WASTE AND RESOURCE RECOVERY (W)

SCIENTIFIC ASSESSMENTS Part III

Commissioner *for* Environmental Sustainability Victoria

Traditional Owners

The Commissioner for Environmental Sustainability proudly acknowledges Victoria's Aboriginal community and their rich culture and pays respect to their Elders past and present.

We acknowledge Aboriginal people as Australia's first peoples and as the Traditional Owners and custodians of the land and water on which we rely. We recognise and value the ongoing contribution of Aboriginal people and communities to Victorian life, and how this enriches us.

We embrace the spirit of reconciliation, working towards the equality of outcomes and ensuring an equal voice.

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Waste and Resource Recovery Background

Waste is produced at all stages of extraction, consumption and creation of products and services, as well as at the end of a product's lifecycle. Within a traditionally linear model of economy, the 'take-make-waste' process results in a range of negative impacts on Victoria's environment: depletion of natural resources, environmental pollution and a compounding of the risks and effects of climate change.

Depending upon the way it is managed, waste can have multiple environmental impacts, including:

- greenhouse gas (GHG) emissions
- amenity impacts and pollution of water from landfill (particularly groundwater)
- impacts on amenity, ecosystems and human health from hazardous wastes
- increased energy and water use, and accompanying GHG emissions, through utilisation of virgin materials rather than recycled products[1]
- impacts of unmanaged outputs such as litter and dumped wastes.

Reducing these impacts requires prioritising avoiding waste in the first place, minimising externalities through avoiding unnecessary wastes, and focusing on resource efficiency and productivity.

When resources are not re-used, recycled or used efficiently, waste is created and there is an opportunity lost as the material can no longer be used to contribute to the economy. Victoria produced approximately 12.9 million tonnes of solid waste in 2016–17, a figure which has been relatively steady over the past five years.[2]
Figure W.1 illustrates the trend over the previous 10 years. Note that a further 1.4 million tonnes of hazardous waste is estimated to be managed in Victoria.[3,4]

Recycling waste not only returns materials to the economy but also reduces the demand for resource extraction. In most instances, creating products from recycled waste materials uses less energy and water than manufacturing products from virgin materials. In 2016–17, of the 12.9 million tonnes of solid waste produced, approximately 67% or 8.6 million tonnes was recovered for reprocessing. However, 4.2 million tonnes still went to landfill.

1. Sustainability Victoria 2018, 'Lifecycle Kerbside Recycling Calculator', http://www.sustainability.vic.gov.au/Government/Victorian-Waste-data-portal/Lifecycle-assessment-of-kerbside-recyclables-in-Victoria/LCA-kerbside-recycling-calculator Accessed 3 December 2018.

2. Sustainability Victoria 2018, 'Victorian Recycling Industry Annual Report 2016-17', Melbourne, Victoria.
3. Ascend Waste and Environment and Blue Environment 2017, 'Hazardous Waste in Australia 2017', a report for the Department of the Environment and Energy, p30. http://www.environment.gov.au/system/files/resources/291b8289-29d8-4fc1-90ce-1f44e09913f7/files/hazardous-waste-australia-2017.pdf Accessed 3 December 2018.
4. Sustainability Victoria 2018, 'Statewide Waste and Resource Recovery Infrastructure Plan', Melbourne, Victoria.

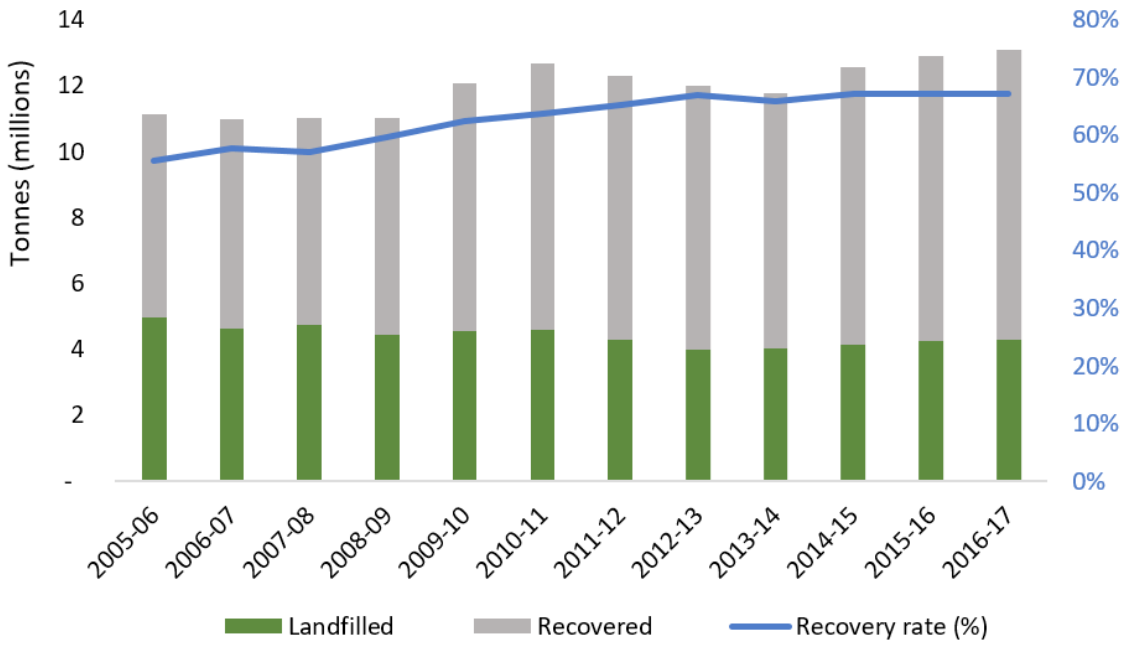

Figure W.1 Total waste generated, landfilled and recovered 2005–06 to 2016–17 [2]

Note: Data excludes hazardous waste.

The concepts of waste minimisation and recycling of materials are central to the development of a circular economy, where material that would previously have been classified as 'waste' is retained in the system and repurposed. A circular economy aims to redefine growth by decoupling economic activity from the consumption of finite resources, and designing waste out of the system.

Circular economic thinking requires a whole-of-system approach. It is a critical component in climate change mitigation, and it underpins the United Nations Sustainable Development Goals (SDGs). Sustainable consumption and production – critical elements in the circular economy – are incorporated into Goal 12 of the SDGs ('Ensure sustainable consumption and production patterns'). Having a full understanding of their interactions, both positive and negative, is key to unlocking their full potential.

Since a significant amount of global GHG emissions are a result of the management of materials, there are emissions reduction benefits in implementing the circular economy.

While Victoria has continued to increase its waste recovery rate, waste volumes continue to grow. The waste and resource recovery sector in Victoria is facing the following challenges:

- Increasing volumes of material are entering the waste and resource recovery sector. As Victoria's population grows, so too is the amount of materials that are used and discarded. By 2046, this figure is projected to reach 20 million tonnes – an increase of 57% on the 2015-16 amount.[5]
- The existing system is struggling to manage waste materials and composites that are created in the design of new products (for example composite plastics or emerging battery technologies (lithium-ion)). Also problematic are high volumes of legacy wastes that exist due to a lack of recovery methods (for example 7.5 million tonnes of dewatered contaminated biosolids at Melbourne's Western Treatment Plant).

5. Sustainability Victoria 2018, 'Statewide Waste and Resource Recovery Infrastructure Plan', Melbourne, Victoria.

- Victoria's recycling system – household collections in particular – has been impacted by major disruptions and restrictions in global commodity markets, particularly from China and other south-east Asian export destinations. This has highlighted vulnerabilities in resource recovery including heavy reliance on the exporting of unsorted comingled recycling (baled plastic, paper and cardboard) for processing and a lack of diversification in local markets. While exports and commodity prices of high-value paper, cardboard and metals continue, market disruptions have highlighted the need to develop a stronger and more resilient recycling system and to ensure that recovered materials are used for productive purposes such as re-manufacturing, domestically.
- Managing increasing diffuse sources of pollution (litter and illegal dumping) presents management and monitoring issues for waste that does not enter the formal collection system. While there has been a long-term trend of reduction in litter in Victoria as measured by the annual National Litter Index[6], problematic materials such as plastics accumulate in the environment for many years because they do not biodegrade.
- Food waste is estimated to be nearly 1,000,000 tonnes annually[7] and at least 20% of all food produced, contributing to undue pressure on finite natural resources, the environment and climate change.[8]

6. Keep Australia Beautiful 2017, 'National Litter Index', Newtown, New South Wales http://kab.org.au/litter-research/national-litter-index/ Accessed 3 December 2018.
7. Sustainability Victoria 2018, 'Statewide Waste and Resource Recovery Infrastructure Plan', Melbourne, Victoria.
8. Institution of Mechanical Engineers 2013, 'Global Food: Waste Not, Want Not', Westminster, London https://www.imeche.org/docs/default-source/default-document-library/global-food---waste-not-want-not.pdf?sfvrsn=0 Accessed 4 December 2018.

Current Victorian Government Settings: Legislation, Policy, Programs

Materials and wastes can be harmful to human health, damage the natural environment and impact on amenity. Therefore, the system, which is regulated by EPA Victoria, must operate to minimise these risks. Under the *Environment Protection Act 1970*, EPA Victoria can develop waste management policies (WMPs) to improve management of waste and material streams. WMPs provide enforceable statewide objectives and directions. Currently, a series of WMPs address movement of controlled waste, landfills, used packaging materials and other waste-related operations.

Sustainability Victoria has a legislated responsibility for long-term planning for waste and recycling infrastructure in the state. It released the first *Statewide Waste and Resource Recovery Infrastructure Plan* (SWRRIP) in 2015, with an update in April 2018 to reflect the priorities identified in the seven regional implementation plans. The SWRRIP provides a blueprint for investment and highlights the gap between current capacity and future needs.

The SWRRIP is premised on a circular economy model. It sets goals and strategic directions to ensure that the system continues not only to provide an efficient and well-operated service, but also to maximise the recovery of materials and reduce reliance on landfill. It draws on data and information from a range of sources and identifies opportunities – both local and statewide – to increase infrastructure and the recovery of materials. The strategic directions underpin government interventions, but also play a critical role in informing industry investment and government decisions, such as strategic land-use planning and approvals. The SWRRIP critically notes the importance of viable markets for recycled materials and has led to an increased focus on the recovery of organic materials, which is building momentum for a significant increase in recovery. Monitoring and evaluation will measure progress and inform future iterations and action.

Since the SWRRIP's publication, Victorian Government investments from the Sustainability Fund[9] have been aligned to priorities identified in the Plan. Sustainability Victoria has also worked to promote opportunities for investment and growth in Victoria's resource recovery sector through its Investment Facilitation Service.

While the primary role of the SWRRIP is to plan for the infrastructure needed to manage the waste and materials entering the waste and resource recovery system, the Victorian Government's supporting initiatives provide a broader framework that include:

- *Victorian Organics Resource Recovery Strategy*
- *Victorian Market Development Strategy for Recovered Resources*
- *Victorian Waste Education Strategy*
- *Victoria's Waste and Resource Recovery Infrastructure Investment Prospectus*
- *Waste Data Service.*

The Victorian Government has also provided funding in 2018–19 to build a better evidence base for hazardous waste management. This will deliver a research program for new and emerging hazardous wastes, better data management and collection, and an agreed process to include hazardous waste in the SWRRIP.

9. DELWP 2018, 'Sustainability fund', Melbourne, Victoria https://www.environment.vic.gov.au/sustainability/sustainability-fund Accessed 3 December 2018.

Recycling Industry Strategic Plan

On 3 July 2018 the Victorian Government released Victoria's *Recycling Industry Strategic Plan* which sets out a vision for a more sustainable, resilient and efficient recycling sector. The suite of complementary actions included in the plan aims to support industry in the medium to long-term, minimise costs for Victorian households, and improve the resilience of Victoria's recycling sector.

The implementation of this plan will be supported by a $37 million package of initiatives that includes:

- leveraging private investment in recycling infrastructure
- ensuring Victorians clearly understand what they should place in their recycling bin
- supporting research institutions and industry to identify new uses for priority waste materials
- leveraging government procurement to drive demand for recycled materials
- developing a whole-of-government circular economy policy and action plan by 2020.

It is an important step for Victoria and reaffirms the state's intention to work towards a circular economy.

Greater efficiency and resilience in the recycling sector will be important in anticipating and reducing costs in the longer term.

E-waste Management

Electronic waste (or 'e-waste') volumes are growing three times faster than general municipal waste. E-waste contains hazardous components that pose risks to the environment and human health, and valuable materials that can be recovered. To manage this growing waste stream, the Victorian Government has new regulatory measures that will ban e-waste from landfill and specify how e-waste must be managed. These will take effect on 1 July 2019. To support these regulatory measures, the government has committed to upgrading Victoria's e-waste collection network, which will increase community access to safe e-waste disposal points. The government also recently launched an education and communication campaign that will increase community and industry awareness of e-waste and what to do with it.

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Managing the Risks from Stockpiled Combustible Materials

The Victorian Government is committed to reducing the risk of fire at waste and resource recovery facilities. In August 2017, the interim Waste Management Policy (Resource Recovery Facilities) placed requirements on sites that store combustible and recyclable waste materials to minimise their fire risk. The interim policy was replaced by a longer-term *Waste Management Policy (Combustible Recyclable and Waste Materials)* in August 2018.

The Resource Recovery Facilities Audit Taskforce was also established in 2017. It has conducted 295 on-site inspections across 114 sites, issued 70 remedial notices and 10 sanctions (as at 3 July 2018). Compliance has been achieved by about 50% of notice recipients. The Taskforce has been actively working with facilities through those inspections to minimise their fire risk and improve their understanding of obligations.

Addressing Plastic Pollution

The Victorian Government recently announced that a ban on lightweight plastic shopping bags will come into effect in Victoria by the end of 2019. The ban will include degradable, biodegradable and compostable plastic shopping bags. Victoria is also working with other states, the Commonwealth, and retail associations on a national voluntary phase-out of thick plastic bags. The government will consider designing the ban so that thicker plastic bags can be included in the future if voluntary action is not effective.

In 2019, the Victorian Government will develop a plastic pollution reduction plan to prioritise the most effective actions to reduce other types of plastic pollution, such as beverage containers, balloons and cigarette butts. The government is establishing a reference group of government, industry, community and environmental representatives to help guide this plan.

The SoE 2018 indicators and analysis can be understood in terms of the circular economy – all aspects of which need to function to maximise the sustainable use of resources. Stakeholders need to think and act operationally

Resource flows in Victoria's circular economy

2016-17 total waste 12.87 million

Households separating before collection

4.2m tonnes (49%) from Construction and Demolition	1.3m tonnes (15%) from Municipal	3.1m tonnes (36%) from Commercial and Industry

Landfill 4.23m tonnes

Diversion from landfill - **67%**

Reprocessing, in Victoria

7.4m tonnes 2016-17

PET plastic (26,000 tonnes)
recycled into plastic bottles

Glass (137,000 tonnes)
recycled into glass packaging or used as sand replacement

Organics (1.1m tonnes)
processed into compost and soil conditioners for dairy farms

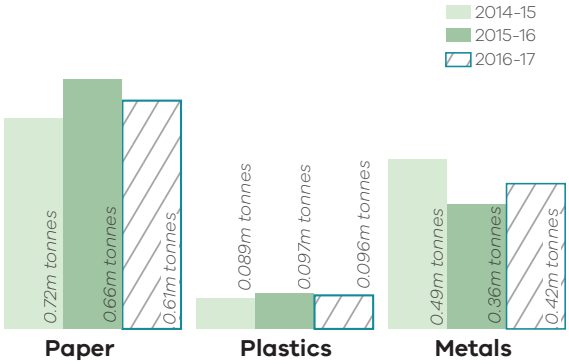
Paper/cardboard (1.4m tonnes)
pulped for cardboard products

Metals (1.7m tonnes)
recycled into new product

Export

1.22m tonnes 2016-17 exported for recycling

~50% to China / ~50% to other destinations



Source Victorian Recycling Industry Annual Report 2016-17 (2018)

*not including hazardous waste

Indicator	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
W:01 Total Waste Generation	FAIR	→	DATA QUALITY: Good
Data Custodian EPA and Victorian Recycling Industry Annual (SV)			

Some waste materials may be generated but not managed and therefore not measured in Victoria's waste data system. Waste managed refers to materials or wastes that have passed through or been managed at a waste and resource recovery facility and the figures in this report reflect waste managed.[10]

In 2016–17, the amount of waste managed in Victoria was 12.87 million tonnes, with approximately 4.25 million tonnes (33%) of waste sent to landfill and 8.62 million tonnes (67%) of material diverted from landfill for reprocessing (see Figure W.2).[11]

The total amount of waste managed has trended upward over the past 10 years (see Figure W.2), increasing by 16% – a slower trend than the 40% increase measured in the 10 years leading up to 2011, as reported in SoE 2013. The data suggests a correlation between waste managed and population growth, which has increased by around 23% over the same period.[12] Although the amount of waste managed has risen overall, the amount going to landfill has declined from 4.75 million tonnes in 2007–08 to 4.28 million tonnes in 2016–17; this is due to an increase in the proportion of materials recovered for recycling.

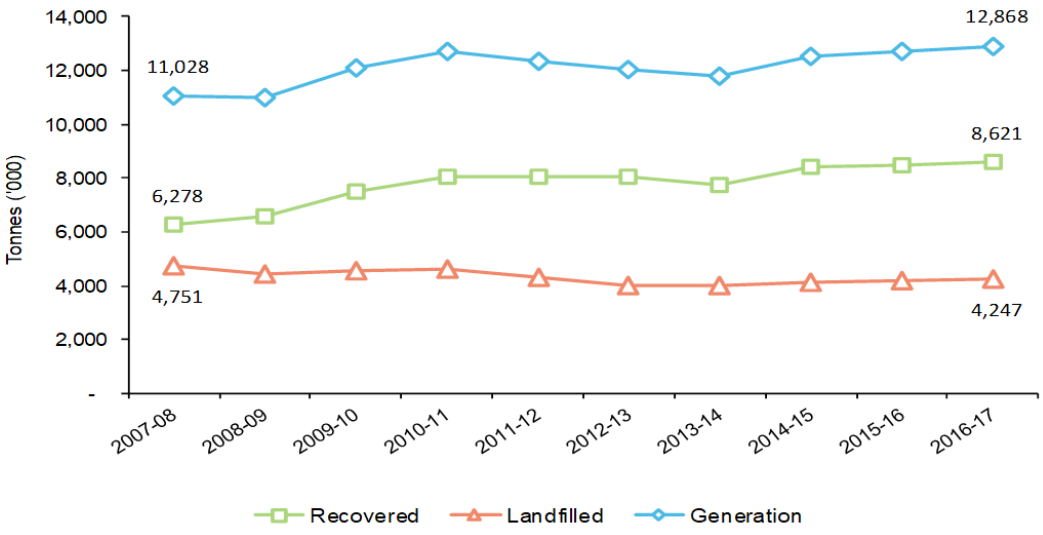


Figure W.2 Waste managed, Victoria, 2007–08 to 2016–17 (tonnes)[13]

10. Sustainability Victoria 2018, 'Statewide Waste and Resource Recovery Infrastructure Plan', Melbourne, Victoria, p170.
11. Sustainability Victoria 2018, 'Victorian Recycling Annual Survey Report 2016–17', Melbourne, Victoria.
12. ABS 2018, 'Australian Demographic Statistics, Estimated Resident Population, Persons, 3101.0 – Victoria.'
13. Sustainability Victoria 2018, 'Victorian Recycling Annual Survey Report 2016–17', Melbourne, Victoria.

In 2016–17, total waste managed per capita was 2.1 tonnes, an amount that has been relatively consistent since 2006–07.[14] Total waste per capita has stabilised at around 2.1 tonnes per year with a high of 2.29 and a low of 2.09 tonnes per capita in 2010–11 and 2013–14 respectively. The variability is mainly due to changes in the amount of waste generated by the construction and demolition sector. Note that this has shifted since the State of the Environment Report 2013, which noted an increase over the previous 10 years from 1.7 to 2.1 tonnes per capita.

Waste managed relative to Gross State Product (GSP) (a proxy for resource productivity) has decreased from 38.7 tonnes in 2007–08 to 29.8 tonnes of waste managed for every million dollars of GSP in 2016–17 (Figure W.3), a 23 % reduction. Noting that the rate of population growth exceeds the rate of waste managed, this per GSP unit decline is possibly due to the changing nature of business in Victoria (including the closure of some large manufacturing sites, and trends of recovering materials in construction and infrastructure) but could also be due to efficiency improvements in material use. These assumptions need to be tested.

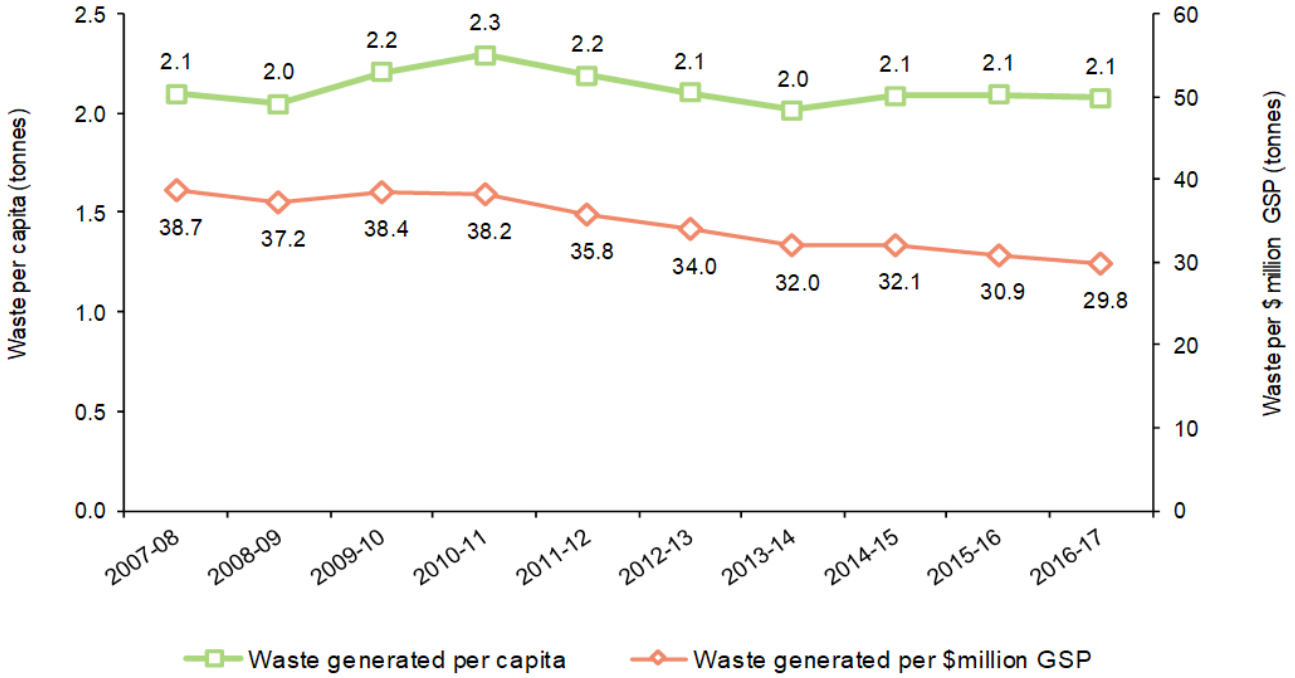


Figure W.3 Total waste managed relative to economic and population trends, Victoria, 2007–08 to 2016–17 (tonnes)[15]

14. Sustainability Victoria 2018, 'Victorian Recycling Annual Survey Report 2016–17', Melbourne, Victoria.
15. Ibid

Figure W.4 demonstrates the changes in the amount of recovered materials over a nine-year period from 2007–08 to 2016–17. Aggregates, masonry and soils (predominately derived from the construction and demolition sector) comprise 40% of total managed materials in 2016–17 and had a 34% increase in recovery during the nine years to 2016–17. Similarly, paper and cardboard (approximately 16% of the total waste managed), has seen recovery increase by 51%, with 78% of the total being derived from the commercial and industrial sector. Organics recovery has increased significantly, although notably linked to the introduction of garden organics collections by local governments, whereby much had previously been managed by households.

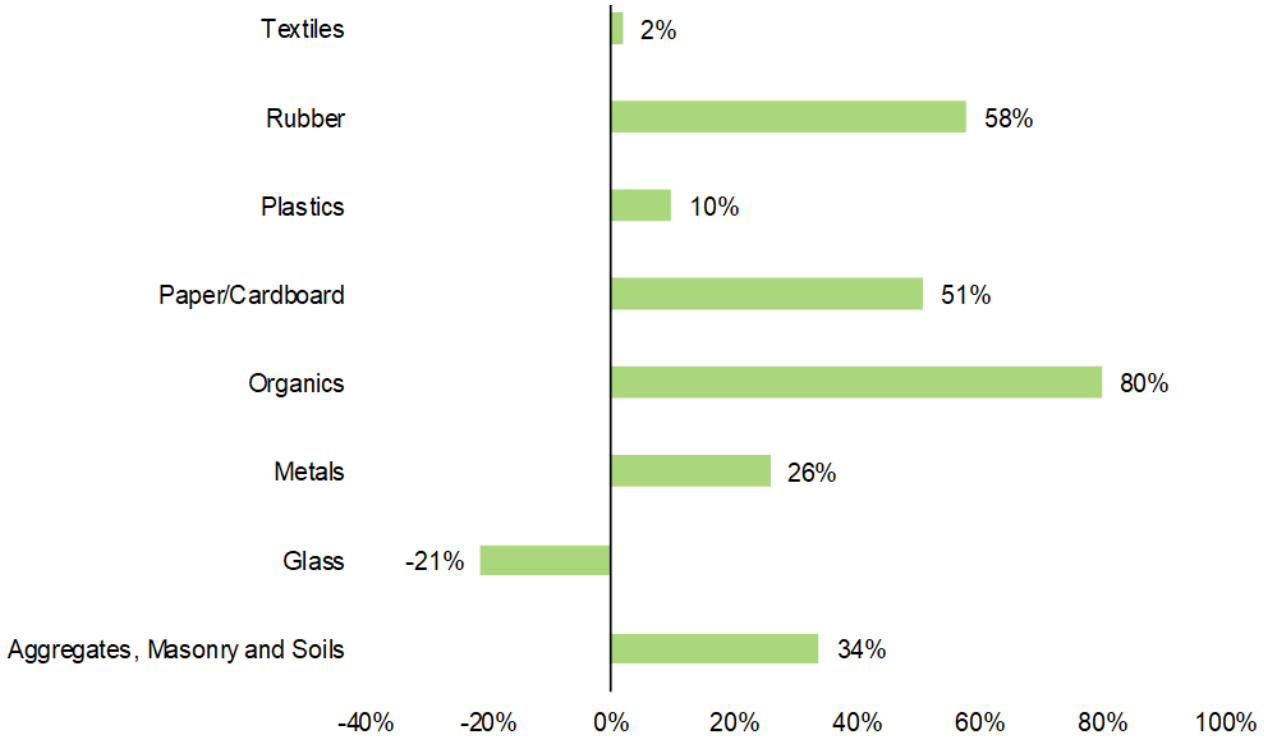


Figure W.4 Percentage change of tonnes of material types recovered for reprocessing, Victoria, 2007–08 to 2016–17

Indicator	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
W:02 Generation of municipal waste per capita Data Custodian Victorian Local Government Annual Survey (SV) and ABS Population Figure	FAIR	→	DATA QUALITY Good

Municipal solid waste (MSW) comprises primarily household waste, which is collected through kerbside bin services and at resource recovery centres (often referred to as transfer stations). Service levels are high across the state, with over 96% of households having a kerbside collection service. The total per capita MSW in 2016–17 was 353 kg. Figure W.5 demonstrates the trend of household waste generated per capita since 2001–2002.

Figure W.5 shows that municipal waste per capita has increased slightly from 326 kg in 2001–02 to 362 kg in 2016–17. The largest increase is in organic wastes (garden organics and food organics), which have risen from 25 kg in 2001–02 to 73 kg in 2016–17. This increase was driven by the introduction, or expansion, of kerbside services for organic waste, including combined food and garden organics, in several council areas. Some of the organics would have been taken out of the residual waste service; hence, residual waste per capita fell steadily from 228 kg to 186 kg (although since 2012–13 this has been relatively stable). However, it is likely some of this material was managed outside of the kerbside system through services like hard rubbish collections, self-haul to transfer stations and on site compost bins.

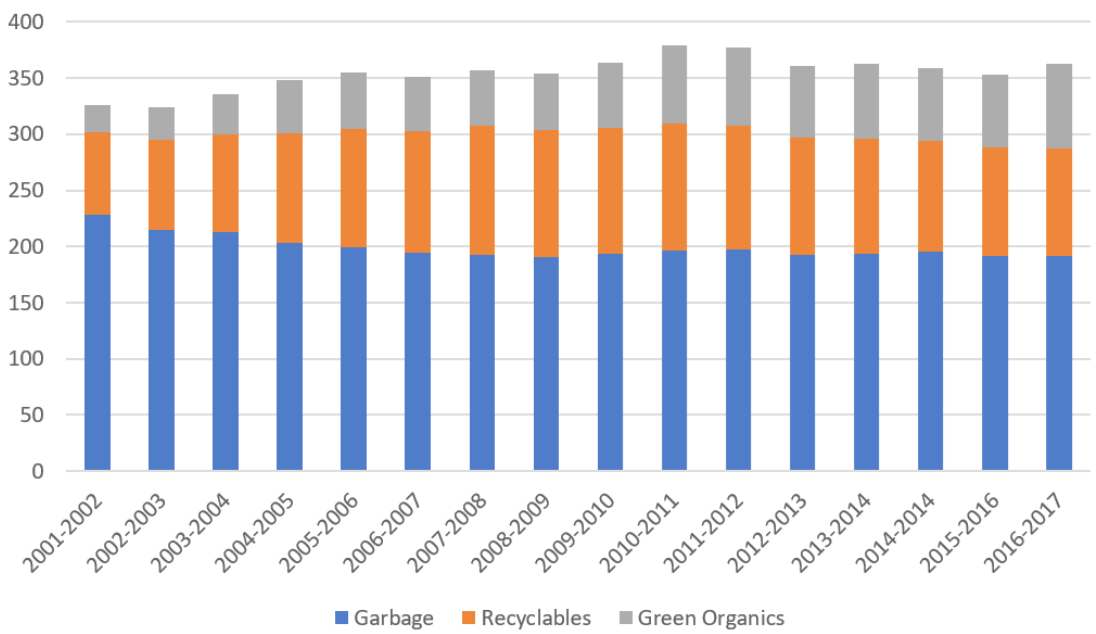


Figure W.5 Municipal solid waste per capita, 2001–02 to 2016–17 (kg) [16]

16. Sustainability Victoria 2018, 'Victorian Local Government Annual Waste Services Report 2016-17', Melbourne, Victoria.

The quantity of commingled recyclables showed a steady increase from 2001–02 (74 kg) through to 2007–08 (115 kg) and then a decline to 93 kg in 2016–17. This is most likely due to the light-weighting of packaging materials (these have moved from glass to plastics and then to lighter, flexible plastics) and a decline in the amount of paper/cardboard being managed and recycled. The commingled service offering by councils has been largely consistent in terms of materials collected, and the relatively small changes are likely a function of household consumption and behaviour.

The relationship between municipal waste generation and GSP reflects the total decline in waste per GSP (refer Figure W.6).

The direct environmental benefits of Victoria's kerbside commingled recyclables collection service are significant. In 2016–17, of the 591,103 tonnes of recyclables collected by local government household kerbside services, 552,704 tonnes (94%) was recycled. Applying this figure, along with 462,599 tonnes of recycled organics, to the Life Cycle Assessment Calculator,[18] the environmental benefits of the combined 1,015,303 tonnes are estimated to include savings of:

- 8,726 megalitres of water – equivalent to filling 3,491 Olympic-sized swimming pools
- 477,884 tonnes of greenhouse gases (CO_2-e) in a year, or equivalent to taking 125,759 cars off the road[19] for an entire year
- saving 3,747,243 gigajoules of energy – enough to provide power to almost a million Victorian households for a month

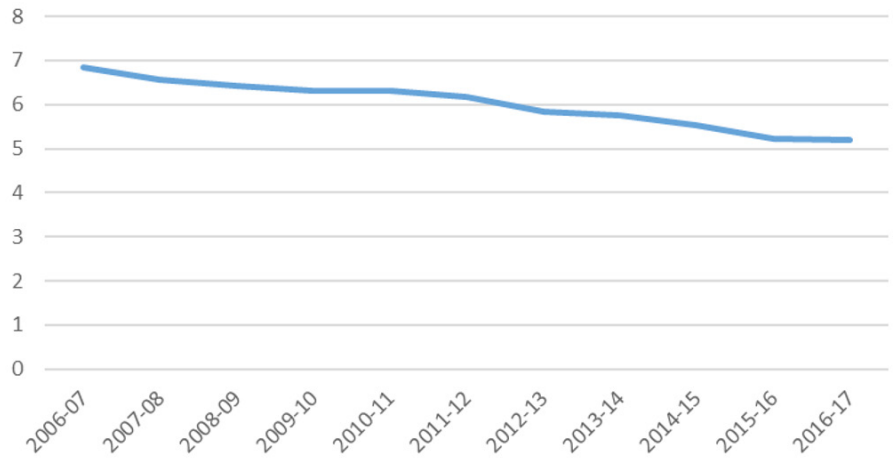


Figure W.6 The amount in tonnes (y-axis) of municipal solid waste generation per capita from 2006–07 to 2016–17 [17]

17. Sustainability Victoria 2018, 'Victorian Local Government Annual Waste Services Report 2016-17', Melbourne, Victoria.

18. Sustainability Victoria 2018, 'Lifecycle assessment of kerbside recycling', Melbourne, Victoria https://www.sustainability.vic.gov.au/Government/Victorian-Waste-data-portal/Lifecycle-assessment-of-kerbside-recyclables-in-Victoria Accessed 3 December 2018.

19. Australian Bureau of Statistics 2018, '9208.0 - Survey of motor vehicle use, Australia, 12 months ended 30 June 2016', http://www.abs.gov.au/ausstats/abs@.nsf/mf/9208.0/ Accessed 4 December 2018. Department of the Environment and Energy 2016, 'National greenhouse accounts factors, Australian national greenhouse accounts', Canberra, Australian Capital Territory http://www.environment.gov.au/system/files/resources/e30b1895-4870-4a1f-9b32-3a590de3dddf/files/national-greenhouse-accounts-factors-august-2016.pdf Accessed 4 December 2018.

Indicator	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
W:03 Total Waste Generated		→	DATA QUALITY Good
Data Custodian SV 2009 landfill audit			

Food is a significant component of the waste generated in Victoria. It is estimated that, for 2016–17, 990,000 tonnes of food waste were generated in the state[20] – approximately two-thirds from households and a third from commercial and industrial activities (restaurants, hotels, food manufacturers, retailers etcetera). Audits undertaken by local governments and Sustainability Victoria show that food is about 40% of the waste thrown out by households of which half was avoidable.

The data presented in Figure W.7 shows that food waste generation decreased from 2005–06 to 2010–11, and has been relatively consistent since 2011–12. The causes of the decline in food waste generation prior to 2011 is not known.

From 2009 to 2017, estimates of the total food waste generated have been made through modelling of food waste in kerbside collections and the amount of food waste sent to landfill. New landfill and commercial and industry audit data from work being carried out in 2018 will provide more current estimates of food waste generated.

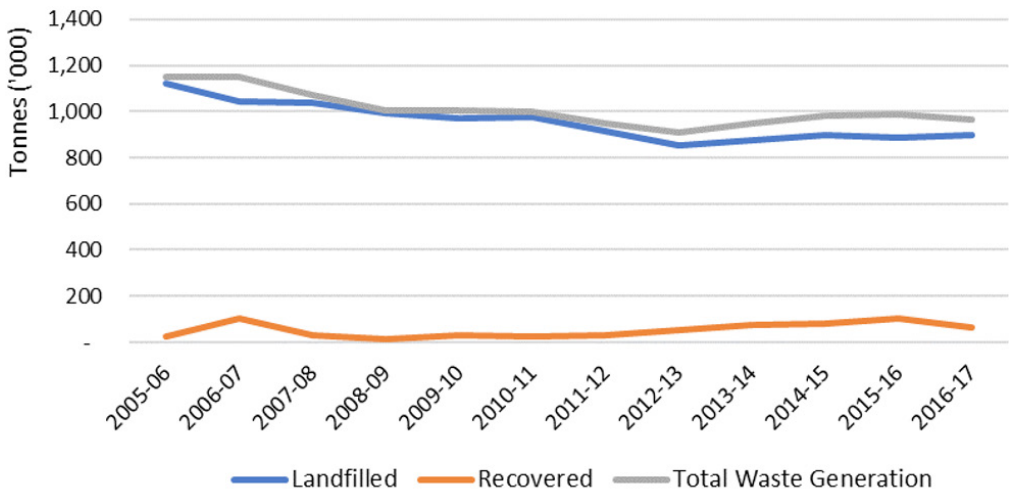


Figure W.7 Food organics, recovered and landfilled, Victoria, 2005–06 to 2016–17 [21]

20. Sustainability Victoria 2018, 'Statewide Waste and Resource Recovery Infrastructure Plan', Melbourne, Australia.

21. Sustainability Victoria 2018, 'Waste projection model', Melbourne, Victoria https://www.sustainability.vic.gov.au/Government/Victorian-Waste-data-portal/Interactive-waste-data-mapping/Waste-projection-model# Accessed 3 December 2018.

Indicator	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
W:04 Diverson Rate	○ ○ ● ○	→	DATA QUALITY Good
Data Custodian EPA Victoria and Victorian Recycling Industry Annual Survey (SV)			

The diversion of waste from landfill (that is, the movement of waste into recycling, recovery and reuse options as alternatives to landfill) increased steadily from 2005–06 until 2011–12 but has largely plateaued since 2012–13. Figure W.8 shows the increase in diversion rate of solid waste since 2007–08 and Figure W.9 demonstrates the trends in diversion rate by source sector.

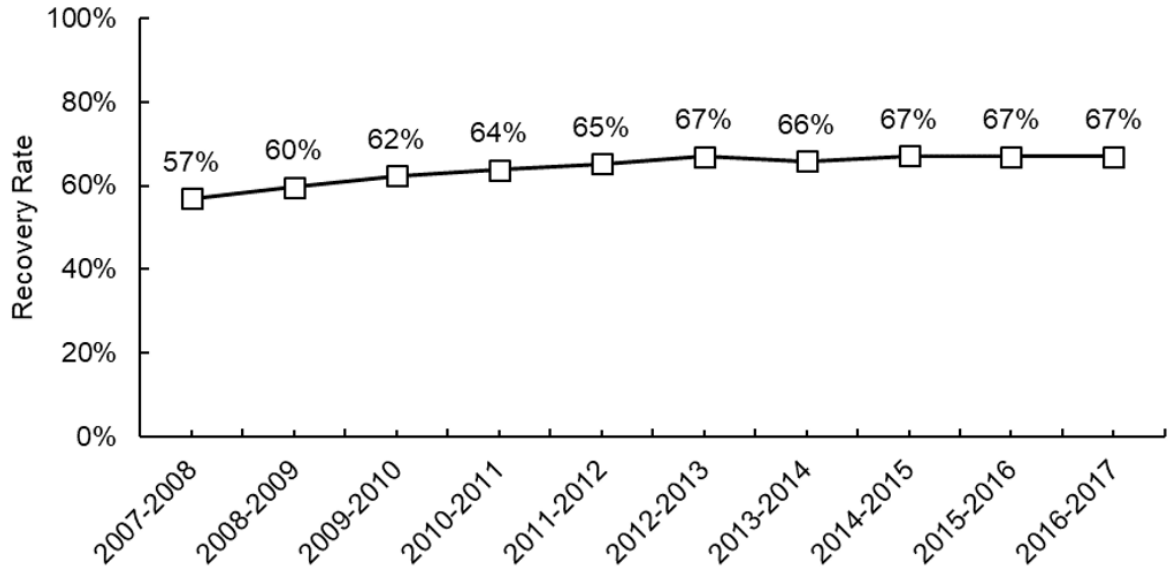


Figure W.8 Resource Recovery; Diversion rate of solid waste, Victoria, 2007–08 to 2016–17 [22]

22. Sustainability Victoria 2018, 'Victorian Recycling Annual Survey Report 2016–17', Melbourne, Australia.

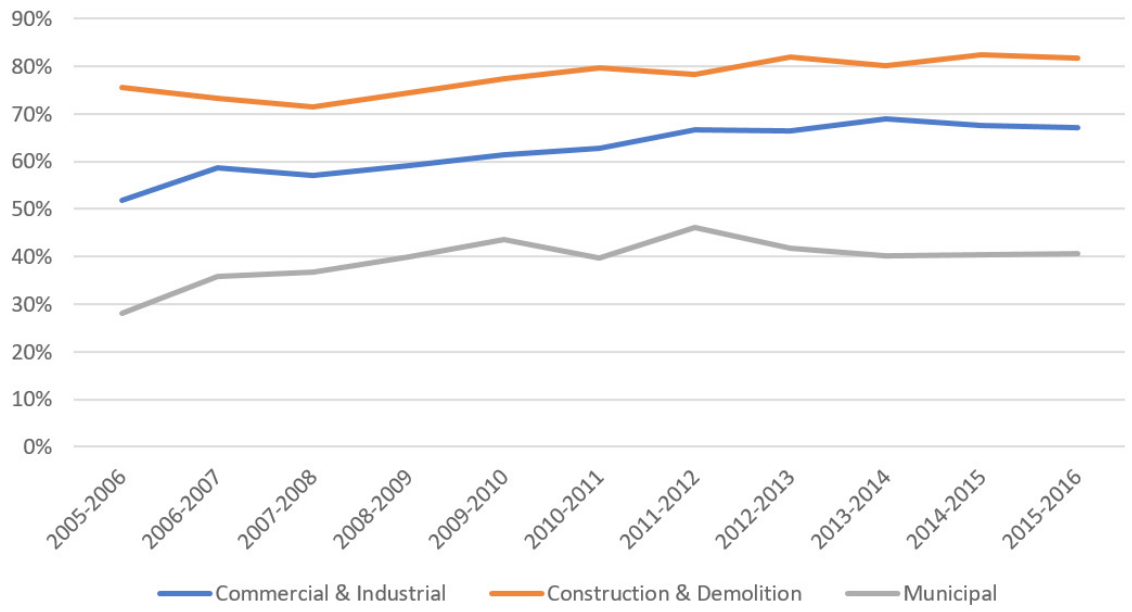


Figure W.9 Annual diversion rate by source sector, Victoria, 2005–06 to 2015–162 [23]

The increase in construction and demolition recovery has been mainly in aggregates, masonry and soils from large new construction projects; these materials are readily able to be recycled into products that can be used in construction. Crushed concrete and masonry (bricks) are readily used as a replacement for gravel products, particularly for roads. The construction and demolition recycling industry is well-established, with financially viable models in current policy settings and markets for end-products, and contributes significantly to the overall diversion from landfill.

Glass recycling is an exception to the overall trend. Glass can be melted and recycled, but requires colour sorting. An alternative is for mixed, broken glass to be further crushed for use as a fitforpurpose sand replacement in some settings. Specifications and changes in procurement practices have not yet developed sufficiently and the overall recovery rate for glass has fallen.

Contamination is an ongoing challenge, with some forms of contamination rendering the recycling of materials less viable. For example, glass and oily liquids readily contaminate paper and cardboard.

Municipal diversion significantly increased from 2005 to 2008 when new collection systems were implemented. However, it has slightly declined since 2011–12, most likely due to the light-weighting of packaging materials (that is, replacing heavier recycled materials with lightweight materials that are added to garbage) and reduced amounts of paper and cardboard being recycled. An increased number of local government authorities offered organics collections, which contributed to the contributed to the increase recovery rate for organics (refer Figure W.10), but not yet at a sufficient level to substantially increase the municipal diversion rate. Variations in total organics collections due to local weather conditions (households generate more garden organics in wetter years) also impacts on the overall diversion rates.

23. Ibid

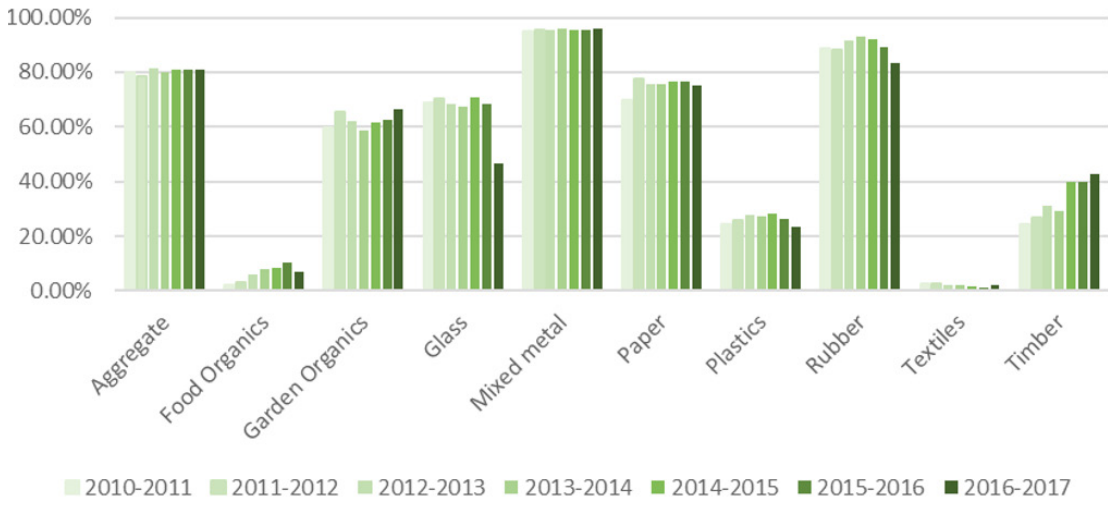


Figure W.10 Recovery rate by material type in Victoria from 2010–11 to 2016–17 [27]

Reprocessing and Recovery

Figure W.10 shows the recovery rates for major material categories from 2010–11 to 2016–17. These material categories include: aggregate, food organics, garden organics, glass, mixed metal, paper, plastics, rubber, textiles and timbers. Note, not all materials can be diverted from landfill and recovery rates apply to specific materials which can be recycled.

Aggregates[24] (mainly from the construction and demolition sector) had a recovery rate of 81%, a rate which has been relatively stable over the past seven years; similarly, mixed metals had a recovery rate of 96%. These materials have strong markets, and in the case of metals, benefit from international demand. The material that shows the greatest need for recovery (and reduction) is food organics which, despite recovery rates increased from 2% to 10% in 2015–16,[25] still requires substantial improvement. Food and garden organics comprise nearly 2.5 million tonnes of the waste managed. Food waste is nearly 1 million tonnes of this. It contributes close to 25% of total waste to landfill, and generates methane in landfill, contributing odour and GHG emissions.

The recovery of plastics is also problematic, with recovery rates consistently around 25% – noting that there are many types of plastics, with varying properties that can influence recovery rates.[26]

24. Excluding contaminated soils, which are considered hazardous.
25. Sustainability Victoria 2018, 'Victorian Recycling Annual Survey Report 2016–17', Melbourne, Victoria.
26. The changes in China's policy restricting the import of recovered materials, including plastics, came into effect in 2017-18 and is not evident in this data set.
27. Sustainability Victoria 2018, 'Victorian Recycling Annual Survey Report 2016–17', Melbourne, Australia.

Indicator	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
W:05 Litter and Illegal Dumping Data Custodian National Litter Index (Keep Australia Beautiful) SV	GOOD	↗	DATA QUALITY Poor

Litter and Illegal dumping can have significant impacts on the environment: they threaten wildlife and can lead to long-term contamination of land and waterways. Collecting data on litter and illegal dumping is problematic because of the diffuse nature of the issue. The National Litter Index has provided a consistent measure of litter over the past nine years and while there are methodological shortcomings in the approach it does provide some comparative insights.

National Litter Index

The National Litter Index surveys 151 sites across Victoria, with an area surveyed of 239,403 square metres. While the primary focus of the monitoring is across Melbourne suburban areas, several regional and rural sites are also surveyed. A further 15 rural highway and road sites are also surveyed.

As shown in Figure W.11, with the exception of 2009–10, there has been a steady reduction of litter in Victoria. It also shows that while there are year-on-year changes, the overall shape of the litter stream has not significantly changed. In Victoria in 2016–17, cigarette butts represents approximately 53% of items counted, while takeaway food packaging is 15%.

The sites with the highest number of the littered items found in Victoria are parks and industrial and retail precincts.

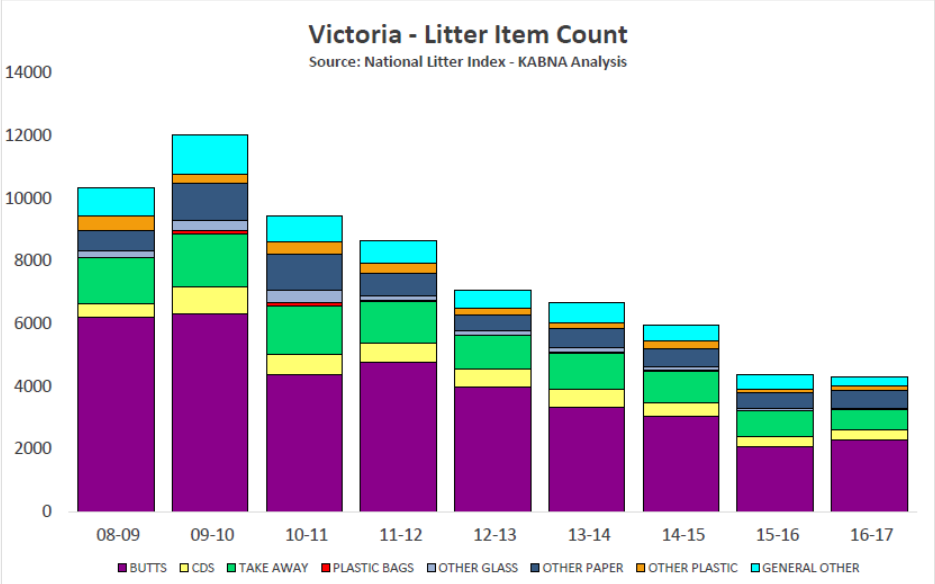


Figure W.11 Litter item count trends in Victoria from 2008–09 to 2016–17. Note: The numbers on the y-axis refer to the number of items counted [28]

28. Keep Australia Beautiful 2017, 'National Litter Index, 2016-17, Victoria Results', Newtown, New South Wales http://kab.org.au/wp-content/uploads/2018/02/1802_KAB_nli_report_v2_2016-17.pdf Accessed 4 December 2018.

Victorian Litter Report Card

In 2016 the Victorian Litter Report Card was developed to research, collate and analyse current litter and illegal dumping data from across Victoria. The Litter Report Card identifies Victoria's top five litter issues, providing evidence for future investment.

In developing the Litter Report Card, the purpose, activities and available datasets in relation to litter of 25 organisations that deliver litter prevention and/or management programs were examined. The organisations reviewed included localised and specialised groups, regional bodies, statewide authorities and national organisations. Following the collation of evidence, a multi-criteria analysis (MCA) was undertaken to enable an efficient and objective analysis, considering both the qualitative and quantitative data. The MCA rating framework was designed to weight litter themes and score litter issues, to determine rankings for prioritisation based on environmental, social, economic and health and safety impacts.

The top five litter issues identified by this project were:

- litter in coastal areas and waterways
- illegal dumping of waste
- roadside litter
- cigarette butt litter
- plastic and micro-plastic litter.

Illegal Dumping

Illegal dumping is a cost that is difficult for councils to plan for, because dumping is an unknown until after it happens.

Research conducted by EPA Victoria's Illegal Dumping Strike Force program in 2016 has shown that, on average, each council is paying around $76,000 a year to clean up 38,697 incidents of dumping, totalling more than 33,000 tonnes of illegally dumped waste.

Indicator	Status (UNKNOWN / POOR / FAIR / GOOD)	Trend	Data Quality
W:06 Total Hazardous Waste managed Data Custodian Dept.Environment and Energy 2017, EPA Victoria	FAIR	→	DATA QUALITY Fair

Hazardous wastes are those that pose a substantial present or potential threat to human health and the environment. In Victoria, they are also known as Prescribed Industrial Waste and are regulated by the EPA Victoria.

In 2014–15, 920,000 tonnes of hazardous waste (excluding biosolids) were recorded as arising in Victoria (see Figure W.12). Hazardous waste is said to 'arise' when it is delivered to processing, storage, treatment or disposal infrastructure.[29] It reflects how much waste is required to be managed by the various types of infrastructure, often at several locations, rather than the non-hazardous waste data which enables a calculation of the amount of material being managed by the system overall.

From 2003–04 to 2014–15, hazardous waste arising in Victoria ranged between approximately 800,000 and 1.1 million tonnes. The decline in hazardous waste from 2007 to 2009 is found across a range of types of hazardous materials[30] and could be related to a decline in manufacturing in Victoria during this period.

Figure W.12 Hazardous waste arising in Victoria

(Data source: Derived from Hazardous Waste in Australia 2017 (Dept. Environment and Energy 2017))

29. The term 'arise' is used in relation to hazardous waste data derived from tracking systems. Waste 'arises' when it is delivered to hazardous waste processing, storage, treatment, or disposal infrastructure. This is distinct from 'generation', a term commonly used in waste reporting, in that if waste is transported to more than one site it may 'arise' more than once in the tracking system data.
30. Department of the Environment and Energy 2017, 'Hazardous Waste in Australia', Canberra, Australian Capital Territory.

There are two main waste types that are not immediately apparent in the trend data – those of legacy and emerging wastes. Legacy wastes are those wastes that are missing from the tracking data and can be present (usually stockpiled) in large volumes. In Victoria, this includes fly ash, a residue generated from combustion (of coal at coal-fired power stations), that is captured by filtration equipment. Emerging hazardous wastes include lithium-ion batteries and various flame retardants (such as per- and poly-fluoroalkyl substances). The risks posed by hazardous wastes do not always correlate to volume, with some materials posing a much greater risk to human health and the environment than others.

EPA Victoria, under the Environment Protection (Industrial Waste Resource) Regulations 2009, classifies hazardous waste into more than 70 waste types. Hazardous wastes are generally a result of manufacturing or industry processes, or construction and demolition. They include contaminated soils, asbestos from construction projects, wastes from the chemicals and heavy manufacturing industry, spent industrial catalysts and other residual wastes contaminated with heavy metals. Hazardous wastes are also produced through everyday sources such as tyres, oils and oily water, grease-trap waste (commercial cooking) and lead-containing wastes such as lead acid batteries and leaded glass from used televisions and computers.

The top 10 hazardous wastes produced in Victoria in 2014–15 by weight (approx. tonnes) were:

1. biosolids (429,000)
2. contaminated soils (359,000)
3. grease-trap wastes (119,000)
4. tyres (93,000)
5. asbestos (80,000)
6. oil/water mixtures (59,000)
7. other putrescible/organic wastes (42,000)
8. other soil and sludges (28,000)
9. oils (26,194)
10. paints, resins, inks, organic sludges (16,000).[31]

Recent research undertaken at the national level [32] identified weaknesses in the hazardous waste data available in Victoria. It found:

The data quality issues arise through a mix of systemic weaknesses, poor quality assurance (QA), system-user knowledge gaps and ambiguity in coding and definitional conventions. In summary:

- source industry identification coding is absent or unreliable in all five state tracking systems
- user choices of waste codes and management codes are sometimes incorrect and often inconsistent
- incorrect use of units (e.g. m^3 instead of kg) has a major impact on annual estimates
- management type data is missing from Victorian data for wastes sent interstate.

Total Hazardous Waste Per Capita

The hazardous waste dataset does not enable this calculation, as data relating to wastes arising means that materials may be measured a number of times as they move through the system. Similarly, hazardous waste is generated largely by the industrial sector, and a per capita measure is not meaningful. Furthermore, the potential or current impacts of hazardous waste relate to the risks posed and not necessarily by volume. A more nuanced indicator, relating to the SDGs, may be required to be developed.

31. Department of the Environment and Energy 2017, 'Hazardous Waste in Australia', Canberra, Australian Capital Territory.
32. Ibid

Future Focus

Develop indicators and reporting for the circular economy

Waste is produced at all stages of extraction, consumption and production, as well as at the end of a product's lifecycle. Victoria produced approximately 12.9 million tonnes of solid waste in 2016–17 – about as much as has been produced over the past five years.[33] The Victorian Government has committed to developing a circular economy strategy for Victoria by June 2020. This commitment is consistent with, and builds on, the current Victorian Statewide Waste and Resource Recovery Infrastructure Plan (SWRRIP) released in 2015 and amended in 2018.

The SWRRIP, and the regional plans (WRRIPs), are developed on the principles of a circular economy. A circular economy aims to:

- re-define growth by decoupling economic activity from the consumption of finite resources and design waste out of the system
- keep resources in use for as long as possible
- extract maximum value from resources while in use
- recover and regenerate products and materials at the end of each service-life so that material is not lost from the system as a waste, but becomes a resource for another use.

The concepts of waste minimisation and recycling of materials are central to the current model of waste management and resource recovery in Victoria, but transitioning our current linear economy (a 'take-make-dispose' supply-chain approach) to a circular economy model will require a paradigm shift.

Designing and implementing the transition pathway will require deep community and business engagement, and whole-of-government buy-in. It will also require more comprehensive and intensive monitoring, and a deeper understanding of system operation, than government has currently, and a shared understanding of the roles and responsibilities of all partners. A circular economy cannot focus only on waste and recycling if it is to drive change in the way people consume resources. It needs to encompass all aspects of the resources cycle, including resource extraction, imports, consumer behaviour and procurement by government. It also needs to consider approaches by, and impacts on, all sectors and markets.

To achieve this, the circular economy strategy in preparation must be supported by evidence that sets a baseline and includes performance measures to enable government and businesses to demonstrate progress and foster transparency and accountability in delivery. This will require a review of the adequacy of the planning and procurement practices of the Victorian waste management and resource recovery groups, and the Victorian Government more broadly. The Victorian Government Procurement Board could provide advice on mechanisms for executing circular economy outcomes, particularly with a focus on leveraging government procurement to create and develop markets. Changes to Financial Reporting Directions (prepared by the Department of Treasury of Finance in accordance with Australian Accounting Standards) may be a useful mechanism.

This recommendation aims to shift reporting on waste and resource recovery from transactional, ad hoc accounting to a strategic evidence base that better tracks and reports on the operation of Victoria's waste and resource recovery system – now, and as it transitions to a circular economy model over the next decade. The reporting needs to clarify the roles and responsibilities of the agencies and partners in the system and what data they are responsible for collecting, interpreting and/or maintaining.

33. Victorian Recycling Industry Annual Report 2016-17, Sustainability Victoria 2018

Recommendation 13: That Sustainability Victoria, in 2019, develop indicators and implement a comprehensive monitoring and reporting framework to measure delivery of the current SWRRIP and WRRIPs against their circular-economy design principles. From July 2020, that Sustainability Victoria expand that monitoring and reporting framework to track the progress of the implementation of the strategy and publicly report, at least annually, on Victoria's transition to a circular economy.

Align the Institutional Framework for Waste and Resources Recovery to Support a Circular Economy

One of the key priorities of the SWRRIP is the consolidation of infrastructure to collect and process recovered resources. Household and municipal waste from across local government areas is an anchor for investment in infrastructure by providing reliable, base-load volumes and creating the opportunity for potentially longer contract terms which are conducive to investment in best-practice technologies for resource reuse and recovery. Victoria has seven regional Waste and Resource Recovery Groups (WRRGs), the largest of which is the Metropolitan WRRG, servicing the majority of Victoria's population. The WRRGs share an important purpose: to undertake collective, strategic procurements for local government. Given the importance of collaborative procurement in making large volumes of recovered materials available to the market, it would be timely to evaluate success against desired objectives, and what changes may be required to achieve the delivery of a circular economy. There is scope to accelerate the pace and scale of joint procurements; however, evidence is required to identify where barriers exist and how best to remove them.

Resource recovery infrastructure needs to be established and upgraded so that recovered materials are sorted and processed to a higher standard. These recycled materials need strong domestic markets – so that various types of wastes are 'pulled' through into other material uses and products by stimulating market demand.

Recommendation 14: That the Victorian Government, commencing within the metropolitan region as a minimum, align the institutional planning and procurement processes (including leveraging Victorian Government procurement) to support the delivery of the circular economy strategy from July 2020. Ultimately, this alignment would be adopted statewide and enable an orderly transition to a circular economy in Victoria by 2030. In developing the action plan to deliver the circular-economy strategy, the roles and responsibilities of all agencies should be clarified to nominate those agencies responsible for delivering policy, procurement, program, reporting and regulatory roles. Further, that the Victorian Government commit to long-term, systemic, statewide community education to support this transition and assist the change in behaviours that will be required to improve long-term system outcomes. Reducing consumption and contamination levels in kerbside recycling would be the initial focus.

Accounting for the Environment

Environmental-economic accounting provides a framework for measuring flows of waste within the economy and from the economy to the environment. In the System of Environmental-Economic Accounting (SEEA), waste is categorised as a product flow or residual flow within the economy, or a residual flow from the economy to the environment (see Figure W.13).

Waste accounts record these connections, showing the generation (supply) and use of waste by different economic units (such as industry, government and households). Over time, accounts can be used to identify trends in waste generation and use by different sectors, including the relationship between waste generation or use and economic activity. Waste accounts provide a useful set of information for evaluating government, industry and household waste management activity.

In 2013, the Australian Bureau of Statistics (ABS) produced Australia's first and only waste accounts, which valued the supply of waste management in 2009–10 at just over $9.5 billion. These accounts report supply and use of waste in physical (tonnes) and monetary (purchasers' prices) terms, and they align with industry classifications used by the ABS.

Unlike some residual flows, such as air emissions, solid waste often remains within the economy as it is recycled or disposed of in controlled landfills. However, there can be residual flows of liquids and gaseous materials (such as leachate and methane) from landfills to the environment. Solid waste also enters the environment as litter or dumping.

Ecosystems can be a sink for waste, providing important waste assimilation services through processing and absorption of residuals. In the case of solid waste, assimilation services are limited, as waste materials such as plastic and metal take a long time to break down. This is different to other residual flows from the economy to the environment, such as air emissions or nutrients, which are more readily assimilated.

SEEA definition	Example
Product flow within the economy	Waste that is recovered and re-used
Residual flow within the economy	Waste collected in landfill sites
Residual flow from the economy to the environment	Litter, illegal dumping Leachate or methane emissions from landfills

Figure W.13 Types of waste flows in the SEEA