INFRASTRUCTURE VICTORIA

Advice on Recycling and resource recovery infrastructure

April 2020

About us

Infrastructure Victoria is an independent advisory body with three functions:

- preparing a 30-year infrastructure strategy for Victoria, which is refreshed every three to five years
- providing written advice to government on specific infrastructure matters
- publishing original research on infrastructure-related issues.

Infrastructure Victoria also supports the development of sectoral infrastructure plans by government departments and agencies.

The aim of Infrastructure Victoria is to take a long-term, evidence-based view of infrastructure planning and raise the level of community debate about infrastructure provision.

Infrastructure Victoria does not directly oversee or fund infrastructure projects.

Aboriginal acknowledgment

Infrastructure Victoria acknowledges the traditional owners of country in Victoria and pays respect to their elders past and present, as well as elders of other Aboriginal communities. We recognise that the state's infrastructure is built on land that has been managed by Aboriginal people for millennia.

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Executive summary

Victoria's recycling and resource recovery sector is under increasing pressure. The amount of waste being generated is growing while our resource recovery rates have stagnated. Simultaneously, changes in international markets, combined with weak end markets in Victoria, have led to large amounts of recyclables being stockpiled or sent to landfill.

In April 2019, the Victorian Government asked Infrastructure Victoria to help address these issues and provide advice on the infrastructure required, and the role for government, to improve recycling and resource recovery in Victoria.

Our advice builds on the considerable work underway across the Victorian Government and supports the state's move to a circular economy, where we all minimise waste and make the most of resources. Shifting to a more circular economy will grow the economy, increase jobs and reduce impacts on the environment.

In this report, we have identified Victoria's specific infrastructure needs in the sector. We have also developed the most comprehensive and up-to-date data of current and projected waste generation in Victoria and infrastructure capacity and capability. The data and methodology developed for this report can support infrastructure investment and network management across Victoria.

We make 13 recommendations to the Government on infrastructure, supporting actions and governance, all of which have been tested against a set of outcomes developed with stakeholder input. Our work shows there is not one single approach to achieve these outcomes. All levels of government, business and households will need to work together if we are to realise the huge opportunity before us.

We estimate about $1.21 billion worth of resources was recovered in Victoria in 2018/19. While highly dependent on commodity prices, this figure demonstrates the potential that higher rates of resource recovery could deliver to the state every year, particularly if these materials are processed and used in Victoria.

Victorians are passionate about recycling but some have lost confidence in the system, with around a quarter of people we polled thinking the contents of their recycling bins ends up in landfill. However, the community also has a high level of willingness to help improve recycling outcomes, with 92% of people saying they are willing to change the way they sort their rubbish. This indicates a strong desire from the community to do the right thing and an opportunity to rebuild trust in the system.

The Victorian Government is already working hard to address these challenges. It has provided funding of $135 million since 2015 for waste and resource recovery initiatives. The recently released *Recycling Victoria: A new economy* provides the overarching policy framework and long-term focus the sector needs if it is to meet Victoria's growing recycling and resource recovery needs.

Our advice focuses on six priority materials:

- plastics
- paper and cardboard
- glass
- organics
- tyres
- e-waste.

This is because some materials we dispose of and recover are more problematic, or present greater opportunities than others. Our evidence shows that improving recycling of these six materials has the potential to deliver the greatest benefit to Victoria.

The infrastructure we have identified in this report supports improved resource recovery for priority materials and enables more to be reprocessed and re-used in Victoria. We have identified 87 potential new or upgraded facilities – 52 in regional Victoria – to ensure Victoria has the capacity and capability to meet our needs, now and into the future. While this will require significant initial investment from both government and business, it should be viewed in the context of value that can be captured from increasing resource recovery on an ongoing basis.

We have identified 87 potential new or upgraded facilities – 52 in regional Victoria – to ensure Victoria has the capacity and capability to meet our needs, now and into the future.

Expanded infrastructure is just part of the solution. High-performing jurisdictions, like Wales, Germany, South Korea and South Australia, have used a mix of policy, regulatory and financial interventions. These include targets, taxes, incentives and investments over the long term to achieve their current high levels of resource recovery. This is a clear lesson for Victoria about what can be achieved with the right mix of policies.

Improving the quality of the materials going into the recycling and resource recovery system is another key focus as it impacts the quality of the materials produced, and the cost of processing these materials. At the same time, it is important to ensure that there is enough demand for these resources to meet supply.

Making it easier for Victorians to recycle correctly is one of the keys to cleaner materials streams.

We recommend a clear and consistent approach to kerbside collections across the state, supported by greater separation of materials – including organics, glass, paper and cardboard. This should be accompanied by an ongoing behaviour change campaign to ensure Victorians understand what they need to do and are assured that their efforts are not wasted.

The Victorian Government can play an active role in stimulating demand and supporting markets for recovered resources. Research and development funding to identify and test new uses for recovered materials can create new markets. As *Recycling Victoria* recognises, Government can demonstrate its commitment to greater recycling and resource recovery by buying products made from recovered materials.

The Victorian Government can further demonstrate its leadership in the recycling and resource recovery sector by reviewing and updating its own governance arrangements. Implementation of *Recycling Victoria* will be an opportunity to provide greater clarity of the roles and responsibilities of different agencies. This can make it easier for other players to navigate the sector and empower local governments in their delivery of waste services. Also, a clearer position on the role of waste-to-energy, to reduce the amount of waste going to landfill as the state transitions toward a more circular economy, could encourage greater investment in this technology. These efforts can be further supported by improving the collection and sharing of quality performance data to support ongoing policy development and measure progress. Consistent with other high performers around the world, we support the introduction of targets to drive performance.

Funding for these initiatives will come from both Government and the private sector. The Victorian Government has committed $300 million to deliver the *Recycling Victoria* policy. The Victorian Government has several additional funding streams available to support the necessary transition through annual budget allocations, the Sustainability Fund and other economic development programs.

The Australian Government also has a role to play by supporting transitional infrastructure investments and through encouraging producers to take greater responsibility for the products they create when they reach their end-of-life. Extended Producer Responsibility schemes are in use internationally and are particularly effective in managing hard-to-recycle products and reducing problematic materials.

Our advice represents 12 months of evidence gathering and development, as well as significant stakeholder and community engagement. With the right settings in place, investment in infrastructure for collections, processing and energy recovery, we can not only meet the growing need for resource recovery but also support our long-term transition to a circular economy and better outcomes for all Victorians.

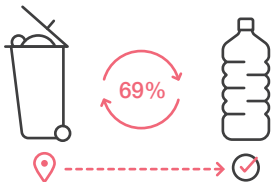
02.

Recycling and resource recovery by the numbers

Six priority materials

Plastics | Paper and cardboard | Glass | Organics | Tyres | E-waste

Now

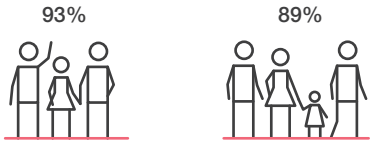


69% current **recovery rate**

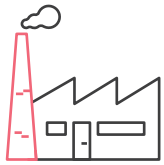
$1.2 billion

Total annual value of **potential resource recovery in 2018/19** – **$1.2 billion**

In the future



93% of Victorian households feel it **is important to reduce non-recovered waste**, and **89%** are open to **changing how their household sorts waste**



3.1 million tonnes

3.1 million tonnes of **processing capacity** required

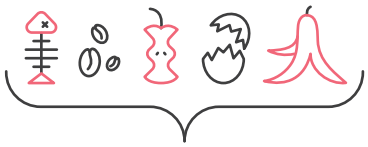
Approximately **$1 billion investment required by 2039**

x 87 facilities

87 new or upgraded facilities, 52 in **regional Victoria**

5,000+ jobs

Over **5,000 jobs** could be **created by 2039** if 90% recovery rate is achieved



Around **1.46 million** tonnes of organic waste will be generated in 2039. The food organics/garden organics recovery rate is currently 20% – **almost all of this is recoverable**

03.

Terms of reference

In April 2019 the Special Minister of State requested Infrastructure Victoria provide advice on the infrastructure required and the role of government to improve the performance of Victoria's recycling and resource recovery sector.

The Government requested advice on the infrastructure required and the role of Government to:

- Develop Victoria's reprocessing sector for recycled material, particularly those that currently rely heavily on overseas markets, such as plastics.
- Enable the use of products containing recycled materials in a variety of Victorian industries, such as manufacturing, construction and agriculture.
- Support a waste-to-energy sector that prioritises the extraction of recyclable material and recovers energy only from residual waste.
- Support high levels of resource recovery for organics, particularly food organics.

Infrastructure Victoria was asked to undertake comprehensive engagement with industry, the community, government, local government and other key stakeholders, draw on international comparisons and research, and develop its own modelling and analysis to inform the advice.

The advice was requested in two parts:

01.

An interim report, within six months of the request, setting out key early findings, significant risks or opportunities, and the proposed strategic direction of the final advice. The interim report was published in October 2019.

02.

A final report, supported by evidence and analysis, detailing potential infrastructure requirements for the recycling and resource recovery sector. The final advice will also consider the regulatory, policy and market settings that underpin the recycling and resource recovery sector and identify potential timing of infrastructure delivery.

The full terms of reference are on our website.

A note on methodology

To inform our advice, we commissioned and undertook detailed technical analysis across a range of subject matter areas. A summary of our approach to this work can be found in Section 8 of this report. All the analysis can be found in the full set of reports available at **infrastructurevictoria.com.au**

04.

Recycling and resource recovery infrastructure outcomes

In recent years, the lack of an overarching policy framework and shared objectives for the Victorian recycling and resource recovery sector has been a barrier.

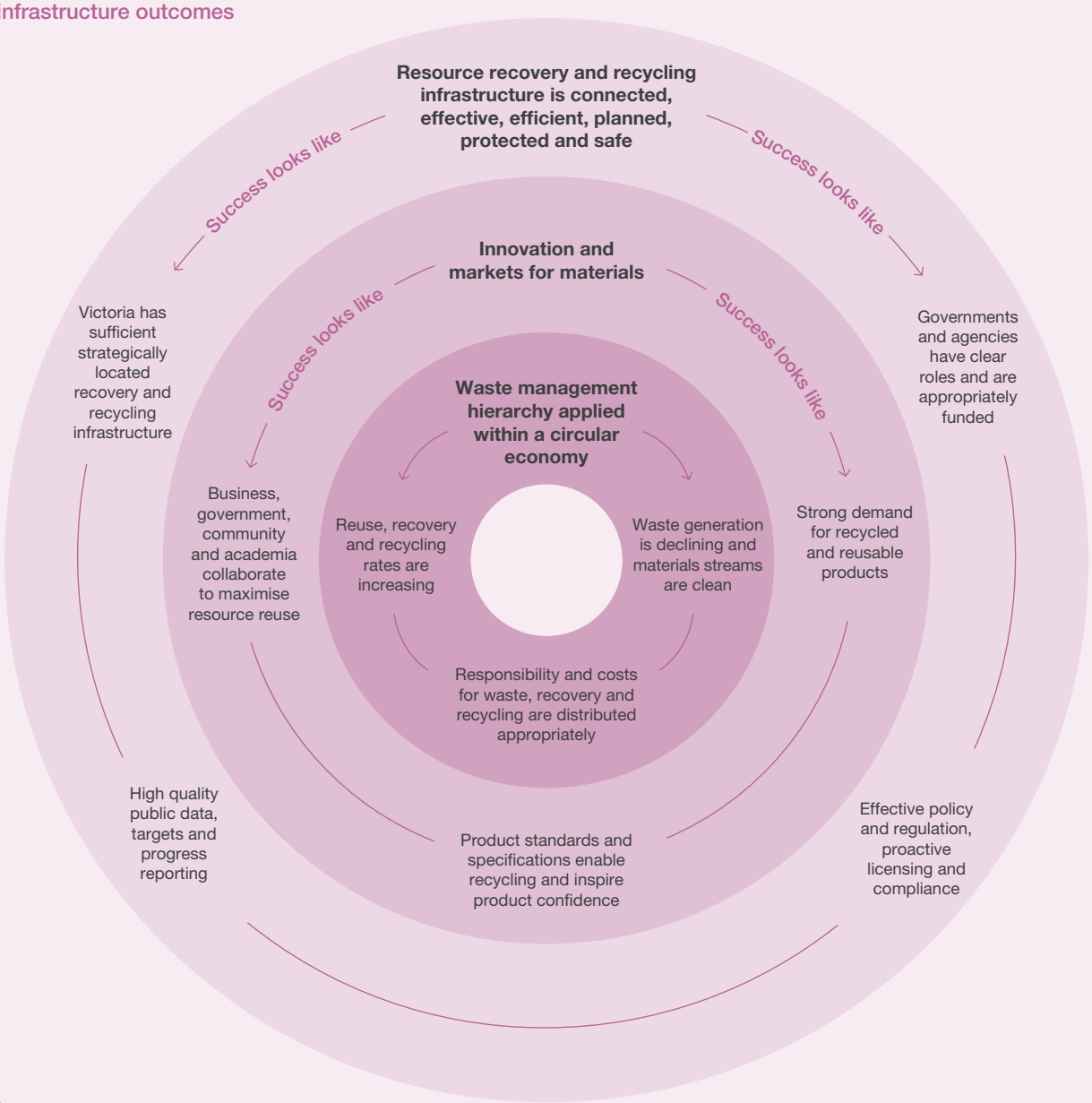
However, considerable work is underway across the Victorian Government to improve recycling and resource recovery and increase resilience.

In our *Evidence Base Report*, we proposed outcomes for the sector. We asked for feedback so we could refine these outcomes and develop our final advice to government.

Based on feedback from stakeholders, we have developed outcomes that reflect the principles of a circular economy, emphasise the waste hierarchy and meet the requirements outlined in the terms of reference for this advice. Figure 1 illustrates these proposed outcomes.

The recommendations in this report represent the key actions we think are necessary to achieve these outcomes.

Figure 1: Recycling and resource recovery infrastructure outcomes



Summary of recommendations

Recommendation	Supports a circular economy	Supports reprocessing in Victoria	Supports waste-to-energy within the waste hierarchy	Supports recovery of organics
Improve infrastructure capacity and capability for recovering and reprocessing priority materials	✓	✓	✓	✓
Increase the diversion of organic waste from landfills	✓			✓
Provide clarity to the waste-to-energy sector & establish regulatory settings to achieve desired waste-to-energy outcomes	✓		✓	
Review funding mechanisms to increase infrastructure capacity and capability		✓		✓
Provide ongoing statewide and locally tailored behaviour change programs	✓	✓	✓	✓
Reduce contamination in materials streams	✓	✓	✓	✓
Introduce waste minimisation initiatives	✓			
Remove barriers and strengthen markets for priority materials	✓	✓		✓
Ensure that producers and consumers involved in making and using products share the responsibility for their fate	✓			
Provide greater clarity of roles and responsibilities of Victorian Government bodies involved in recycling and resource recovery	✓	✓	✓	✓
Improve the quality and use of data to support resource recovery	✓	✓		
Use targets to drive performance	✓	✓		✓
Strengthen the status of and processes around the Victorian Recycling Infrastructure Plan (VRIP)		✓	✓	✓

05.

Recommendations

Infrastructure Victoria makes the following recommendations to the Victorian Government:

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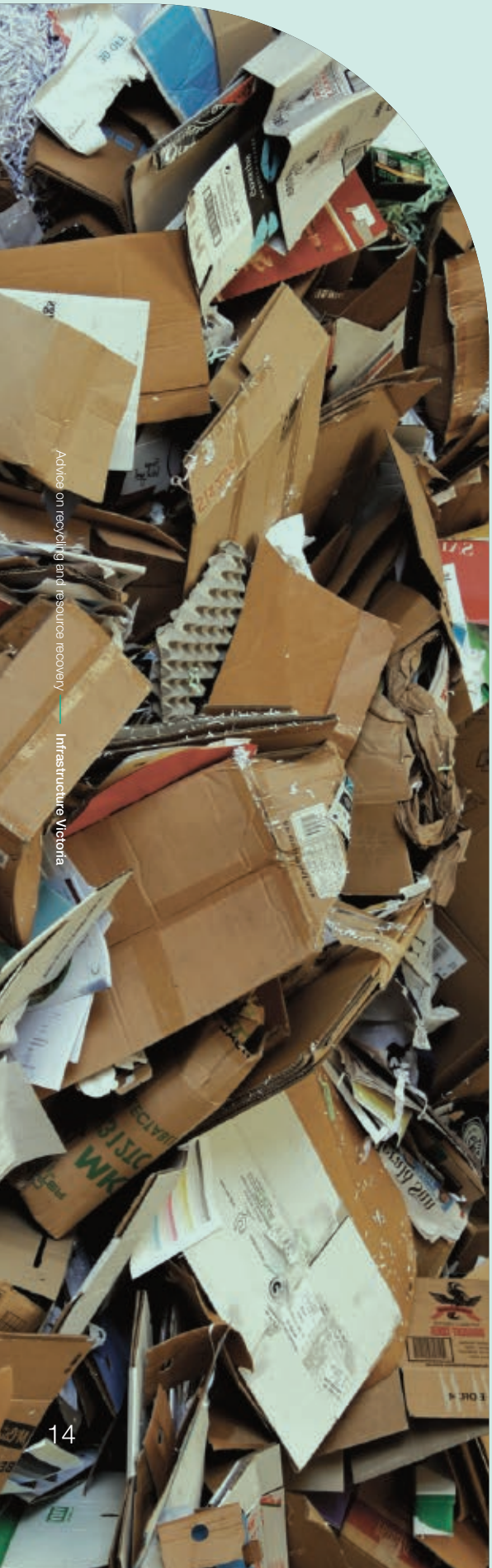


Recommendation 01

Improve infrastructure capacity and capability for recovering and reprocessing priority materials

Context

The amount of waste Victorians generate is forecast to grow. Victoria needs investment to increase resource recovery and recycling infrastructure capacity.

This investment also needs to address the capability to meet market demand, international import restrictions, and a range of Victorian and Australian Government policies, such as the Council of Australian Governments (COAG) waste export ban. Bans will cause significant infrastructure capacity and capability shortfalls for paper and cardboard in 2024, followed by a shortfall for plastics in 2025 unless further investment is made.

Similarly, Victoria's capacity and capability to manage recovered organics and e-waste will be exceeded by 2025 and 2030 respectively, as a result of policies such as the National Waste Policy and Victoria's e-waste landfill ban, introduced in 2019.

Appendix A includes a summary of additional infrastructure capacity and capability requirements by 2039, and indicative costs.

While much of the recovery and reprocessing infrastructure in Victoria is owned, operated and funded by the private sector, the Victorian Government has a role to play in facilitating investment, leveraging existing investment and providing direct funding to the sector where the market fails to do so.

The data used to inform these recommendations are based on modelling that provides projections to inform Victorian Government decision making. The projections should be considered approximations rather than precise predictions.

Priority materials are paper and cardboard, plastics, glass, organics, e-waste and tyres.

Recommendation

Key infrastructure requirements for each priority material are outlined below.

Paper and cardboard

\ 600,000 tonnes of additional paper sorting and pulping infrastructure from 2024.

\ Additional capacity and capability to manufacture paper and cardboard packaging products, such as tissue, paper towels and egg cartons.

\ Improved mechanical sorting of mixed paper and cardboard at Materials Recovery Facilities (MRFs) to recover different paper grades, enhancing access to paper reprocessing markets.

Plastics

\ 288,600 tonnes of total capacity and capability to produce plastic flakes and pellets by polymer in metropolitan Melbourne and regional Victoria from 2025.

\ Transition from recovering mixed plastics bales to recovering plastics separated by polymer using improved optical sorting. This will enable MRF operators to sell to export markets or domestic reprocessors.

\ Upgrade Victorian resins manufacturing infrastructure to incorporate recycled plastics into new plastic products.

Glass

\ Additional glass beneficiation (removing contaminants, sorting by colour and maintaining a minimum piece size) capacity and capability in metropolitan Melbourne to achieve higher value glass use where possible (e.g. for recycled glass containers instead of glass sand).

\ Glass sand reprocessing in regional areas to enable more use of recycled glass sand in regional road construction.

Organics

\ Additional dedicated organics recovery transfer stations in the outer northern and western growth corridors (in line with the *Statewide Waste and Resource Recovery Infrastructure Plan*'s hubs of state importance) to aggregate and consolidate increasing amounts of food and garden organics (FOGO) from metropolitan Melbourne.

\ Additional capacity of 130,000 tonnes by 2025 and 555,000 tonnes by 2039, through a combination of:

- Open windrow composting capacity in regional Victoria, particularly Barwon South West and Grampians Central West by 2025.
- In-vessel composting capacity in metropolitan Melbourne and throughout regional Victoria.
- Anaerobic digestion capacity in Metropolitan Melbourne to process metropolitan food organics, and in regional Victoria, co-located with existing wastewater treatment plants and food production hubs that generate significant volumes of food waste.

\ Hardstand infrastructure in regional agricultural areas to encourage maturation and tailored blending of compost for specific applications.

E-waste

\ 4,300 tonnes of mechanical reprocessing infrastructure capability to enable high-value e-waste materials to be recovered across metropolitan Melbourne and regional Victoria by 2030.

\ Support ongoing research into new technologies to manage hard to recover and hazardous e-waste. Emerging techniques to consider include improved mechanical and optical, thermal, chemical, nano and biological processing.

\ Consider improvements to the existing e-waste disposal network focussed at resource recovery centres, with increased drop-off points where electronic goods are purchased. This may require appropriate cost-sharing in line with product stewardship approaches and compliance with waste handling requirements.

\ Continue to collaborate with the Australian Government to develop a product stewardship approach for end-of-life solar photovoltaic panels, vehicle and household batteries.

Tyres

\ Investigate opportunities to use passenger vehicle tyres in the production of crumb rubber for road construction.

\ Increase fibre separation infrastructure in metropolitan Melbourne to assist the domestic reuse of passenger tyres or as a contingency for international market constriction. Separated fibre will need to go to waste-to-energy solutions, such as process engineered fuel, or require additional support to develop a market for it.

Other materials

\ Develop MRF (Materials Recovery Facility) input and output quality standards that complement Victorian and local government efforts to reform kerbside recycling.

\ Assess the viability of establishing small to medium-sized MRF infrastructure in regional Victoria for better recovery of recyclables starting with Grampians Central West and Barwon South West Waste and Resource Recovery Group (WRRG) regions.

\ Optimise Victoria's extensive Resource Recovery Centre and Transfer Station network to improve regional resource recovery and, where necessary, consolidate sites for better resourcing and more efficient transport.

Key findings

\ There is an immediate need to plan for investment in paper and cardboard reprocessing infrastructure in Victoria to comply with the COAG Waste Export Ban.

\ To make up a large proportion of the shortfall, and to continue Australian exports, investment in large-scale paper sorting and pulping facilities is required in Victoria. Alternative processing will also need to increase or be developed. Alternate processing can include:

- moulded fibre production
- insulation
- kitty litter
- composting.

\ Victoria does not have the capability to sort mixed plastics at MRFs. With no market outlet for mixed plastics, this material is either being stockpiled or landfilled. This prevents Victoria from maximising existing industry reprocessing capacity.

\ Victoria has an estimated glass processing capacity of around 494,200 tonnes. This is enough to meet requirements of the COAG ban and Victorian policies.

- While we expect there will be enough capacity to process the amount of glass generated in future, there may be opportunities in regional areas for processing glass into glass sand, aggregates and other products. There is also an opportunity to increase the percentage of recycled glass currently used in glass packaging production in Melbourne.
- Without further investment in organics processing capacity, increasing collection of FOGO will lead to a shortfall in Victorian infrastructure capacity and capability to reprocess these materials.
- Melbourne's processing capacity for organics is significantly less than what is recovered; Melbourne relies on regional and interstate processing. Access to suitable sites that can meet regulatory requirements is likely to restrict opportunities to add processing capacity in Melbourne. There is an immediate need to invest in Victoria's organics consolidation and reprocessing infrastructure to meet current and future generation and recovery rates. A more practical solution is to aggregate and consolidate organic material, with initial processing that reduces weight and volume followed by transport to regional areas for additional processing and use.
- E-waste generation is increasing in Victoria due to rapid product innovation, the falling cost of new products, and consumer desire to upgrade. Following the 2019 introduction of a Victorian e-waste landfill ban, there are now pathways for collection, with waste facilities in Victoria providing a separate bin for e-waste and other disposal points at various council and private facilities. Drop-off facilities at retail sites have proved successful for other e-waste collections, such as Mobile Muster for mobile phones.
- There are some emerging e-waste products of concern, specifically solar photovoltaic panels and batteries for solar systems and electric vehicles. Growing amounts of these will reach the end of their useful life in coming years. There is a lack of proven technological reprocessing solutions that can be deployed at scale. Infrastructure Victoria raised this issue in its *Advice on Automated and Zero Emissions Vehicles Infrastructure* in 2018 (Recommendation 15).
- There is sufficient tyre reprocessing capacity to meet the requirements of the COAG export ban and Victorian policies. There are no immediate investment opportunities in regional areas, with the largest output – shredded tyres – almost entirely exported overseas. However, there is an opportunity to increase the use of recovered passenger vehicle tyres, along with their commodity value, by improving Victoria's infrastructure capability. This provides important contingency planning for these materials if market conditions change.
- Victoria relies on a relatively small number of MRFs for Municipal Solid Waste (MSW) processing, which makes the sector less resilient and creates problems if one player exits the industry. In addition, the location of resource recovery and reprocessing infrastructure is determined by the private sector, so it does not necessarily minimise transport costs for local government. Market dynamics can also affect the way infrastructure is used – where it may be to one player's advantage to slow production in certain circumstances.

Recommendation 02

Increase the diversion of organic waste from landfills

Context

Organic material is one of the largest waste streams in Victoria, estimated to make up around 35% of household garbage bins. There is also a large amount of organic waste from the commercial and industrial sector but the data in this sector is not comprehensive. Given that almost all of this material can be recycled in some way, this represents a significant opportunity.

Recommendation

Beyond the infrastructure capacity and capability recommendations already identified for organics, Infrastructure Victoria also recommends that the Victorian Government:

- Support Victorian councils to increase FOGO kerbside collection services for greater recovery of food waste and reduced contamination in the organic material stream, as mentioned in the *Recycling Victoria* policy.
- Complement FOGO collection services with community behaviour change programs to ensure organics collections are well-promoted and utilised. These programs should prioritise food waste reduction and align with the Love Food Hate Waste campaign (see Recommendation 5).
- Increase Commercial and Industrial (C&I) food organics recovery rates, starting with hospitality and food manufacturing businesses.
- Conduct targeted organics research, development and demonstration activities to promote recovered organics as an alternative to soil conditioners in agricultural production.
- Develop product standards and agricultural industry guidance to support the use of recycled organics products in agriculture and provide information to increase confidence in their use.
- Investigate the merits of a Hazard Analysis and Critical Control Point (HACCP) regulatory framework for anerobic digestion.
- Collaborate with the Australian Government to clarify the application of the Australian Carbon Credit Unit (ACCU) system to waste-to-energy systems, including anaerobic digestion.
- Consider landfill bans or other incentives if landfill diversion rates plateau.

Key findings

- There is a significant opportunity for Victoria to divert organic waste from landfill, recover these valuable resources and improve the environment. Victoria's recovery rate for organics (42.3%) is significantly lower than other material streams (69% on average).
- Food waste makes up 19% of landfill, and produces methane as it breaks down, which has a global warming potency around 25 times that of carbon dioxide.[1] Emissions from the waste sector account for 2% of Victoria's total emissions.
- Twenty-seven of Victoria's local governments offer FOGO collection and a further 31 only offer a garden organics collection. This leaves 21 local governments offering no organics collection of any kind – two of which are metropolitan and 19 are regional.
- The performance of FOGO systems can differ greatly. The 2018 *National Waste Report* says that well-promoted, carefully designed systems can capture about 70% of food waste. In some local government areas less than 4% of the population participate.
- A full rollout of FOGO is estimated to cost $10-$60 per household initially, depending on whether a kitchen caddy and/or a kerbside bin is provided. This will depend on the residential setting (house or apartment and size of garden). Ongoing collection and processing costs range from $8 to $50 per household.
- Only around one-third of food waste generated in Victoria is estimated to come from households, with the remainder coming from the C&I sector. There is limited detailed data around food waste generation and recovery from the C&I sector in Victoria, making it difficult to develop specific responses for this sector.
- Sustainability Victoria (SV) estimates that for the 447,000 tonnes of organics recovered in 2017/18, around 103,00 tonnes of CO_2 equivalent emissions are avoided. This implies that for a 10% increase in FOGO recovery rate, the environmental benefit would be an additional 10,000 tonnes of CO_2 could be avoided.
- Clean organic material streams can lead to more recovered organics used on the land, which has significant benefits to soil health, strengthening the market for these materials. Behaviour change can support cleaner streams and further strengthen the market.
- There is a high demand for some recycled organics, such as timber and mulch, for use in urban areas. This includes residential and commercial landscaping. There is less demand for recovered food organics. Providing greater information about the quality and potential uses of recycled organics can increase demand.
- A combination of transportation costs and gate fees can limit recycled organics use in agriculture due to distance from the supply (metropolitan Melbourne).
- C&I food waste is generally more suitable than household waste for use as an anaerobic digestion feedstock.
- Widespread adoption of anaerobic digestion in the European Union (EU) is supported by HACCP regulatory frameworks, product certification and guidelines for safe use. These measures in combination ensure digestate is safe for agricultural use and streamline the requirements that apply to waste suppliers and digestate users. HACCP is widely used for food production in Australia.
- There is uncertainty around the application of carbon credits to anaerobic digestion, particularly for some proponents.

1 Sustainability Victoria (2018) *Guide to Biological Recovery of Organics*

Recommendation 03

Provide clarity to the waste-to-energy sector and establish regulatory settings to achieve desired waste-to-energy outcomes

Context

There is a role for waste-to-energy to deal with residual (non-recoverable or non-recyclable) waste in Victoria. In the waste hierarchy, energy recovery is a better outcome than disposal to landfill. Evidence suggests policy uncertainty is stifling private sector investment in waste-to-energy infrastructure. The Government's *Recycling Victoria* policy has committed to development of a waste-to-energy framework. Clear policy is necessary to ensure desired outcomes and mitigate against risks, such as demand for feedstock creating perverse incentives to generate more waste, and undermining improvements to reuse and recycling options.

Recommendation

Develop a waste-to-energy policy that reflects the waste hierarchy and supports, rather than hinders, a transition toward a circular economy. A Victorian waste-to-energy policy should contain the following:

- Information on how waste-to-energy's role in Victoria supports and facilitates the waste hierarchy.
- A government commitment to build social licence for residual waste-to-energy and a requirement that projects involve extensive community consultation, and provide ongoing and comprehensive information to the community.
- Measures that prevent harm to human health and the environment, in line with existing Environment Protection Authority (EPA) requirements and overseas technical and regulatory experience from places such as the EU. Existing EPA standards for emissions, noise, dust and odour will apply, but EU standards and best practice methods should also be considered for product design, emission control, and ongoing and continuous monitoring.
- Requirements that energy recovery meet minimum energy efficiency thresholds, consistent with international practice.
- Ways to avoid overcommitting to waste tonnages. Long-term secure feedstock contracts are necessary for waste-to-energy projects to be financially viable, which risks creating perverse incentives to increase waste.
- Encouragement for strategic site locations, including co-location with industry that can either provide feedstock for, or use the residual energy and heat from, waste-to-energy infrastructure. Prioritise development either within strategic hubs identified by the Victorian Recycling Infrastructure Plan (VRIP) or co-locate facilities with industry.
- Standards for residual products to facilitate market development. Waste-to-energy processes generate residual materials which, unless used elsewhere, will go to landfill. Reusing these products, where possible, is preferable. For example, fly and bottom ash can be used for building and road construction.
- Measures to ensure landfill levies do not make waste-to-energy uncompetitive with landfill.

Key findings

- Waste-to-energy is a preferable alternative to landfill if there are no other viable recovery options. Victoria should still prioritise waste reduction, reuse and recycling. A future waste-to-energy policy should not encourage waste that could have feasibly been recycled, reused or avoided to become feedstock. Waste-to-energy solutions higher on the waste hierarchy (for example, anaerobic digestion of organic materials – see Recommendation 2) are higher priority.
- For waste-to-energy facilities to be competitive, the landfill levy needs to be set to an appropriate level.[2] Government has a role to play in ensuring that regulations and market prices support options that are higher on the waste hierarchy. The private sector is responsible for making financially viable business models for waste-to-energy facilities, but government can support the pursuit of waste-to-energy by removing barriers to entry.
- Facilities should account for the changing generation and composition of residual waste.
- The amount of energy generated from waste-to-energy should not be overstated. The Clean Energy Finance Corporation estimates that energy from waste could meet up to 2% of Australia's electricity needs.[3]
- Waste-to-energy by-products may contain contaminants that make them unsuitable for recycling in some cases – particularly if facilities are used to manage hazardous wastes. Landfill planning should include the potential need to manage these materials.
- The Queensland Government found that pre-sorting residual waste to extract recoverable materials prior to energy recovery imposes additional costs for energy recovery facilities and recovers lower quality recyclable materials.[4]
- The amount of residual waste in the future is uncertain. Our modelling and analysis suggests that by 2038/39, Victoria will generate 650,000 tonnes per year of residual waste from the six priority materials alone, assuming a 90% recovery rate. The business-as-usual forecast is for up to 5.7 million tonnes per year of residual waste. Not all of this residual waste will be suitable for waste-to-energy.
- The need for waste-to-energy to manage residual waste will be highly dependent on efforts to reduce waste and recycle materials, as well as the planned landfill capacity. The *Recycling Victoria* policy's stated capacity cap of one million tonnes per year for waste-to-energy should be regularly reviewed to manage these uncertainties. If combined efforts to reduce waste generation and recycle material are not highly successful then there is a risk that significant amounts of residual waste above the one million tonne waste-to-energy cap will be consigned to landfill.

2 Department of Environment, Land, Water and Planning (2017) *Turning waste into energy, Join the discussion*

3 Clean Energy Finance Corporation (2016) *Energy from waste in Australia: a state-by-state update*

4 Office of Resource Recovery, Department of Environment and Science (2019) *Energy from Waste Policy – Discussion paper for consultation*

Recommendation 04

Review funding mechanisms to increase infrastructure capacity and capability

Context

Typically, grants of up to $500,000 have been given by Sustainability Victoria to increase the quantity of recycled products sold, increase resource recovery, divert waste from landfill, fund infrastructure projects, develop new markets, and fund research and development. Through the new *Recycling Victoria* Infrastructure Fund, grants of up to $8 million are now available for some materials. In addition, other arms of government may provide grants and other investment assistance.

Although grants can have some competitive elements, they are essentially a negotiation between government and industry. In negotiations, a well-informed supplier will often benefit over a less-informed buyer. Firms and organisations know their costs of production and Governments often do not.

Recommendation

The Victorian Government and responsible agencies should review the effectiveness of existing funding mechanisms such as grants, tenders and collaborative procurement and trial the use of auctions to secure reprocessing infrastructure capacity, as identified in Recommendation 1, in the following way:

- A field pilot to test implementation and cost-effectiveness of auctions.
- Separate auctions for each waste processing class because the cost of additional waste processing will vary for different types of waste (i.e. glass, plastics etc.).
- An auction in which bidders submit bids as in a tender. However, rather than submitting one proposal, each bidder would be allowed to submit a bid schedule to indicate the quantity of additional waste processing effort they would offer over a range of prices.
- An assessment of the effectiveness of the field pilot compared to other funding approaches.

Key findings

- Grants may not always lead to the best outcomes or value for money for government. In recent years, resource recovery grants have been capped at a maximum of $500,000 which may not be enough to achieve significant increases in resource recovery and recycling rates.
- There is significant potential to increase the coordination across government of various investment initiatives to improve resource recovery.
- Auctions can reveal information needed to efficiently allocate resources by harnessing competition between competitors as a means of identifying who wins and at what price. Well-designed auctions have been shown to achieve a given outcome at lower price compared with a grant mechanism.
- Auctions are an alternative approach used successfully in Victoria to achieve government objectives related to infrastructure and efficiently allocate resources, including for the allocation of aquaculture sites in Victoria and to allocate mobile phone spectrum.
- The Victorian Government (and other governments throughout Australia and around the world) already use a range of other financial support approaches to deliver policy outcomes, such as rebates, subsidies and low-interest loans which could also be applied to resource recovery.
- An auction creates a competitive environment in which the supply schedule is expanded by asking bidders to nominate the amount of additional effort they would be willing to supply at different prices. Competition forces bidders to seek compensation only for the difference between the cost of supplying additional effort and returns for selling the waste material processed.[5]

5 Centre for Market Design (2019) *Opportunities to improve infrastructure investment in the Victorian waste economy*, report for Infrastructure Victoria

Recommendation 05

Provide ongoing statewide and locally tailored behaviour change programs

Context

Overall, people are willing to change the way they sort their waste. Our community research shows that nearly 90% of Victorians are open to it.

The Victorian Government should harness this willingness and partner with local government and industry to make it easier for households to minimise and better sort their waste. Greater separation of waste in homes and businesses can reduce contamination and improve the quality of recycling. Promoting behaviour change is critical to achieving this.

Recommendation

The Victorian Government should ensure its investment in household and business behaviour change programs is consistent and ongoing. The key objectives of the *Recycling Victoria* policy's behaviour change programs should include:

- waste minimisation
- contamination reduction
- buying more recycled, reusable, and recyclable or compostable products.

At a minimum, a behaviour change program should be designed using the following principles:

- Centrally managed and funded.
- Consistent messaging across Victoria, with nuance for local areas as needed.
- Persistent and ongoing, evolving as performance improves.
- Tailored to meet the needs of specific audiences e.g. culturally and linguistically distinct or diverse communities, residents of multi-unit developments, hospitality businesses etc.
- Considers the role of both positive and punitive incentives and other interventions over the medium to long term.
- Prioritises specific actions and solutions for households that build on existing good intentions and understanding.
- Monitored and evaluated.
- Integrated with relevant initiatives like the APCO targets and Australasian Recycling Label.
- Draws from consumer behaviour research.
- Supported by easy-to-use source-separation infrastructure at the point of disposal (see Recommendation 6).

Key findings

- Victorians already understand the need to recycle, so behaviour change efforts should harness the enthusiasm and goodwill of the community to do even better. We surveyed 1,000 Victorians to understand their attitudes and perceptions about how they sort their waste at home, and their willingness to change their behaviour. We found that most Victorians feel it is important to reduce landfill waste (93%), and they consistently recycle when provided with a kerbside recycling bin (85%).
- There is significant room for improvement in individual recycling practices. We looked at why this is and discussed what the community would like to see and hear to help them recycle more effectively. Key points include simplicity (separate bins for different materials), consistency and a strong understanding of the benefits.[6]
- There is limited coordination and sharing of materials between Sustainability Victoria, the Metropolitan Waste and Resource Recovery Group and local governments, which all provide waste education.[7] We have heard from industry stakeholders that there is also limited information sharing between industry and government.
- Waste education in Victoria does not often prioritise waste avoidance but usually focuses on what to do with waste after it is generated. Avoidance education is generally only provided in short bursts and under-funded relative to other government campaigns, limiting its reach, impact and ability to effectively change behaviour.[8]
- Behaviour change programs will be most effective in changing recycling outcomes where correct recycling is already as simple, easy and consistent as possible. Eliminating or reducing barriers to better recycling behaviour is key to behaviour change. Programs need to be supported by a more consistent approach across Victoria.
- Examples of successful programs include the TAC Towards Zero and the Target 155 campaigns. Both have a long-term focus, consistent messaging and ongoing funding. While it is difficult to determine the contribution of the Towards Zero campaign to changes in Victoria's road toll as opposed to changes in technology, the number of lives lost on Victorian roads has declined significantly since the campaign began, even as the number of drivers on Victorian roads has increased.

6 Quantum Market Research (2019) *Kerbside Collection Deep Dive*, report for Infrastructure Victoria

7 Victorian Auditor-General's Office (2019) *Recovering and Reprocessing Resources from Waste*

8 ibid.

Recommendation 06

Reduce contamination in material streams

Context

Contamination occurs when an item is disposed of in the wrong bin. Contamination reduces the value of recyclable materials because either additional sorting is needed to remove unwanted materials, which can be costly, or the processor needs to dispose of these materials to landfill, which is also costly.

This lowers the market value of materials which lowers the incentive to invest in reprocessing and recycling infrastructure. In some cases, these costs make recycling more expensive than using virgin materials.

An important element in reducing contamination is improving source separation and consistency in the way waste is collected – particularly for household waste. Not all councils accept the same materials in recycling collections, due to differences in what processors will accept. At the same time, bin lids differ in colour and meaning across local government areas.

These differences can lead to confusion for households and contamination of material streams, and create a barrier to efficiently and effectively educating the community on what they can recycle.

Recommendation

To reduce contamination of materials streams, Infrastructure Victoria recommends that the Victorian Government:

- Require and support all local governments to standardise bins for household collections, consistent with the Government's commitment in the *Recycling Victoria* policy to standardise bins and kerbside services.
- Advocate for and support the review of the *Australian Standard for mobile waste containers AS4123.7*.
- Establish a minimum service standard for local government waste services to promote greater consistency in collections across Victoria.
- Promote greater source separation of MSW by encouraging and supporting the rollout of separate kerbside bins for glass, or paper and cardboard.
- Drive greater consistency in the materials collected within each service (e.g. FOGO and commingled) across Victoria.
- Evaluate existing models to design the best Container Deposit Scheme for Victoria.

An important element in reducing contamination is improving source separation and consistency in the way waste is collected.

Key findings

- Infrastructure Victoria's community polling suggests that 25% of all respondents who have commingled kerbside collection are unsure of which bin things should go in.[9]
- Countries that have high rates of resource recovery from MSW tend to have a more consistent approach to sorting and collection. Currently, approaches differ across Victoria's 79 local councils.
- Standardising bins is estimated to cost between $22-$60 per household depending on whether the entire bin is replaced, or just the lid.
- A consistent approach to collections is estimated to cost between $35-$60 per household for an additional bin and $3 per collection.
- In 2017/18, contamination rates in Victorian MSW ranged from 3% to 27%, with an average of 10.4% across all local government areas[10] depending on the effort put into education and enforcement along with the socio-economic characteristics of the area.
- There is limited detailed data on contamination rates in the C&I sector in Victoria making it difficult to develop specific responses for this sector.
- Container Deposit Schemes are in place across Australia. Results in each state or country vary depending on the exact model used. Our consultation indicates that Queensland (active scheme) and Western Australia (scheme in design phase) are leading examples to investigate further.
- One of the key benefits of CDS is that they can reduce contamination. Cleaner materials streams can increase the potential for their re-use.
- The introduction of a CDS was commonly identified by stakeholders who provided feedback on our *Evidence Base Report* as an initiative that could improve Victoria's waste and resource recovery system.
- 92% of people we polled favoured the introduction of a CDS.
- The Victorian Parliamentary Budget Office (PBO) costed a CDS for the *Victorian Parliamentary Inquiry into recycling and waste management* and found that a CDS would deliver a financial benefit to Victoria of $244.5 million from 2019-20 to 2022-23. This reflects an increase in government revenue of $253.5 million due to uncollected deposits from containers not being returned, partially offset by an increase in operating expenses of $9.0 million to manage the scheme.
- Commingling of glass with paper and cardboard leads to lower recyclability of these materials from household collections. This is because the glass gets broken and becomes embedded in the paper and cardboard. Separating these materials is therefore key to improved recycling. Depending on the proximity of paper or glass reprocessing, it may be more appropriate to prioritise one or the other in some regional areas.

9 Quantum Market Research (2019) *Waste Advice Research*, report for Infrastructure Victoria

10 Sustainability Victoria *(2019) Victorian Local Government Annual Waste Services Report 2017-18*

Recommendation 07

Introduce waste minimisation initiatives

Context

In line with the waste hierarchy, waste minimisation or avoidance is the best way to manage waste.

Minimising waste will not only ease pressure on Victoria's recycling and resource recovery infrastructure, it will also reduce pressure on Victoria's finite natural resources and reduce the environmental and human health impacts of waste, such as polluted waterways. Waste minimisation is also one of the key objectives of the *Recycling Victoria* policy.

Minimising waste will not only ease pressure on Victoria's recycling and resource recovery infrastructure, it will also reduce pressure on Victoria's finite natural resources and reduce the environmental and human health impacts of waste.

Recommendation

The Victorian Government should:

- Provide support and funding to household food waste minimisation initiatives (such as Sustainability Victoria's Love Food, Hate Waste), to target avoidable MSW food waste which currently accounts for a third of Victoria's household garbage stream by weight. Ensure that the statewide municipal recycling behaviour change campaign emphasises the importance of waste avoidance (see Recommendation 5).
- Consider levies or bans on specific materials that are difficult to recycle or contribute to environmental problems, if viable alternatives exist.
- Work with the Australian Government and industry to evaluate EU regulations underlying the Waste, Electrical and Electronic Equipment Directive (WEEE) for potential adoption. These regulations include longer warranties for the products, requiring spare parts to be guaranteed, and mandating manufacturer repair to support the development of repair culture.

Key findings

- The amount of waste we generate has been growing. This is due partly to population growth and partly to changes in our economy and society, such as increased consumption and packaging.
- The most cost-effective way to manage waste is to create less in the first place. The waste hierarchy calls for waste avoidance and minimisation, including better product and packaging design, and reusing or repairing products and items. Avoiding and reducing waste will reduce pollution, greenhouse gas emissions, and the pressure on our waste management infrastructure.
- Reducing waste reduces sorting costs and contamination.
- Levies or bans on single-use plastic straws and cutlery, along with non-recyclable coffee cups may help combat Victoria's litter problem and promote behavioural change. That said, poorly designed levies or bans on some materials, such as single-use plastics can lead to unintended consequences. Some industries rely on single-use plastics for medical or research purposes.
- Food waste accounts for a third of Victoria's MSW garbage stream by weight. Nearly two-thirds of this is avoidable food waste (such as bakery items, meals, dairy, eggs, fresh vegetables and fresh fruit). Victorians estimate that they waste around $39 worth of food and drink a week – $2000 a year. Across Victoria, this adds up to about $4 billion a year.
- E-waste – end-of-life electronic products with a plug or battery – is a fast-growing waste stream. E-waste is a complex mixture of materials and components that, because of their hazardous content, can cause major environmental and health problems if not properly managed. While there are already Australian product stewardship schemes for televisions, computers and mobile phones, many electronic products do not have such arrangements. An EU directive created collection schemes where consumers return their e-waste free of charge. These schemes aim to increase e-waste recycling and/or re-use. Most electronics brands with an Australian presence are also operating in the EU and therefore are required to comply with these requirements in Europe.

Recommendation 08

Remove barriers and strengthen markets for priority materials

Context

Over the last decade, there has been a significant focus in Victoria on establishing infrastructure to collect, sort and, to an extent, reprocess recovered resources. However, this supply of recyclable materials has not always been matched by significant, ongoing demand for recycled products.

With the lack of demand, stockpiling has occurred, the commercial viability of some operators has been challenged, waste sector operators have at times failed to comply with regulatory requirements, and there have been multiple waste material fires throughout Victoria.

To address this supply and demand imbalance, further market development is required to identify opportunities that can use significant and reliable volumes of recycled materials. The Victorian Government has indicated in *Recycling Victoria – a new economy* that it will play a significant role here.

Recommendation

Infrastructure Victoria recommends the Victorian Government use multiple approaches to develop end markets for recycled materials. The actions identified here should be applied first to priority materials: glass, organics, plastics, paper and card, e-waste and tyres.

- Support research and development in the use of recycled materials and products and conduct targeted research and demonstration activities for each priority material. This will overcome product-specific market challenges, such as the application of organic materials to land and the use of recycled plastic in packaging.
- Build on research, development and demonstration working groups with representatives from government, the recycling industry, end market industries and researchers to accelerate the use of recycled materials.
- Build on recent efforts to update standards and specifications more quickly to enable greater use of recycled materials and products in Victoria.
- Transition to performance-based specifications in Victoria to ensure recycled materials are fit-for-purpose, particularly for use in construction and agriculture. This would prescribe the desired outcomes, allowing industry to decide which materials (including recycled products) it will use to comply.
- Develop and provide recycled product information and guidance to increase confidence in the use of recycled products, such as the use of recovered organics in agriculture or plastics in packaging manufacturing. This may include approaches such as eco-labelling, environmental product declarations, standards, product specifications and safety data sheets.
- Update the Sustainable Procurement Objectives in the Victorian Government's *Social Procurement Framework* to include more explicit requirements about the use of recycled content. Prioritise sustainable outcomes in evaluating procurement proposals. The Victorian Government's recently announced 'Recycled First' program for major construction projects is an example.
- Collaborate with the Australian Government to investigate the costs and benefits of taxes, levies and other incentives to increase the competitiveness of recycled materials relative to virgin materials.

Key findings

- Research and development with industry has been effective in the roads and rail sectors, with the approval of several Victorian specifications permitting the use of recycled materials. This approach could be applied to plastics manufacturing, packaging, agriculture, and paper and cardboard manufacturing.
- Performance-based specifications are less prescriptive when it comes to how materials are made, and the processing required to meet infrastructure performance criteria and encourage innovation.
- Where the Victorian Government is not responsible for authorising standards and specifications, it can play a key role by resourcing and facilitating working groups to increase the use of recycled materials across a range of industry sectors.
- Recycled materials have sometimes been seen as lower quality than virgin materials. Research and development activities are crucial to identifying the potential of recycled materials as either direct substitutes for virgin materials or where there are new uses and benefits associated with using them.
- The Government supports research and development through funding facilitated by Sustainability Victoria. This can be scaled up and down, but an increase will be required to move forward on all priority materials.
- The UK Government recently implemented a tax on the production and import of non-recyclable plastic packaging from 2022. The tax was a response to high levels of plastic packaging waste, which predominantly came from new plastics.[11] It is difficult for the Victorian Government to impose a similar tax as Victoria is just one part of a larger market and products can flow across state borders relatively easily.

11 AlphaBeta (2019) *Recycling and resource recovery infrastructure in Victoria: International and Australian comparisons*, report for Infrastructure Victoria

Recommendation 09

Ensure that producers and consumers involved in making and using products share the responsibility for their fate

Context

In many instances, producers of goods and services do not face the cost of waste created by packaging or the end-of-life fates of products.

By not considering these costs, producers may over-invest in packaging to attract buyers' attention or manufacture goods that cannot be easily repaired. Further, consumers do not face all the costs of their consumption, or their sorting and disposal choices.

Recommendation

To provide an incentive for consumers and producers to consider the cost of disposing of or recycling materials, the Victorian Government should:

\ Work with the Australian Government to update the *Product Stewardship Act 2011* Product List, which has not been updated since 2017-18.

\ Collaborate with the Australian Government and the electronics industry to increase the scope of e-waste product stewardship covering a wider range of e-waste types, where justified based on the material value and environmental risks they present.

\ Work with the Australian Government and industry groups to further develop product stewardship schemes under the *Product Stewardship Act 2011*, assessing the merits of voluntary, co-regulatory or mandatory schemes.

\ Work with the Australian Government and industry groups to consider the key elements of successful international product stewardship schemes and their suitability in Australia. Key elements include:

- levies and deposit refunds
- take-back requirements
- advance disposal or recycling fees
- product labelling requirements
- product design and repair requirements
- recycled content targets
- resource recovery rate targets.

\ Work with the Australian Government to fast-track and prioritise the development of a national product stewardship approach for photovoltaic systems in the short-term.

\ Work with the Battery Stewardship Council to include electric vehicle batteries, addressing the risks set out win Infrastructure Victoria's *Advice on Automated and Zero Emissions Vehicles Infrastructure* (Recommendation 15).

Key findings

- Product stewardship (PS) and extended producer responsibility (EPR) measures can facilitate the shared responsibility of manufacturers, retailers and consumers for the impact of products on the environment, public safety and human health. They aim to ensure that everyone involved in the creation and use of a product shares the burden of what happens to it at the end of its useful life.
- Consumers and producers are not exposed to the full cost of the waste they generate. This is a 'negative externality' that can be addressed through EPR or PS.
- The most successful international examples of PS are underpinned by mandatory approaches.[12] There are currently no mandatory Australian schemes.
- Multiple stakeholders raised the need for mandatory PS for 'difficult to recycle materials', such as packaging made from multiple materials.
- The *Product Stewardship Act 2011* is administered by the Australian Government to provide a framework for reducing the environmental and other impacts of products. It is currently only applied to a limited number of products. Of the several voluntary schemes, participation and effectiveness vary widely.

12 AlphaBeta (2019) *Recycling and resource recovery infrastructure in Victoria: International and Australian comparisons*, report for Infrastructure Victoria

Recommendation 10

Provide greater clarity of roles and responsibilities for Victorian Government bodies involved in recycling and resource recovery

Context

There is confusion about the responsibilities of different government bodies involved in the waste and resource recovery sector. This is well documented by the Victorian Auditor-General's Office and was raised with us by stakeholders.

VAGO found that the lack of an overarching waste policy and gaps in statewide guidance resulted in ad hoc and reactive responses from agencies instead of strategic responses, and an inability to plan for sufficient infrastructure.

In November 2019, the Victorian Parliament's *Environment and Planning Committee Inquiry into Recycling and Waste Management* also recommended a review of governance arrangements to ensure clear roles, responsibilities and accountabilities for various organisations. Infrastructure Victoria supports this recommendation.

The Victorian Government has indicated in the *Recycling Victoria* policy that it will create a new body, which will provide an opportunity to clarify roles and responsibilities.

Recommendation

Infrastructure Victoria recommends that the Victorian Government:

- Eliminate overlap in roles and responsibilities of the Department of Environment, Land, Water and Planning (DELWP), Sustainability Victoria (SV) and the Waste and Resource Recovery Groups (WRRGs). For waste, key areas to distinctly allocate are policy, strategy, behaviour change, waste collection, waste processing, infrastructure planning and contingency planning.
- Specify the waste management services roles and responsibilities of local governments in legislation.
- The roles and responsibilities of local government should include minimum service standards, implemented through subordinate instruments. Minimum service standards could include bin lid colours and the specific materials accepted.
- Provide financial support for local governments to transition to minimum standards, where necessary.
- Consider changes to the way waste and material processing services are procured to address market power imbalances between local governments and service providers. This could include mandating participation in collective procurement processes or having these processes handled by a statewide or regional authority.

Local governments play a crucial role in the waste and resource recovery sector, particularly in waste collection.

Key findings

- Clarity in roles and responsibilities is critical for effective and coordinated planning and implementation of the state's waste programs and activities. Greater clarity can improve transparency, making it easier to monitor performance and track progress.[13]
- DELWP, SV and the metropolitan WRRG are not clearly or publicly reporting on the progress of individual actions, overall objectives and outcomes of their strategies in a way that enables industry and community to track their progress.
- Differences in service provision between local government areas limits the ability to have consistent statewide education[14] and can create confusion for households, leading to contamination of material streams.
- Local governments play a crucial role in the waste and resource recovery sector, particularly in waste collection. However, their collection roles and responsibilities are not enshrined in legislation.[15] Defining these roles and responsibilities in legislation is an opportunity to set minimum standards for waste collection.
- The market for MSW recovery and reprocessing services in Victoria is dominated by a few large players. Victoria's approach to procuring collection and recovery services has, in part, contributed to this problem by creating consolidation in the market as businesses bid for larger and larger numbers of council contracts to achieve economies of scale.
- Local governments, individually, are at a disadvantage when negotiating waste processing services.
- Improved governance arrangements, such as mandatory collective procurement or the creation of a suitable authority, have the potential to counterbalance growing market power issues in Victoria's waste sector.
- In the face of recent major disruptions to the sector, responsible agencies worked together to minimise the amount of recyclable materials that went to landfill. Having a clear lead agency and decision-making powers for this work would have streamlined processes.

13 Victorian Auditor General's Office (2019) *Recovering and Reprocessing Resources from Waste*

14 ibid.

15 Infrastructure Victoria (2019) *Legislative and regulatory review*

Recommendation 11

Improve the quality and use of data to support resource recovery

Context

The Victorian Government's planning and policy decisions need to be informed by reliable data on recycling and resource recovery. Gaps in data create issues for policy and strategy implementation, particularly in monitoring progress towards targets (refer to Recommendation 12).

The responsibility for data collection is currently shared by SV, the EPA, local governments and the WRRGs. SV has responsibility for coordinating reporting of this data. There is significant scope to improve the quality and coverage of data currently published by SV.

In *Recycling Victoria: A new economy*, the Victorian Government has committed to modernising Victoria's waste data. Data on the state of Victoria's recycling sector reports 69% of materials are currently recovered for recycling. However, this data does not include information on whether the recovered material is recycled, illegally dumped or has some other fate.

Recommendation

The Victorian Government can implement its commitment to modernising Victoria's waste data by:

- Introducing new data reporting requirements in regulatory and contractual conditions for recycling and resource recovery operators.
- Providing clearer guidance to local governments and recycling and resource recovery operators on how to report data in a standardised, consistent way.
- Introducing new controls and quality assurance to verify and validate data.
- Implementing enhanced data analysis to evaluate the data gathered through the above recommendations. This should include monitoring for perverse outcomes, identifying risks to performance (by sector and material) and identifying opportunities to realise circular economy outcomes (e.g. where waste from one business can be used for production in another business).
- Regularly reporting performance data to improve transparency in the sector.
- Ensuring Victorian data quality standards align with other Australian jurisdictions.

Key findings

- Introducing new data reporting requirements and providing guidance on how to report data would improve the coverage and quality of information on the fate of recovered materials and help overcome issues with data quality.
- A 2011 report by VAGO on MSW management found that deficiencies in data quality had reduced the reliability of performance data, and that complete, timely, accurate data is necessary to effectively report on performance.[16]
- Data is often collected through voluntary surveys of local governments and waste recovery and reprocessing operators, so is incomplete and not necessarily accurate.
- There is scope to impose data requirements on operating licenses within the waste and resource recovery sector through amendments to the *Environment Protection Act 1970*. Licencing conditions should require regular, periodic reporting of material flows data at all resource recovery facilities.[17]
- There is scope to improve data provision and reporting in waste processing contracts. This can support improved outcomes for materials as well as contingency planning for sector disruption.
- Data reporting and governance requirements should be specified where legislation is used to define the scope of different government entities, including local governments.[18]
- Timely data publishing can improve transparency and accountability around the performance of the sector and inform education and behaviour change campaigns. It can also assist to predict disruption to or emerging gaps in the system. Victoria's 2017-18 data was published in September 2019.
- Data governance and system improvements should meet the following objectives:
  - establish a framework for monitoring progress towards the circular economy, including the identification of indicators and metrics
  - introduce a new waste and resource recovery data system to enable better waste management and circular economy monitoring
  - expand waste and recycling market intelligence reporting
  - improve the usefulness and accessibility of Victorian waste data to local governments, industry and the community.
- Clear governance for a data improvement program is required for efficient delivery. Costs are uncertain but may be in the range of $20 million over three to five years.

16 Victorian Auditor General's Report, *Municipal Solid Waste Management*

17 AlphaBeta (2019) *Recycling and resource recovery infrastructure in Victoria: International and Australian comparisons*, report for Infrastructure Victoria

18 Refer to Recommendation 10 which recommends their role should be defined in legislation

Recommendation 12

Use targets to drive performance

Context

In the high-performing international and Australian jurisdictions we examined, clear long-term vision and ambitious quantitative targets were common.

These included overall system performance as well as waste reduction. In some jurisdictions, targets were statutory with non-compliance penalties. To be effective, targets require rigorous data collection (see Recommendation 11) as well as necessary funding and detailed sector planning. We support the targets that have been formally adopted in the Victorian Government's circular economy policy – *Recycling Victoria: A new economy*.

Recommendation

To leverage the adopted targets, Infrastructure Victoria recommends:

- In the longer-term, investigate more ambitious and complex targets (e.g. based on carbon emission reduction) and penalties for non-compliance.
- Consider the use of existing legislative and regulatory tools to improve performance in specific areas such as:
  - The application of planning and building permit conditions to establish performance standards for waste reduction and resource recovery during both construction and ongoing operations.
  - The application of food business licence conditions to establish performance standards for food waste reduction and organics recovery.
  - The application of EPA operating licence conditions to establish performance standards in the industrial sector.

Key findings

- Our analysis of places around the world with high-performing recycling and resource recovery sectors shows that they have taken a long-term approach to targets, revisiting and increasing these as performance improves.[19]
- In other countries, targets are also progressing from simple weight or volume-based targets to more sophisticated carbon emission reduction or material-specific targets. These address perverse outcomes and focus effort where the greatest environmental outcomes can be achieved.
- Legislative and regulatory tools outlined above could be used to implement the Government's proposed new requirement for business to sort commonly recyclable materials and organic wastes from unrecoverable wastes.
- Waste management services for multi-unit developments are not fully integrated with the MSW system. In many cases, waste management services are provided directly by commercial operators on behalf of the body corporate, rather than by local governments. Sustainability Victoria has developed the *Guide to Better Practice for Waste Management and Recycling in Multi-unit Developments* to improve waste management practices and increase recycling in multi-unit developments. This guidance has now been incorporated into the Victorian Planning Provisions.
- In the City of Melbourne, there are high concentrations of high-rise residential buildings, restaurants and cafes. City of Melbourne residents recycle only 25% of their waste, which is low compared to the Victorian average of 45%.[20] This reflects the higher barriers and lower rates of recycling in multi-unit developments generally.[21] [22]

19 AlphaBeta (2019) *Recycling and resource recovery infrastructure in Victoria: International and Australian comparisons*, report for Infrastructure Victoria

20 City of Melbourne (2019) *Waste and Resource Recovery Strategy 2030*

21 Quantum Market Research (2019) *Kerbside Collection Deep Dive, report for Infrastructure Victoria*

22 Quantum Market Research (2019) *Waste Advice Research*, report for Infrastructure Victoria

Recommendation 13:

Strengthen the status of, and processes around, Victoria's Recycling Infrastructure Plan

Context

The Victorian Recycling Infrastructure Plan (VRIP), formerly known as the Statewide Waste and Resource Recovery Infrastructure Plan (SWRRIP) has provided a long-term vision and roadmap to guide planning for waste and resource recovery infrastructure across the state.

However, the private sector primarily provides waste management, resource recovery and recycling infrastructure, with limited matching of strategic considerations (like waste generation trends, land use planning or minimisation of costs to households and businesses) to the type and location of infrastructure. The objectives of the Plan are therefore difficult to realise.

Recommendation

The Victorian Government should use existing planning mechanisms to improve recycling and resource recovery performance by:

- Strengthening the status of the VRIP to ensure cohesion of waste management and planning decisions across multiple levels of government. Further amendment of the Victorian Planning Provisions could achieve this.
- Proactively encouraging the appropriate location of waste and resource recovery operations.
- Establishing and strengthening standardised land use buffers around waste management sites, considering the implications of local government area boundaries. This would provide greater certainty to the market in developing these sites.
- Developing and maintaining spatial data on waste generation and flows, as well as resource recovery and reprocessing infrastructure capacity and capability.
- Facilitating the appropriate location of waste and resource recovery through the formal development of an inter-agency working group of responsible Victorian resource recovery agencies, economic development agencies, and local governments
- Undertaking active and transparent contingency planning to provide greater network resilience.
- Including provision for waste-to-energy and landfill capacity in the VRIP, to optimise the management of residual waste in both business-as-usual (BAU) conditions and disruption.

Key findings

- For resource recovery and reprocessing to be cost-effective and for recycled products to be attractive to markets on a price basis, the location of particular industries is important. If they are continually pushed further out of the metropolitan area as land value increases and sensitive uses encroach upon them, performance will decrease due to a lack of suitable facilities. We found multiple instances where waste management and reprocessing sites are at risk from the lack of alignment between waste planning and land use planning decisions. For example, a major construction and demolition (C&D) recycler in the south eastern suburbs is likely to lose their current site in the medium term. With no other suitable sites nearby, 100,000 tonnes of processing capacity may be lost.
- We have also heard from multiple stakeholders that government agencies often appeal land use planning decisions at VCAT based on their presence in the SWRRIP. Although these cases are generally won for the cause of waste management, going to the tribunal is funded by taxpayers and causes delay. The Metropolitan Waste and Resource Recovery Group (MWRRG) is working to identify and protect waste management hubs of state significance through collaborative processes with local government and other agencies. However, the current approach and resourcing limits the completion of the protection plans to two sites (or hubs) per year.
- Currently there is limited communication and collaboration across government levels and portfolios to facilitate strategic investment in the Victorian waste and resource recovery industry. For the best outcomes, regulators need to understand the compliance status of industry operators and non-regulatory agencies. They also need to understand the business operations of the waste sector industry operators to ensure waste and resource recovery programs are aligned with market conditions. Improved coordination across government could improve the sector. The interagency working group for the Combustible Waste Recyclable Materials (CWRM) taskforce has been effective in bringing together responsible regulating agencies, aligning efforts and improving communication and collaboration. This could serve as a model for future efforts.
- Waste-to-energy and landfills will likely both play a role in managing waste in the future. The VRIP needs to reflect this point, while ensuring that Victoria does not over-invest in capacity.
- The VRIP's objectives need to integrate with a range of government planning policies and plans, including land use planning, economic development, and resources strategies.

06.

What we found

Victoria's recycling resource recovery system is under pressure.

Since 2015, the Victorian Government has invested more than $135 million in supporting the recycling and resource recovery sector in Victoria, to ensure continuity of service to Victorians and to minimise the likelihood of otherwise recoverable material being sent to landfill.[23]

Victoria's recycling and resource recovery sector needs to respond to the immediate challenges facing the sector and deal with upcoming changes in national policy.

Some recyclable material is still being landfilled and some Victorians have become sceptical about the fate of their recycling. In developing our advice, we polled community members and found that a quarter of Victorians we surveyed believe their recycling goes to landfill.[24]

In the past 18 months, Victoria has seen recyclable material being sent to landfill after a major materials recovery operator closed. In Victoria, particularly metropolitan Melbourne, the recovery and processing sector is concentrated, so there is limited competition. Market concentration also means there is little incentive for operators to improve and limited redundancy in the sector. This leaves Victoria vulnerable to commercial or global shifts.

Responding to these challenges requires a combination of short and long-term initiatives. Victoria's recycling and resource recovery sector needs to respond to the immediate challenges facing the sector and deal with upcoming changes in national policy. At the same time, all Victorians need to take a different approach to waste. Long-term, waste reduction and avoidance will assist to ensure the circumstances of the past 18 months are not repeated.

China National Sword Policy

Like many countries around the world, Victoria has relied on international markets to accept some recovered material. In 2016/17, a significant amount of Victoria's waste exports – nearly all plastic exports and 75% of paper and card – went to China. The introduction of the China National Sword policy placed strict limits on the level of contamination China would accept in recovered materials.

Before China National Sword, many Material Recovery Facilities (MRFs) were paying Victorian councils for recyclables, which subsidised the cost of collecting Municipal Solid Waste (MSW). MRFs then sold these materials to China. After China National Sword, the global price for materials, particularly paper, card and plastics, plummeted. Victorian operators scrambled to find new export destinations for these materials. This was repeated on a global scale, with developed economies looking to redirect collected recyclables to other waste markets throughout Asia.

China National Sword shone a spotlight on the fact that a number of Victoria's major MRF operators were operating as recovery businesses, not actual recyclers. Their practice of collecting and storing materials to take advantage of economies of scale for recovery led to stockpiles of combustible materials. These posed significant fire risks to the Victorian community as the market for the materials dried up.

23 Department of Environment, Land, Water and Planning (2020) *Recycling Victoria: A new economy*

24 Quantum Market Research (2019) *Waste Advice Research,* report for Infrastructure Victoria

Improved waste avoidance, recycling and resource recovery are key in a circular economy

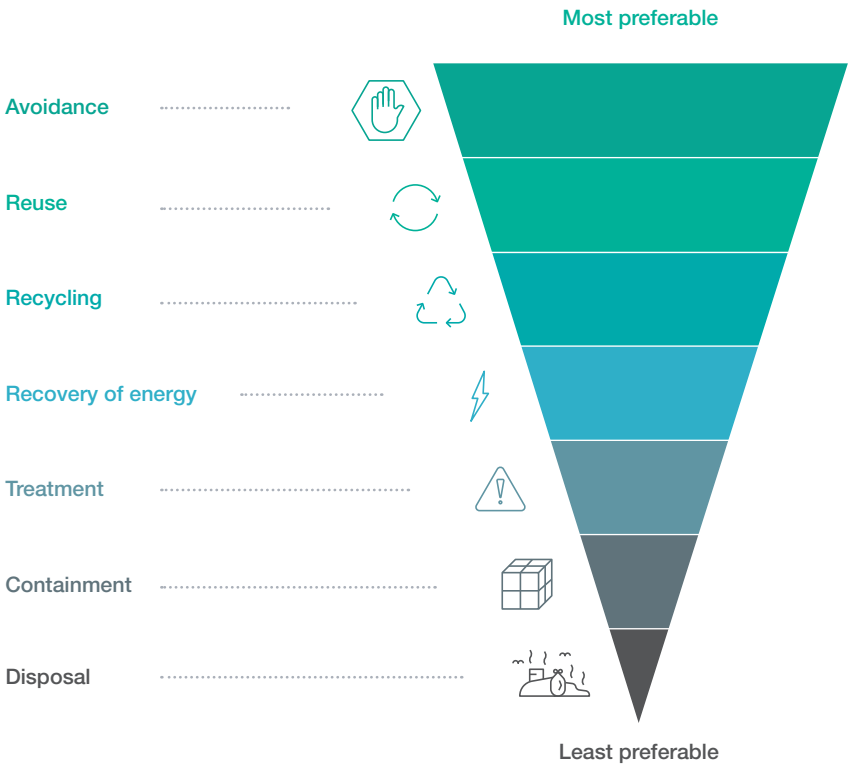
Waste is a growing by-product of modern life. A growing population and increasing consumption mean the amount of waste is growing in line with our demand for products and services. Unless Victorians change their approach to waste, the need for recycling and resource recovery infrastructure will also continue to grow to deal with ever-increasing quantities of material.

Recycling, re-use and recovery all lead to positive outcomes and are better than simply disposing of waste to landfill. The waste hierarchy shows the best ways to deal with waste, avoidance being the most preferable. Managing waste in line with the waste hierarchy is legislated in Victoria through the *Environment Protection Act 1970* (the EP Act).

Avoidance is at the top of the waste hierarchy. Re-using, recycling, recovering energy and disposing of waste all incur economic and environmental costs. As the scale of these tasks grows, so will the costs. The most cost-effective way to manage waste is to create less in the first place.

A policy approach that prioritises transitioning to a circular economy can support a long-term focus on avoidance, re-use and recycling. A circular economy aims to reduce the environmental impacts of production and consumption, along with more productive use of natural resources.[25]

Figure 2: Preferred waste outcomes



In February 2020 the Victorian Government released *Recycling Victoria: A new economy*, which outlines its vision for how materials are used and managed, and provides long-term direction for the sector.

While investment in resource recovery infrastructure is essential for the immediate and medium-term stability of the sector, a circular economy could reduce the significant, growing pressure on the sector by reducing the material it needs to manage.

Waste generation in Victoria, now and into the future

A circular economy could also improve the quality of recyclable material collected and increase demand for recovered materials.

In this advice, we consider some of the challenges facing the recycling and resource recovery sector in Victoria, focusing on boosting resource recovery rates and promoting use of recycled material. However, many of the solutions proposed will be costly to sustain in the long-term, unless Victorians change their attitudes to waste. Reducing the amount of waste Victorians generate will not only help to manage these costs, but also reduce pressure on finite natural resources and lessen the environmental impacts of production and consumption.

Re-using, recycling, recovering energy and disposing of waste all incur economic and environmental costs. The most cost-effective way to manage waste is to create less in the first place.

Victoria's recycling and resource recovery sector manages increasingly large amounts of waste from three sectors:

- Municipal Solid Waste (MSW). MSW is waste managed by local governments. Most MSW comes from kerbside bin collection services (predominantly from households, along with some small businesses). MSW tends to be separated into three streams: garbage, commingled recycling and food and garden organics. In 2018, about 3 million tonnes of MSW was generated in Victoria, which is around 21% of the total waste stream.[26]
- Commercial and Industrial waste (C&I). C&I is waste generated by business and industry. About 4.8 million tonnes of C&I waste was estimated to be generated in Victoria in 2018, which is around 33% of the total waste stream.
- Construction and Demolition Waste (C&D). C&D waste comes from construction and demolition and can be collected as mixed or segregated streams. C&D is the largest part of the waste stream, making up an estimated 46% of total waste generated in Victoria in 2018 – about 6.6 million tonnes.

Across all three sectors, a total of 14.4 million tonnes of material is estimated to have entered the waste pathway in 2018.

This poses a significant task for the Victorian recycling and resource recovery system. Without changes to the way products are designed, consumed and disposed of, this task is only going to get bigger as our population and economy grows.

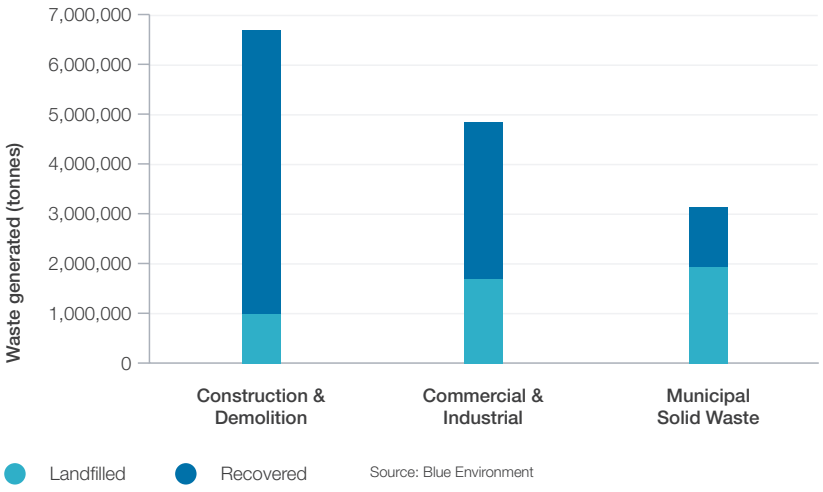
Unless Victorians change how they think about waste, the resource recovery sector will need to significantly expand its capacity to deal with different materials, especially if Victoria is to improve its recovery rate and reduce the amount of material going to landfill. In 2018, an estimated 10 million tonnes of material was recovered and 4.4 million tonnes went to landfill – a recovery rate of about 69%. If Victoria simply maintains the status quo in terms of resource recovery, the sector will need to be able to process over 12.5 million tonnes of material by 2038/39.

The past 18 months have shown that the status quo is unsustainable. More of the materials recovered for recycling are being stockpiled or disposed of in landfill due to lack of an end market, which means the 69% of resources that are recovered are not all being recycled. We have an opportunity to truly recycle these materials for other uses. However, Victoria's recycling and resource recovery system lacks the capacity and capability required to process recovered materials to a standard that means they can be re-used locally or exported for re-use overseas.

25 Department of Environment, Land, Water and Planning (2019) *A circular economy for Victoria – Creating more value and less waste*

26 Blue Environment (2019) *Victorian waste flows projections*, report for Infrastructure Victoria

Figure 3: Recovery of household and commercial waste is low, and is an opportunity



Source: Blue Environment

Each type of material (i.e. paper and cardboard, organics, glass, plastics) will require particular processing with different infrastructure to meet our growing needs, and each will have different end markets. Therefore, it is important to understand the projected growth for each material stream.

Priority materials are plastics, glass, organics, paper and cardboard, tyres and e-waste. The following section looks at each of these materials in more detail. We have identified opportunities to improve the recycling and resource recovery rates for these materials through a mixture of policy and infrastructure responses.

These include improving infrastructure capacity and capability for processing, developing end markets, or reducing the amount of these materials entering the recycling and resource recovery system altogether.

Each type of material (i.e. paper and cardboard, organics, glass, plastics) will require particular processing with different infrastructure to meet our growing needs.

There are six priority materials for the sector to manage

While Victoria's overall recovery rate is relatively high, the recovery rate for each material varies significantly. This depends on how easy the material is to recover, its quality, and how strong end markets are for that material.

Metals, for example, have a high recovery rate (around 91%). Metals are relatively simple to recover and process and have a relatively high value in end markets. Plastics, on the other hand, have a low recovery rate (around 23%) due to the complexity and cost of recovering and processing them, and weak end markets.

For Victoria to increase its overall recovery rate, we need enough capacity and capability to process increasing amounts of a range of materials. At the same time, the way we process these materials needs to change if Victoria is to meet the policy objectives announced by the Council of Australian Governments (COAG) in March 2020, which progressively bans export waste from 1 July 2020. We also need to change to meet the increasingly high import standards from international markets.

The COAG export ban will require a step-change in recycling and resource recovery in Victoria. The ban will be introduced in phases over the next two years, starting with the export of unprocessed glass, which will be banned by July 2020, followed by mixed waste plastics by July 2021, all whole tyres in December 2021 (except bus, truck and aviation tyres for re-treading), and mixed paper and cardboard, by 1 July 2024. Value-added materials can still be exported under the proposed ban. These include:

\ Plastic: clean plastics sorted to a single resin type and processed ready for further use (e.g. flakes and pellets).

\ Paper: paper pulp and single stream bales.

\ Glass: cullet ready for further use.

\ Tyres: crumb rubber, powder and granules, shredded tyres for tyre-derived fuel or bus, truck and aviation tyres for re-treading.

Victoria has relied heavily on export markets for recovered materials.

Metals have a high recovery rate because they are relatively simple to recover and process and have a high value. Plastics, on the other hand, have a low recovery rate due to the complexity and cost of recovering and processing them, and weak markets.

With the introduction of the ban, Victoria will need to ensure materials can be processed to meet the export standards, and develop local markets for recovered materials.

In our advice, we are focusing on organics, e-waste and the four materials covered by the proposed export ban. These materials either:

\ align with specific elements of the terms of reference for this advice

\ make up a high volume of material entering the recycling and resource recovery stream

\ have low recovery rates

\ represent a high environmental impact

\ have a combination of these factors.

Figure 4 shows a range of materials assessed against these criteria. Materials including masonry, metals and textiles do not meet as many of the criteria and have been excluded from in-depth analysis. The proposed export ban reinforces the need to improve Victoria's recycling of these materials.

Figure 4: Some materials are more problematic than others

	Organics	Plastics	Glass	Paper & cardboard	E-Waste	Masonry	Metals	Tyres	Textiles
Tonnes of material generated	2,522,497	593,983	349,313	2,024,337	84,662	6,633,503	1,610,570	64,164	192,894
Tonnes of materials recovered	1,096,433	138,981	267,846	1,500,784	67,147	5,576,791	1,473,986	57,916	168
Recovery rate	43%	23%	77%	74%	79%	84%	92%	90%	0%
Proportion of waste generated that is exported*	2%	7%	3%	32%	1%	0%	31%	62%	0%
Indicator of environmental hazard	Methane	Litter, micro plastics in wasterways, food	Stockpile safety	Fire risks	Hazardous	Inert	Leaching	Fire risks	Not significant
Net environmental benefit of recycling**	High	Medium	High	High	Not assessed	Not assessed	High	Not assessed	Not assessed
Opportunity to increase value adding in Vic***	High	High	High	High	Medium	Low	Low	Medium	Low

Data from Blue Environment

* based on SV/RMIT 2013 method, considers CO2, energy & water saved only

** red means export markets at risk from export ban

*** estimate of economic opportunity considering likelihood that export market will decline and/or local supply will increase, potential for value-added local or export uses, commodity value uplift likely from changes to sorting and collection

Our analysis of the current infrastructure capacity for these priority materials identifies 430 facilities across Victoria. Figure 5 summarises these facilities.

Figure 5: Resource recovery infrastructure comes in many different forms

Infrastructure type	Paper & cardboard	Plastics	Glass	Tyres	Organics	E-waste	Multiple
Processing Infrastructure							
Reprocessing Facility	9	32	6	3	19	4	-
Recovery Infrastructure							
Specific Materials Recovery Centre	7	-	1	5	5	24	-
Materials Recovery Facility	-	-	-	-	-	-	13
Resource Recovery Centre	1	-	-	-	-	-	265
Bulk Haul Consolidation Centre	-	-	-	-	-	-	1
Drop-off Centre	-	-	-	-	-	6	15
Other	-	-	-	-	-	-	14

Source: Brock Baker Environmental Consulting

In addition to the COAG export ban, we have assessed the impact of other policy changes already announced by the Australian and Victorian Governments that focus on improving recycling and resource recovery, specifically the National Waste Policy Action Plan targets. We have modelled the impact of these targets in our analysis and, where relevant, discussed their potential impact on the infrastructure and market development that will be needed.

Here we assess the projected generation and processing capacity for each priority material to show the potential infrastructure required for each to meet the COAG waste ban requirements and particular recovery rates (%RR). The data used in this section are based on future projections, and should be considered approximate only. Figure 6 summarises our analysis, with further details below.

National Packaging Targets and the National Waste Policy Action Plan

The Australian Government and other state and territory governments have adopted targets initially proposed by the Australian Packaging Covenant Organisation (APCO) to greatly improve the management of packaging waste by 2025. The four targets for 2025 are:

- 100% reusable, recyclable or compostable packaging
- 70% of plastic being recycled or composted
- 30% of average recycled content included in packaging
- phasing out problematic and unnecessary single-use plastics.

In 2018, the Australian Government released the *National Waste Policy: Less waste, more resources*. The policy was agreed on by Australia's Environment Ministers and the President of the Australian Local Government Association in December 2018.

The *National Waste Policy Action Plan* presents targets and actions for its implementation. The *Action Plan* established a target of 80% average resource recovery from all waste steams following the waste hierarchy and a 50% reduction in food waste by 2030. The plan is intended to complement and support the implementation of the national packaging targets.

Figure 6: Reprocessing capacity varies by material

Priority material	2025 (COAG ban & 70% RR)	2030 (80% RR)	2039 (90% RR)
Paper and cardboard	✗	✗	✗
Plastic	✗	✗	✗
Organics	✗	✗	✗
E-waste	✓	✗	✗
Glass	✓	✓	✓
Tyres	✓	✓	✓

Plastics

Seven different categories of plastics are recovered in Victoria. End-of-life plastics are forecast to increase from 586,300 tonnes in 2018 to more than 735,000 tonnes in 2039.[27]

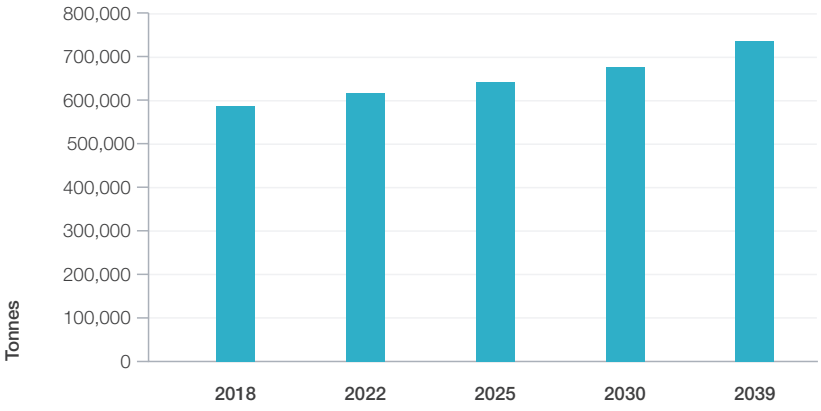
Around 130,000 tonnes of plastic were recovered in 2018, or 23%. Over half of the plastic recovered comes from MSW. The majority is commercial and industrial packaging material.

Recyclability varies depending on plastic type. Polyethylene terephthalate (PET) and high-density polyethylene (HDPE) tend to have higher recovery rates than other types of plastic. Recovery rates also vary across sectors. Recovery rates of MSW plastics were estimated at around 32% in 2018, with C&I and C&D at 18% and 10% respectively.

Victoria has the capacity to manage end-of-life plastics at current recovery rates until 2022, but the challenges go beyond capacity. Victoria, like many jurisdictions, relies heavily on export markets for plastics, with around 63% of recovered plastics exported for processing offshore. The COAG Waste Export Ban will stop mixed and unprocessed plastics from being exported.

The COAG Waste Export Ban requires that from July 2021, the export of mixed plastics that are not of a single type (i.e. they require further sorting, cleaning, and reprocessing before they can be remanufactured) will be banned.

Figure 7: End-of-life plastic generation is expected to grow in Victoria



Source: Brock Baker Environmental Consulting

Figure 8: Plastics processing shortfall is expected by 2025

Priority material	2025 (COAG ban and 70% recovery rate)	2030 (80% recovery rate)	2039 (90% recovery rate)
Generation	641,100	676,700	735,300
Current processing infrastructure capacity	160,050	160,050	160,050
Projected recovery required to meet policy settings	448,700	541,300	661,800
Excess or shortfall in capacity	-288,650	-381,250	-501,750
	×	×	×

27 Brock Baker Environmental Consulting (2020) *Waste and Resource Recovery Infrastructure Data and Spatial Analysis*, report for Infrastructure Victoria, and Infrastructure Victoria analysis

By June 2022, this will extend to single-resin plastics that have not been re-processed (e.g. cleaned and baled PET bottles). From July 2022, only clean plastics sorted into a single resin type and processed for further use (e.g. flakes and pellets) will meet the new export requirements. National recovery targets of 70% for plastics by 2025 and 80% overall recovery by 2030 further complicate this, as shown in Figure 8.

Victoria has limited infrastructure to sort or process plastics so they can be used locally or exported. Victoria's collections systems and MRF sorting infrastructure cannot sort plastics adequately by type (plastics codes 1 to 7) or process these into value-added flakes and pellets for use as plastics feedstocks.

There is an immediate need to plan for investment in plastics reprocessing infrastructure in Victoria. Investment will also be necessary to meet the APCO and National Waste Policy target recovery rates of 70% and 80% in Melbourne and regional Victoria, respectively. Current plastic processing facility capacities range anywhere from 100 to 15,000 tonnes. Most regions generate enough plastic waste to support new infrastructure, as long as there is a market for the recovered material.

There is also a gap in capacity to sort mixed plastics from MRFs, with no market for recovered material. This means material is either being stockpiled or landfilled. Because resource recovery rates for plastics are very low, at 23%, significant change in people's recycling behaviour is also necessary to complement any infrastructure upgrades.

Glass

The amount of end-of-life packaging glass is forecast to increase from 344,000 tonnes in 2018 to more than 442,000 tonnes in 2039.[28]

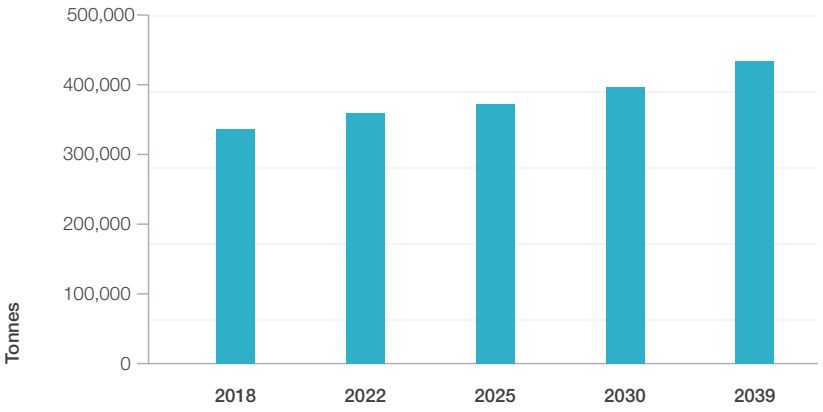
About 264,000 tonnes of glass were recovered in 2018, around 77%. Of this, MSW recovery rates were 87%. This glass was made up of packaging glass such as jars, bottles and other containers. C&I and C&D make up very little of the material stream — 2% and 0% respectively. Glass recovered from C&I is mostly packaging glass. There is limited data on other glass types generated by C&I, and no data on glass recovery from C&D.

There are two main markets for recovered packaging glass:

- recycling into new glass packaging, such as bottles and jars
- recycling into glass sands, aggregates and other uses, such as abrasives, beads and rendering.

The capacity and capability of infrastructure to meet these markets varies. In Victoria, two beneficiation plants recover glass cullet from packaging glass as feedstock for glass manufacturing, and there is only one manufacturer of glass packaging. This reliance on a single manufacturer is a potential risk for future glass reprocessing.

Figure 9: End-of-life glass generation will grow by 2039



Source: Brock Baker Environmental Consulting

Figure 10: Glass processing is sufficient

Priority material	2025 (COAG ban and 70% recovery rate)	2030 (80% recovery rate)	2039 (90% recovery rate)
Generation	382,000	404,900	442,600
Current processing infrastructure capacity	494,200	494,200	494,200
Projected recovery required to meet policy settings	267,400	323,900	398,400
Excess or shortfall in capacity	**226,800**	**170,300**	**95,800**
	✓	✓	✓

Source: Brock Baker Environmental Consulting (2020) *Waste and Resource Recovery Infrastructure Data and Spatial Analysis*, report for Infrastructure Victoria, and Infrastructure Victoria analysis

28 Brock Baker Environmental Consulting (2020) *Waste and Resource Recovery Infrastructure Data and Spatial Analysis*, report for Infrastructure Victoria

However, recovering glass for use as glass sand is growing in Victoria. There has been significant new investment in resource recovery in this area, supported by changes to construction specifications, which have increased how much recycled glass sand can be used in road and rail construction. Victoria's infrastructure construction pipeline provides a significant market for these materials.

As Figure 10 shows, across these two uses, there is expected to be enough infrastructure capacity to manage end-of-life glass generation and recovery rates over the next 20 years.

Using materials at their highest value for as long as possible is key in a circular economy.[29] Turning recycled glass into glass sand rather than back into glass packaging can be seen as 'downcycling'. However, with limited domestic demand for glass production, glass sand will be particularly important in resource recovery end markets. Glass sand is also one of the only end-uses for glass fines – small glass fragments that are difficult to recover with existing MRF and glass beneficiation infrastructure.

Glass sand will play a vital role as virgin sand becomes scarce due to growing demand for infrastructure. Scarcity of virgin sand is leading to significant increases in cost, and in many metropolitan uses, recycled glass sand is very cost competitive. Using glass sand will also reduce the need to quarry for virgin sand. This will support a circular economy in which already extracted natural resources continue to cycle through the economy.

The capacity for packaging glass and glass sand reprocessing only exists in metropolitan Melbourne. There may be opportunities to invest in small-scale glass crushing infrastructure in regional areas, allowing these facilities to process locally collected glass packaging into glass sand for use in local roads. This would require the collection and aggregation of glass in regional hubs.

Turning recycled glass into glass sand rather than back into glass packaging can be seen as 'downcycling'. However, with limited domestic glass production, glass sand will be particularly important as a market for recycled glass.

29 Department of Environment, Land, Water and Planning (2019) *A circular economy for Victoria – Creating more value and less waste*

Organics

Organics include food organics (FO), garden organics (GO), mixed food and garden organics (FOGO), timber and biosolids.

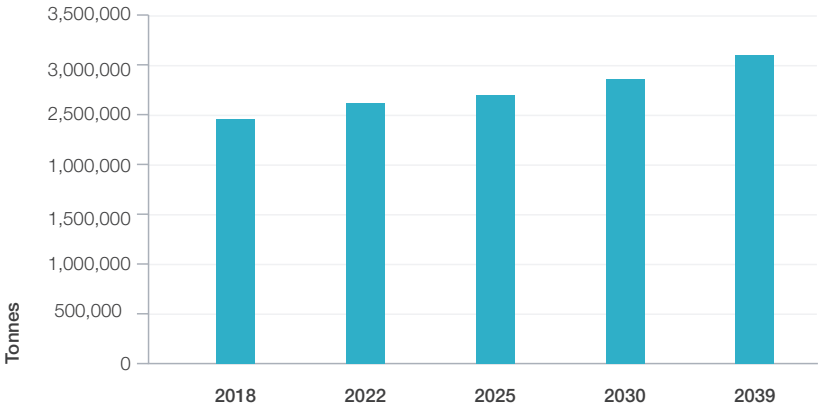
Organic material is one of the largest waste streams in Victoria, estimated to make up around 35% of household garbage bins.[30] Given almost all this material can be recovered in some way, this represents a significant opportunity to improve resource recovery.

In 2018, the overall resource recovery rate for organics in Victoria was 43%. The amount of organic waste generated in Victoria is forecast to increase from 2,489,200 tonnes in 2018 to more than 3,128,400 tonnes in 2039.

Organics recovery from MSW was 29% in 2018. This was mainly garden and timber waste. Some food waste is recovered from MSW, but less than garden and timber waste. One reason for this could be the relatively small proportion of councils offering FOGO collection. C&I sector resource recovery rates were 58%, made up of garden, timber and food wastes, while recovery rates in C&D were around 91%, which mainly came from recovered timber construction materials.[31]

One of the biggest opportunities to improve resource recovery is by increasing household food waste recovery.

Figure 11: More organic waste is expected over time



Source: Brock Baker Environmental Consulting

Figure 12: Organics processing shortfall is expected by 2025

Priority material	2025 (COAG ban and 70% recovery rate)	2030 (80% recovery rate)	2039 (90% recovery rate)
Generation	1,277,700	1,348,900	1,466,400
Current processing infrastructure capacity	764,800	764,800	764,800
Projected recovery required to meet policy settings	894,400	1,079,100	1,319,800
Excess or shortfall in capacity	-129,600	-314,300	-555,000
	×	×	×

Source: Brock Baker Environmental Consulting (2020) *Waste and Resource Recovery Infrastructure Data and Spatial Analysis*, report for Infrastructure Victoria, and Infrastructure Victoria analysis

Currently, a significant proportion of household food waste enters landfill in Victoria because there is no separate collection service, leading to an MSW recovery rate for food of 10.6%.[32] However, more local governments are introducing kerbside FOGO collection, which is expected to increase FOGO recovery over time. Based on current FOGO recovery rates, our analysis suggests there is enough capacity to recover FOGO from households and businesses through to 2022. Beyond 2022, we expect there to be a shortfall, particularly if more local governments introduce kerbside FOGO collection.

Metropolitan Melbourne will need more capacity to manage current and future organics recovery. Given the challenges in processing organics material – particularly the infrastructure and buffer zones required – the opportunities for significant new reprocessing in Melbourne will likely be limited and small-scale. A more practical solution is to aggregate and consolidate organic material, with initial processing that reduces weight and volume followed by transport to regional areas for additional processing and use. Regional Victoria will also need more capacity to manage its organic waste.

Given the challenges in processing organics – particularly the infrastructure and buffer zones required – the opportunities for significant new reprocessing will be in regional Victoria.

30 Sustainability Victoria (2014) Victorian Statewide Garbage Bin Audit 2013

31 Brock Baker Environmental Consulting (2020) *Waste and Resource Recovery Infrastructure Data and Spatial Analysis*, report for Infrastructure Victoria

32 ibid.

There is an immediate need to plan for future investment in paper and cardboard reprocessing infrastructure in Victoria, particularly to meet the COAG Waste Export Ban.

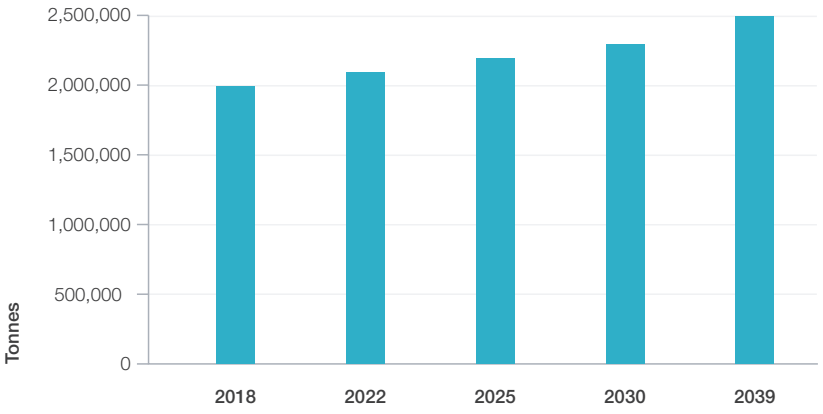
Paper and cardboard

Paper and cardboard includes mixed paper and cardboard, office paper, and newspapers and magazines. End-of-life paper and cardboard is forecast to increase from 1,997,800 tonnes in 2018 to more than 2,491,500 tonnes in 2039.[33] (see Figure 13)

The overall recovery rate for paper and cardboard in Victoria was 74% in 2018. The vast majority of recovered paper and cardboard in Victoria comes from the C&I sector, with a resource recovery rate of 81%. Paper and cardboard collected directly from businesses is a single type (a clean stream) making it easier to process and more valuable. Paper and cardboard from MSW, however, is mostly commingled and has a recovery rate of around 35%.[34] C&D only accounts for a small amount of recovered paper and cardboard.

There is currently enough capacity to manage end-of-life paper and cardboard in Victoria. However, once the COAG export ban comes into effect, there is expected to be a reprocessing shortfall from 2024 onward. The COAG Waste Export Ban requires that by July 2024, all mixed paper and cardboard be banned from export. Paper will need to be pulped or sorted by paper type in order to be exported.

Figure 13: End-of-life paper and cardboard volumes are expected to increase



Source: Brock Baker Environmental Consulting

Figure 14: Paper and cardboard processing shortfall is immediate

Priority material	2025 (COAG ban and 70% recovery rate)	2030 (80% recovery rate)	2039 (90% recovery rate)
Generation	2,178,400	2,296,300	2,491,600
Current processing infrastructure capacity	1,116,105	1,116,105	1,116,105
Projected recovery required to meet policy settings	1,524,900	1,837,000	2,242,400
Excess or shortfall in capacity	-408,795	-720,895	-1,126,295
	×	×	×

Source: Brock Baker Environmental Consulting (2020) *Waste and Resource Recovery Infrastructure Data and Spatial Analysis*, report for Infrastructure Victoria, and Infrastructure Victoria analysis

There is an immediate need to plan for future investment in paper and cardboard reprocessing infrastructure in Victoria.

Most paper and cardboard reprocessing in Victoria is located in metropolitan Melbourne with one notable paper mill, Australian Paper, in regional Victoria.

To meet the COAG Waste Export Ban, Victoria will need to invest in more paper pulping or more paper type separation at MRFs.

33 Brock Baker Environmental Consulting

34 There are several conflicting data sources in the public domain for paper and cardboard and it is suspected that the MSW recovery rate for paper and cardboard may actually be around 50%.

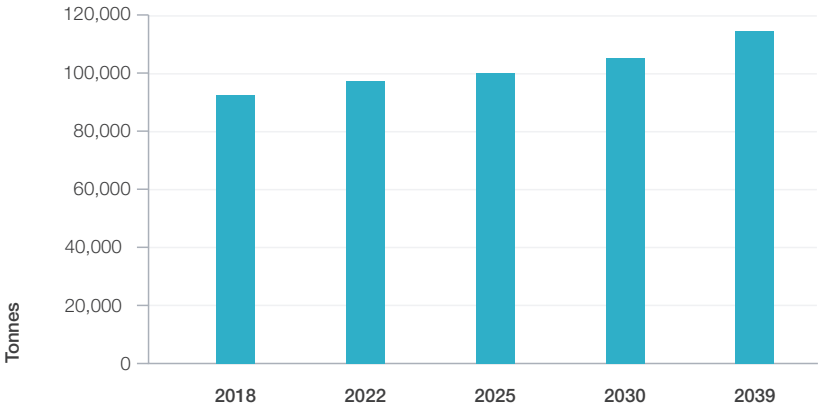
Tyres

Tyres are a composite product made from natural and synthetic rubber, steel, carbon, fibre and bonding agents. Tyres are shredded to separate the materials, most of which have markets for recovery. The amount of end-of-life tyres is forecast to increase from 91,700 tonnes in 2018 to more than 113,000 tonnes in 2039.[35]

In 2018, the overall resource recovery rate for tyres in Victoria was 87%. Of this, MSW recovery rates were 100%. This is because only a small proportion of tyres are managed through the MSW sector. These are usually tyres that are disposed of at Resource Recovery Centres and Transfer Stations, or collected through the clean-up of tyres dumped on local government land. Whole tyres are banned from landfill in Victoria, but shredded tyres can be disposed of in landfill.

The vast majority of tyres in Victoria are managed through the C&I sector with a resource recovery rate of 83%. This is because end-of-life tyres are removed at and collected by tyre retailers when new tyres are fitted. A contractor then removes tyres from these premises for processing or export. Data indicates that there are some tyres entering landfill. C&D does not contribute to generating end-of-life tyres.

Figure 15: End-of-life tyres are expected to increase by 2039



Source: Brock Baker Environmental Consulting

Figure 16: Tyre processing capacity is sufficient

Priority material	2025 (COAG ban and 70% recovery rate)	2030 (80% recovery rate)	2039 (90% recovery rate)
Generation	99,700	104,900	113,600
Current processing infrastructure capacity	112,500	112,500	112,500
Projected recovery required to meet policy settings	69,800	83,900	102,200
Excess or shortfall in capacity	**42,700**	**28,600**	**10,300**
	✓	✓	✓

Source: Brock Baker Environmental Consulting (2020) *Waste and Resource Recovery Infrastructure Data and Spatial Analysis*, report for Infrastructure Victoria, and Infrastructure Victoria analysis

35 Brock Baker Environmental Consulting (2020) *Waste and Resource Recovery Infrastructure Data and Spatial Analysis*, report for Infrastructure Victoria

There are three main pathways for recovered end-of-life tyres:

- baling of tyres for export as Tyre Derived Fuel or as casings for re-tread/seconds markets
- shredding of tyres for export as Tyre Derived Fuel
- further reprocessing into feedstocks such as crumb rubber, granules or powder.

Victorian infrastructure capacity and capability are different for each of these recycling pathways. The COAG Waste Export Ban requires that by December 2021, all whole tyres, including baled tyres, will be banned from export, except for bus, truck and aviation tyres for re-treading. Tyres will need to be shredded for use as tyre derived fuel, or further processed into crumb rubber, granules or powder.

Figure 16 shows there is enough mechanical infrastructure in Victoria to shred or crumb tyres to meet a range of product requirements. There is no immediate need for future investment in tyre reprocessing infrastructure in Victoria.

All major tyre reprocessing in Victoria is located in metropolitan Melbourne. Given the high level of investment mechanical reprocessing of tyres requires to create shred or crumb rubber, it is likely that future investments will continue to be in Melbourne.

There have been several attempts at regional reprocessing through pyrolysis (thermal treatment), but so far none have been successful. In fact, proposed pyrolysis facilities have resulted in notable stockpiles such as those at Stawell and Numurkah, both of which have recently been cleaned up by the EPA and respective local governments, at a cost to Victorian taxpayers.

Given the high level of investment mechanical reprocessing of tyres requires to create shred or crumb rubber, it is likely that future investments will continue to be in Melbourne.

E-waste

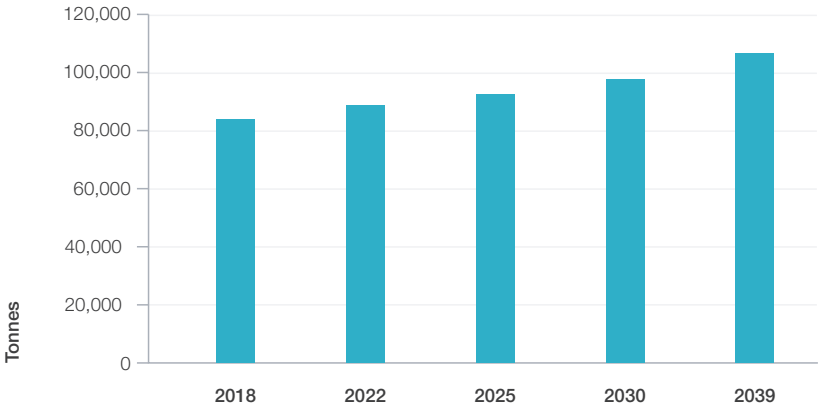
E-waste covers a wide range of electronic items – anything with a battery or a plug – including televisions, computers, mobile phones, kitchen appliances and whitegoods. These items can contain both valuable and hazardous materials. E-waste is forecast to increase from 83,400 tonnes in 2018 to more than 106,500 tonnes in 2039.[36]

In 2018, the overall resource recovery rate for e-waste in Victoria was 79%. Since then, an e-waste landfill ban was introduced in July 2019. As a result, we expect a drop in reported e-waste disposal to landfill. As e-waste is such a broad category it is important to note that approximately one third of e-waste in Victoria is made up of large household appliances, i.e. whitegoods that are predominantly metals.

These materials are largely managed by metals recyclers, not dedicated e-waste recyclers. As Figure 18 shows, based on the best available data, there is enough reprocessing capacity to manage e-waste containing hazardous materials in the short-term, with a small shortfall from 2030 onward.

However, waste projections suggest increasing tonnages of hazardous items that are yet to reach their end of useful life, such as solar photovoltaic panels (PVs), entering the waste stream in future.

Figure 17: E-waste is projected to grow



Source: Brock Baker Environmental Consulting

Figure 18: E-waste processing shortfall is expected by 2030

Priority material	2025 (COAG ban and 70% recovery rate)	2030 (80% recovery rate)	2039 (90% recovery rate)
Generation	63,400	67,100	73,200
Current processing infrastructure capacity	49,400	49,400	49,400
Projected recovery required to meet policy settings	44,400	53,700	58,500
Excess or shortfall in capacity	5,000	-4,300	-9,100
	✓	✗	✗

Source: Brock Baker Environmental Consulting (2020) *Waste and Resource Recovery Infrastructure Data and Spatial Analysis*, report for Infrastructure Victoria, and Infrastructure Victoria analysis

36 Brock Baker Environmental Consulting (2020) *Waste and Resource Recovery Infrastructure Data and Spatial Analysis*, report for Infrastructure Victoria

E-waste: The waste of the future, today

Future e-waste is likely to look very different from current forecasts due largely to two technologies – one existing and one emerging – solar PVs and electric vehicles.

Currently, low volumes of PV system components enter Australia's waste stream, with minimal impact. However, solar PVs are an emerging e-waste stream. Industry and government are concerned that there will be insufficient options to safely dispose of end-of-life PV system components across Australia, as well as a lack of established reprocessors and recyclers capable of recovering valuable and hazardous resources.

As PV equipment reaches the end of its useful life span, the level of recovery, recycling, re-use and safe disposal becomes important to the environmental benefits of PVs. End-of-life management is also important to protect the environment and human health from the uncontrolled release of hazardous materials.

PV panels and system components have an estimated average life span of approximately 25 years and are expected to enter Australia's waste stream in significant volumes from around 2023, due to the recent boom in solar installations since 2010. In Victoria alone, it is estimated that by 2035 there will be 22,000 tonnes of PV panel waste requiring disposal.

In addition, automated and zero emissions vehicles are emerging technologies that could also produce significant volumes of e-waste.

In our *Advice on automated and zero emissions vehicles infrastructure*, we found that if the entire vehicle fleet transitioned to battery electric vehicles, the volume of lithium battery waste and other e-waste generated would exceed current projections and infrastructure plans. We recommended the Victorian Government make changes to the *Statewide Waste and Resource Recovery Infrastructure Plan* to incorporate the impacts of automated and zero emissions vehicles.

Without proper planning, e-waste could greatly exceed the capacity of waste infrastructure, leading to increased illegal dumping, stockpiling or illegal exporting – issues that are already a concern for e-waste.

Finally, there is also the potential to develop local industry to handle and reprocess e-waste in a more economically and environmentally viable manner.

Residual waste

Residual waste is material that is unable to be recovered for alternative uses or has otherwise reached its end-of-life. Currently almost all residual material is disposed to landfill.

Disposal is the least preferable outcome on the waste hierarchy, as all remaining value of these materials is lost. There will always be a role for landfill in broader waste management systems and it plays a particularly important role in contingency planning (as shown in the last 18 months). However, there is an alternative to landfill for some residual materials that allows for some of the energy embedded in these materials to be recovered through waste-to-energy processes.

There are a number of residual waste-to-energy infrastructure projects currently proposed for Victoria. These have the potential to further reduce Victoria's reliance on landfill when combined with waste avoidance and improved resource recovery.

If Victoria continues its current, business-as-usual trajectory, the amount of residual waste going to landfill is projected to increase from 4.4 million tonnes in 2017/18 to 5.7 million tonnes in 2037/38.[37] Alongside developing waste-to-energy projects, Australian and Victorian Governments could reduce this by taking steps to reduce the amount of materials going to landfill. This could include banning organic material from landfill or mandating the use of re-usable, recyclable or compostable packaging.

The amount of residual waste in the future is highly uncertain. We estimate that the combined impact of the two policy interventions above could reduce the amount of material going to landfill in 2038/39 by around 700,000 tonnes each year, with a projected 5 million tonnes of residual material going to landfill. Our analysis suggests that by 2038/39, Victoria will generate 650,000 tonnes per year of residual waste from the six priority materials alone, assuming a 90% recovery rate. Not all of this residual waste will be suitable for waste-to-energy.

The need for waste-to-energy to manage residual waste will be highly dependent on efforts to reduce waste and recycle materials, as well as the planned landfill capacity. The *Recycling Victoria* policy's stated capacity cap of one million tonnes per year for waste-to-energy should be regularly reviewed to manage these uncertainties. If combined efforts to reduce waste generation and recycle material are not highly successful then there is a risk that significant amounts of residual waste will remain above the one million tonne waste-to-energy cap and be consigned to landfill.

37 Blue Environment (2019) *Victorian Waste flows projections*, report for Infrastructure Victoria

Landfills, waste-to-energy, and the circular economy

Using materials for as long as possible is key to a circular economy. When those materials no longer have a useful role to play, it is often still possible to extract energy as an alternative to disposal.

The waste hierarchy shows that recovery of energy is better than disposal or containment of waste, because this recovers some value, reduces greenhouse gas emissions from organic waste and lessens the long-term environmental impacts of landfills.

As a result, waste-to-energy is a pragmatic approach to managing residual waste, but is less desirable than waste reduction, re-use and recycling. There are some risks associated with waste-to-energy infrastructure while also transitioning to a circular economy.

Waste avoidance and increased recycling and resource recovery can reduce the amount of feedstock for waste-to-energy infrastructure, particularly thermal waste-to-energy plants. Conversely, over-investment in waste-to-energy infrastructure could discourage transition to a circular economy.

The two most common forms of waste-to-energy technologies are thermal and biological. Thermal technologies use heat to release energy from waste, for example through incineration and capture of energy. Biological processes use microorganisms that feed on organic waste to produce heat, energy, biogas and 'digestate'. The most common biological process is anaerobic digestion.

Both biological and thermal waste-to-energy facilities could stop some residual waste going to landfill – particularly organic material – and recover some energy from the material. The solid residues that remain could be further reused and recycled. For example, digestate from anaerobic digestion processes could be transformed into soil conditioner, while some of the bottom ash from thermal processes could be used in construction.

Landfills will remain part of Victoria's waste management system. Landfills can assist in residual waste management and sector contingency planning. They may also be the best option in regional areas where there is not enough waste to support an economically viable waste-to-energy facility.

Further, there are some materials for which containment or landfill is the safest and best option.

However, Victoria's reliance on landfill is expected to decline in the long term as new and better ways to avoid waste and recover materials for reuse are developed. Waste-to-energy can support this by creating ways to reduce the need for new landfills and keeping existing airspace capacity for unrecoverable materials into the future. This aligns with Victorian Government's planning documents, such as the SWRRIP, which aims to minimise the amount of waste going to landfill.

The Metropolitan Waste and Resource Recovery Implementation Plan, for example, does not plan for new landfills in the metropolitan area.

Victoria's circular economy policy – *Recycling Victoria: A new economy* – limits the amount of material that can be processed at thermal waste-to-energy facilities in Victoria. Limiting the amount of material that can be accepted by these facilities may mean that material that could viably be used for recovery of energy will instead go to landfill.

More resources, less waste

If potentially recoverable resources are not recovered, this is a missed economic opportunity.

Figure 19 shows that based on the amount of waste recovered in Victoria and current commodity prices, the value of materials is $1.21 billion. Metals makes up the largest share, worth $889 million, or 73% of the market. Paper and cardboard and masonry have the next largest market shares, at 8% and 7%, respectively. However, the value of a number of materials (such as plastics and paper) has fallen significantly since the collapse of export markets.

We have found that prices for some recovered materials are higher in South Australia. For example, glass prices are higher due to the cleaner stream of glass recovered from CDS. This shows that there is potential for Victoria to increase the value of its recovered resources from improved resource recovery.

To estimate the potential increase in market value from higher commodity values, we applied South Australian commodity prices to the amount of resources recovered in Victoria and found that they would be worth up to $2 billion.

Figure 19: Estimated value of recovered materials in 2019 – Victorian prices / South Australian prices*

Source: Blue Environment (2019) and Infrastructure Victoria analysis
*Based on December 2019 commodity prices in Victoria and 2016/17 commodity prices in South Australia

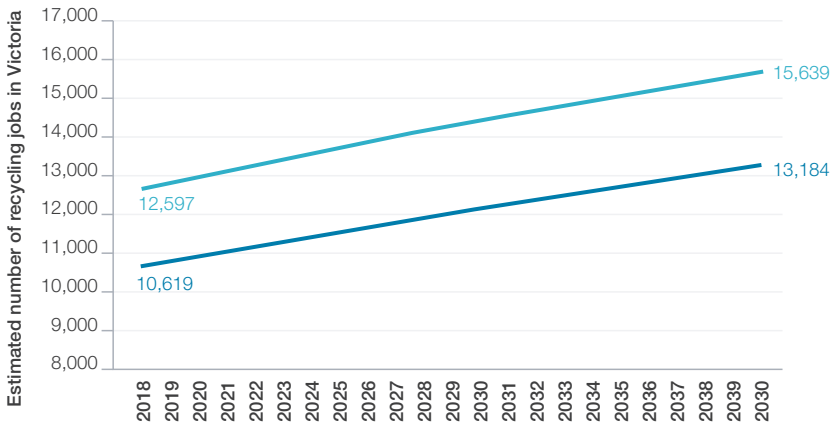
Resource recovery and recycling are higher value and more productive than disposal, creating new opportunities for employment and industry growth.

Recycling can create more jobs than disposal

Increasing the amount of value generated by the sector is also likely to lead to more jobs. Resource recovery activities are higher-value and more productive than disposal, creating new opportunities for employment and industry growth. Victoria will be well-placed to realise these opportunities, but it will require ongoing evaluation of infrastructure and policy settings.

Evidence suggests that for every 10,000 tonnes of waste recycled, 9.2 jobs are generated compared to 2.8 jobs for landfill.[38] Using this approach, we estimate the number of jobs in the sector could grow to around 13,200 by 2039 if the current recovery rate of 69% is maintained. However, if Victoria increased its recovery rate to 90%, the number of people working in the sector could grow to over 15,600 by 2039 (Figure 20), an additional 2,400 jobs more than 'business-as-usual' and over 5,000 more than today.

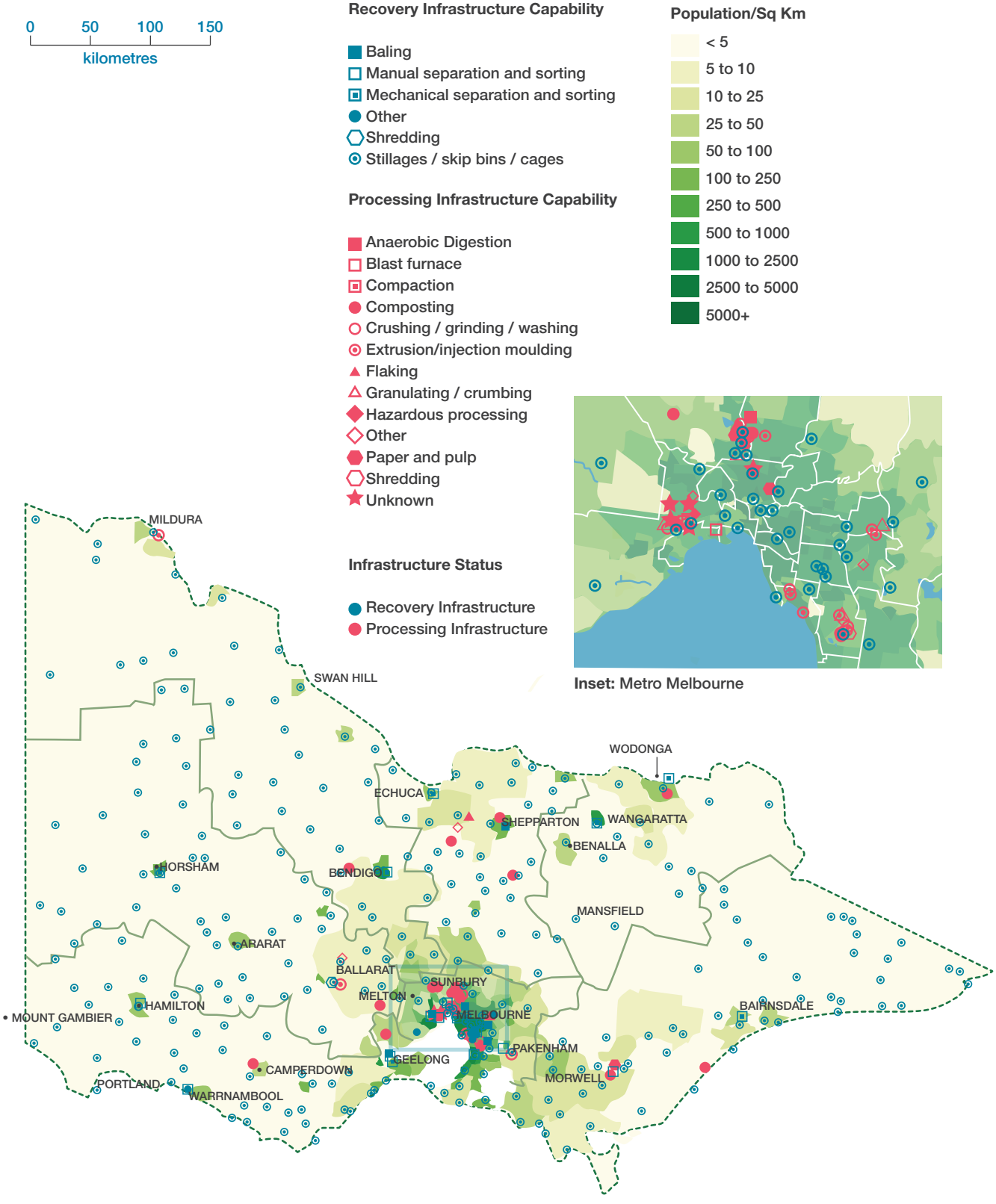
Figure 20: The Victorian recycling industry has the potential to generate up to 5,000 new jobs by 2039



Source: Infrastructure Victoria Analysis, Access Economics, Blue Environment

38 Access Economics (2009) *Employment in waste management and recycling*, report for the Department of the Environment, Water, Heritage and the Arts

Figure 21: Reprocessing infrastructure is highly concentrated around Melbourne



Infrastructure is unevenly spread

In identifying challenges and opportunities for Victoria's regional and rural areas we sought feedback from stakeholders from local regional councils and industry.

Our consultation identified high transportation costs as a barrier to improving recycling and resource recovery. In many cases, it is more economical to use landfill. Several submissions identified a need for more recovery infrastructure in regional areas.

Our analysis shows there are some inconsistencies in infrastructure provision across the state. As Figure 21 shows, the majority of processing infrastructure – marked in red – is clustered around metropolitan Melbourne, while recovery infrastructure – marked in blue – is spread more evenly across the state.

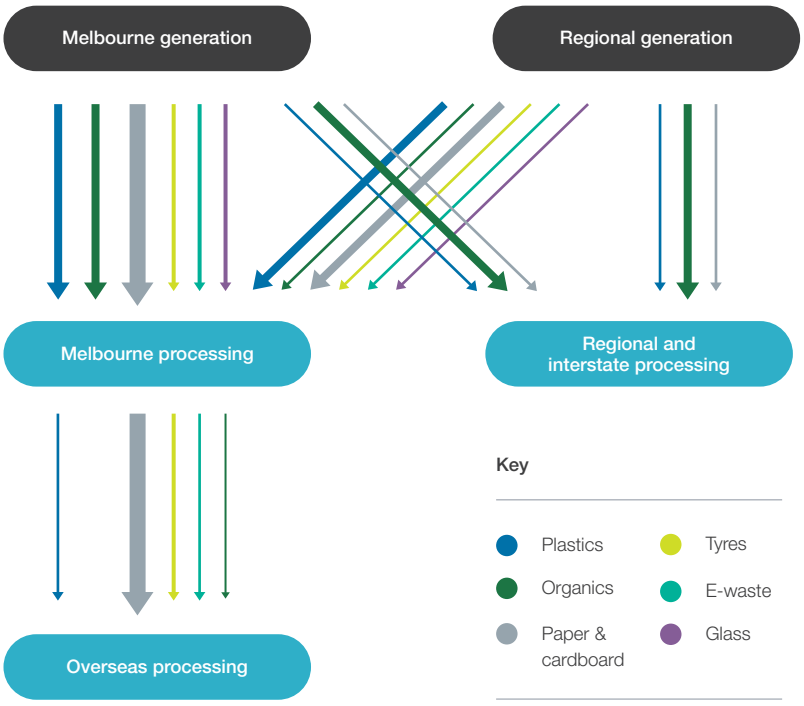
Many of the recovery infrastructure sites marked in blue are small, local resource recovery centres. These often serve as points of aggregation for materials, with limited actual recovery occurring. Materials will often be transported to another facility for processing. Figure 21 also shows that there is a specific need for MRF infrastructure in the Grampians Central West and Barwon South West WRRG regions, as both these regions lack any mechanical separation and sorting infrastructure.[39]

This means material generated in regional areas often flows to the metropolitan area for processing. Some materials are easier to process in the metropolitan area. Due to the amount of material generated in Melbourne, metropolitan facilities tend to be bigger than regional ones. With size often comes efficiency, meaning it is cheaper and more efficient to transport some materials to the metropolitan area for processing.

On the other hand, some materials require more space for processing, such as organics.

Figure 22 illustrates the flow of materials in Victoria, with each arrow representing a different material type, and the thickness of each arrow representing the volume of the material. It shows, for example, that more organic material flows to regional areas for processing than is processed in the metropolitan area, and that all glass generated in regional areas is processed in Melbourne.

Figure 22: Most processing occurs in Melbourne; except for organics



39 Brock Baker Environmental Consulting (2020) *Waste and Resource Recovery Infrastructure Data and Spatial Analysis*, report for Infrastructure Victoria

Waste transport

Moving materials is not necessarily a bad thing, depending on the material. High-volume or heavy materials such as masonry and aggregates, or glass, cost more to transport due to their weight.

Organic materials may not necessarily be more expensive to transport, but often don't have as much value as a reprocessed material such as compost, making them less economical to transport. In these instances, investment in regional recovery and processing facilities could lower transport costs, improve recovery rates and support end markets for these materials. Local recovery and reprocessing can create jobs in regional areas.

Regional and rural areas are more likely to have nearby markets for reprocessed organic products, such as soil conditioner and compost, and facilities to process these materials due to the space available for buffer zones. However, this needs to be weighed against cost of transport and the ability to aggregate enough waste for a viable market.

Overall, transporting waste is not necessarily problematic, as long as it is optimised. As the private sector is largely responsible for providing this infrastructure, the geographic spread of facilities is not optimised to reduce transport costs. Minimising transport costs will be important in improving recycling and resource recovery rates by helping recovered materials become cost competitive with virgin materials. Currently there are dozens of resource recovery centres across Victoria, of varying capacity and capability, that aggregate materials from their local areas for transport and further recovery.

Rationalising our resource recovery centre network and focusing on fewer centres that are more strategically located and better resourced could reduce the costs of transporting materials. This could encourage more aggregation of materials, resulting in fewer trips and better economies of scale in waste transport.

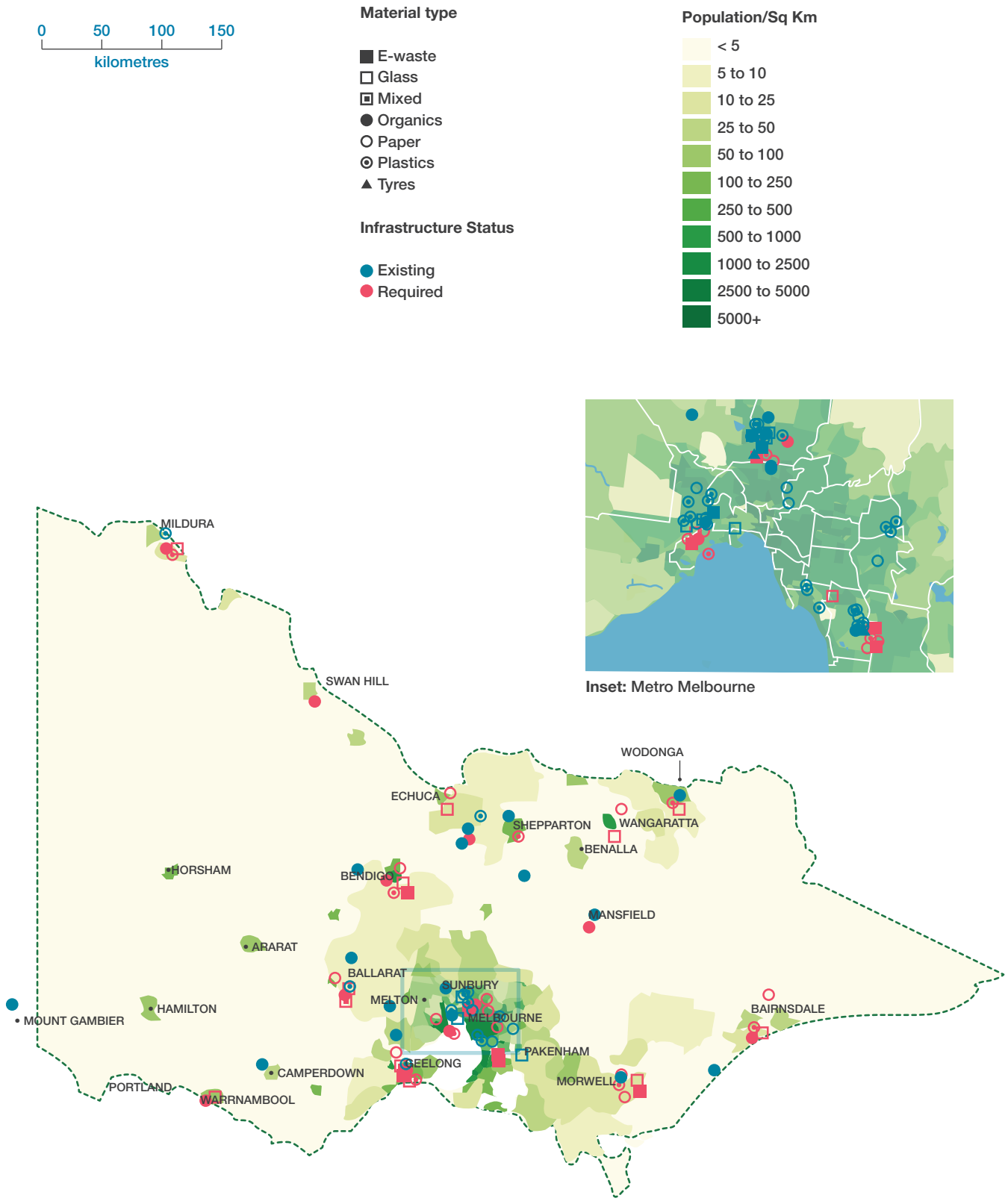
Future infrastructure provision

To identify potential locations for new recycling and resource recovery infrastructure, we considered current and predicted waste generation and reprocessing capacity by material type, proximity to end markets, existing resource recovery hubs of statewide significance, the statewide and regional resource recovery infrastructure plans and stated government priorities to support regional economies in transition (for example, the Latrobe Valley).

Using this methodology, we are proposing 87 new or upgraded facilities, many of which are in regional areas. Shown in Figure 23, these facilities can address identified infrastructure gaps, minimise transport costs, capitalise on existing resource recovery and recycling hubs and maximise the likely economic viability of facilities.

Transporting waste is not necessarily problematic, if it is optimised. As recovery and recycling infrastructure is largely provided by the private sector, the geographic spread of infrastructure is not optimised to reduce transport costs to households and businesses.

Figure 23: Indicative location of required recovery and reprocessing infrastructure



Inset: Metro Melbourne

Not investing can be expensive

A number of the recommendations we make may require spending by the Victorian Government, both in upfront capital expenditure and also ongoing operational expenditure. When the Victorian Government decides whether to make particular investments it helps to consider both the cost of investment and the potential costs to Victoria if no investment occurs.

We have already seen what can occur with a weakened market for recyclables and without sufficient infrastructure to process recycling. VAGO noted in its 2019 report that without clear state-level plans for how to manage recyclables in this new environment, stockpiles will likely continue to grow and pose unnecessary risks, and waste to landfills will continue to rise.[40]

We have broken down the potential costs to Victoria of not increasing recycling and resource recovery into four categories, representing other (often unplanned) investments and foregone revenue from poor recycling and resource recovery outcomes.

These are:

- Emergency and incident response costs
- Enforcement and regulatory costs
- Environmental impact and restoration costs
- Economic impact and business disruption

Emergency and incident response costs

Waste material mismanagement has seen an increase in stockpile fires, waste abandonment and illegal dumping. These can all be costly. Based on events of the past few years, the EPA estimates that it costs Victoria around $193 million per year to respond to avoidable waste management issues. This estimate is made up of $105 million per year to respond to waste stockpile fires, $58 million per year in annual clean-up costs of abandoned waste sites, and $30 million per year in clean-up costs and lost landfill levy revenue from illegal dumping.[41] As an example, the Victorian Government recently invested $30 million to clean up a stockpile in Lara where the operator has gone into liquidation, which is a job that may take several years.

Stockpile fires also incur significant costs for other agencies. The Ecotec Somerton fire in 2015 cost the CFA alone $2.3 million to respond to. Further costs for other agencies responding to that fire included $242,000 for VicRoads' emergency response, $295,145 for Melbourne Water impact management costs, $30,000 for Hume City Council, and $1 million for DELWP.[42]

Enforcement and regulatory costs

As well as the costs of responding to specific incidents, there are also ongoing enforcement and regulatory costs, which can increase over time if the scale and frequency of poor waste management practices increase when issues arise in the sector. The 2019/20 Victorian Budget allowed for $204.3 million in statutory activities and environment protection from DELWP.[43]

Without clear state-level plans to manage recyclables in this new environment, materials will likely go to stockpiles, which pose unnecessary risks, or to landfill.

Environmental impact and restoration costs

Waste stockpile fires cause immediate and long-term environmental damage to the site and surrounding areas. For the 2017 Coolaroo fire alone, DELWP has estimated that approximately $6 million was spent on the management and clean-up of the site. This amount does not include the ongoing management costs and clean-up costs borne by several agencies, particularly the EPA but also Melbourne Water, Yarra Valley Water and Hume City Council.[44]

Economic impact and business disruption

When dangerous incidents happen, the costs to the state can go beyond the cost of the immediate response. There can also be an economic impact on surrounding communities if businesses are disrupted. The impact on the local community and businesses of the 2017 Coolaroo fire was quantified in a recent class action, where over 200 residents of Coolaroo succeeded in a claim against the operator of the Coolaroo site, who was ordered to pay $1.2 million.[45] DELWP separately estimated that the cost of this fire in business disruptions alone amounted to $200,000.[46]

40 Victorian Auditor-General's Office (2019), *Recovering and Reprocessing Resources from Waste*

41 Deloitte (2019) *Regulatory Impact Statement: Proposed environment protection regulations*, report for the Department of Environment, Land, Water and Planning and the Environment Protection Authority

42 Department of Environment, Land, Water and Planning (2018) *Management and storage of combustible recyclable and waste material*, Policy Impact Assessment

43 Department of Treasury and Finance (2019) *Victorian Budget 19/20 – Budget Paper No. 3*

44 Department of Environment, Land, Water and Planning (2018) *Management and storage of combustible recyclable and waste material, Policy Impact Assessment*

45 7 News (2019) *Class action win for residents affected by Coolaroo recycling plant fire*. Available at https://7news.com.au/news/court-justice/class-action-win-for-residents-affected-by-coolaroo-recycling-plant-fire-c-378097, accessed on 7 October 2019

46 Department of Environment, Land, Water and Planning (2018) *Management and storage of combustible recyclable and waste material, Policy Impact Assessment*

Supplements to infrastructure investment

The Victorian Government can work with other governments and stakeholders to reduce the amount of material coming into the recycling and resource recovery system. There are multiple approaches the Victorian Government can take to either reduce the amount of material entering the system or increase recyclability of materials.

Product stewardship

Product stewardship, or extended producer responsibility (EPR), is the shared responsibility of manufacturers, retailers and consumers to manage the full lifecycle impacts of products.

Product stewardship schemes aim to ensure that everyone involved in making and using a product shares the burden of what happens to it. This addresses one of the market failures associated with waste, in which neither businesses who create the products that lead to waste or households who consume and dispose of products as waste are exposed to the costs of managing those materials once they have been disposed of.

If businesses and households are exposed to those costs, they are more likely to minimise waste and improve how it is disposed of. In addition, making producers responsible for the disposal of products may encourage them to make products easier to re-use or recycle.

The Australian Government has established a framework for product stewardship through the *Product Stewardship Act 2011*, a commitment originally made in the 2009 National Waste Policy.

The National Waste Policy was updated in 2018, encouraging the design of products made to last, the use of recoverable materials and minimising waste. The legislation allows for mandatory, voluntary, or co-regulatory schemes. In the eight years since this Act was introduced, no mandatory schemes have been established. Instead, existing product stewardship schemes tend to be voluntary, industry-led schemes, such as those in place for tyres, packaging products and mobile phones.[47]

Product stewardship in Victoria is even less formalised and lacks legislation. However, Sustainability Victoria has undertaken product stewardship partnerships for computers, batteries, paint and compact fluorescent lights.[48] Like the Australian Government's approach, none of these schemes are mandatory and were effectively delivered as pilot programs.

We looked at approaches to product stewardship around the world and found that national, mandatory schemes are most effective. Mandatory schemes tend to be easier to enforce. Mandatory schemes also enable government to apply more stringent product standards. For example, under a mandatory scheme, the government could introduce product standards to exclude materials from the system that are hard to recycle. Countries that perform well, such as the Netherlands, Germany and Switzerland have mandatory schemes that focus on problematic materials, like electrical equipment and packaging.[49]

Around the world, mandatory product stewardship schemes are the most effective.

47 Parliament of Victoria Legislative Council Environment and Planning Committee (2019) *Inquiry into recycling and waste management – final report*

48 ibid.

49 AlphaBeta (2019) *Recycling and resource recovery infrastructure in Victoria: International and Australian comparisons*, report for Infrastructure Victoria

Container Deposit Scheme in Victoria

A common example of a product stewardship scheme is a container deposit scheme (CDS).

A CDS allows consumers to take containers to collection points (sometimes in the form of a reverse vending machine) and deposit them in exchange for a refund. CDSs have operated in Australia for some time. South Australia has had a scheme since 1977 and, over time, other Australian jurisdictions have followed suit. Victoria has recently announced an intention to implement one by 2022/23.

One of the key benefits of CDSs is that they can reduce contamination. This is because the different materials are separated at the source and are not commingled – particularly glass and plastics.

Cleaner material streams can increase their potential for re-use. A CDS can improve the chances that glass containers will be remanufactured into new bottles. With plastics, a CDS allows for separation and remanufacturing of food-grade plastics – a product with a strong end market.

The introduction of a CDS was commonly identified by stakeholders who provided feedback on our Evidence Base Report as an initiative that could improve Victoria's waste and resource recovery system. We heard from businesses, local councils and individuals who advocated for the introduction of a CDS in Victoria. We separately undertook polling of Victorians on a range of issues, including a CDS. In total, 92% of people we polled favoured the introduction of a CDS.

The Victorian Parliamentary Budget Office (PBO) recently costed a CDS for the Victorian Parliamentary Inquiry into recycling and waste management. The PBO costed a model where the cost of the scheme is borne by drinks suppliers and the refund for each container was fixed at 10 cents.

The PBO found that a CDS would provide Victoria with $244.5 million from 2019-20 to 2022-23. This is a $253.5 million increase in government revenue due to uncollected deposits from containers not being returned, partially offset by an increase in operating expenses of $9 million to manage the scheme.

Along with financial benefits, a CDS can:

- act as an 'anchor' in a broader network of recycling infrastructure
- reduce litter
- improve community engagement in recycling as consumers benefit when they return containers
- increase the value of recovered material while reducing collection, transport, processing and landfill costs
- create employment
- increase resource recovery.

A CDS has merit in Victoria as part of a suite of reforms to collection and processing to secure cleaner materials streams and improve resource recovery rates. This has been recognised in the *Recycling Victoria* policy, which commits to the introduction of a CDS.

Further work is needed to identify the best CDS model for Victoria, but we consider the approaches taken in Western Australia and Queensland to be good examples. In the longer term, a nationally consistent approach to CDS should be considered.

Financial incentives

Businesses that manufacture products that are later disposed of by households do not often face the cost of disposal. In the absence of costs that would change their behaviour, this can lead to excessive and unnecessary waste. This market failure can be addressed by putting a price on waste through taxes or levies on virgin materials to encourage greater use of recycled content, or on specific products to disincentivise their production altogether.

The UK Government recently implemented a plastic packaging tax on the production and import of non-recyclable plastic packaging that will come into effect in 2022. This will incentivise the use of more recycled plastics and reduce plastic waste. The tax was a response to high levels of plastic packaging waste, which predominantly came from new plastics.[50]

It is difficult for the Victorian Government to unilaterally impose a similar tax, mostly because Victoria is just one part of a larger market and products can flow across state borders relatively easily, limiting the impact of a state-based tax. However, the Victorian Government can work with the Australian Government to investigate the potential costs and benefits of taxes or levies on specific materials, such as plastics or virgin materials.

Product bans

The most definitive legislative tool the Victorian Government could use to reduce residual waste is a ban on certain materials. Single-use plastics, such as plastic bags, straws and disposable food packaging, are commonly identified due to their high profile in discussions around waste and the visibility of their environmental impact.

In November 2019, the Victorian Government banned the provision of single-use plastic bags through amendments to the Environment Protection Act 1970, with penalties for businesses. A similar approach could be used for other materials. For example, the European Union issued a directive in June 2019 on the impact of certain plastic products on the environment. This included a ban on single-use plastic products such as cotton bud sticks, cutlery, plates, straws, beverage stirrers, balloon sticks, and polystyrene food and beverage containers. The Member States have until 2021 to transpose these bans into national law.

The *Victorian Parliamentary Inquiry into recycling and waste management* identified difficulties with this approach. Certain industries rely on single use plastics for medical or research purposes. Although this problem could be addressed through exemptions or other ban design considerations, it could be highly problematic to impose a ban on some items.[51] There are alternatives to banning specific materials without creating unintended difficulties, such as product stewardship schemes or minimum recycled content requirements.

In November 2019, the Victorian Government banned the provision of single-use plastic bags through amendments to the Environment Protection Act 1970, with penalties for businesses. A similar approach could be used for other materials.

50 AlphaBeta (2019) *Recycling and resource recovery infrastructure in Victoria: International and Australian comparisons*, report for Infrastructure Victoria

51 Parliament of Victoria Legislative Council Environment and Planning Committee (2019) *Inquiry into recycling and waste management – final report*

Market failures are stopping the sector from performing at its best

Several challenges make the Victorian recycling and resource recovery sector less efficient. In our *Evidence Base Report*, we described the sector as a decentralised system in which sorting, collecting, processing, reusing and disposing of waste is done by private individuals or businesses. This means it is difficult for government to achieve public policy objectives because the motivations of these businesses do not necessarily align with the objectives of the Victorian Government. Market design approaches can help with this.[52]

At the same time, the market for recovery and reprocessing services in Victoria is dominated by a few large players. This is especially true of MSW recovery. Victoria relies on a relatively small number of MRF operators – a problem known as 'thin markets' – which makes the sector less resilient and created problems if one player exits the industry. Victoria's approach to procuring collection and recovery services has, in part, contributed to this thin market problem. It has led to consolidation in the market as businesses bid for larger and larger numbers of local government contracts to achieve economies of scale.

This has led to a significant power imbalance between firms and the local councils seeking to procure their services.[53] Market dynamics can also impact on the full utilisation of all infrastructure where it may be to one player's advantage to slow throughput in certain circumstances.

These market failures contribute to poor recycling and resource recovery outcomes. In Victoria's decentralised waste management sector, where market failures exist across the waste lifecycle, single and centralised solutions are unlikely to be effective. A combination of policies is most likely to succeed in addressing these failures.

52 Centre for Market Design (2019) *Opportunities to improve infrastructure investment in the Victorian waste economy*, report for Infrastructure Victoria

53 *Opportunities to improve infrastructure investment in the Victorian waste economy*, report for Infrastructure Victoria

Sorting MSW

MSW is made up of a wide range of materials and is mostly generated by households. Although a large proportion of the waste generated could be reused, processed or recycled, only around 39% of MSW was recovered in 2018 with the remaining amount sent to landfill.[54]

There are a number of reasons MSW has a lower recovery rate than C&I and C&D streams. One of the biggest causes is the diversity of the waste stream. Households consume a varied range of products, which flow through to the waste they generate. In some cases, the materials are not suitable for recovery, and rightly become residual waste. However, audits of landfill bins in Victoria have found that a large proportion of material in these bins could be recovered.[55]

Contamination of materials in recycling bins also presents challenges for processors and can have an impact on their recyclability. These are both problems that could be addressed by better source separation and improved sorting.

Sorting is the first step in waste recovery. Households (and businesses) need to invest time and effort to separate residual waste and segregate the remaining items into relatively clean streams suitable for recycling. Failures at this 'front-end' of the system can reverberate through the whole system.

Contamination of one bin can flow through the system and affect the recyclability of a larger amount of material.

Countries that have high rates of resource recovery from MSW tend to have a more consistent approach to sorting and collection. Currently, sorting and collection differs across Victoria's 79 local councils. Not all councils accept the same materials in recycling due to differences in what some processors will accept. For example, some councils have contracts that allow them to separate soft plastics for recycling, but others consider soft plastics a contaminant. There are also multiple approaches to organics collection, including combining food and garden organics – 19 councils allow residents to put food scraps in their green waste bin – and some councils do not separate organics at all.

Added to these issues, bin lid colours and meanings differ across local government areas. As Figure 24 shows, nine councils were fully compliant with the *Australian Standard for Mobile Waste Containers* as at December 2016.

54 Blue Environment (2019) *Victorian Waste Flows*, report for Infrastructure Victoria

55 Sustainability Victoria (2014) *Victorian Statewide Garbage Bin Audit 2013*

Victorians on their best behaviour

Victorians feel strongly about recycling. In June 2019, we undertook a community survey to understand Victorians' views on recycling and their willingness to change. 89% of people we surveyed were open to changing the way they sort and dispose of their waste. A big reason for this is that Victorians feel strongly about the environment, and these feelings are a strong driver of how they recycle.

However, the way household collections currently work throws up barriers to good recycling. Differences in bins across councils and sporadic and inconsistent messaging is leading to uncertainty about what can and cannot be recycled. This doubt can lead people to put their recyclables in their landfill bin, to be safe, or to throw everything into their recycling bin to let the system take care of it.

We also ran focus groups to understand what would work for Victorians, and identified three critical factors that would support improved sorting practice:

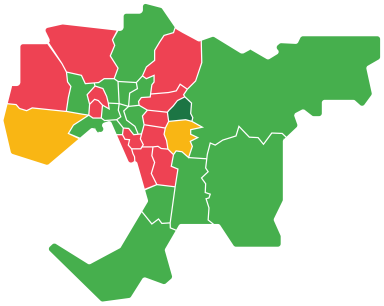
- Frictionless – simple to use and understand
- Clear environmental benefits – a compelling reason, such as reducing material going to landfill
- Consistently functional – the right bin capacity and collections approach

These findings are promising about the potential success of future efforts by the Victorian Government to affect change in households' behaviour and provide an insight of what needs to be done. We know that Victorians want to recycle, and are open to ways to do it better, so they do not need much convincing to change.

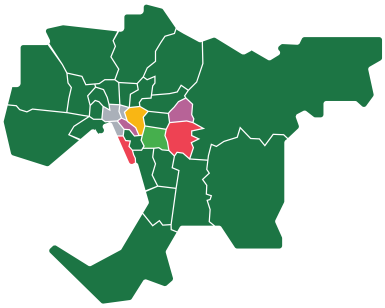
What they do need, and what the Victorian Government can provide, is the means to do it (easy-to-use, more consistent infrastructure at home), information on how to do it (clear and consistent messaging, with local nuance if needed), and confidence that their efforts are not wasted.

Figure 24: Bin lid colours are inconsistent across Melbourne

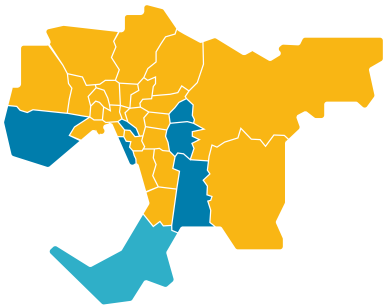
Colours of garbage bin lids



Colours of organics bin lids



Colours of recycling bin lids



Overall:

- 9 councils are fully compliant with bin lid colour
- 12 councils are compliant with recycling and organics bin lid colours
- 1 council has compliant garbage and recycling bin lids
- 9 councils have systems that do not comply

Source: Sustainability Victoria (2019): *Victorian Local Government Annual Waste Services Report 2017-18*

These differences can lead to confusion for households, contamination of material streams, and make it difficult to educate the community about what they can recycle.

In 2017/18, contamination rates in Victorian MSW ranged between 3% and 27%, with an average of 10.4% across all local government areas.[56] Minimising contamination in MSW, which has the lowest recovery rate of the three waste streams, will contribute to improved resource recovery in Victoria.

Consistency in sorting and collection can also make it easier for local governments to provide information on how to recycle. Our polling of Victorians found that a quarter of respondents did not know which bins things should go in, which was a barrier to sorting recyclable waste.[57] This suggests that providing more information to households about which materials can be recycled and how to recycle them can reduce contamination.

Better source separation can also lead to improved resource recovery by providing cleaner materials streams. At a minimum, our analysis suggests that either glass, or paper and cardboard, need to be collected separately from commingled recyclables.

Glass is a key contaminant of other commingled recyclables, particularly paper and cardboard. Separating the collection of these materials could reduce contamination. This should be supplemented by a separate FOGO collection, which could reduce the amount of organic material going into the residual garbage bin and to landfill.

In 2017/18, contamination rates in Victorian household waste ranged between 3% and 27%, with an average of 10% across all local government areas.

Procurement of waste services

Unlike commercial business waste services, which are contracted, household waste collection and sorting services are procured by local councils. While households could collect and transport wastes themselves, there are obvious cost advantages to coordinating waste collection and transport.

To benefit, households cooperate through their regular collection service and local councils procure these services from the private sector.

A simple tender process is used to price and allocate these contracts. Households pay a flat rate for this service as a component of council rates. To build on economies of scale, some councils have investigated pooling demand for waste collection services across council boundaries.[58] While this can lead to short-term cost savings it can also lead to consolidation in the number of collections services, reducing competition and driving up costs.

To correct this, a new auction approach could be used known as descending simultaneous package smart auctions.[59] [60] These auctions are used by governments and businesses for a range of procurement and allocation problems (e.g. allocation of aquaculture sites in Victoria, and mobile phone frequencies) and can harness competition to minimise costs and allocate contracts efficiently.

56 Sustainability Victoria (2019) *Victorian Local Government Annual Waste Services Report 2017–18*

57 Quantum Market Research (2019) *Kerbside Collection Deep Dive*, report for Infrastructure Victoria

Funding of waste processing services

In waste collection, this type of auction minimises costs through a decentralised process in which service providers can put together combinations of collection zones through competitive bidding. This approach can reduce costs to households by mitigating the market power of service providers.

58 Positive network externalities arise because additional participants to a network reduce the cost of providing services to all participants.

59 Plott, Charles R. and Lee, Hsing-Yang and Maron, Travis (2014). *The Continuous Combinatorial Auction Architecture. American Economic Review*, 104 (5). pp. 452-456. ISSN 0002-8282

60 Crampton, P. (2001). *Handbook of Telecommunications Economics*, Martin Cave, Sumit Majumdar, and Ingo Vogelsang, eds., Amsterdam: Elsevier Science B.V.

Although markets generally allocate resources efficiently, governments can further increase investment in recycling and resource recovery.

The Victorian Government actively ensures the recycling and resource recovery sector is meeting community needs and government objectives. Grants are widely used to encourage industry initiatives to align with the Government's strategic objectives.

Although grants can have some competitive elements, they are essentially a form of bi-lateral negotiation between government and industry. In bi-lateral negotiations, a well-informed supplier will often benefit over a less informed buyer. Firms and organisations know their costs of production, and governments often do not. As a result, grants may not always lead to the best outcomes or value. Resource recovery grants have historically been capped at a maximum of $500,000.

The Centre for Market Design at the University of Melbourne identified auctions as an alternative approach that could achieve these goals. Auctions can reveal information needed to efficiently allocate resources. They do this by harnessing competition between competitors to identify who wins and at what price. Well-designed auctions have been shown to achieve a given outcome at lower prices than grants.[61]

In addition, the Victorian Government and other governments throughout Australia and around the world already use a range of other financial support approaches to create policy outcomes. Approaches such as rebates, subsidies or low-interest loans could also improve resource recovery in Victoria by encouraging more competition or new technologies in the market for resource recovery and processing services. One example is the Clean Energy Finance Corporation (CEFC) model.

The CEFC invests in clean energy projects in several sectors including energy, agriculture, manufacturing, property, as well as waste. In 2019, the CEFC established the Australian Recycling Investment Fund to fund recycling projects that use clean energy technologies.

Grants may not always lead to the best outcomes or value.

61 Stoneham et al (2002) *Auctions for Conservation Contracts: An Empirical Examination of Victoria's Bush Tender Trial*, Australian Journal of Agricultural and Resource Economics

Governance and policy settings in the sector are not quite right

All three tiers of government (Australian, Victorian and local) have important but different roles in recycling and resource recovery. These roles are not always clearly defined in legislation or elsewhere, and often overlap. Significant gaps in legislation and regulation can lead to missed opportunities.[62]

In Victoria, government waste and resource recovery portfolio agencies work together to manage, plan and deliver services for Victoria. These agencies collaborate to reduce waste to landfill by working with local councils, industry and the Australian Government to increase the recovery of resources where possible.

The relevant Victorian Government agencies are the Department of Environment, Land, Water and Planning (DELWP), Environment Protection Authority Victoria (EPA), Sustainability Victoria (SV) and seven Waste and Resource Recovery Groups (WRRGs). In addition to these agencies, local government and private sector operators deliver recycling services to households and businesses. EPA, SV and the WRRGs receive most of their funding from the Municipal and Industrial Landfill Levy.

Victoria's current recycling and resource recovery system governance does not deliver on the Victorian Government's waste and recycling objectives. There is a significant opportunity to clarify policy direction and regulatory application and enforcement.

The future of the Landfill Levy

Established under section 70 of the Environment Protection Act 1970, one of the key purposes of the Landfill Levy is to provide an incentive to minimise waste, encourage greater re-use and recycling and promote investment in alternatives to landfill. Given that the amount of waste generated in Victoria is increasing, and is forecast to continue to do so, the landfill levy alone is not providing enough of an incentive to meet these objectives.

As we identified in our Evidence Base Report, this is likely because the cost of the landfill levy is not felt by manufacturers, or directly by households. This suggests that the landfill levy should be considered just one of a suite of policies the Government can use, including regulatory interventions like product stewardship schemes, setting targets, supporting market development and investing in infrastructure.

This aligns with what we have observed in high-performing jurisdictions around the world, where a landfill levy or tax is only part of a broader policy framework applied across the waste lifecycle.

The Landfill Levy can also contribute to poor outcomes. The impact of the levy on landfill gate fees can lead to waste stockpiling or illegal dumping. Also, inconsistencies in landfill levies across state borders can encourage cross-border waste flows to places where costs are lower.

Recognising this challenge, the National Waste Policy Action Plan made Victoria responsible for investigating how to harmonise waste levies across Australia to encourage best practice waste management. This work is ongoing and there have been recent announcements of a Victorian levy increase as part of the *Recycling Victoria* package.

There is an opportunity to consider Victoria's Landfill Levy in the broader context of the Victorian Government's policy objectives for the recycling and resource recovery sector. For example, increases to the Landfill Levy could make alternatives to landfill more cost competitive, including energy recovery through waste-to-energy. Given energy recovery is preferable to disposal, setting the right price is consistent with existing Victorian Government policy

and can help transition toward a circular economy. In the longer term, the Landfill Levy could continue to be assessed as the impact of other policies begin to be felt. Any future changes to the levy rate should consider the potential disruption that may be caused by a sudden increase such as disruption to existing commercial arrangements, increased illegal dumping or stockpiling. A phased approach to Landfill Levy changes could minimise this risk.

There is also potential to put the Landfill Levy to greater use. Unspent Landfill Levy is held in the Sustainability Fund (the fund). We heard from a range of stakeholders, both in face-to-face consultation and through submissions, that more of the Landfill Levy should be invested in the recycling and resource recovery sector.

This is supported by the Victorian Government Auditor General's Office (VAGO) 2019 analysis that Victoria spends less than other jurisdictions on waste and resource recovery, despite managing much higher volumes of waste.

This could ensure that current governance structures do not slow development. Harmonising Victoria's policy and strategy to improve recycling and resource recovery with applicable legislation and regulation could benefit the state significantly.[63] In addition, a recent VAGO report and feedback from a range of stakeholders shows confusion in the roles and responsibilities of government agencies. This may prevent the sector functioning efficiently.[64]

In 2019, VAGO also found that in the absence of a statewide waste policy, Victorian agencies involved in waste management lack clarity on their priorities and how best to use resources. In its report, VAGO found that existing waste and resource recovery strategies and plans, developed by DELWP, SV and the WRRGs, have a range of objectives and actions that do not provide clear and coherent guidance in place of a statewide policy.

Without an overarching policy, there are no targets for agencies in the Victorian Government to aim for or measure against. Adding to this is the lack of certainty and stability of funding for recycling and resource recovery. This presents a barrier to understanding whether Victorian Government agencies have enough resources to perform their roles and responsibilities.[65]

In looking at jurisdictions with high-performing recycling and resource recovery systems, we found that an overarching policy framework for waste, recycling and resource recovery, supported by specific targets for recycling, is the foundation.[66] Targets can be used to incentivise performance. It is also important to ensure that they have net benefits and do not place additional burdens on households or businesses.

62 Victorian Auditor General's Office (2019) *Recovering and Reprocessing Resources from Waste*

63 Infrastructure Victoria (2019) *Legislative and regulatory review*

64 Centre for Market Design (2019) *Opportunities to improve infrastructure investment in the Victorian waste economy*, report for Infrastructure Victoria

65 Victorian Auditor General's Office (2019) *Recovering and Reprocessing Resources from Waste*

66 AlphaBeta (2019) *Recycling and resource recovery infrastructure in Victoria: International and Australian comparisons*, report for Infrastructure Victoria

The United Kingdom provides an international example of governance frameworks that could be adopted in Victoria to provide greater clarity.

The role of local governments and the WRRGs

Victorian local governments are, in many ways, the front line of recycling and resource recovery in Victoria. Local governments are responsible for waste collection and recycling services for their residents with support from the Waste and Resource Recovery Groups (WRRGs).

According to the VAGO *Delivering Local Government Services Report* (September 2018), most council services are not legally mandated, including recycling services. Current legislation gives councils the option to deliver a service, but household recycling and collection is not mandatory for councils. This presents practical barriers to transparency and accountability, and funding of waste collection services. Without clear roles and responsibilities for local governments, it is difficult to measure their delivery over time.

Greater role clarity is likely to be a low-cost fix with wide-ranging benefits to the performance of the sector. This could be achieved through either amendments to the *Local Government Act 1989*, or the introduction of waste management-specific legislation.

There are seven WRRGs across Victoria The WRRGs are responsible for developing Regional Waste and Resource Recovery Infrastructure Plans (RWRRIPs), supporting local councils to procure waste and recycling services, infrastructure and service planning at a regional level, and educating the community on waste avoidance and reduction. Currently, the WRRGs support councils in procuring recycling and resource recovery services by supporting collaborative procurement processes to achieve economies of scale. However, it is not mandatory for councils to participate in procurement processes run by the WRRGs, which can lead to market power imbalances between individual local governments and recycling and resource recovery service providers.

Some of the roles and responsibilities of the WRRGs, specifically for regional resource recovery infrastructure planning, overlap with SV's role in statewide resource recovery infrastructure planning. This was identified by VAGO as a cause for confusion among stakeholders in the sector.[67] In addition, VAGO noted that the Metropolitan WRRG (the biggest WRRG covering the greatest number of councils) does not have enough funding to perform its functions. Specifically, MRWWG's remit was expanded to include C&I and C&D waste, but MWRRG was not given additional ongoing funding to support these responsibilities. As such, MWRRG has reallocated funds internally to deliver a C&I strategy, which may hinder its ability to meet other core objectives.[68]

The United Kingdom provides an international example of governance frameworks that could be adopted in Victoria to provide greater clarity. There, similarly to the EPA in Victoria, the Environmental Agency acts as a regulator; and similarly to DELWP, the UK waste management policies are set by central government. However, the collection and processing of waste and recycling are provided by a Waste Collection Authority (local authorities) and a Waste Disposal Authority.

The UK's Environmental Protection Act 1990 (the Act) sets out the roles and responsibilities for Waste Collection Authorities (WCAs) and Waste Disposal Authorities (WDAs). It is prescriptive, and very specific when compared to equivalent bodies and legislation in Victoria and separates the responsibility of waste collection and waste processing services into different authorities. A similar approach in Victoria could improve role clarity, supporting greater consistency of service provision and better data collection, and has the potential to address some of the market power imbalances currently seen in the sector by aggregating procurement of processing services.

Data collection and reporting

The availability and use of timely and accurate data will be key to improving Victoria's recycling and resource recovery. A clearer understanding of the volume and flows of materials will help both the Government and private sector plan and invest in infrastructure. This can ultimately strengthen the end markets for these materials and lead to greater recycling and re-use.

In 2011, VAGO found that a lack of data quality had affected the reliability of performance data and projected performance. VAGO recommended that SV develop a knowledge management system to rationalise data, and to identify and rectify data quality issues along with modelling accuracy. Better data collection can help monitor improvements in performance.[69]

In 2019, VAGO again noted that data quality issues limit the Government's ability to understand how much waste is being generated and what happens to materials when they are recovered for recycling. This limits the Government's ability to plan for, or invest in, infrastructure and to develop an overarching waste policy.[70]

The data currently available is collected through voluntary surveys of councils and waste reprocessing operators, which means data is often inaccurate or incomplete.

VAGO noted that without regulatory or legislative requirements for councils or operators to report data, or to monitor the flow of materials segregated for recycling after these are sent to recovery or reprocessing facilities, it is difficult for SV to resolve data limitations and these problems are likely to persist.[71]

67 Victorian Auditor General's Office (2019) *Recovering and Reprocessing Resources from Waste*

68 ibid.

69 Victorian Auditor General's Office (2011) *Municipal Solid Waste Management*

70 Victorian Auditor General's Office (2019) *Recovering and Reprocessing Resources from Waste*

71 Victorian Auditor General's Office (2019) *Recovering and Reprocessing Resources from Waste*

The end markets for materials vary greatly

Developing end markets for recycled materials is a challenge for countries all over the world. Even countries that are considered best in the world for recycling and resource recovery with large manufacturing bases, such as South Korea, rely heavily on export markets for some materials, particularly plastic composites.[72]

The lack of strong end markets for recovered materials is stifling the development of Victoria's recycling and resource recovery sector. If recovered materials are not valued by producers or consumers, there is little to no incentive for businesses to invest in processing infrastructure.

The strength of end markets varies by material type. Figure 25 provides an overview of the performance in resource recovery across a range of indicators for key materials.

There has been a significant focus in Victoria on establishing infrastructure to collect, sort, and to an extent, reprocess recovered resources but the supply of recycled materials has not always been matched by demand. In many cases, there is limited market interest to establish significant, ongoing demand for products made from recycled materials.

Effectively, investment in developing local markets for recycled products or high-quality products for export have been limited. Fostering sustainable end markets for recyclable glass, plastic, paper and organic materials can play a larger role in solving the stockpiling problems Victoria has recently experienced and reducing the state's reliance on landfill.

72 AlphaBeta (2019) *Recycling and resource recovery infrastructure in Victoria: International and Australian comparisons*, report for Infrastructure Victoria

Figure 25: The opportunity for improved recovery and reprocessing in Victoria varies by material

	Organics	Plastics	Packaging glass	Paper and cardboard	E-waste	Masonry	Metals	Tyres	Textiles
Tonnes of material generated	2,489,166	586,282	344,093	1,997,800	83,445	5,222,935	1,590,409	69,537	190,411
Tonnes of materials recovered	1,081,845	137,167	263,686	1,481,017	66,162	4,179,629	1,455,579	57,200	165
Proportion of total waste generated	19%	4%	3%	15%	1%	39%	12%	1%	1%
Recovery rate	43%	23%	77%	74%	79%	80%	92%	82%	0%
Proportion available in garbage bin	35%	11%*	11%*	11%*	1%	0%	0%	0%	0%
Proportion of waste generated that is exported	2%	15%	3%	32%	1%	0%	31%	43%	15%
Proportion of waste recovered that is exported	4%	63%	4%	43%	1%	0%	34%	53%	N/A

* 11% is the combined total of plastics, packaging glass and paper and cardboard

Source: Blue Environment & Infrastructure Victoria analysis

Markets are important

One challenge in developing end markets for recycled materials is the cost of using recycled content in manufacturing. This is especially true of plastics. Recycled plastics manufacturers operate in the same market as virgin plastics producers, and so must compete with virgin producers. The raw feedstocks for most plastics are fossil fuels, which are cheaper to use than recycled materials.

The reasons for the differences between the cost of virgin and recycled materials are two-fold. First, the price of any product reflects the cost of making it. In the case of recycled materials, this includes the cost of collecting, transporting, sorting and processing recovered materials to a point where they are a substitute for virgin material, such as glass cullet, plastic pallets or resin, or pulp for paper and cardboard.

Second, the price of virgin materials tends not to include the full lifecycle costs of these products, such as the environmental impact of extracting them or the costs of disposal, due to regulatory and market failures to ensure all these costs are reflected.

Most producers, seeking to minimise costs in production, will choose the lowest-cost input that serves their needs. Because virgin materials can be cheaper, producers are less likely to use recovered materials, limiting their market.

Another barrier is lack of awareness or concerns about the quality of recycled products. Concerns about contamination of materials, or insufficient information about the potential uses of recovered materials, can mean that consumers and producers are reluctant to buy products containing recycled content. This can be seen with plastics, due to concerns about the potential use of recycled plastics in food packaging.

Multiple stakeholders have raised the importance of standards or certification of recycled materials with us. Creating certification standards for products made from recycled content can address the lack of information and certainty about the quality of recycled products and provide an indicator of quality. This can increase the price of these products, making them more attractive to producers and ultimately strengthening the end market for recycled materials.

For example, the regulatory settings for the management of digestate – which is the by-product from the anaerobic digestion process – can be refined. The biggest regulatory issue raised by regional stakeholders is how the digestate is managed and its viability in agricultural use.

For stakeholders running anaerobic digestion plants, the biggest issue was the current regulations. While the EPA's current regulations do permit the use of digestate in agriculture, the approach requires approval of all individual waste suppliers and digestate consumers, which can be difficult to manage as these change. Widespread adoption of anaerobic digestion in the EU is supported by HACCP regulatory frameworks to ensure the resulting digestate is safe for use in agriculture. HACCP is widely used for food production in Australia. In addition, there is uncertainty around the application of carbon credits to anaerobic digestion, particularly where operators are obliged to reduce carbon emissions through regulation. Standards and specifications should be reviewed and relaxed only where there is no risk of causing harm to human health or the environment.

A lack of demand for recycled material in production, regardless of costs, is also a barrier to developing end markets for recycled materials, particularly mixed materials. Producers want clean, single-stream materials. Recycling becomes far more complex when dealing with products that use composite materials. Composite materials, which use multiple polymers can be difficult to separate during recycling. For example, disposable coffee cups are predominantly made from paper, but an interior lining – commonly made of polyethylene – make these cups very difficult to recycle.

The Victorian Government can enable the use of recycled materials by changing design specifications and procurement standards.

Market development approaches

Enabling the use of products containing recycled materials supports the development of markets and improves the sustainability and resilience of the sector by providing a pathway for materials.

Regulation and legislation can be both a barrier and an enabler, and these are prime opportunities for government. Victoria already performs well in this regard – VicRoads is a national leader in the use of recycled products in pavement construction – but we can do more.

Government can support demand for recycled materials by supporting research and development to commercialise the use of recycled products, particularly packaging, manufacturing and agriculture. This provides an evidence base to give people confidence in using recycled products, and shows that recycled products are fit for purpose. The Victorian Government can also provide a supportive environment for using recycled materials by either changing design specifications and procurement standards to encourage or mandate the use of recycled materials.

Recycling Victoria – a new economy includes commitments to increase innovation, prioritise the use of recycled materials in construction and to develop and promote standards, specifications and guidance materials to increase the use of recycled materials. The Commonwealth Government has also made similar recent commitments.

Since 2016, SV has awarded a total of $4.1 million in R&D grants to a total of 29 projects. These grants leverage funding and in-kind contributions from industry and research partners. Small R&D projects typically focus on one line of enquiry, with limited scope of lab testing of materials.

Large R&D projects typically focus on two to three lines of enquiry, with broader scope of lab testing of materials. Demonstration projects and field trials are the opportunity to prove performance in the real world in a controlled manner with associated monitoring and evaluation to allow for specifications to be changed and/or commercialisation to occur.

Funding in recent years has been spread across up to eight materials. Given the trial and error nature of research and development, success cannot be guaranteed. A more ambitious program with a higher chance of commercialisation could be pursued with the following indicative contribution from the Victorian Government, and additional funding and in-kind support provided by the Commonwealth Government, industry and academia.

Figure 26: Market development for multiple materials takes considerable research and development

Material	Small R&D project indicative cost	Large R&D project indicative cost	Field trials	Total indicative R&D cost
Paper & cardboard	$100,000 x 10	$200,000 x 10	$200,000 x 5	$4,000,000
Plastics	$100,000 x 10	$200,000 x 10	$200,000 x 5	$4,000,000
Glass	$100,000 x 10	$200,000 x 10	$200,000 x 5	$4,000,000
Organics	$100,000 x 10	$200,000 x 10	$200,000 x 5	$4,000,000
Tyres	$100,000 x 10	$200,000 x 10	$200,000 x 5	$4,000,000
E-waste	$100,000 x 10	$200,000 x 10	$200,000 x 5	$4,000,000
Total				**$24,000,000**

07.

What we heard from our stakeholders

Infrastructure Victoria is committed to consultation and creating recommendations through an open, evidence-based, transparent process.

The consultation program for this advice included two main phases. The first phase ran from April to August 2019. We met with more than 150 individuals and organisations from across the waste sector, business and government, all of whom provided valuable input and helped us refine the scope of our research and analysis. A report that summarises the outcomes of this phase is available at infrastructurevictoria.com.au

Throughout our work, we also regularly consulted with a Sector Advisory Group which included people representing local government, the WRRGs, the waste management industry and broader industry.

We released our *Evidence Base Report* for consultation in October 2019. This report discussed the findings of technical research we commissioned in developing the evidence base. Consultation on the Evidence Base Report was open from 13 October 2019 to 13 December 2019.

In our *Evidence Base Report*, we posed seven questions for response:

01.

Have we identified the right outcomes for Victoria to aim for?

02.

Have we identified the most effective potential actions for government to take?

03.

Which, if any, of the initiatives implemented in Wales would you like to see applied in Victoria?

04.

What do you think of the market design opportunities proposed to improve waste sector outcomes and efficiency?

05.

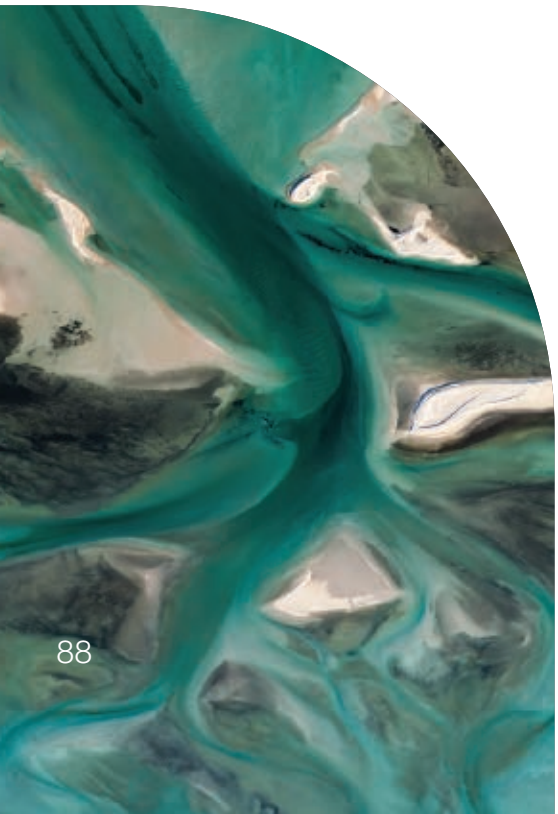
Where do you think government should focus their efforts to increase recycling and resource recovery? (For example, through setting targets, promoting consistency or funding local councils?)

06.

Which materials or infrastructure types present the most opportunity in your region?

07.

What is a legislative barrier or enabler that you have encountered when trying to use recycled materials?



We received 53 submissions from individuals, organisations, business and local governments. The feedback we received helped us understand stakeholders' priority issues and concerns and helped us refine our advice and recommendations.

There were several key themes that emerged in the feedback we received on the *Evidence Base Report*. A summary of the most common issues and how they relate to our final advice to the Victorian Government is below. Submissions are available in full at infrastructurevictoria.com.au

The feedback we received from stakeholders has provided highly valuable insights that have informed our final advice. Infrastructure Victoria would like to thank everyone who contributed to this work.

Container Deposit Scheme (CDS)

The most commonly raised issue in the submissions we received was the desire for a CDS in Victoria. Victoria is the only jurisdiction in Australia that has not introduced or announced it is planning to introduce a CDS.

Reasons for introducing a CDS in Victoria ranged from the potential to reduce contamination of other materials streams in resource recovery to supporting stronger end markets for recycled glass and ensuring consistency across Australian jurisdictions. Some feedback we received suggested there should have been more consideration given to a CDS in our *Evidence Base Report*.

In this report, we included additional analysis of the costs and benefits of a CDS, including research and consultation undertaken by the Victorian Parliamentary Inquiry into Recycling and Waste Management. Our analysis of the evidence suggests that a CDS can improve outcomes in recycling and resource recovery as part of a broader suite of initiatives.

Product stewardship and extended producer responsibility

The concept of product stewardship schemes received support from many stakeholders, particularly for hard-to-recycle products like electronics or complex packaging. Our analysis supports this position.

We found that without well-designed product stewardship schemes there is little incentive for consumers or producers to consider the cost of waste. This is a market failure, suggesting there is a role for government to intervene. We also found that the most successful product stewardship schemes in high-performing jurisdictions around the world are compulsory. There are a number of product stewardship schemes in place across Australia, but none are compulsory.

Waste-to-energy

The terms of reference for this advice asked Infrastructure Victoria for advice on the infrastructure required for, and the role for government in providing support to, a waste-to-energy sector that prioritises extracting recyclable material and recovers energy only from residual waste.

A number of stakeholders identified waste-to-energy as a preferable to landfill, which aligns with the waste hierarchy, but noted the importance of prioritising avoidance, re-use and recovery. Stakeholders also identified practical barriers to establishing waste-to-energy infrastructure in Victoria being the lack of policy clarity around waste-to-energy in Victoria, the lack of an end market for residual waste to energy by products, and the role of the landfill levy in influencing the competitiveness of waste-to-energy.

Landfill Levy

The Landfill Levy was identified as having potential for better use. Some stakeholders suggested that, at a minimum, the Victorian Government should consider making the Landfill Levy consistent with neighbouring states. Victoria has recently announced an increase to its levy and is leading efforts for national levy consistency under the *National Waste Policy Action Plan*.

This work can consider the potential for the Landfill Levy to be used to further support a transition toward a circular economy and alternatives to landfill, such as waste-to-energy. This view aligns with a point made by multiple stakeholders who highlighted the need to reinvest more of the Landfill Levy with a specific focus on infrastructure that supports a transition towards a circular economy.

Collections

Stakeholders commonly identified that the approach to kerbside collections is a barrier to improving resource recovery, particularly for MSW. We received feedback that improved source separation – particularly separating paper and cardboard from other co-mingled recyclables – and a more consistent approach to collections across councils, could increase recovery rates. We agree.

Our analysis suggests that greater source separation leads to cleaner streams, which can improve resource recovery rates. At the same time, a more consistent approach to kerbside collections makes it easier for households to separate their waste correctly and reduces contamination.

Market development

We heard that the Victorian Government has a role to play in supporting end markets for recycled materials. Without an end market for recycled materials, the design of collection and processing systems is irrelevant.

Government procurement can go some way to supporting an end market for these materials by buying them directly. The Government can also support their use in the broader economy by facilitating the development of standards and specifications for recycled products (such as compost, digestate from anaerobic digestion, bottom ash from thermal waste-to-energy, and plastics in construction or packaging applications).

Standards and certification can build consumer confidence in these products, supporting a market. Stakeholders commonly identified the lack of confidence in these products as a barrier.

Regional infrastructure

Regional stakeholders identified lack of access to recycling services and infrastructure as a barrier to resource recovery in regional areas. In some cases, geographic consolidation of infrastructure makes sense due to economies of scale.

In others, providing processing infrastructure in regional areas can reduce costs by eliminating or reducing transport costs, leading to improved recovery rates. Our analysis supports this, particularly with materials that are sensitive to transport costs and gate fees, such as organics. Regional infrastructure can also provide jobs in regional areas.

08.

Methodology

We developed our advice to the Victorian Government in three phases of stakeholder engagement and technical analysis. During the first phase of the project, which was completed in August 2019, we met with and heard from more than 150 organisations and individuals from across the waste sector, business, industry and government who provided valuable input and helped us refine the scope of our research and analysis.

The second phase of the project was the delivery of our *Evidence Base Report* in October 2019. This report built on the outcomes of our stakeholder consultation with detailed modelling and analysis, supported by international examples for comparison, including engagement with key stakeholders in Wales and England.

Our technical work packages, summarised below, consider the infrastructure, policy and market settings for Victoria's recycling and resource recovery sector. We also compiled the most up-to-date and comprehensive dataset for recycling and resource recovery performance in Victoria to inform our analysis.

The final phase, the focus of this report, is to articulate the advice and recommendations for the Victorian Government on the basis of the evidence we have gathered through our technical work, site visits to facilities across Victoria and South Australia, and feedback we have received from stakeholders including the Sector Advisory Group. We also coordinated with a Government Advisory Group to ensure resource recovery and recycling work across government was shared.

The full versions of all technical work undertaken to inform this advice are available at infrastructurevictoria.com.au

Inter-jurisdictional analysis

We commissioned an assessment of recycling and resource recovery practices, technologies and markets in other jurisdictions to understand the potential for the Victorian Government to adopt and adapt similar practices, technologies and associated policies.

Sector mapping and market design

We worked with the Centre for Market Design at the University of Melbourne to analyse the Victorian recycling and resource recovery sector. This analysis identified major decision or transaction points in the cycle, those involved at each point, where markets are missing or failing, and what the causes are.

We looked at the incentives influencing each transaction including the availability of information, the effect of regulation and the role of price, and applied market design principles to find approaches to build resilience in the sector.

Infrastructure analysis

The infrastructure analysis identifies and explores technologies and processes for waste and resource recovery. It considers the context for the planning, funding, construction and operation of infrastructure under different policy and investment scenarios.

This enables us to understand the potential for the Victorian Government to adopt specific approaches to resource recovery and recycling through policy, regulation, market design, support of new infrastructure proposals and/or the potential to attract new operators to Victoria to further develop the market.

Materials flow analysis and sensitivity testing

This work presents a current benchmark of waste flows, material market values, value add opportunities and fates of materials in the Victorian waste and resource recovery sector. It identifies opportunities to increase recovery rates and improve material outcomes to realise a circular economy in Victoria. This analysis shows where materials could go if subject to improved processing or end market development under a range of different scenarios, reflecting different policy settings. These policy settings represented a refinement of the scenarios that were considered in our initial infrastructure analysis.

Legislative and regulatory settings

We examined the legislative and regulatory settings in place in the sector as well as any existing plans or strategies that are barriers or enablers to enhancing the sector in Victoria. This work was intended to understand the authorising environment for waste and resource recovery, such as the barriers to using recycled materials in a range of applications and the regulatory requirements for resource recovery facilities (including planning and land use settings).

The final phase, the focus of this report, is to articulate the advice and recommendations for the Victorian Government on the basis on the evidence we have gathered through our technical work, site visits to facilities across Victoria and South Australia, and feedback we have received from stakeholders including the Sector Advisory Group.

Community polling

Using a representative sample of 1,000 Victorian households, we undertook a quantitative online survey in July 2019 to better understand community attitudes and perceptions on recycling and resource recovery. The survey covered attitudes and perceptions towards waste sorting practices, people's willingness to change their behaviour and perceptions of product packaging.

Community focus groups

We engaged Quantum Market Research to develop a deeper understanding of how Victorians' attitudes and perceptions will influence the success of various potential kerbside waste sorting and collection initiatives. Focus group participants were engaged to help investigate levels of motivation amongst Victorians to adhere to new sorting and collection initiatives, and the underlying factors that either motivated people or limited their adherence to new rules and practices.

End market barriers and enablers

This work analysed the market for recycled and recovered materials and found that there are variety of market failures and complexities relating to the generation, collection and processing of waste, in addition to weak end markets for many recovered materials.

We identified specific policy levers that government can use to address these market failures and complexities, and facilitate a well-functioning market that will improve resource recovery.

Infrastructure gap analysis

Building on our initial infrastructure analysis, this work was undertaken to inform our understanding of the waste and resource recovery infrastructure needs across Victoria now and into the future, with specific consideration of the needs of different regions and managing a range of different waste material.

This work informed our recommendations about what infrastructure will be required, and where, by analysing current waste and resource recovery infrastructure capacity and capability throughout Victoria and identifying gaps in future capacity or capability.

Our analysis also considered the potential impacts of Victorian and Australian Government policy directions as well as priority materials for short-term effort to increase recycling capacity and capability.

Appendix A:

Resource recovery infrastructure forecast investment by 2039

Infrastructure Gap Analysis Overview

Infrastructure Victoria have undertaken an Infrastructure Gap Analysis to consider the appropriate infrastructure facility types that will be required to manage current and future resource recovery needs of Victoria considering:

- projected waste generation and resource recovery rates
- the required capacity to manage future waste tonnes
- the required capability to transform recovered resources into valuable commodities
- the potential suitable locations for future infrastructure
- the indicative capital investment required
- the indicative timing of when infrastructure will be required based on current and emerging waste policies and market challenges.

The recommended infrastructure facilities are an estimated forecast of what may be required in future years to respond to emerging waste and resource recovery trends. They are not prescriptive and should be used for guiding purposes only. The complete Infrastructure Gap Analysis can be viewed as a Technical Document at

www.infrastructurevictoria.com.au/project/advice-on-waste-infrastructure-in-victoria/

Infrastructure Victoria developed a methodology to guide its recommendations for types of infrastructure needs and the potential locations of infrastructure to respond to current and emerging waste trends. To guide this, Infrastructure Victoria commissioned Brock Baker Environmental Consulting to undertake a 'Waste and Resource Recovery Infrastructure Data and Spatial Analysis' report and Blue Environment to develop a 'Victorian Waste Flows Projection' model. These data sets informed Infrastructure Victoria's gap analysis.

Priority materials

Infrastructure Victoria has identified and undertaken detailed analysis of six priority waste material streams: E-waste, glass, organics, paper and cardboard, plastics, and tyres.

Infrastructure Victoria has identified these as priority waste materials for analysis based on:

I. Their exposure to current market challenges including international import bans and fluctuating commodities prices.

II. The potential impacts of the COAG waste export ban that seeks to restrict the export of 'scrap' glass, paper and cardboard, plastics and tyres which will be phased in from July 2020 and come into full effect by July 2024.

III. The opportunity to divert organics from landfill, which comprises significant tonnes that could be readily recovered for beneficial uses.

IV. The introduction of the Victorian e-waste landfill ban in July 2019 which requires diversion of e-waste to resource recovery pathways. It is noted that e-waste is also heavily exposed to increasing international import restrictions as well.

Infrastructure Gap Analysis Methodology

Drawing upon this work, Infrastructure Victoria's methodology included analysis of:

- current and predicted waste generation by material type
- reprocessing capacity by material type
- reprocessing capability by material type
- location of resource recovery infrastructure and its proximity to end markets
- the Statewide Resource Recovery Infrastructure Plan (SWRRIP) and Regional Implementation Plans
- existing resource recovery hubs of statewide significance as identified in SWRRIP
- stated government priorities to support regional economies in transition e.g. in the Latrobe Valley.

- The ability to meet a range of policy and resource recovery target scenarios by 2022, 2025, 2030 and 2039. These include:
  - The COAG Waste Export Ban proposal that seeks to restrict the export of 'scrap' glass, paper and cardboard, plastics and tyres which will be phased in from July 2020 and come into full effect by July 2024.
  - The APCO plastics recycling target of 70% of plastics to be recycled in Australia by 2025.
  - The National Waste Policy target of an 80% average resource recovery rate from all waste streams following the waste hierarchy by 2030.
  - The Victorian e-waste landfill ban.

Infrastructure Gap Analysis Key Assumptions

- The results and recommended infrastructure facility types are indicative only. Technology choices and accepted feedstocks must be chosen at the discretion of any project proponent. The Infrastructure Gap Analysis presents data that can inform these decisions.
- The Infrastructure Gap Analysis is based on responding to forecast waste generation and resource recovery trends.
- Recovery and reprocessing capacity are based on both known and estimated capacities.
- Recovery and reprocessing capability are based on both known and estimated capabilities.
- Full businesses cases have not been developed.
- Consultation with key stakeholders has not occurred.
- Capital expenditure costs are based on industry estimates and comparable recent investments in the waste and resource recovery sector.
  - Infrastructure has been costed at 2020 costs. This has been extrapolated out to 2039 based on 2020 costs alone. There has been no inclusion of NPV, discount rates, CPI, etc.
  - It is noted that over time, capital investment for infrastructure will most likely increase.
- Operating costs have been excluded from this analysis.
- Locations are indicative only and are based on assumptions around potential site opportunities.
  - Suburbs and towns have been identified based on the aforementioned methodology and are for illustrative purposes only.
  - Any decisions on locations will need to be made primarily by the private sector and guided by appropriate land use planning and environmental approvals.
  - Suburbs and towns are named as a locality guide only and are approximate.
  - For example, where an organics reprocessing facility is identified in a township, the facility would have to be located in an appropriately zoned area and would likely be on private land within the broader area of any given township.

Infrastructure Gap Analysis Recommendations

Infrastructure Victoria recommends that there is an immediate and an ongoing need for investment in Victoria's waste and resource recovery network. Infrastructure Victoria estimates that by 2039:

- Investment in approximately 87 new or additional resource recovery infrastructure facilities will be required throughout Victoria.
- An increase in total resource recovery infrastructure capacity of 3,157,500 tonnes is required.
- A forecast capital investment of between $800 million to $1.1 billion by 2039 will be needed to deliver the required infrastructure.

Appropriate phasing of infrastructure investment, construction and commissioning will be different for each priority material. Specifically:

- By 2024 investment in recovery and reprocessing infrastructure will be needed for paper and cardboard, to meet the requirements of the COAG waste export ban.
- By 2025, investment in recovery and reprocessing infrastructure will be needed for organics and plastics.
- By 2030, investment in recovery and reprocessing infrastructure will be needed for e-waste.
- And by 2039, investment will be needed in value-add recovery and reprocessing infrastructure for glass and tyres.

To manage total forecast resource recovery trends by 2039, it is estimated that future resource recovery investment required by 2039 will include:

- e-waste investment between $12m to $55m to manage 34,500 tonnes per annum
- glass investment between $17.5m to $24.3m to manage 328,000 tonnes per annum
- organics investment between $229.75m to $317.32m to manage 805,000 tonnes per annum
- paper and cardboard investment between $157m to $198m to manage 2 million tonnes per annum
- plastics between $367.9m to $511.28m to manage 515,000 tonnes per annum
- tyres investment between $6m to $8m to manage 15,000 tonnes of commingled recycling per annum
- new MRF investment between $12m to $20m to manage 80,000 tonnes of commingled recycling per annum.

Infrastructure Facility Type Considerations

E-waste

- Infrastructure is recommended to manage emerging waste streams of high hazard and high value.
- Reprocessing locations for e-waste products including batteries, televisions, computers, monitors and peripherals have been recommended in existing metropolitan Melbourne hubs.

Solar photovoltaic (PV) panel reprocessing has been recommended:

- To account for installation of solar PV panel uptake and density throughout Victoria based on data from the Clean Energy Regulator and mapping by the Australian PV Institute (https://pv-map.apvi.org.au/historical#7/-36.545/144. 316).
- To complement existing metropolitan Melbourne e-waste reprocessing hubs.
- In Bendigo due to its proximity to current and future deployment of household, commercial and large-scale solar in central and northern Victoria.
- In both Geelong and Morwell to service future end-of-life arisings in south west Victoria and Gippsland and to leverage existing infrastructure and labour forces where economic transition is occurring in Victoria.
- Outside Melbourne and the Geelong region, the northern and eastern regions of Victoria have the highest density of solar PV installations. Both Bendigo and Morwell can potentially serve as the reprocessing hubs for these regions.

Glass

- Infrastructure is recommended to manage future glass recovery with a view to increasing capacity and capability to process glass into glass sand products for use in sand replacement applications, crushed rock and aggregate blends, and abrasives.
- In particular, glass sand and aggregate infrastructure is recommended to be deployed throughout regional Victoria to realise the potential for use in local road and infrastructure construction activities to manage future end-of-life arisings and support local circular economic activity.

- One additional glass beneficiation plant has been recommended due to the recent decrease in capacity following the January 2020 closure of the GRS beneficiation facility in Coolaroo. However, Infrastructure Victoria cautions that any investment in additional glass beneficiation should consider both current and long-term market demand for glass cullet for use in Victorian glass packaging production.

Organics

- Anaerobic digestion has been identified as a suitable technology to manage current and future commercial food organics recovery.
  - The north of Melbourne is already serviced in Wollert, servicing key clients such as the Melbourne Market (wholesale fruit and vegetables).
  - There are still significant opportunities to service food production businesses in Melbourne's south east (Dandenong South) and in Victoria's Goulburn Valley (Girgarre).
  - Other locations throughout Victoria may also be viable and further investigation of suitable location is recommended
- As Melbourne councils introduce further FOGO services, the existing capacity to consolidate and reprocess organics into compost will be insufficient.
  - Dedicated Special Materials Recovery Centres (transfer stations for organics) are recommended for hubs identified in the SWRRIP in Melbourne's western (Laverton North) and northern (Epping) suburbs.
  - Due to the challenges in meeting EPA requirements and managing social licence to operate, it is unlikely that any future significant organics reprocessing will occur in metropolitan Melbourne.
  - To meet the increasing FOGO service demands, and to meet Melbourne's growing population and traffic congestion, Infrastructure Victoria recommends that SMRCs are constructed to provide opportunities to consolidate and aggregate FOGO prior to transportation, enabling transport efficiencies to be realised and haul FOGO to regional Victorian reprocessing facilities.
  - Laverton North is approximately 50km from the Barwon South West region and approximately 100km from the Central West region. Epping is approximately 30km from the southern end of the Goulburn Valley region and approximately 125km from the Central West region.
  - Melbourne's south east is presently well serviced.
- In-vessel composting has been recommended in areas close to large regional centres to manage EPA requirements, social licence and urban amenity issues.
- Open windrow composting has been recommended in regional Victorian locations that are potentially more likely to manage EPA requirements, social licence and urban amenity issues.

Paper and cardboard

- Pulp mills have been recommended following the COAG export ban to manage the shortfall in both capacity and capability to meet these new requirement and/or domestic production requirements. However it must be noted that such infrastructure is expensive and based on current paper markets, the entrance of any new stakeholders is considered to be unlikely. Therefore, any new pulp mills would likely need to complement existing market players.
- There is an opportunity for niche and bespoke paper and cardboard products to be produced to meet shifting consumer sentiment and corporate shifts away from single use plastics in packaging.
- Additional paper separation technology upgrades at MRFs are recommended to meet the COAG waste export ban requirements.
- Further C&I paper recovery facilities are also recommended to meet the COAG waste export ban requirements.

Plastics

\ Further investment is required in plastics reprocessing infrastructure including to mechanically shred, wash, granulate, flake by single polymer type or pelletise by single polymer type.

\ Victoria potentially has significant competitive advantage and existing plastics manufacturing infrastructure that could be leveraged to manage this challenge. Victoria is currently home to two major plastics resins manufacturing businesses.

- Qenos has resins manufacturing production operations in NSW and in Altona, Victoria. Qenos is the sole manufacturer of polyethylene in Australia.
- LyondellBasell has resins manufacturing production operations in NSW and Geelong, Victoria. LyondellBasell is the sole manufacturer of polypropylene in Australia.
- The presence of these two major resins manufacturers in Victoria, with considerable market access, represents a significant opportunity to use recovered plastics in resins manufacturing in Australia.

\ Investment in both metropolitan Melbourne and regional Victoria would be appropriate. Regional Victoria has historically proven to be suitable for the reprocessing of plastics and there are opportunities for regional flaking and pelletising infrastructure.

Tyres

\ No further tyre reprocessing to shred tyres is required in Victoria to meet current domestic and export market demands.

\ However, should there be interest in building domestic demand for Tyre Derived Products from passenger tyres, then there is an opportunity for investment in increased fibre separation infrastructure.

\ It is recommended that such infrastructure be located in Melbourne's northern suburbs where Victoria's two major tyre reprocessing businesses are located.

MRFs

\ Generally, Victorian MRF infrastructure will need upgrading to increase the ability to sort and separate mixed materials. Presently, MRFs typically produce bales of mixed materials including paper and plastics. The market demand and in some cases, market authorisation, is seeing limited outlets for mixed baled materials. Further investment will be required in infrastructure to present sorted, clean streams of recovered materials.

\ Beyond this, there are notable gaps in the provision of MRF infrastructure in Victoria's south west and central western regions. Infrastructure Victoria sees opportunities for new MRF infrastructure to be located in Geelong and Ballarat to service these Victorian regions.

Figure 27: Resource recovery infrastructure forecast investment by 2039

Note: Locations are indicative only based on Infrastructure Victoria methodology. In some instances facilities are likely to be outside of the identified town centres in a neighbouring area. Capex costs are based on 2020 cost estimates only. Tonnes per annum are based on Waste Data Flows analysis. Number of facilities to manage projected TPA may be scaled up or down based on facility size design. Proposed scale is indicative only.

Infrastructure Victoria Recycling and Resource Recovery Infrastructure Facility Recommendations 2020 to 2039							
Supply chain role	Material type	Facility type	No. of facilities 2039	Capacity (Tonnes per annum) 2039	Low capex	High capex	Indicative location
Recovery	Mixed	MRF – Mechanical separation and optical sorting	2	80,000	$12,000,000	$20,000,000	Ballarat, Geelong
	Organics	SMRC – Transfer stations dedicated to organics with hard stand, cover, bays	2	240,000	$18,000,000	$36,000,000	Epping, Laverton North
	Paper	MRF – Paper separation upgrades	11	440,000	$16,500,000	$33,000,000	Bendigo, Coolaroo, Dandenong South, Echuca, Heidelberg, Laverton North, Lucknow, Morwell, Springvale, Truganina, Wangaratta
	Paper	SMRC – C&I paper recovery	6	300,000	$51,000,000	$60,000,000	Ballarat, Coolaroo, Dandenong South, Geelong, Laverton North, Truganina
Reprocessing	E-waste	Manual disassembly & mechanical processing – Batteries	2	4,000	$1,750,000	$2,200,100	Dandenong South
	E-waste	Solar photovoltaic panel reprocessing	5	25,000	$7,500,000	$50,000,000	Bendigo, Dandenong South, Geelong, Laverton North, Morwell
	Glass	Beneficiation plant	1	108,000	$8,100,000	$13,338,000	Laverton North
	Glass	Sand/aggregate plant – Large	2	100,000	$4,250,000	$5,000,000	Clayton South
	Glass	Sand/aggregate plant – Small	12	120,000	$5,160,000	$6,000,000	Bairnsdale, Ballarat, Bendigo, Echuca, Mildura, Morwell, North Geelong, Wangaratta, Warrnambool, Wodonga
	Organics	Anaerobic digestion	2	60,000	$15,000,000	$48,000,000	Dandenong South, Girgarre
	Organics	In-vessel composting – large & medium	4	250,000	$137,500,000	$161,250,000	Ballarat, North Geelong
	Organics	In-vessel composting – medium	3	75,000	$41,250,000	$46,875,000	Mansfield, Morwell, Warrnambool
	Organics	Open Windrow composting	6	180,000	$18,000,000	$25,200,000	Bairnsdale, Bendigo, Mildura, Swan Hill, Wallan
	Paper & cardboard	Other e.g. food fibre packaging and tissue, paper towel	4	40,000	$6,000,000	$7,000,000	Dandenong South, Laverton North
	Paper & cardboard	Pulp mill	2	600,000	$90,000,000	$105,000,000	Dandenong South, Laverton North
	Plastics	Chemical processing	1	20,000	$34,000,000	$40,000,000	Dandenong South
	Plastics	Chemical processing & flaking & pelletising plant (food grade)	2	70,000	$67,350,000	$90,000,000	Altona
	Plastics	Chemical processing, pelletising plant, flaking & pelletising plant (food grade & non-food grade)	4	145,000	$104,850,000	$143,760,000	Geelong
	Plastics	Flaking & pelletising plant – Small	8	80,000	$53,360,000	$80,000,000	Bairnsdale, Bendigo, Mildura, Morwell, Shepparton, Warrnambool, Wodonga
	Plastics	Flaking & pelletising plant (food grade & non-food grade)	2	100,000	$45,850,000	$64,285,000	Ballarat
	Plastics	Pelletising plant	1	25,000	$25,000,000	$39,475,000	Laverton North
	Plastics	Pelletising plant & flaking, pelletising plant (non-food grade)	2	75,000	$37,500,000	$53,760,000	Campbellfield
	Tyres	Fibre separation plant	1	15,000	$6,000,000	$8,025,000	Somerton
Total number of facilities and total capex			**87**	**3,157,500**	**$808,695,000**	**$1,141,543,200**	

Infrastructure has been costed at 2020 costs. This has been extrapolated out to 2039 based on 2020 costs alone. There has been no inclusion of NPV, discount rates, CPI etc.

Appendix B:
Defined terms

Term	Definition
%RR	Percentage recovery rate
ACCU	Australian Carbon Credit Unit
APCO	Australian Packaging Covenant Organisation
C&D	Construction and Demolition Waste
C&I	Commercial and Industrial Waste
CDS	Container Deposit Scheme
CEFC	Clean Energy Finance Corporation
COAG	Council of Australian Governments
DELWP	Department of Environment, Land, Water and Planning
E-waste	In Victoria, e-waste (electronic waste) refers to any item with a plug, battery or cord that is no longer working or wanted
EP Act	Environment Protection Act (both the Environment Protection Act 1970 and Environment Protection Act 2017)
EPA	Environmental Protection Authority Victoria
EPR	Extended Producer Responsibility
EU	European Union
FOGO	Mixed Food Organics and Garden Organics
HACCP	Hazard Analysis and Critical Control Point
HDPE	High-density polyethylene (type of plastic)
MRF	Material Recovery Facility
MSW	Municipal Solid Waste
NTCRS	National Television and Computer Recycling Scheme
PBO	Victorian Parliamentary Budget Office

Term	Definition
PET	Polyethylene terephthalate (type of plastic)
Pyrolysis	A thermal process for separating materials without oxygen
PVs	Solar photovoltaic panels
R&D	Research and Development
VRIP	Victorian Recycling Infrastructure Plan
SMRC	Specific Materials Recovery Centre
SV	Sustainability Victoria
SWRRIP	Statewide Waste and Resource Recovery Infrastructure Plan, now referred to as the Recycling Infrastructure Plan (RIP)
VAGO	Victorian Government Auditor General Office
WEEE	Waste Electrical and Electronic Equipment Directive
WRRGs	Waste and Resource Recovery Groups

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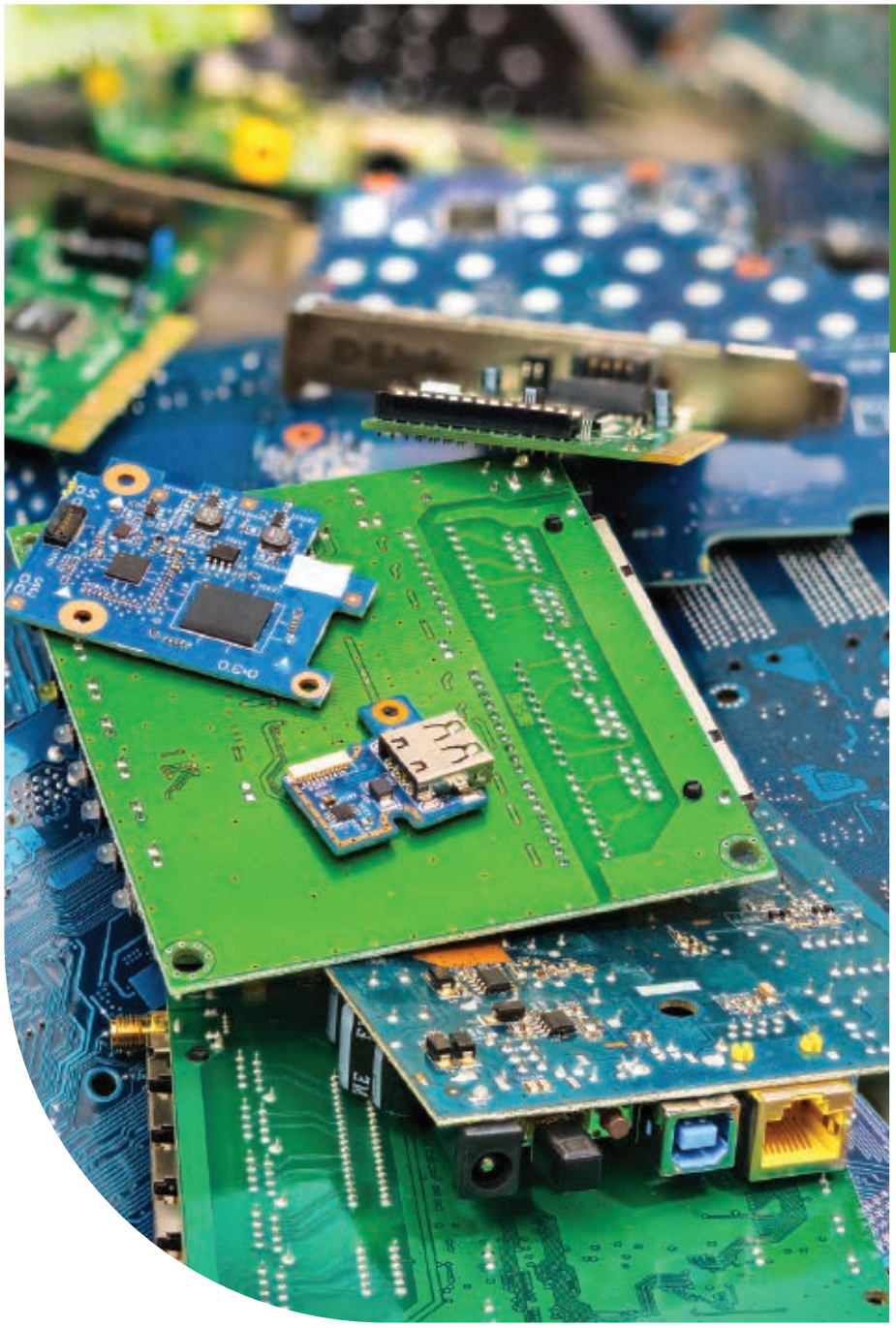

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