching capacity. For example, Coffs Harbour Council on the New South Wales north coast, recently indicated that its landfill will be full in between one and three years but they don't have another site ready.[237]

The 20 year waste infrastructure strategy will need to look at the need for additional landfill operations based on existing diversion rates and alternate scenarios.

10.3 Hazardous and liquid waste

10.3.1 Overview

In 2014-15 Australia produced around 5.6 million tonnes of hazardous waste (including hazardous liquid waste), which is about 9% of all waste generated (64 million tonnes) in this period. Hazardous waste in Australia moves in three sub-markets, each focused on different wastes with distinct scale and issues of interest: 94% of waste is generated in, and managed by, infrastructure located within a state/territory border; 5% crosses interstate borders; and 1% is exported to or imported from overseas for management in specialised infrastructure not available (or economic) within the generating jurisdiction.[238]

In NSW, waste classified as 'hazardous' in accordance with the Waste Classification Guidelines due to high levels of contaminant(s) and is therefore generally not suitable for disposal to landfill. However, if the contaminants are 'immobilised' so that they will not be released into the landfill leachate at levels of concern, then the EPA may grant an immobilisation approval to enable the waste to be landfilled. Immobilisation approvals will only be issued where it is not possible to reuse, recycle or reprocess the waste. Where feasible, treatment to remove or destroy the contaminants is preferable to immobilisation.[239]

Jurisdictions tend to have different definitions of hazardous waste. In NSW, under the Waste Classification Guidelines[240], a number of materials have been pre-classified as hazardous, including:

- containers that have contained a substance classed under the Transport of Dangerous Goods Code from which residues have not been removed;
- coal tar or coal tar pitch waste;

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237 Coffs Coast Outlook. (2018). Coffs Coast landfills "drowning in rubbish". Sourced from: https://coffscoastoutlook.com.au/coffs-coast-landfills-drowning-in-rubbish/

238 Department of Environment and Energy. (2017). *Hazardous Waste in Australia 2017*. Sourced from: http://www.environment.gov.au/system/files/resources/291b8289-29d8-4fc1-90ce-1f44e09913f7/files/hazardous-waste-australia-2017.pdf

239 NSW EPA 2017. *Waste Immobilisation*. Source from: https://www.epa.nsw.gov.au/your-environment/waste/tracking-transporting-hazardous-waste/immobilisation

240 NSW EPA (2014). *Waste Classification Guidelines – Part 1: Classifying Waste*. Sourced from: https://www.epa.nsw.gov.au/~/media/EPA/Corporate%20Site/resources/wasteregulation/140796-classify-waste.ashx

- lead-acid or nickel-cadmium batteries;
- lead paint waste arising otherwise than from residential premises or educational institutions.

Other materials may also be classified as hazardous under the Waste Classification Guidelines.

Three major waste companies manage most of the hazardous waste generated in Australia, and tend to offer services for a broad range of wastes:

- Cleanaway (now incorporating Toxfree)
- Veolia
- Suez

These large operators have facilities nationally that can receive hazardous wastes, mostly covering transfer and storage, chemical/physical treatment and some recycling (typically of oils/ oily waters and grease trap waste). Some also own dedicated hazardous waste landfills.

Other operators tend to be either location-specific or technology/waste specific and include JJ Richards (major waste oil rerefining capabilities) and specialised companies such as Daniels Health and Ace Waste (clinical waste), Geocycle (solvents, paints, oils, other liquid organics recycling into fuels), Renex (contaminated soils remediation), Regain and Weston Aluminium (SPL and other aluminium smelting wastes), smaller waste oil rerefining and treatment companies (Hydrodec, Wren Oil, etc.), various large composters, specialist lead recovery facilities (from used lead acid batteries and leaded glass from e-waste) such as Nyrstar, Hydromet and ARA, and smaller specialists such as CMA Ecocycle (mercury recovery) and solvents/ paints recovery facilities such as Solveco, Planet Paints and Resolve Waste.

The remainder of the market is made up of many small players, with either specific niches (such as hazardous waste packaging recyclers, which deal largely in steel drums) or niche geographic coverages (such as the large number of small regional landfills, that typically may take limited hazard wastes, such as low level contaminated soils or asbestos, although these may not be considered 'hazardous waste' as such under NSW definitions).[241]

There are a range of approaches that hazardous waste companies use to either treat or dispose of hazardous waste. The table below outlines the management of tracked hazardous waste in NSW, Qld, Vic and WA in 2014-15 by fate.

Table 35: Management fate of tracked hazardous waste in NSW, Qld, Vic and WA (2014-15, tonnes)

Description	Quantity (tonnes)	% of total
Recycling	967,422	19%
Chemical/ physical treatment	488,791	10%
Landfill	2,394,619	47%
Biodegradation	154,578	3%
Thermal destruction	20,669	<1%
Storage or transfer	958,061	19%
Other	77,374	2%
Total	**1,681,237**	**100%**

Source: Internal unpublished report procured by the EPA (2017)

[241] Department of Environment and Energy. (2017). *Hazardous Waste in Australia 2017*. Sourced from: http://www.environment.gov.au/system/files/resources/291b8289-29d8-4fc1-90ce-1f44e09913f7/files/hazardous-waste-australia-2017.pdf

As can be seen above the majority of hazardous waste – almost 50 per cent – was landfilled as the primary method of disposal as of 2015. This is in stark contrast to thermal destruction, which represents less than 1 per cent of all waste disposal and treatment in NSW, Qld, Vic and WA in the same period.

The method of treatment and disposal for hazardous waste, whilst heavily weighted towards landfill, is somewhat dependent on waste type. For example, according to the above Department of Environment and Energy Dataset, more than 97 per cent of asbestos containing material is landfilled in NSW, Qld, Vic and WA. For clinical and pharmaceutical waste, however, nearly 20 per cent is thermally destroyed, far more than the average rate for thermal destruction for all hazardous waste material types.[242] Discussions with representatives from the hazardous waste disposal industry indicated that the thermal destruction of medical hazardous waste was often the preferred management method and that regulations were leading to an unnecessary quantity of this waste type being landfilled.

Stockpiling is also a key concern for hazardous waste management. In 2017, EPA Victoria sought to remove a stockpile of approximately one million tyres from a Stawell site after it was determined that the stockpile posed a major hazard for nearby communities in the event of a fire on the site.[243]

Due to the nature of hazardous waste and its potential health and environmental impacts, its treatment and disposal can come under immense public, political and media scrutiny.

10.3.2 Legacy and emerging waste

Hazardous waste and hazardous waste treatment and disposal can be considered in terms of 'legacy' and 'emerging' waste, examples of which are detailed below. Legacy wastes are generally those that have experienced high levels of use and often have existing or developing hazardous waste management systems. Emerging wastes are those which are new and/or increasing in quantity due to trends in consumption and/or changes in technology.

Asbestos

Asbestos is a particularly problematic legacy hazardous waste, which is unable to reused or recycled and must be disposed of carefully and safely. There are health risks associated with asbestos, as asbestos fibres are hazardous when inhaled. If they are incorrectly handled, stored or transported, the fibres can be released into the air. Special legislative requirements apply to the handling, storage and transportation of asbestos. Disposal of asbestos therefore attracts the landfill levy and also higher landfill fees.[244] This may lead to an unwillingness to pay, increasing the likelihood of illegal dumping of asbestos. This is particularly problematic given the associated health risks.

A local government survey conducted by the EPA suggested that asbestos comprised 8% of illegally dumped material (3% mixed with other waste, and 5% not mixed with other waste).[245]

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[242] Department of Environment and Energy. (2017). *Hazardous Waste in Australia 2017*. Sourced from: http://www.environment.gov.au/system/files/resources/291b8289-29d8-4fc1-90ce-1f44e09913f7/files/hazardous-waste-australia-2017.pdf

[243] EPA Victoria. (2018). *Stawell tyre stockpile cleanup*. Sourced from: https://www.epa.vic.gov.au/our-work/current-issues/odour-and-air-quality/stawell-tyre-stockpile-cleanup

[244] KPMG 2012. *Review of the NSW Waste and Environment Levy*. Sourced from: https://www.epa.nsw.gov.au/~/media/EPA/Corporate%20Site/resources/wasteregulation/waste-levy-review-report.ashx

[245] EPA 2015. *Illegal Dumping Research Report*. Sourced from: https://www.epa.nsw.gov.au/~/media/EPA/Corporate%20Site/resources/illegaldumping/150481-illegal-dumping-report.ashx

Per and Poly-fluoroalkyl substances (PFAS)

Some substances can be considered both legacy and emerging waste due to early adoption and ongoing use with an understanding of its hazardous properties. Per- and poly-fluoroalkyl substances, also known as 'PFAS', are a group of manufactured chemicals that have been used since the 1950s in anthropogenic synthetic compounds with a range of common household products and specialty applications, including in the manufacture of non-stick cookware; fabric, furniture and carpet stain protection applications; food packaging; some industrial processes; and in some types of fire-fighting foams. There are many types of PFAS, with the best known substance being perfluorooctane sulfonate, known as 'PFOS'.[246]

Due to concerns about their persistence, bioaccumulation and environmental toxicity, the National Industrial Chemicals Notification and Assessment Scheme (NICNAS), has recommended since 2002 that Australian industries should actively seek alternatives to PFASs and PFAS-related substances.[247] Further, a recent federal parliamentary inquiry has recommended the Australian Federal Government offer financial compensation to Australian residents affected by PFAS contamination.[248]

More recently, PFAS have been found to have contaminated sites where there has been historic use of fire-fighting foams that contained PFAS. Over time, these chemicals have worked their way through the soil to contaminate surface and ground water, and have migrated into adjoining land areas. The release of PFAS into the environment is an emerging concern, because these chemicals are highly persistent, have been shown to be toxic to fish and some animals, and can accumulate in the bodies of fish, animals and people who come into contact with them. However, there is currently no consistent evidence that exposure to PFAS causes adverse human health effects.[249]

Acceptance of PFAS-contaminated materials is a commercial decision for the landfill operator and must be approved by the environmental regulator. Site-by-site assessment will be required when determining whether or not a current or new landfill is appropriate for accepting PFAS-contaminated materials or whether a closed landfill may require additional monitoring or controls.[250]

PFAS-contaminated materials may be considered by environmental regulators for reuse under some circumstances. Assessment of reuse options for PFAS-contaminated materials will be based on the principles that reuse of the material must not lead to an unacceptable risk to human health or the environment. Common uses for PFAS-contaminated materials are as fill material or construction material, noting the need to consider PFAS leachability.[251]

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[246] Australian Health Protection Principal Committee. (2016). *Per- and poly-fluoroalkyl substances (PFAS) FactSheet*. Sourced from: https://www.health.gov.au/internet/main/publishing.nsf/Content/A12B57E41EC9F326CA257BF0001F9E7D/$File/PFAS-factsheet-15June2016.pdf

[247] Ibid

[248] Nguyen, K. (2018). *PFAS crisis opens residents to compensation payouts after federal inquiry report tabled*. ABC News. Sourced from: https://www.abc.net.au/news/2018-12-03/pfas-contamination-residents-compensated-federal-inquiry/10576552

[249] Australian Government Department of Health. (2019). *Per- and poly-fluoroalkyl substances (PFAS)*. Sourced from: (http://www.health.gov.au/internet/main/publishing.nsf/Content/ohp-pfas.htm)

[250] HEPA (Heads of EPAs Australia and New Zealand) 2017. *PFAS National Environmental Management Plan*.

[251] HEPA (Heads of EPAs Australia and New Zealand) 2017. *PFAS National Environmental Management Plan*.

PFAS is treated and disposed of by private companies. One such company, Toxfree (a subsidiary of Cleanaway), treats PFAS by plasma arc destruction and thermal desorption rather than landfill, which would likely exacerbate existing bioaccumulation.[252]

Batteries and E-waste

With the growing use of technology in homes and businesses across NSW, there is an increasing need for the disposal of electronic and electrical wastes (e-waste) and other emerging technological waste types. E-waste with hazardous properties, such as lithium batteries, pose a serious hazardous waste challenge. With quantities of lithium battery waste growing at 20 per cent per year (with a mere 2 per cent recycling rate nationally), treatment of emerging e-waste categories is an acute issue for the hazardous waste treatment sector.[253] Batteries have been a priority for national product stewardship action since 2013. A number of initiatives have taken place to raise awareness and increase the recycling rate of batteries in Australia, however, efforts are not keeping pace with the rate of growth in waste volumes.

The Battery Stewardship Council (BSC), formed in 2018, combines government and industry bodies to undertake background work to understand the markets and barriers to recycling that need to be addressed in a product stewardship scheme.[254] The BSC is also responsible for designing a battery stewardship scheme and is currently consulting on their proposal for a voluntary scheme accredited under the Product Stewardship Act. The BSC is supported by the Australian Battery Recycling Initiative (ABRI), a not-for-profit association established in 2008 to promote responsible environmental management of batteries at end of life. The current membership includes battery manufacturers, consumer electronics suppliers, recyclers, government agencies (including the EPA) and environmental organisations.[255]

Other examples of emerging waste includes photovoltaic systems (solar panels), which have an average operational life of 20-30 years, and has experienced a high level of demand and installation on residential properties. Large quantities of solar panels will likely need to be treated and disposed of in coming years. Environment Ministers agreed in April 2018 to fast-track the development of new product stewardship schemes for photovoltaic solar panels and associated system components. The Victorian Government is currently leading national work to understand the markets and barriers to recycling that need to be addressed in a photovoltaics product stewardship scheme for photovoltaic panels. However, the scheme design has not yet been developed.

Victoria will ban electronic waste in landfill from July 2019, including all parts of a photovoltaic system, which will necessitate the implementation of recycling regimes for all e-waste types.[256]

10.3.3 Considerations for the 20-Year Waste Strategy

Management of hazardous waste, both legacy and emerging, is an important issue, especially from the perspective of potential health and environmental impacts. The 20-year waste strategy may consider the following issues associated with hazardous waste:

- the strategy needs to be agile enough to adapt to information about emerging waste types with strategies being developed in conjunction with the Commonwealth and other states.

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[252] Toxfree. (2019). *PFAS Treatment*. Sourced from: https://www.toxfree.com.au/pfas-treatment/

[253] CSIRO. (2018). *Lithium-ion battery recycling*. Sourced from: https://www.csiro.au/en/Research/EF/Areas/Energy-storage/Battery-recycling

[254] Waste Management Review. (2018). *Battery Stewardship Council welcomes changes*. Sourced from: http://wastemanagementreview.com.au/battery-stewardship-council-welcomes-changes/

[255] ABRI. (2019). *About ABRI*. Sourced from: http://www.batteryrecycling.org.au/about/about-abri

[256] Hasham, N. (2019). *Waste crisis looms as thousands of solar panels reach end of life*. The Sydney Morning Herald. Sourced from: https://www.smh.com.au/politics/federal/waste-crisis-looms-as-thousands-of-solar-panels-reach-end-of-life-20190112-p50qzd.html

Stakeholders have highlighted the need for targeted strategies for known problematic wastes like tyres, asbestos and PFAS (including, for example, amnesty periods for disposal of asbestos waste to combat dumping) and the need for stronger obligations under product stewardship and producer responsibility schemes;

- there is a need for hazardous waste initiatives to be regulated (stakeholders commented that the ACCC's proposed funding model for a battery stewardship scheme, for example, is not enough); and
- there is a need for national enforceable standards and guidelines that industry can adopt and implement. The current landscape of hazardous waste management is characterised by a number of inconsistent state guidelines, which stakeholders claimed created perverse incentives for disposal.

10.4 Illegal dumping

The EPA defines illegal dumping as the disposal of waste larger than litter on land or in water without the appropriate environment protection licence or planning approvals.[257] In urban areas, dumping is often on vacant or pubic land and waterways at the edge of the city. The NSW Government has committed to reducing all types of illegal dumping by 30% by 2020, from a July 2017 baseline. The strategy sets out a number of areas for action to achieve this goal, including building an evidence base, stakeholder engagement and capacity building, education and awareness, prevention, infrastructure and cleanup, regulation and enforcement, and evaluation and monitoring.[258]

Due to the nature of illegal dumping, which often takes place in remote areas, it is difficult to gain a full understanding of the number of incidents that occur. Nevertheless, it is estimated that household waste comprises approximately 47% of all illegally dumped waste in the state, followed by green waste, construction and demolition waste, and tyres.[259]

This corroborates research conducted by the EPA in 2015, which found that more than half of the responding local government areas had noticed an increase in the illegal dumping of household waste and asbestos in the past five years.

The same research also found that for land managers, the primary problem caused by illegal dumping is the cost of dealing with dumped waste, with 11% of local government areas each spending more than half a million dollars a year on activities relating to the prevention, monitoring and management of illegal dumping.[260]

In a submission to the NSW Parliamentary Inquiry, the Waste Contractors and Recyclers Association of NSW identified a number of potential reasons for illegal dumping:

- the high cost of operating and using regulated landfills and transfer stations;
- the potential to claim a waste levy refund on exhumed waste, which acts as an incentive to dump and stockpile waste and then exhume it;

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[257] NSW EPA. (2017). *About illegal dumping and dumpers*. Sourced from: http://www.epa.nsw.gov.au/your-environment/litter-and-illegal-dumping/illegal-dumpingdumpers.

[258] NSW EPA. (2018). *NSW Illegal Dumping Strategy 2017–21*. Sourced from: https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/illegaldumping/17p0158-epa-illegal-dumping-strategy.pdf

[259] NSW Parliament. (2018). *'Energy from waste' technology. Portfolio Committee No. 6 – Planning and Environment. Sydney, NSW*. Sourced from: https://www.parliament.nsw.gov.au/lcdocs/inquiries/2436/Final%20-%20Report%2028%20March%202018.pdf

[260] NSW Parliament. (2018). *'Energy from waste' technology. Portfolio Committee No. 6 – Planning and Environment. Sydney, NSW*. Sourced from: https://www.parliament.nsw.gov.au/lcdocs/inquiries/2436/Final%20-%20Report%2028%20March%202018.pdf

- the potential for certain landfills to operate as de-facto transfer stations and claim a waste levy refund;
- inadequate enforcement;
- rogue elements in the waste sector with little regard for regulations and waste management objectives.[261]

10.5 Litter

Litter is commonly defined as any abandoned material, organic or inorganic, that can be held or carried in a person's hand. Littering reduces urban amenity and pollutes both land and waterways. Litter can also block critical infrastructure, such as stormwater and sewage systems, resulting in localised flooding and infrastructure damage. Once in the environment, some forms of litter such as plastics, metals and glass will persist for decades and accumulate in the environment. There is currently concern about the impacts of the accumulation of plastics in the environment, and particularly their impact on aquatic and marine environments.

It is estimated by the EPA that, each year, over 25,000 tonnes of litter is tossed in NSW.[262] However, annual litter surveys conducted by Keep Australia Beautiful suggest a decline in the number of littered items, particularly cigarette butts and paper.[263] This may reflect a decline in smoking and print media, as well as effective litter prevention and community engagement.

The WARR Strategy had an objective of reducing the number of litter items by 40% and then continue to reduce litter items to 2021-22. The EPA advised that litter items had reduced by 30% in 2016-17.

10.6 Interstate transfer

Interstate transfer is problematic insofar as it hinders recycling efforts in NSW. That is, the opportunity to re-use or recycle waste materials within the NSW economy is lost. It also has other impacts, such as increased heavy traffic on roads and increased carbon emissions as a result of transport.

In 2014, the NSW Government introduced a law in 2014 designed to stop the interstate waste trade, known as the proximity principle. The Protection of the Environment Operations (Waste) Regulation 2014 made it an offence to transport waste by motor vehicle more than 150 kilometres from the place of generation. However, the proximity principle was challenged by a waste transporter, leading to the EPA forming the view that it offended section 92 of the Constitution and hence relaying to the industry that the regulation would not be enforced.[264]

In relation to the interstate transfer of hazardous waste, there is a National Environment Protection Measure (NEPM) in place to cover the transport of controlled waste between Australian states and territories. The NEPM establishes a national system to track controlled waste being moved between states and territories to ensure it is properly identified,

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[261] NSW Parliament. (2018). *'Energy from waste' technology. Portfolio Committee No. 6 – Planning and Environment. Sydney, NSW*. Sourced from: https://www.parliament.nsw.gov.au/lcdocs/inquiries/2436/Final%20-%20Report%2028%20March%202018.pdf

[262] NSW EPA. (2019). *Litter and illegal dumping*. Sourced from: https://www.epa.nsw.gov.au/your-environment/litter-and-illegal-dumping

[263] Keep Australia Beautiful (2019). *National Litter Index*. Sourced from: http://kab.org.au/litter-research/national-litter-index/

[264] NSW Parliament. (2018). *'Energy from waste' technology. Portfolio Committee No. 6 – Planning and Environment. Sydney, NSW*, p. 48. Sourced from: https://www.parliament.nsw.gov.au/lcdocs/inquiries/2436/Final%20-%20Report%2028%20March%202018.pdf

transported and handled.[265] A controlled waste is one that can harm human health and the environment unless it is managed properly (controlled wastes are listed in Schedule 1 of the *Protection of the Environment Operations (Waste) Regulation 2014*).

It has been estimated that, during 2016-2017, 830,000 tonnes of waste was transported to Queensland from New South Wales. This was an increase from 430,000 tonnes of waste was transported in 2015-2016. It has also been observed that the waste being transported interstate to Queensland from NSW is largely C&D waste.[266]

The primary driver behind the transfer of waste from NSW to Queensland is the fact that Queensland has no waste levy, making it significantly cheaper to landfill waste in Queensland than in the regulated area of NSW. The Queensland Government has released a new waste management and resource recovery strategy to increase recycling rates within the state. The strategy will be underpinned by a waste disposal levy which is proposed to commence on 1 July 2019.[267]

Stakeholders have expressed the view that waste will continue to be transported to Queensland as long as it is cost effective to do so. Stakeholders estimated that up to two thirds of the volume currently being transported to Queensland will be seeking alternate landfill options in NSW post 1 July 2019. The shift of NSW waste volumes away from Queensland may negatively impact on operators who have invested in infrastructure to take advantage of the difference in the waste levies between the two states.

It will be important to monitor the impact of Queensland's new waste levy on rates of interstate transfer of waste, which may highlight other drivers of interstate transfer. It will also be important to consider how the price differences between the NSW and Queensland schemes will continue to influence rates of interstate transfer.

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[265] NSW EPA (2018). *Tracking Waste out of NSW or overseas*. Sourced from: https://www.epa.nsw.gov.au/your-environment/waste/tracking-transporting-hazardous-waste/tracking-waste-out-nsw

[266] NSW Parliament. (2018). *'Energy from waste' technology. Portfolio Committee No. 6 – Planning and Environment. Sydney, NSW*. Sourced from: https://www.parliament.nsw.gov.au/lcdocs/inquiries/2436/Final%20-%20Report%2028%20March%202018.pdf

[267] Queensland Government. (2018). *Waste disposal levy*. Sourced from: https://www.qld.gov.au/environment/pollution/management/waste/recovery/disposal-levy

11 Infrastructure

It is generally acknowledged by state and local governments and the waste management and resource recovery industry that NSW is facing the challenge of insufficient infrastructure (including transfer stations and processing plants, organics and recycling facilities).[268]

There is a gap between available facilities for waste processing and projected waste generation figures. For example, an Infrastructure Needs Assessment conducted by the Western Sydney Regional Organisation of Councils in 2015 identified that by 2021, there will be a 994,000 tonne gap between the capacity of processing facilities and the volume of waste generated in the Sydney metropolitan region.[269]

Local Government NSW, in its submission to the NSW Parliamentary Inquiry into Energy from Waste, noted that many regional areas have limited access to adequate recycling facilities. However, the focus was predominantly on the insufficient supply of waste services in the Sydney metropolitan area, including:

- limited recycling and resource recovery facilities for all types of waste and technologies;
- insufficient access to putrescible landfill, with the Suez facility at Lucas Heights the only active putrescible landfill in Sydney, and access to Veolia's Woodlawn facility constrained by licensing requiring transport by rail;
- limited capacity of the two AWT facilities in metropolitan Sydney (Suez AWT at Kemps Creek and UR-3R at Eastern Creek).

There are a range of factors hampering waste infrastructure planning and development. Submissions to the NSW Parliamentary Inquiry into Energy from Waste highlighted the following factors:

- a failure to hypothecate a sufficient portion of the waste levy to infrastructure development, rather than it being remitted to the state's consolidated revenue;
- the government has to date played a limited role in strategic planning for waste infrastructure, leading to industry-led, 'ad hoc' infrastructure planning and development driven by commercial imperatives rather than long-term, strategic waste management considerations; a lack of up-to-date waste data has also undermined the ability of government and industry to assess the current demand for waste services and to systematically and pre-emptively identify and address any gaps in infrastructure;
- a lack of certainty in the planning process, and no dedicated approvals pathway for waste infrastructure.

In this context, two key areas of opportunity in relation to waste management and resource recovery infrastructure are investment and planning.

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[268] NSW EPA (2017). *Waste and Resource Recovery Infrastructure Strategy 2017-2021*. Sourced from: https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/wastestrategy/140876-warr-strategy-14-21.pdf

[269] NSW Parliament. (2018). *'Energy from waste' technology. Portfolio Committee No. 6 – Planning and Environment. Sydney, NSW*. Sourced from: https://www.parliament.nsw.gov.au/lcdocs/inquiries/2436/Final%20-%20Report%2028%20March%202018.pdf

11.1 Infrastructure investment

Local governments and regional organisations of councils face legal and financial limitations that hinder their ability to support the development of waste infrastructure. Individual councils lack the influence and resources to secure suitable sites and address these issues. Regional and joint organisations are similarly limited in their power and capability to drive the procurement of appropriate sites for waste infrastructure.

On the other hand, private operators often lack the certainty to make invest decisions or attract funding for new waste infrastructure. This is due both to uncertainty in relation to planning pathways (addressed below), as well as uncertainty in relation to government policy and regulations, future waste streams, and ongoing demand for recycled materials.

11.2 Infrastructure planning

It is clear from consultations that there is a pressing need for waste management planning at a strategic level and better access to timely and accurate data if the state's long term resource recovery and waste disposal infrastructure needs are to be met.

Unlike other Australian jurisdictions, NSW does not currently have a waste infrastructure strategy or plan. In 2017, recognising that achievement of NSW's recycling and waste avoidance targets required significant investment in infrastructure, the EPA released the draft *NSW Waste and Resource Recovery Infrastructure Strategy 2017-2021*.

The purpose of the draft strategy was to assist councils and waste industry participants to understand the expected increase in waste streams and to plan to ensure sufficient infrastructure capacity is available to process the projected volumes. A consultation process was undertaken and this draft has not been finalised. Responses were wide ranging but largely reflected five themes:

1 clarifications, additional information and updates to data (including a desire for a proposed projections tool that allows users to develop their own projections by adjusting assumptions and timeframes);

2 increased coordination and planning across State government departments and between State, Federal and Local government – i.e. to make planning and building of new facilities simpler;

3 market development – the need for government assistance to develop end markets for recyclable materials;

4 develop a long-term strategy beyond 2021 – the draft strategy was seen more as a needs analysis than a strategy that sets long-term goals and the actions needed to achieve them. There was consensus that industry and local government want a longer-term strategy that goes beyond 2021; and

5 need for an accurate region by region analysis – in the plan a number of assumptions had been made for each region. Local knowledge was used to comment on some of these assumptions.

An overarching strategy would allow a coordinated approach to a number of key infrastructure challenges, including:

- the availability of land to site projects, particularly in metropolitan areas, as a result of urban encroachment and competition for industrial and commercial land;
- waste transportation between facilities, particularly where it is not viable to build waste infrastructure in certain locations, particularly Sydney, as a result of high land prices and urban encroachments;
- community challenges and opposition to waste facilities, particularly in urban areas;

- identification of appropriate precincts and locations, including buffer zones, for waste infrastructure;
- the demand and support for and viability of alternative waste treatment facilities;
- transportation challenges, such as poor road networks, long travel times and lack of convenient aggregation points;
- closure of key facilities.

Within this context, there is an opportunity to review the planning system with a view to developing a dedicated planning approvals pathway to help streamline approvals for necessary waste infrastructure. This could be in the form of a waste management infrastructure strategy to provide clear development pathways for waste infrastructure.

11.3 Stakeholder Feedback

Feedback from stakeholders consulted and research undertaken indicated that there is a need to review the existing approach to waste infrastructure planning.[270] Specific observations included:

- the State needs to recognise waste as an essential service with essential infrastructure and future planning needs to be a strategic planning process;
- planning for an effective network of waste infrastructure needs to be coordinated with broader road and rail planning (e.g. access to transfer stations and intermodal facilities) as waste planning failures can manifest as more trucks on the road and bottlenecks in waste movements;
- there is a need for the State to drive the waste agenda by providing a more strategic view of waste management, including influencing where the next generation of waste infrastructure needs to be located;
- the NSW Government would benefit from a waste infrastructure strategy that reflects the collective views and commitments of the various government department (Transport for NSW; Department of Environment and Energy; Department of Industry; EPA; Department of Planning, Premier and Cabinet etc.);
- there is a need for greater coordination between the EPA and the Department of Planning;
- industry would benefit from more timely data. At present there may be a several year lag in the release of waste data. Industry would also benefit from more forward looking information to assist with planning (e.g. megatrends on population growth and movements; state growth strategies; business and infrastructure investment and flow on factors relevant to waste considerations e.g. the nature of number of businesses expected in new precincts – Greater Western Sydney; airport precinct etc.);
- strategic planning needs to recognise the impediment caused by the cost of land in metropolitan locations. Strategic planning needs to identify and secure land for current and future needs;
- creation of waste locations or precincts; establishing buffer zones from residential encroachment; stronger planning requirements for new building developments to support waste infrastructure and appropriate access and turning circles for waste transport equipment;

[270] Including submissions to the recent NSW Government inquiry into 'Energy from Waste' technology

- a greater portion of the waste levy needs to be devoted to waste infrastructure;
- strategic planning needs to be undertaken on a whole of state basis, but recognising strategic priorities and approaches are not uniform across the state (e.g. regional vs metropolitan needs and issues are not uniform);
- local councils can make a positive contribution to regional planning, which will support improved regional coordination and improved waste recycling outcomes. It was recognised that councils currently limit their planning to a shorter time horizon;
- strategic planning and policy development should take into consideration contestability and competition objectives and the need to avoid monopoly or duopoly outcomes.

The above observations were generally consistent across local government and various participants in the waste industry.

11.4 Considerations for the 20-year waste strategy

As part of the 20-year waste strategy it will be appropriate to review the future approach to waste infrastructure planning over the different time horizons and how waste planning requirements can be consistently embedded across the different policy, regulatory and planning frameworks that exist across both State and local governments. Industry has expressed a strong desire to support the development of waste infrastructure strategic plans which they view as aiding business confidence and understanding of the longer term direction of the NSW waste industry. Considerations are discussed further in Key Finding 16 and include:

- developing a waste infrastructure strategy that reflects the collective views and commitments of relevant government departments and agencies and prioritise clear guidance to industry on infrastructure needs and their location;
- strategic planning to identify and secure land for current and future waste infrastructure needs;
- developing a dedicated planning approvals pathway to streamline approvals for necessary waste infrastructure;
- provision of more timely and accurate data to support strategic planning (see Key Finding 20).

Appendices

Appendix A - Waste and Resource Reporting Portal Data

Overview

The majority of scheduled waste facilities in NSW are required to report to the EPA through the Waste and Resource Reporting Portal (WARRP). Levy-liable facilities located in the regulated area, or receiving waste from a regulated area, are required to provide a Waste Contribution Monthly Report (WCMR) with the following information:

- waste received (by source; waste stream; waste type and levy area); and
- waste transported from the facility (by waste stream; waste type; levy area and destination – being disposal at landfill or lawful recovery either intrastate, interstate or overseas or transported under resource recovery orders).

Landfills outside the regulated area, and levy-exempt intermediary facilities which are located in the regulated area, or receiving waste from a regulated area, are required to report the following data on an annual basis (Annual Waste Report "AWR"):

- waste received (by waste stream; waste type and levy area); and
- waste transported from the facility (by waste stream; waste type; destination – being disposal at landfill or lawful recovery e1ther intrastate, interstate or overseas; or transported under resource recovery orders).

Reporting through the WARRP was first implemented in FY16.

The nature of data collected and the structure of its collation is considered to be more comprehensive than the data collected prior to FY16 and is considered to provide a more robust assessment of waste flows in NSW as well as the state's performance against the WARR Strategy targets.

Implementation of the new reporting resulted in a number of errors and quirks in data reported by licensed facilities. The EPA has reviewed the data submitted and made adjustments for reporting errors or quirks in calculation of the FY16-18 datasets. Where a facility was required to report in FY16 but did not do so, FY17 data has been include as a proxy for the FY16.

The EPA advised that the quality of the data reporting has improved since FY16, although there remains a number of areas that require ongoing monitoring (see below).

Whilst the EPA has reviewed the data submitted and made adjustments as required, the FY16 data is considered to be less reliable than FY17 and FY18.

Data Adjustments

In analysing reported data, various adjustments were processed against the underlying data by the EPA including:

- adjustments for double counted tonnes recycled in the following instance:
  - Some tonnes transported intrastate to an unspecified destination for further processing were identified as actually being transported to a licensed reporting facility;
  - Facilities reporting under AWRs are not required to report waste transported to another facility; double-counting was identified through interviews);
- Adjustments to correct errors in the identification of waste streams for Waste Received by facilities: adjustments are made to the extent that EPA identified anomalies through their data analysis. Anomalies are identified through a comparison of the waste mix (MSW, C&I, C&D) of the

destination facility with the originating facility. Anomalies were investigated where the error was +/- 20% and greater than 10,000 tonnes;

- Waste streams reported as unknown for Waste Transported are allocated to MSW, C&I and C&D based on a facility's received waste stream mix.

The EPA utilises an underlying methodology to identify anomalies and proposes adjustments in accordance with the prescribed methodology (providing a measure of consistency year to year).

A number of simplifying assumptions underlie the methodology, which are considered to improve the accuracy of the reported data (relative to the base data reported by facilities), but are likely to incorporate some residual error, which EPA do not consider to have a material impact on the output.

Data exclusions

Whilst the WARRP provides a comprehensive data set, it does not capture all data relevant to NSW waste flows. Exclusions include:

- Some waste recycled in the NLA (although estimates are made in the FY16-18 datasets to account for this);
- Waste subject to a Resource Recovery Order that does not need to go through a waste facility (e.g. VENM transferred from one construction site to another); and
- Waste generated and managed on-site (which encompasses most Mining, Forestry, Fishing and Agricultural wastes).

Data assumptions

- Waste transported interstate and overseas for recovery is treated as being recycled.
- Waste transported interstate for disposal is treated as being disposed to landfill.
- Where gaps exist in the dataset, estimates have been included using other information sources.
- Metals split assumed to be 20% MSW and 40% each for C&D and C&I.
- Metals by levy area was allocated on the basis of the population proportion by levy area.
- Licensed masonry facilities that did not report waste data were assumed to recycle tonnes equal to 60% of maximum licensed throughput.
- A 36% mass loss adjustment factor is applied to organics transported for recovery.
- Organic waste recycled tonnes include an allowance for scheduled waste facilities that did not report in the WARRP based on 70% of their maximum licensed throughput.
- Due to limited available data in the WARRP, the EPA engaged a consultant to determine plastic recycling based on surveys of plastic recyclers and import and export data by waste stream. Recycling of plastics by waste area was based on the population proportion by levy area.

Data deficiencies

The EPA has recognised a number of areas where improvements may be made in data collection. These include:

- Waste originating from an interstate or overseas source, unless specifically notified as being from this source, may influence recovery rates.
- Whilst attempts are made to avoid double counting, AWRs do not identify tonnes transported intrastate to another reporting facility;
- Ongoing issues with the accuracy and completeness of data reporting by facilities;
- A number of resource recovery facilities do not report in WARRP for various reasons. Where relevant, the EPA has sought to estimate the missing data;

- EPA does not have visibility as to what materials are going into landfill. Some insights provided through audits, but these are infrequent;
- Data reporting does not capture C&D materials that are recycled on site and sent to another site (without going through a waste facility); and
- Scrap metal recyclers and processors are unable to identify the waste streams associated with metal waste volumes and so the EPA allocates it on the basis of 20% to MSW and 40% to both C&D and C&I. Metals by levy area are not identifiable and therefore allocated on the basis of population.

The EPA advised that education of facility operators and improvements in the WARRP reporting templates will mitigate the above issues.

Is discussing other potential data quality issues, the EPA has provided the following additional observations:

- **Paper**: Recovery facilities in the NLA and facilities with less than 6,000tpa are not required to report in the WARRP. However, it is assumed that paper and cardboard will end up with at a facility reporting (paper mills) in the WARRP and therefore paper tonnages are captured.
- **Glass**: EPA have indicated concerns over the accuracy of FY17 glass data. The EPA was required to estimate glass volumes for 3 month of FY17 for a new recycling facility (as it was not required to report during the 3 month period). The EPA believes they are likely to have overestimated the volume of glass recycled in this period.

As part of the situational analysis, we have not undertaken a comprehensive assessment of what data is currently being collected, however, the following observations are made.

1. There is a lack of easily accessible information to assist with strategic planning, both within the EPA and for industry. Examples include:
    - There is no comprehensive data strategy in place that supports the timely collection of data in a standard format that can be used for planning as well as reporting purposes. Existing data capture focusses on end outputs (i.e. diversion rates);
    - There is no data portal (accessible internally or externally) that provides access to recent data on waste generation volumes by waste stream; LGA or material type;
    - There is no mapping of waste facilities, including data on location; waste processed; licenced capacity; volumes processed and remaining life (for landfills); and
    - Mapping of waste flows from generation through to disposal is incomplete.

    Access to this level of information would be beneficial for strategy and planning purposes both within the EPA and by industry.
2. There is limited readily accessible and timely information on the composition of waste streams for MSW, C&I and C&D or the composition of waste going to landfill. Information may be contained within various audit consultants reports.
3. There is limited detailed information on the flow of waste across the waste management flow – from collection, transfer, sorting, recycling and disposal. This limits the ability to monitor and evaluate performance against outcomes.
4. Scrap metal recyclers and processors are unable to identify the waste streams associated with metal waste volumes and so the EPA allocates it on the basis of 20% to MSW and 40% to both C&D and C&I.
5. Not all scrap metal processors are required to report waste volumes, the EPA relies primarily on volumes reported by the scrap metal reprocessors and ABS export volumes.
6. Not all processors and users of waste materials are required to report waste volumes. For example, the EPA engages an external consultant to estimate plastic waste flows.

As NSW moves towards a more circular economy, the EPA will need complete and accurate data to understand the volume of waste generated, its movements through the waste stream, how it is managed (whether through landfill; waste to energy; re-use; recycled for use in domestic or export markets) and ultimately what proportion of materials are going back into the circular economy.

The nature of the data required will be influenced by the relevant policy levers and objectives being set. Data will be required to monitor the effectiveness of the policies being implemented (at point of generation as well as the efficiency and effectiveness of processing activities) and the progress being made towards achieving specific targets. It should also be used to identify emerging waste trends; potential areas of underperformance; areas for additional investment or service providers that are failing to support the realisation of the waste policy objectives and therefore may be in need of additional support or other responses.

The transition to a circular economy will occur over an extended period and therefore the data strategy will need to consider immediate as well as longer term data needs.

International experience – Scotland case study

Most of the jurisdictions considered in Volume III – International Benchmarking that are transitioning to a circular economy have implemented comprehensive data strategies.

The following section provides a high level overview of Scotland's waste data strategy.

Scotland Waste Data Strategy

Scotland's waste data strategy aims to meets Scotland's immediate and future waste data needs as it transitions to a more circular economy. The strategy was underpinned by an action plan, containing five strategic aims and actions. Key elements of the actions were to be completed during the first 2 years, with other actions to be completed over the medium term (3-5 years).

The waste data strategy was developed in conjunction with industry and other key stakeholders, allowing industry time to understand why data was required, its importance to the overall circular economy and time for systems to be established and requirements reflected in contractual arrangements etc.

The Strategy's strategic aims and key actions include:

1. **Track waste from the point of production to its final destination**

   The initial action under the Scottish data strategy was to design and implement an electronic waste data and tracking system. The system was designed to meet relevant regulatory requirements, in consultation with industry. The process allowed the identification of those items that would be mandatory and the capacity of industry to respond (and over what time).

2. **Provide data to support the circular economy**

   This action focused on the methodology to understand the composition of waste in C&I and MSW; the methodology for testing the composition of the residual waste streams when they arrived at land fill and methods to communicate key findings to relevant stakeholders.

   The key actions also focused on developing and understanding materials flows; the metrics (and standard definitions) to be monitored (and frequency of reporting) to assess progress towards a circular economy; and options for developing a tool for businesses to benchmark their performance against sector, industry and national standards.

3. **Monitor progress against Scottish Government and EU waste targets**

   The initial focus was on establishing a baseline against which to monitor and publish progress towards waste targets.

   Consideration was also given to internal processes to monitor and if required to implement actions to address non-compliance with reporting or other issues with respect to achieving improved waste outcomes.

4. **Improve the quality of data reported by businesses and local authorities**

   Actions included developing standard data protocols for councils to include in their waste contracts; programs to engage with data providers to try and address issues they were encountering and provide feedback on data quality issues.

5. **Improve the interaction with data customers**

   Key actions focused on agreeing what data would be publicly accessible or published (and when); processes for monitoring the efficiency and effectiveness of the data gathered and opportunities for ongoing engagement with industry and other stakeholders.

MSW reporting requirements

Household waste data is reported via the website WasteDataFLow. This is a data collection portal used by all Scottish local authorities to record the waste it has collected and managed.

Local authorities are given the choice to enter and validate their data either monthly, quarterly or annually. The data verification process is undertaken by the Scottish EPA ("SEPA") annually.

The reporting tool includes survey style questions on waste collection, which allow for input of data and commentary.

For MSW, data is sought in respect of household kerbside collection, residual waste collected, illegal dumping and abandoned vehicles. The questions are directed at local authorities 'or its contractors' - at which point local authorities are required to get this information as a part of their contract with their service provider.

Data on waste material that is sent to a MRF or a sorting facility for recycling is also collected and must be reported through this tool. All licensed facilities are registered as a part of this tool and local authorities need to select the facility and enter the tonnage of waste they processed through the facility including information on the type and volume of wastes.

Local authorities must for each material listed in the reporting tool, report:

- the quantities that are collected by or on behalf of the authority from households for recycling/composting;
- the quantity collected for recycling/composting but actually disposed;
- the number of households receiving a collection; and
- the quantity collected for reuse and the quantity collected for reuse but actually disposed.

Local authorities must also indicate if the material is collected co-mingled.

MRF reporting requirements

A Code of Practice for has been implemented for MRFs that requires the sampling and reporting of materials received by a MRF.

Facilities likely to be in scope include:

- Material Recovery Facilities (MRFs) receiving and sorting mixed dry recyclable waste and/or separately collected dry recyclable waste.
- Commercial waste treatment operations and transfer stations where materials similar to mixed dry recyclable waste are sorted into two or more output materials (e.g. a MRF sorting plastics and cans would be in scope).

The requirements apply to any MRF that receives or is likely to receive more than 1000 tonnes of mixed dry recyclable waste in any reporting year.

Input material (mixed dry recyclable waste and separately collected dry recyclable waste received for sorting) must be sampled to identify the types of target, non-target and non-recyclable materials.

Target materials must, as a minimum; be separately identified by reference to glass, paper, cardboard, metal and plastic.

Whilst there is no requirement to sort and record incoming material into further sub-categories, it is recommended that this is done in order to provide comprehensive management information and maximise the benefits of sampling.

Reporting requirements

Input Materials: For each supplier, the MRF must record and report:

- The total weight in tonnes of input material received at the facility, from each named supplier, during each reporting period.
- For rejected loads and materials transferred onwards for sorting at another facility, the total weight in tonnes, the identity of the supplier and, where appropriate, the buyer, date material rejected / transferred, reason for rejection / transfer and where the rejected / transferred material is sent.
- The weight and composition of each input material sample taken at the MRF from each named supplier during a reporting period, and the total number of samples taken and the total weight in kilograms of all samples taken.
- The mean percentage composition levels of target glass, metal, paper, cardboard and plastic in input material received, based on all applicable sample results.
- The mean percentage composition levels of target material, non-target material and non-recyclable material received, based on all applicable sample results.
- The standard deviation of the mean percentage composition level of target material, based on all applicable sample results.

Output material: In any given reporting period, the MRF, license or permit holders must record and report:

- The weight and composition of each output material sample taken at the MRF, by reference to the type of target, non-target and non-recyclable material that is contained in the sample, and the total number of samples taken for each output material, and the total weight in kilograms of all samples taken for each output material.
- The mean percentage composition levels of all of the samples taken for output material by reference to the grades of glass, metal, paper, cardboard and plastic identified within those samples.
- The mean percentage composition levels of target materials, non-target materials and non-recyclable materials in the output materials, based on all of the applicable sample results.
- The standard deviation of the target materials for each output material sample tested.
- The total weight in tonnes of output material by reference to the type of target, non-target and non-recyclable material that leaves the MRF in each reporting period.
- The total weight in tonnes of mixed dry recyclable waste that leaves the MRF for sorting at another MRF during a reporting period and where it is sent.

SEPA supplies each MRF with an electronic document to capture and assist with calculation of all relevant information.

Next and end destination recording and reporting:

For each type of material leaving the facility in a given reporting period, the MRF, license or permit holder must record and report:

- The end destination or, where this is not available, the next destination for the materials leaving the facility (including the relevant authorisation/permit/license numbers, and where appropriate export destination details).

- The use to which the material will be put and/or the treatment to which the material will be subjected at the end destination or, where this is not available, the next destination.
- The location (country, region, city) to which the materials are to be sent.

MRF residues: Sampling of MRF residues is not required; however, it is considered good practice. Sampling and testing of the residual waste fraction (post sorting) allows:

- The identification of the types and quantity of target materials that are being lost during processing. This information can be used to improve operational practice and identify shifts where the equipment is being operated incorrectly or where additional training may be required. It can also be used to identify where new or additional sorting technologies may be beneficial.
- Identification of common types of non-target and non-recyclable material. This information can be passed back to suppliers for use in communication campaigns.

Sample size and sampling frequency: the Code is prescriptive on the minimum sample requirements based on input weights and output materials type (paper; glass; plastics; cardboard; metals).

All information collected by SEPA is treated as confidential, in keeping with its commercially sensitive nature, subject to being shared with Scottish Government and Zero Waste Scotland. Where this information is shared with the Scottish Government and Zero Waste Scotland, it will continue to be treated as commercially confidential.

Licensed Facilities

All licensed operators of waste management facilities are required to report quarterly or annually.

Facilities are provided with a return form (in Microsoft excel format) for completion.

Key reporting requirements include:

- Description of waste received (using established codes: residual waste; cardboard, tyres, mixed C&D etc.);
- Physical form of each waste type (solid, liquid, gas, sludge);
- Quantity and units;
- Geographic origin of waste (e.g. local government area, split across multiple geographies if required);
- Management methods (landfilled; incinerated; treated on-site; sent off-site);
- Waste treatment on-site (biological; chemical; composed; crushed and screened; physical treatment; recycled; other treatment);
- Waste treatment at landfills:
- Waste outputs – details of the volume of waste (by material type); geographic destination of waste; name of destination facility; management methods for waste outputs issued from site.

Additional requirements and guidance has been issued for:

- Community collection centres and transfer stations;
- Composting operations;
- Anaerobic digestion;
- Incinerators;
- Landfills;
- Scrap metal operators;

- Waste electrical and electronic equipment facilities;
- MRF's and skip hire businesses;
- MBT's
- Mobile plants
- Multiple activity sites.

Landfill operators are also required to report total remaining capacity.

Appendix B - WLRM Evaluation July 2013 – June 2017[271]

The review of the WLRM assessed the effectiveness, efficiency, appropriateness and sustainability of the initiative and associated activities, and identified areas of potential improvement for its future. The evaluation focused on examining the effectiveness, achievement of outcomes and the economic benefits of each fund, and reported on other measures such as distribution of funding across NSW and in levy versus non-levy paying areas. In addition to the overall initiative and evaluation of each underlying fund was completed.

Waste Less, Recycle More Initiative	
Fund Objectives	• Encourage local communities to think differently about waste avoidance, recycling, littering and illegal dumping • Deliver conveniently located, value-for-money waste infrastructure to make it easier for the community to do the right thing • Drive innovative regulatory approaches to protect the environment and support investment in new waste programs.
How much was done	• Invested in new or enhanced municipal and privately-operated waste infrastructure: resource recovery facilities (30 new facilities on track to be completed), community recycling centres (60 operating), small-scale recycling infrastructure for businesses, organic recycling facilities and weighbridges (13 installed) • Supported regional councils to rationalise small landfills (31 closed and 63 improved) • Invested in new or enhanced waste services for households and businesses to deal with problem wastes, organic waste, contaminated waste streams • Invested in research and development for new technologies to recover resources from priority problem waste materials • Provided training to waste operators, council officers and members of the community to build specific skills in managing facilities and recycling • Provided education materials and signage to support state-wide and local awareness raising activities, promoted new or enhanced services and provided community education • Provided tools (including guidelines) for industry operators and councils to improve operations • Developed markets for recycled organic waste and manufacturing waste.
Reach of Activities	• The WLRM Initiative has a significant regional and rural distribution with coverage of 81% of the state. • Of the 152 local government areas (LGAs) in NSW prior to council amalgamations in 2016, 125 received funding of between $0.16 and $298.50 per person. Following amalgamations, there are now only 119 councils in NSW, so some councils may have been awarded grants even after they had amalgamated. • More than 22,000 businesses have accessed free advice on how to improve recycling of waste, and on food waste avoidance • However, there are still groups that need to be reached, for example, take up of education packages is inconsistent and these packages may need to be made more useful. As another example, Community Recycling Centres have had high take-up rates amongst regional and rural councils but lesser take-up rates by metropolitan councils.
Quality of Implementation	• 7 of the 8 funds have largely been implemented as planned, the Recycling Innovation Fund only partially delivered its program of work

[271] Internal unpublished report procured by the EPA (2018)

	• Some programs and activities took longer than expected due to approval processes and other unforeseen issues • Business Recycling, Local Government Waste and Resource Recovery, Tackling Litter and Organics Infrastructure all delivered their program of work on time and as planned • Combating Illegal Dumping, Systems for Household Problem Waste and Waste and Recycling Infrastructure are on track to substantially achieve activity-based performance targets when funded projects are completed • This success is largely due to the effective oversight by the EPA and the Trust
Outcomes	• Number of Grants Programs – 21 • Number of Grants Distributed – 1117 • Number of training sessions and people trained – 9,158 sessions, 24,363 attendees • Number of awareness raising events and attendees – 124 events, 32,690 attendees • Number of businesses that have accessed advice on recycling and food waste – 22,000 • Amount of Waste Diverted per annum as stated on applications at the end of 2016/17 – 2,041,280 tonnes (once construction of additional infrastructure is complete, it is predicted that an additional 1.3 million tonnes of waste will be diverted from landfills each year) • CRCs in operation safely disposed of 3,171.4 tonnes of problem waste • Once all projects are completed, 70% of householders in NSW will be able to access a garden or combined food and garden service, and an additional 400,000 tonnes of capacity to recycle organic waste will be added to the system • The EPA has funded waste experts who directly engaged with and assessed 22,114 businesses between 2013 and 2017 and business waste going to landfill has been reduced by at least 72,000 tonnes annually • A 19% reduction in litter volume has been achieved • Better Waste and Recycling has funded 1,230 projects carried out by regional groups and councils
Awareness and Behaviour Changes	• WLRM has had a positive impact on attitudes to waste amongst the community, local government and businesses • Attitudes of the community towards disposing of household batteries and fluorescent tubes in the bin has changed in the desired direction—from 63% (2013) to 47% (2017) saying they are likely to throw batteries in the bin, and from 63% (2013) to 39% (2017) saying they are likely to throw fluorescent tubes and globes in the bin. • Better Waste and Recycling has funded 307 education projects and awareness campaigns
New Infrastructure	• 5 existing resource and recovery facilities were expanded or enhanced • 10 major resource recovery facilities are being built and 15 facilities in the process of being expanded or enhanced • 87 new community recycling centres built, of those 60 have been formally opened • 43 local councils have used EPA funding to upgrade their litter infrastructure, including new bins, and have installed signage discouraging littering. • Landfill consolidation and environmental improvements under the Landfill Grants program which supported councils to close landfills and establish transfer stations. • Better Waste and Recycling funded 112 infrastructure projects, including infrastructure and equipment to divert waste from landfill, new and upgraded education facilities, weighbridges, new litter and recycling bins and works to prevent illegal dumping • 30 organics infrastructure projects funded • EPA also supported 18 charity or community organisations to increase their capacity to re-distribute edible food. Grants funded the infrastructure and equipment required to receive, store and make surplus food available to those who need it
Investment leveraged	• Total funds allocated to WLRM – $456.7 million

	• Total funds spent by WLRM[272] – $327.5 million (72% of the $456.7 million available) • Funds co-contributed[273] – $286 million • Total value of WLRM expenditure on grants alone[274] - $244.7 million
Unintended Outcomes	• No adverse unintended outcomes emerged that can be directly attributed to the WLRM initiative as a whole. There were some unexpected outcomes from work at the program level.
Implementation Lessons and Barriers	• Each fund had unique challenges in implementing their programs. • In general, businesses wishing to increase their recycling capacity or reuse of waste are held back by the economics of recycling waste, particularly where markets for recycled materials or the products of these are not strong or are still developing. The cost of collecting some type of waste (e.g. lightweight plastics) is difficult to justify or recoup without a strong market in place. • Other challenges include balancing the introduction of innovative technologies with existing licensing regulations in place to protect the environment, specifically in the organics waste and problem waste work areas.

[272] The amount spent by the WLRM as at June 2017. This includes all expenditure by the including on Grants to Councils, Regional Organizations of Councils and Private Industry, and expenditure on advertising, such as the "Hey Tosser" program. Another example of expenditure external grants is for database development and for developing RID squads.

[273] The value of funds co-contributed is from by private sector investment and or by Councils or Regional Organisation of Councils to access available funds / grants.

[274] $244.7 million is the value for Grants alone. This value ignores the funds spent on advertising programs, database development and in expenditure by WLRM initiative on internal programs.

Appendix C - Fairfield MUD recycling program

The follow key learnings have been extracted from the WSROC case study on the Fairfield MUD recycling program.[275]

Build relationships with strata managers and real estate agents

Real estate agents and strata managers are key allies in improving waste outcomes in MUDs. They can provide a wealth of information on who is moving into an area, the rate of resident turnover, and the day to day problems faced by residents of a particular building.

They can also facilitate access to sites, engage cleaning staff, and are the primary point of contact for upgrades to on-site waste infrastructure.

Be ready to assist strata managers and real estate agents with information for new residents, or assistance with other council-related issues and questions they may have.

Present where and when residents are available

In the early stages of the program, Council ran a barbecue for residents to raise issues of waste and recycling, however attendance was low. On-site bin inspections, door knocking, meeting with community groups, and presenting to schools was much more effective for reaching residents – particularly those who would not otherwise be interested in learning about waste services.

Keep it simple, keep it visual

Image-based materials in partnership with translated text is key, particularly in areas with high levels of cultural and linguistic diversity. Waste guides and bin stickers showing pictures of waste items makes it easy for people of all backgrounds to get it right.

Face to face contact is worth its weight in gold

Engaging with the community directly demonstrates that Council is approachable, friendly and there to help. Face-to-face engagement is particularly effective for breaking down cultural barriers and building trust with CALD communities.

Keep interactions as positive as possible.

It is important that Council is not perceived to be criticising or blaming residents for doing the wrong thing. A positive approach – even where contamination rates are high – will ensure that Council is perceived as a helpful guide.

Be prepared for a long-term, ongoing process.

Behavior change programs are never short-term fixes, however in the case of MUDs, the need for consistent, ongoing work is increased by higher frequency of rental turnover. This phenomenon is increased in high migration communities where residents tend to be more transient.

Work with council planners to ensure new MUDs are designed well.

Prevention is always better than a cure. Developing a relationship with Council planners and sharing insights on how residents use bin bays and other waste infrastructure will make it easier for them to ensure waste infrastructure is well designed. This in turn will make it easier for future residents to dispose of waste correctly.

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[275] WSROC. *Case Study: Fairfield MUD recycling program*. Sourced from: www.wsroc.com.au/images/Waste/Case_Study_-_Fairfield_MUDs_education_web.pdf

Appendix D – Waste Facilities Mapping

The following diagrams map the locations of waste facilities across NSW. The maps capture all facilities that report into the WARRP as well as unlicensed facilities in the NLA.

Th mapping is based on data provided by the EPA as well as independent research. The data did not included annual capacity or remaining useful life data.

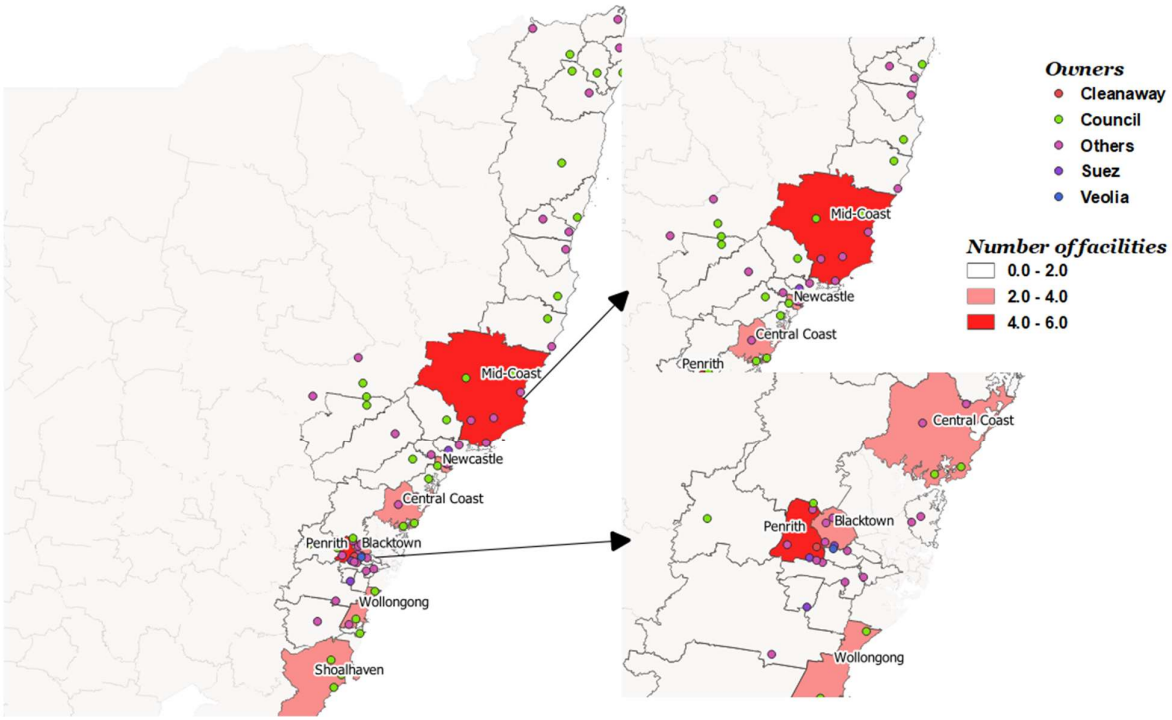
As noted in Appendix A, there are a number of deficiencies in existing data capture processes, that reduce the usefulness of the data mapping completed. Preparation of a more comprehensive data set would assist with understanding the current waste flows, existing capacity, potential ownership and capacity issues.

Map 1: Landfills across the MLA and RLA by Owner

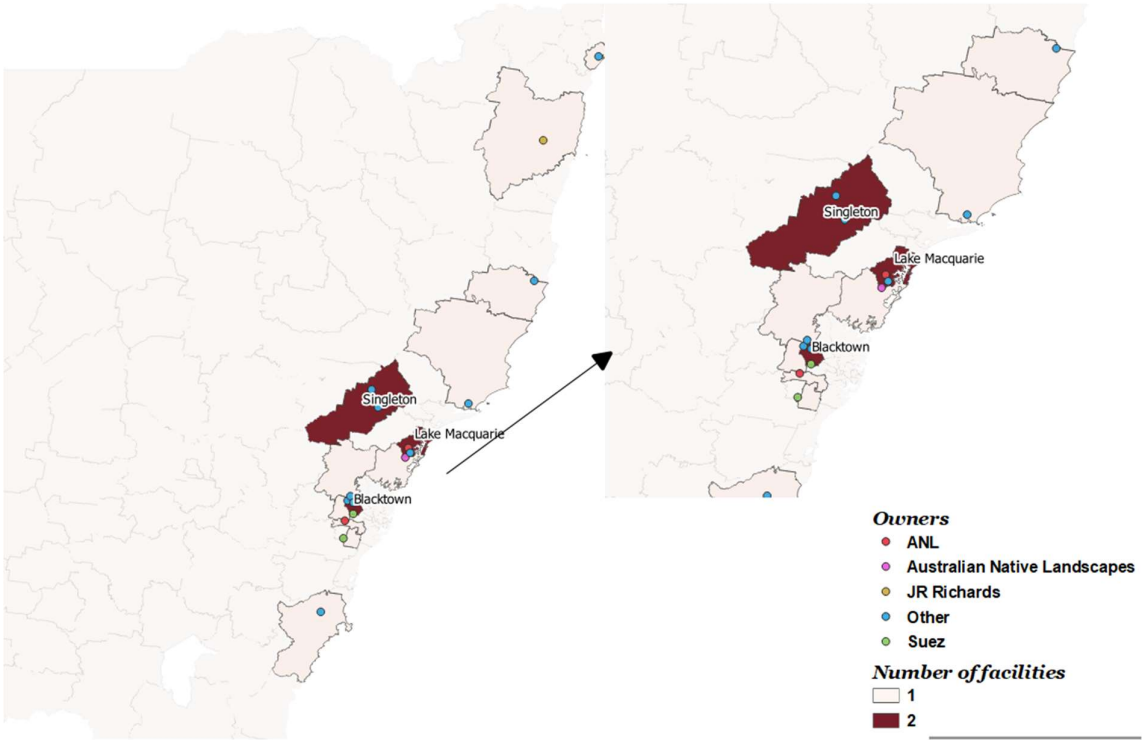
Map 1 sets out the landfills across the MLA and RLA. Sydney has access to only two putrescible landfill operations, the Suez facility at Lucas Heights and Veolia's Woodlawn facility.

18 of the identified lands received in excess of 50,000 tonnes.

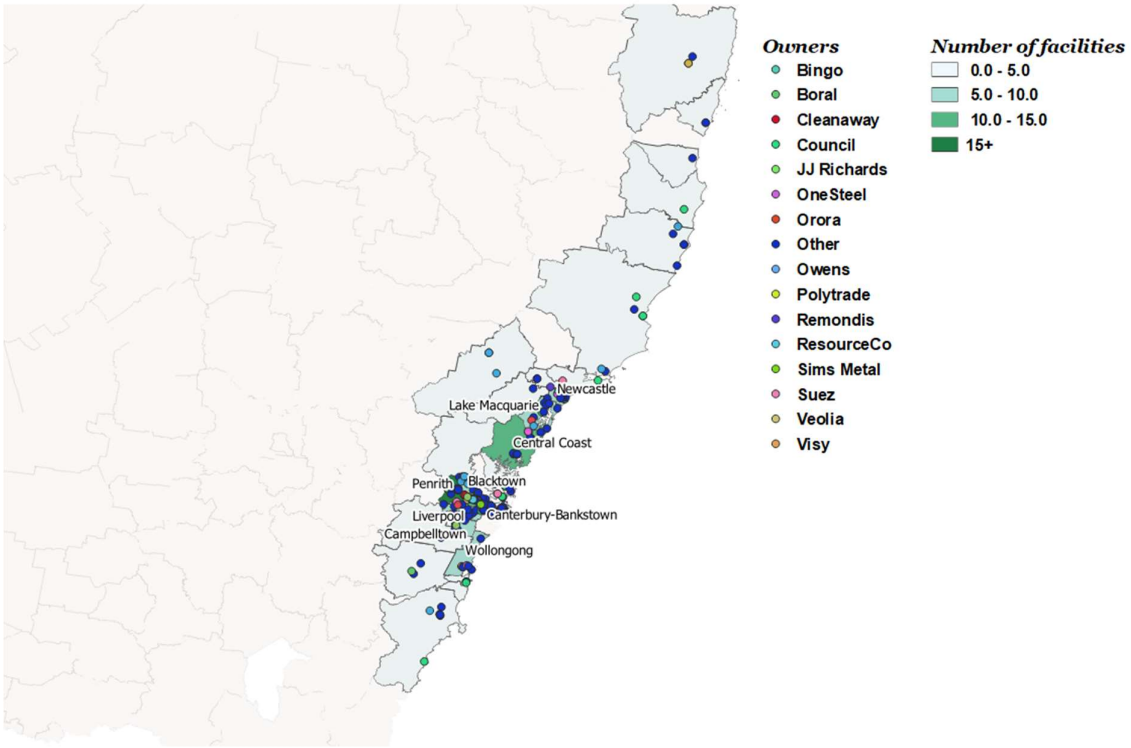
Not all landfills included in the analysis had reported volumes. It is not clear whether these facilities are still operational.



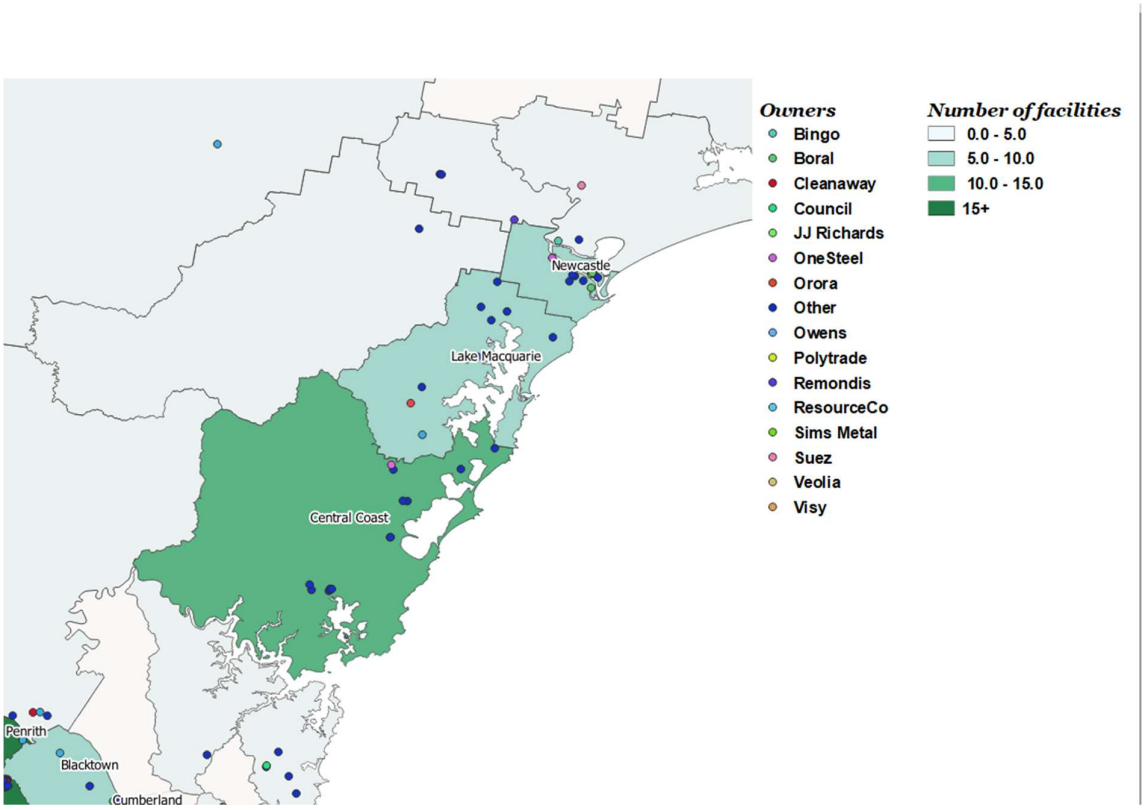
Map 2: Composting facilities across the MLA and RLA by owner



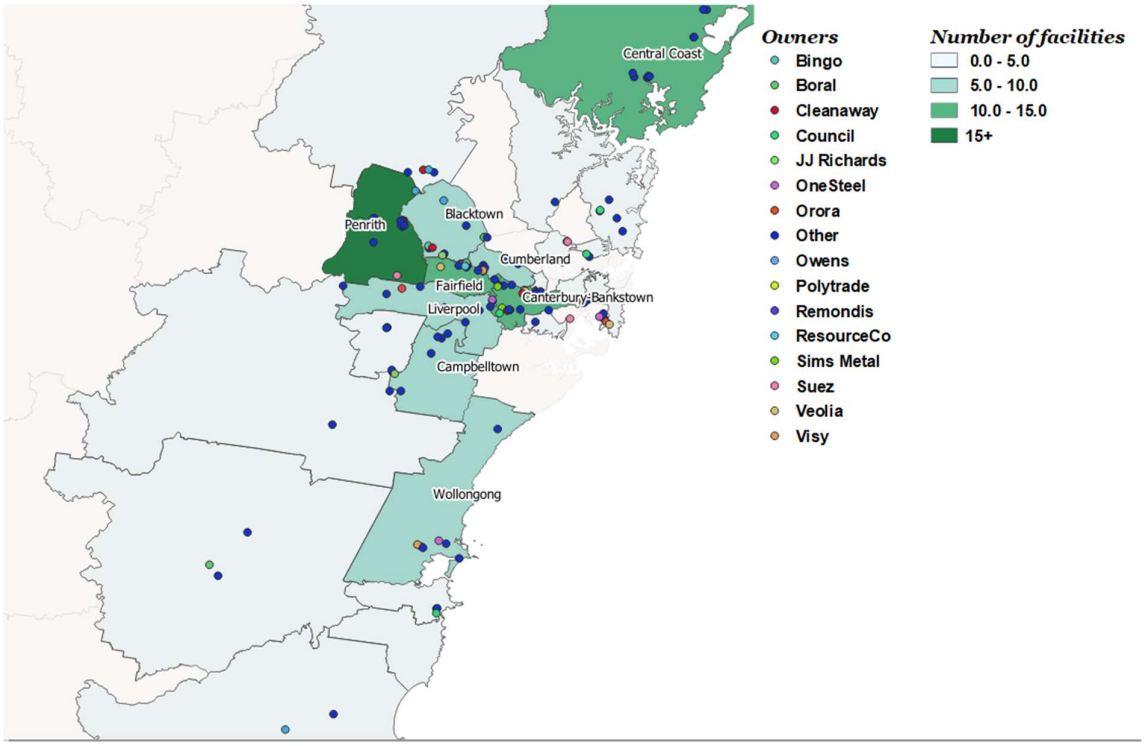
Map 3: Waste processing facilities across the MLA and RLA by owner



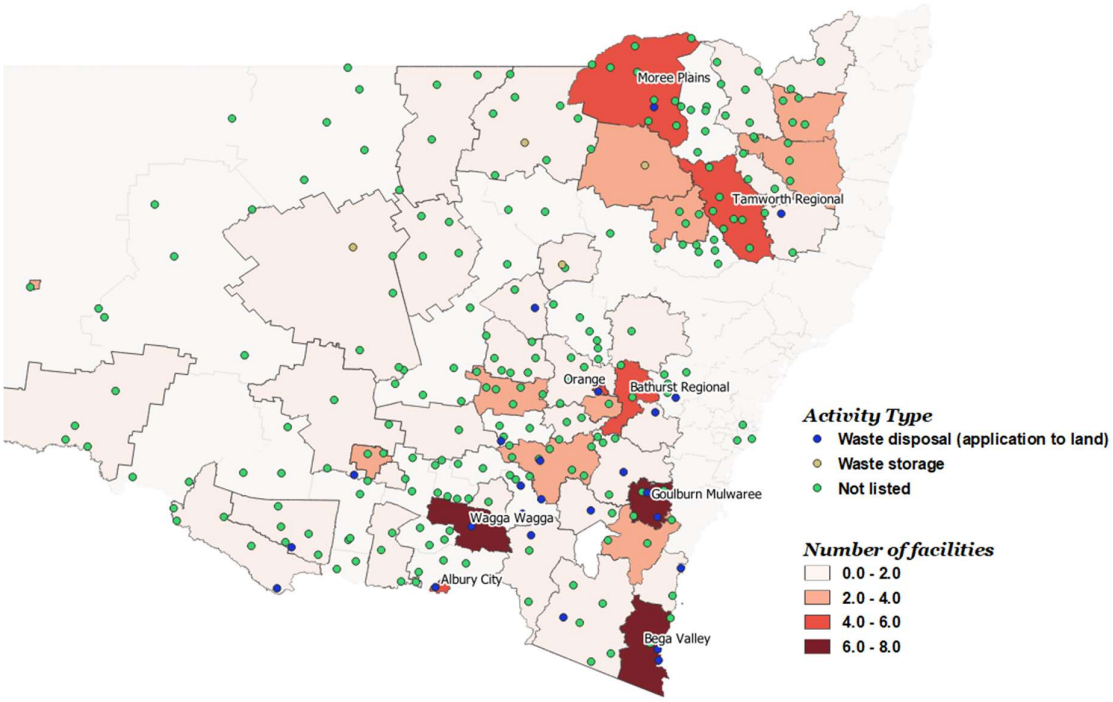
Map 4: Waste processing facilities across the Central Coast by owner



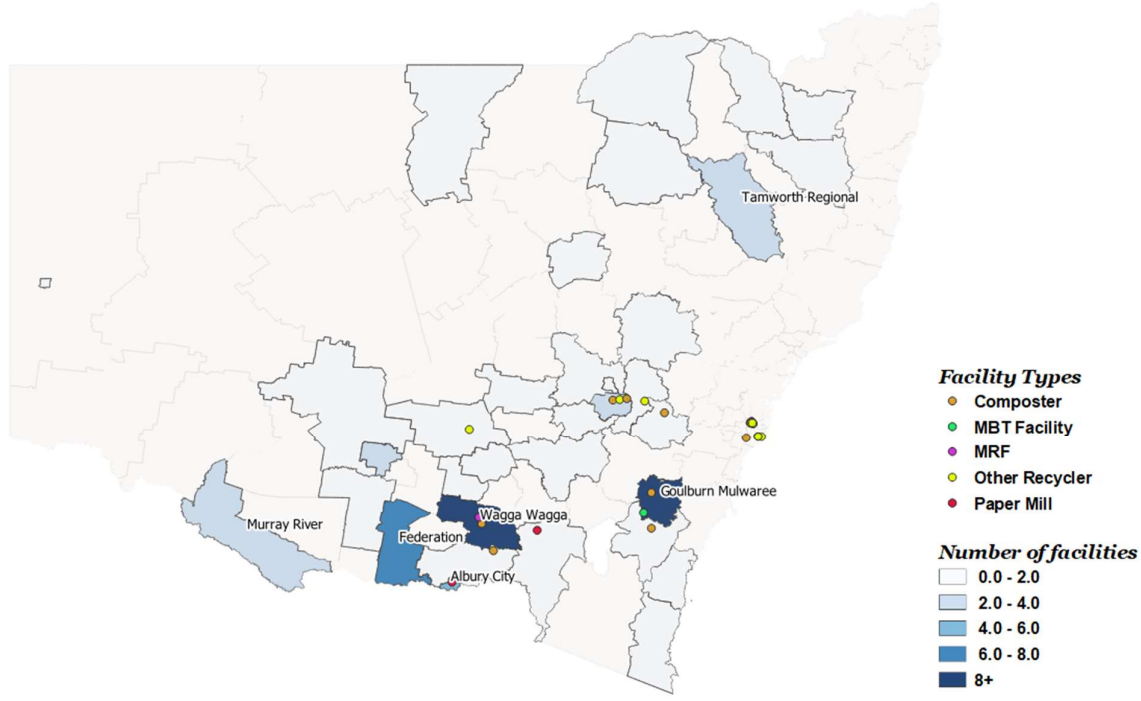
Map 5: Waste processing facilities across the Sydney Metro region by owner



Map 6: Waste disposal facilities across the NLA



Map 7: Waste processing facilities across the NLA by facility type



Appendix E – Glossary

Advisers	PricewaterhouseCoopers and Sphere Infrastructure Partners
C&D	Construction & demolition
C&I	Commercial & industrial
EPA	New South Wales, Environment Protection Authority
FOGO	Food organics garden organics
HH	Household
Kg	Kilogram
Kt	Thousand tonnes
MLA	Metropolitan levy area
MRF	Materials recovery facility
MSW	Municipal Solid Waste
Mt	Million tonnes
MUD	Multi-unit dwelling
NLA	Non levy area
NSW	New South Wales
NTCRS	National Television and Computer Recycling Scheme
PSA	*Product Stewardship Act*
RDF	Refuse derived fuel
RLA	Regional levy area
PwC	PricewaterhouseCoopers
SMEs	Small to medium enterprises
Sphere	Sphere Infrastructure Partners
SUD	Single unit dwelling
t	Tonnes
tpa	Tonnes per annum
VENM	Virgin extracted natural material
WARR	Waste Avoidance and Resource Recovery
WARRP	Waste Avoidance and Resource Recovery Portal
WCMR	Waste Contribution Monthly Report
Wk	Week

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