



Recycling and resource recovery infrastructure in Victoria: International and Australian comparisons

Final Report, July 2019



alphaBeta
strategy x economics

Glossary

Aerobic composting - The controlled biological decomposition of organic materials under aerobic (in the presence of oxygen) conditions, accomplished in open or enclosed windrows or piles.

Alternative waste treatment (AWT) – A range of activities that process mixed solid waste that would have gone to landfill into products such as compost, fuel or biogas, and increase recovery of resources including plastics, glass and metals.

Anaerobic composting - The controlled biological decomposition of organic materials under anaerobic (in the absence of oxygen) conditions, accomplished in enclosed vessels producing combustible methane gas and compost.

Anaerobic digestion - Biological breakdown by microorganisms of organic matter, in the absence of oxygen, into biogas (a mixture of carbon dioxide and methane) and digestate (a nutrient-rich residue).

Construction & Demolition Waste (C&D) - Solid materials and waste generated from residential and commercial construction and demolition activities, e.g. bricks and concrete.

Commercial & Industrial Waste (C&I) - Solid materials and waste generated from trade, commercial and industrial activities including the government sector. It includes waste from offices, manufacturing, factories, schools, universities, state and government operations and small to medium enterprises, e.g. food organics.

Extended Producer Responsibility (EPR) - A policy approach under which producers are given a significant responsibility – financial and/or physical – for the treatment or disposal of post-consumer products. Assigning such responsibility could in principle provide incentives to prevent waste at the source, promote product design for the environment and support the achievement of public recycling and materials management goals.

Feed-in tariff – Provides payments to electricity asset owners, including households, for the generation of renewable electricity.

Materials Recovery Facility (MRF) - A centre for the receipt, sorting and transfer of materials recovered from the waste stream before transporting to another facility for recovery and management. At a MRF, materials may undergo mechanical treatment for sorting by characteristics such as weight, size, magnetism and optical density and may include cleaning and compression. Materials may be received as mixed streams such as commingled recyclables from households and businesses or single streams such as metals.

Mechanical Biological Treatment plant (MBT) – Plants that combine mechanical sorting (such as in a MRF) with biological treatment of organic materials to process residual organic materials. This could include technology such as anaerobic digestion to stabilise the material and generate heat and power. Material remaining after further treatment (often referred to as 'digestate') can be added to compost or used as fuel in a thermal WtE facility.

Municipal Solid Waste (MSW) - Solid materials and waste generated from municipal and residential activities, and including that collected by, or on behalf of, municipal councils.

Organics (food) - Food materials discarded from households or industry, including food processing waste, out-of-date or off-specification food, meat, fruit and vegetable scraps. Excludes liquid wastes.

Organics (garden) - Organics derived from garden sources, e.g. grass clippings, tree prunings. Also known as green organics.

Pay As You Throw (PAYT) – A model for disposing of municipal waste where the user (the waste generator) is charged a rate based on how much waste they present for collection to the municipality or local authority.

Polyethylene Terephthalate (PET) - a polyester used to make plastic bottles and containers for packaging foods and beverages, and other products (i.e. carbonated soft drink bottles/beer and wine bottles, in a wide range of colours, sizes, weights and finish types)

Recovery rate - The proportion of generated waste that is recycled, including energy recovery.

Recycling rate – The proportion of generated waste that is recycled, without energy recovery.

Volume-based weight fee/charging – Where households are charged a fee in proportion to the amount of waste they generate.

Waste to Energy (WtE) - The production of usable forms of energy from individual or mixed material streams. Energy products include electricity, heat, biogas and process derived fuels.

Agenda

Objectives and introduction to project

Summary of findings

Selection of jurisdictions

Overview of Victorian system

Jurisdictional case studies

Wales: Targets and collections

South Korea: Organics and overall recycling

Germany: Overall recycling, landfill bans and EPR

Netherlands: Circular economy and waste-to-energy

South Australia: Strategy and licensing

New South Wales: Strategy and Alternative Waste Treatment

Additional deep-dives

Waste avoidance

Responses to China's National Sword Policy

Waste-to-energy

Bibliography

Background: Victoria needs to respond to a range of domestic and international waste challenges

- **Melbourne and Victoria's population is growing.** Addressing potentially adverse health and environmental impacts of waste, while preserving our limited resources, remains a challenge for communities around the world.
- **The established Australian model of exporting sorted waste has been impacted by changes in international practice.** While these changes have been disruptive, they also provide an opportunity to re-evaluate the focus of domestic recycling and resource recovery policies, and the infrastructure required to achieve those objectives.
- **Changes to Victoria's materials re-processing infrastructure could deliver greater resilience to Victorian recycling and waste systems,** while also producing economic opportunities and environmental benefit for the state. Policy and investment decisions required to achieve these outcomes will need to be informed by advice on industry demand and markets for recovered material.
- **Victoria's waste and recycling system is currently reliant on a small number of large, best practice landfills,** with comparatively few options for extracting recyclable material and/or recovering energy from residual waste.
- **The waste to energy sector is under-developed compared to other leading nations.** There is a degree of uncertainty about return on investments, security of feedstock, social license and the potential to adversely divert waste from uses higher up the waste hierarchy.
- **Organic waste, particularly food waste, creates significant environmental and amenity problems in landfill,** creating greenhouse gases, toxins and odours when decomposing. There are opportunities to divert organic waste to create new products and/or energy, yet recovery and processing of food waste has not been adopted at an industrial scale in Victoria.

Purpose of project was to apply the experience of other jurisdictions with strong recycling performance to the Victorian context

Infrastructure Victoria's scope of advice

The Government is seeking advice on the **infrastructure requirements and the role for government** in providing support to:

- **Develop Victoria's re-processing sector for recycled material**, particularly those that currently rely heavily on overseas markets such as plastics
- Better enable the use of products containing **recycled materials in a variety of Vic 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 the residual waste
- Support high levels of resource recovery for **organics, particularly food organics**

Purpose of this project

This project informs Infrastructure Victoria's understanding of **opportunities, barriers and risks to adopting specific recycling and resource recovery approaches**, enabling infrastructure and market models by:

- Assessing **relevant collection, sorting, recycling, secondary processing, residual and organic waste processing approaches**
- **Comparing infrastructure, infrastructure networks, regulatory settings, models and consumer behaviours** with Victoria's current landscape, and identifying areas of alignment or divergence
- **Identifying the implications of adopting specific technologies** or market models or aligning with particular jurisdictions.



Our approach was to use analysis of the Victorian system as a baseline for comparison with selected other jurisdictions, then distil key lessons

1 Baseline Victorian system

- Outline **historical system performance**
- Identify **key challenges for system**
- **Identify drivers of key challenges**
- Identify where there are **opportunities to improve performance**
- Understand **Victoria context to determine transferability** approaches from other jurisdictions

2 Compare against jurisdictions with stronger recycling

- A. Select jurisdictions with strong recycling performance**
 - Choose 4-6 **international / Aus. jurisdictions** with strong recycling rates
 - Supplement with **additional deep dives of best practice**
- B. Analyse key drivers of performance**
 - Outline **historical system performance**
 - Identify **key drivers of out performance**
 - **Deep dive on 2 - 3 key drivers**
- C. Describe overall system context**

Describe how overall jurisdiction manages waste including:

 - Sector dynamics, Infrastructure and technology, End markets, Policy enablers and culture & behaviour

3 Identify key lessons for Victoria

- Identify **common lessons** from jurisdictions with strong recycling performance, and **key features across the waste value chain**
- Review, group and contrast **the different drivers of performance across the comparison jurisdictions** that are applicable to the Victorian context
- Consider the **transferability** of those drivers to Victoria, having regard to **risks, barriers, cost and time to implement**

Note: Key levers of performance are examined within context of overall system to ensure the critical role of context is properly understood

We chose six jurisdictions based on their recycling performance and diversity of system strengths, and supplemented with deep dives

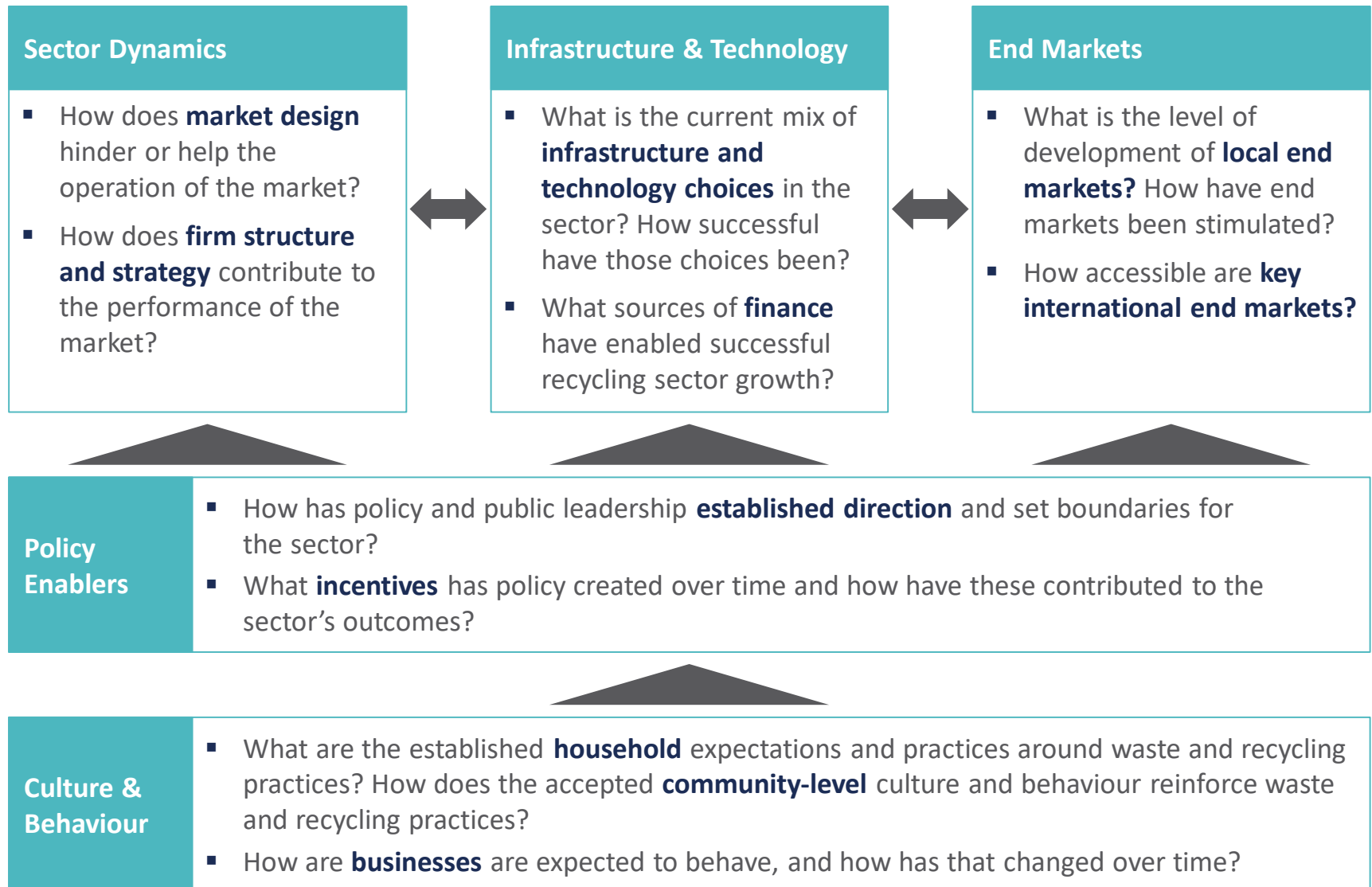
Comparison jurisdictions					Additional deep dives	
			MSW recycling rate (%)*	System focal points / reasons for selection	Area	Jurisdiction/s
International	Wales		63	Recycling targets, Collections Blueprint, organics infrastructure, supporting local procurement & waste to energy approach	Waste avoidance	Multiple
	South Korea		59	Volume based charging, high source separation, end to end food waste system	Responses to China Sword	Multiple
	Germany		68	Mandatory landfill bans and comprehensive EPR scheme	Waste-to-energy	Multiple
	Netherlands		57	Weight based charging and sustainable circular procurement		
Australia	South Australia		54	Clear licensing regime, early and effective container deposit scheme		
	NSW (select elements)		42	Clear strategy and policies, high regulatory standard for waste to energy		

Victoria has a 40% MSW recycling rate for comparison

* MSW recycling rate chosen as MSW statistics are most robust for comparison across jurisdiction, but other waste streams are included in this assessment. Rates differ slightly from Eunomia estimates quoted later in this report as years and inclusions are slightly different;

Source: Welsh Assembly Government, EuroStat, OECDStat, National Waste data 2016-17, NSW EPA, WARR Strategy progress

We have used a five-part framework for analysing each of the comparison jurisdictions



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Additional deep-dives

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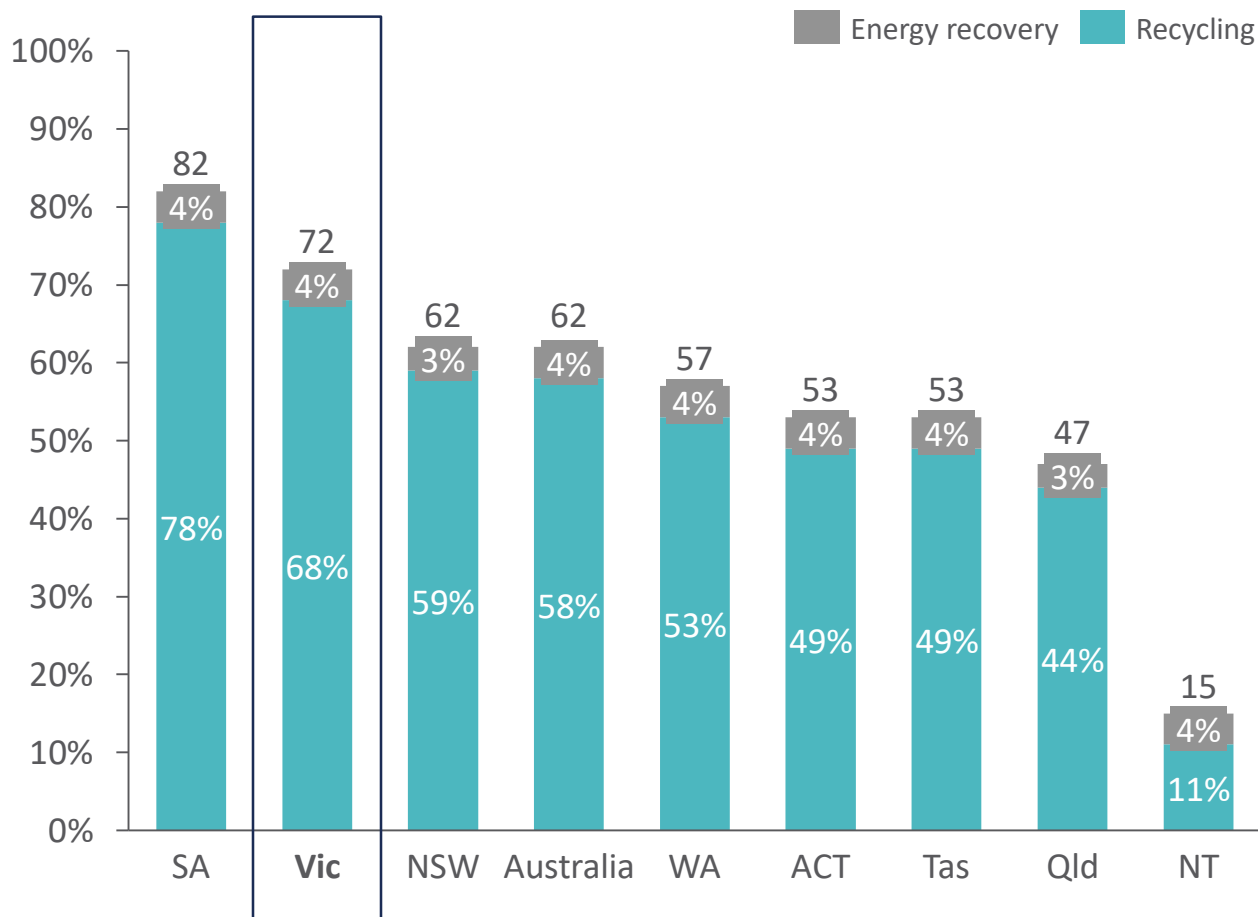
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Bibliography

Victoria's resource recovery performance is above average by Australian standards, with the second-highest rate of recycling nationally

Resource recovery and recycling rates of total waste by Australian jurisdiction (%), 2016-17



Key strengths

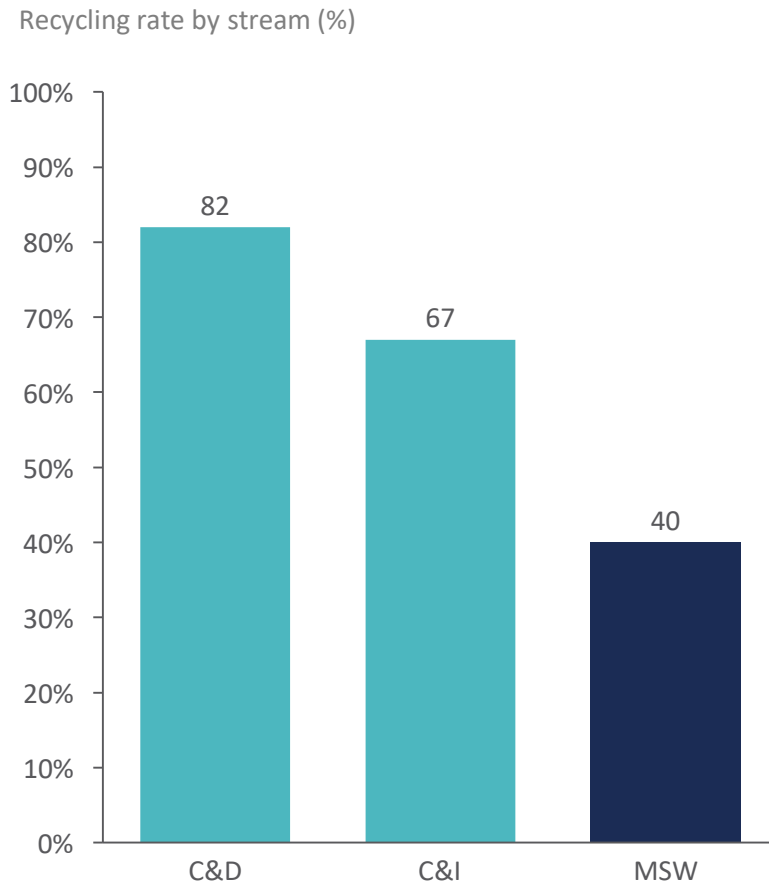
- High rate of C&D recycling (~80%)
- Landfills bans on “Category A” waste (i.e. paint, industrial transformers) likely leading to stronger C&I performance
- Landfill levies apply to all waste streams
- Approx. 70% of households have access to kerbside garden waste collection
- Strong culture around recycling practices

Source: National Waste Report 2018, p.26

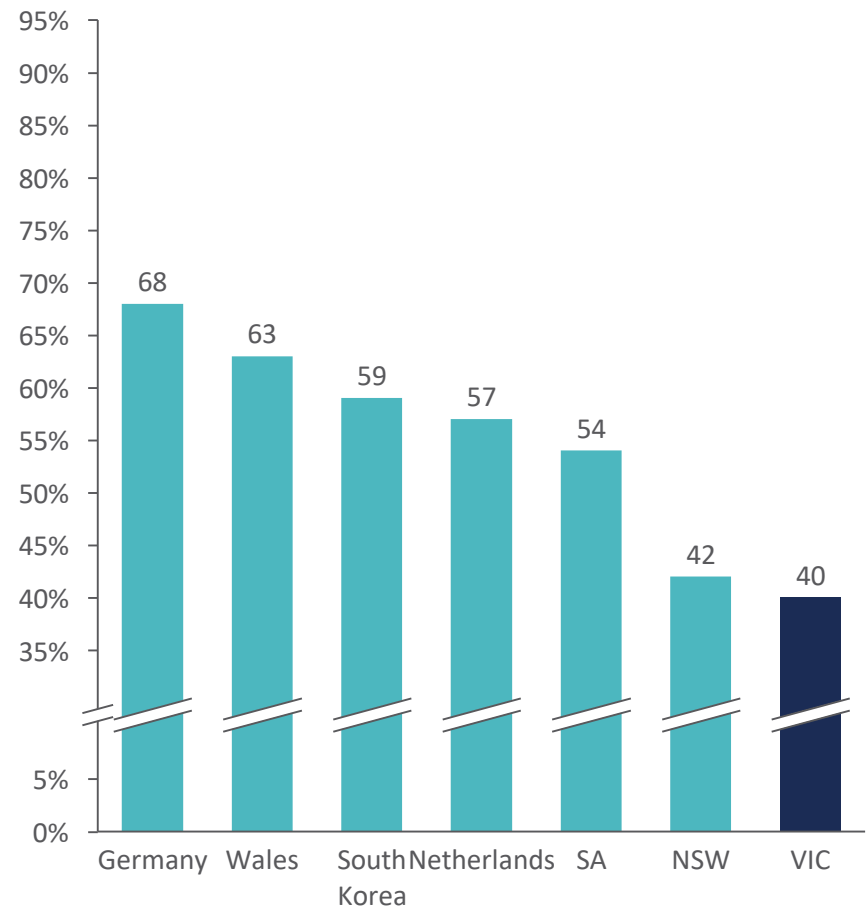
Note: National Waste Report 2018 notes Victorian recycling rate of 68%; Victorian Government diversion rate for 2016-17 is 67%

But while Victoria performs well on C&D and C&I, MSW recycling rates are low and lag both other states and international jurisdictions

Breakdown of waste generation and recycling rates in Victoria, 2015-16, %



MSW recycling rate by jurisdiction, latest data, %

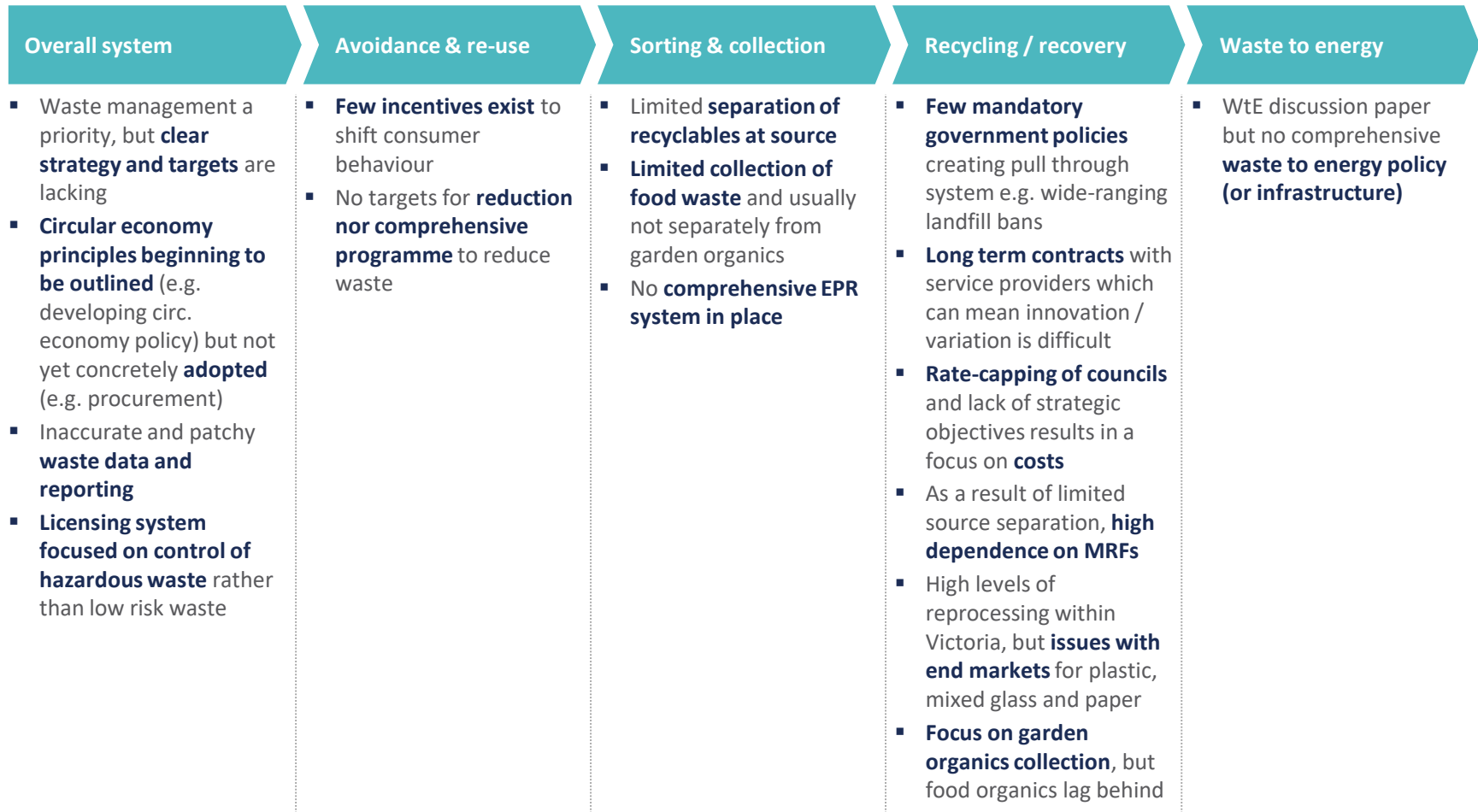


Notes: Only 2015-16 data available—Victorian Recycling Survey 2016-17 does not include detailed breakdowns of waste streams by C&D, C&I or MSW

Source: Statewide Waste and Resource Recovery Infrastructure Plan, pp.83-87; Welsh Assembly Government, EuroStat, OECDStat, National Waste data 2016-17, NSW EPA, WARR Strategy progress

The Victorian system also suffers from some significant challenges, particularly in household waste











Key challenges for Victorian recycling and recovery system*



* Discussion with key experts suggest there are important improvements in discussion on several of these challenges (e.g. licensing approach)

SOURCE: Victorian Auditor General Report 2019; Australia Senate, Never Waste a Crisis, 2018;; Submissions to Australian Senate report: Victorian Waste management Association, Visy, Suez Australia; Law Institute of Victoria; Infrastructure Victoria, 1st stakeholder consultation forum on challenges for Victorian waste system (50 representatives across government and business)

The best practice jurisdictions that we have studied provide common lessons that may apply to the Victorian system

	Description of lesson	Examples
Long term commitment	Most jurisdictions have taken at least 10 years to improve their recycling and resource recovery performance, some as long as 20 years	 Germany's landfill ban was implemented over 12 years, providing time for local authorities to adjust  South Korea's transformation to one of the best MSW recyclers in the world took around 15 years
A range of policies and a policy evolution	There is no silver bullet to improving resource recovery; most top performers have used a range of policies and flex these policies over time	 South Australia started by focusing on collection in its first waste strategy, then moved to avoidance and recycling infrastructure in the second strategy and organics in the third strategy
Coordination and collaboration	Waste is always a split responsibility between levels of government, and the public and private sector, so effective collaboration is critical	 The Welsh Government transformed collection practices through patient collaboration with its local authorities  In Germany, PPPs in waste infrastructure have been a common tool to align interests of public and private sectors
Government's mandating role	In all of the high performing jurisdictions, there are some mandatory measures that government imposes to drive performance	 Germany imposed strong landfill bans and mandated EPR  South Korea use a variable volume-based charge for mixed waste  Wales has statutory recycling targets with penalties for local governments that don't meet them
Complementary interventions across value chain	Policy interventions across the value chain work together (though even high performing jurisdictions often had underdeveloped end markets that have been exposed in recent years)	 In South Korea, a landfill ban was coupled with separate collection and PAYT, supporting higher-value recovery  The Netherlands has combined landfill bans and recycling taxes with government support for development of bioeconomy

Across the waste and recovery value chain, best practice systems have a range of features, though not all are needed for success



Overall, a combination of national coordination and new investments could significantly lift Victoria's recycling and resource recovery performance

Opportunities for the Victorian system

National coordination

Greater need for federal involvement including stable policy framework for reducing GHG emissions, embedding circular economy, harmonising levies, but particularly:

- 1 Advancing progress towards a **nation-wide, comprehensive EPR** scheme to ensure producers of goods have the right incentives to avoid and manage waste
- 2 Introducing **stronger incentives for specific goods** (e.g. batteries, PV systems, plastic packaging) to drive development of second processing infrastructure and reduce use of less recyclable materials

Victorian investments

A comprehensive Victorian strategy with targets and an effective compliance system that encourages and supports the following investments:

- 3 Development of a **best-in-class collections process and infrastructure** that encourages greater separation at source, weight based payment and avoidance
- 4 Investment in an **end-to-end food organics** recycling system, which may include biological waste-to-energy
- 5 Developing **2 – 3 end markets where Victoria** could expect to generate a long term competitive advantage

There are a range of specific approaches that helped best practice jurisdictions transform their performance

Degree of change required: Little Medium High Very high

Hierarchy step	High level actions	Approaches	Jurisdictions	Change required
Overall system	Comprehensive vision, strategy and policies that underpin recycling system	Comprehensive vision & strategy		
		Targets		
		Licensing mechanisms		
		Sustainable procurement		
Waste avoidance	Incentivising waste reduction	Pay-as-you-throw waste		
		Targets for waste reduction		
Sorting & collection	Improving the quality of collections	Collections Blueprint		
		High source separation, including PAYT		
		Container deposit scheme		
Recycling	Stimulating development of recycling infrastructure	Supporting local govt to procure infra.		
		Extended producer responsibility		
		Mandatory landfill bans		
	Recovering organic / food waste	Food waste systems		
		Organics infrastructure progression		
Waste-to-energy	Effective waste-to-energy approaches	Slow and careful uptake		
		Feed-in tariffs		
		High regulatory standards		

Overall system: a strong vision and clear, measurable targets have helped drive system performance in other jurisdictions

Degree of change required:  Little  Medium  High  Very high

Approach	Examples / details	Outcome	Change required	Comment on transferability
Comprehensive vision & strategy 	<ul style="list-style-type: none"> Since 2003, NSW has been pursuing a Waste Avoidance & Resource Recovery (WARR) Strategy including a clear vision and targets, managed by a single agency (the EPA) – current strategy covers the period 2014-2021; A new 20-year waste strategy is under development to create a longer-term vision NSW regularly reports on progress on the WARR strategy The implementation of the strategy is supported by the Waste Less, Recycle More (WLRM) grants and funding initiative, which is funded from NSW’s waste levy 	<ul style="list-style-type: none"> WARR strategies and clear responsibility of the EPA provide a coherent approach to waste management activities in NSW, and while not all targets have been met there has been a strong increase in MSW and C&I recycling in NSW Some question the level of funding provided under WLRM as only a portion of waste levy funds are directed to waste services 		<ul style="list-style-type: none"> As recently highlighted in the Victorian Auditor-General’s report, Victoria lacks a “statewide policy or plan to manage waste” Establishing a clear long-term strategy linked to appropriate levels of funding, including clarifying roles in the waste management system, is an important and achievable step for Victoria However, persisting in the implementation of that strategy over the long term may be challenging
Recycling targets 	<ul style="list-style-type: none"> Wales has used a series of recycling targets as pillars of its waste management strategies since 2002, with other interventions (including funding and sector plans) linked to achieving targets The current targets progress towards a recycling rate of 70% across each waste stream (90% for construction) by 2025 and are statutory, so local authorities that do not meet targets can be fined 	<ul style="list-style-type: none"> Recycling targets have largely been met and Wales has significantly improved its recycling performance; other targets for waste prevention have been harder to achieve Use of a composting target in the 2002-2010 period likely slowed the uptake of W2E in Wales and has led to Wales’ historically strong performance on organics 		<ul style="list-style-type: none"> Victoria does not currently have a recycling or recovery target in order to drive overall system performance and support funding priorities The experience of Wales demonstrates that targets can be useful in maintaining long term focus, but to be effective they need to be accompanied by funding streams and detailed sector planning to ensure targets can be met








Overall system: strong enforcement mechanisms and government procurement also support system performance

Degree of change required:  Little  Medium  High  Very high

Approach	Examples / details	Outcome	Change required	Comment on transferability
Licensing and enforcements mechanisms 	<ul style="list-style-type: none"> South Australia's EPA has a range of powers to investigate and remediate illegal dumping and other illicit practices, including environment protection orders, clean-up orders, expiations and prosecution The regulatory regime in South Australia also creates stringent requirements for stockpiling of recyclables in resource recovery facilities 	<ul style="list-style-type: none"> The EPA has been able to aggressively pursue offenders, including the state's first jail sentence for an environmental offence in 2016 when a waste company failed to comply with an environmental protection order This provides a strong disincentive for others to engage in illegal waste activities 		<ul style="list-style-type: none"> Victoria has a significant challenge with waste stockpiles and fire risks, and the Victorian Auditor-General has already noted that the relative laxness of Victoria's enforcement regime has led to waste problems in other states being transported to Victoria The SA model is highly transferrable to Victoria given similarities in the overall legal system
Circular public procurement 	<ul style="list-style-type: none"> The Dutch Government and local governments have shifted from green public procurement towards circular public procurement (CPP), including products as services (e.g. leasing models) in order to promote the development of a circular economy In 2013 the Dutch Government established the Circular Procurement Green Deal to accelerate transition to the circular economy, bringing together 45 public and private parties to conduct pilot CPP initiatives 	<ul style="list-style-type: none"> Over three years, 80 pilots were conducted; this led Dutch government to place special emphasis on circular procurement for its 2016 'Roadmap to a Circular Economy', with the aim of raising the proportion of circular procurement for government purchases to 100% by 2020 Projects include buildings constructed for disassembly and requiring textiles to have a certain share of recycled fibres 		<ul style="list-style-type: none"> Victoria is already pursuing a sustainable procurement approach based on the environmental objectives in the state's Social Procurement Framework and work under the Recycling Industry Strategic Plan Incorporating more circular business models into procurement requirements to provide demand signals into the recycling and resource recovery system could be an extension of this approach
Mission driven organisations 	<ul style="list-style-type: none"> The Waste and Resources Action Programme (WRAP) is a registered UK charity and a company that works with governments, businesses and communities to deliver practical solutions to improve resource efficiency WRAP also help deliver UK, EU and other funder's policies on waste prevention, resource efficiency 	<ul style="list-style-type: none"> WRAP's work has included research that has helped prevent £10m worth of food waste as well as other research initiatives, consumer campaigns around waste avoidance and recycling and delivering grant programmes to promote waste prevention, resource efficiency and sustainability of products 		<ul style="list-style-type: none"> Victoria could look to set up a mission driven organisation similar to WRAP in order to collaborate with different stakeholders and improve resource efficiency and deliver various funding programs

Avoidance: charging mechanisms, innovative municipal targets and sector plans have been used to reduce waste generated

Degree of change required:  Little  Medium  High  Very high

Approach	Examples / details	Outcome	Change required	Comment on transferability
Volume- or weight-based charging*  	<ul style="list-style-type: none"> In South Korea: <ul style="list-style-type: none"> A volume-based waste fee (VBWF) for residual waste was implemented in 1995 In 2013 this pay for service approach was extended to food waste Netherlands provinces have been experimenting with charging residents for their waste since 1997: <ul style="list-style-type: none"> Volume – pay per bin (chips in bins) Frequency – pay per bag (official bags – bought) Weight – pay per kg (bins weighed) 	<ul style="list-style-type: none"> The S. Korean VBWF is regarded as having been successful in reducing waste and increasing recycling performance in South Korea Importance of other complementary measures to improve recycling performance and minimise generation, e.g. mandatory EPR from 2003, landfill ban for food waste in 2005 In Netherlands, differentiated tariffs were found to lead to a 12 to 30% reduction in household waste, with greater impacts observed with weight and sack based schemes 		<ul style="list-style-type: none"> Victoria charges indirectly for waste through local rates However, charging has been successfully introduced to a number of jurisdictions when accompanied by a public education campaign Policy should also be accompanied by relevant funding for infrastructure and a clear plan for implementation
Local authority targets 	<ul style="list-style-type: none"> The Walloon Region of Belgium introduced a new and innovative specific tax on every tonne of waste that exceeds a pre-set, gradually decreasing threshold level, to be paid by the municipalities to the Walloon Region 	<ul style="list-style-type: none"> The tax has caused increasing levels of municipal waste taxes and introductions of pay as you throw schemes The municipalities are also encouraged to develop new activities for segregation and prevention of waste. 		<p>Innovative local authority targets could be transferred if</p> <ul style="list-style-type: none"> Accompanied by a comprehensive set of policy measures to be rolled out across regions Clear instructions for municipalities on how to achieve those targets Funding for local government to achieve those targets
Sector plans and waste prevention 	<ul style="list-style-type: none"> Welsh Government has released a number of sector plans and a Waste Prevention Programme which outline the priority sectors and areas for action for MSW, C&I and C&D as well as the government's initiatives to support individuals, businesses and organisations in Wales to take action 	<ul style="list-style-type: none"> C&D waste prevention includes a “design for destruction” program, reuse of surplus materials and value engineering on large projects with priority materials including (but not limited to) gypsum & insulation, metal, concrete bricks, tiles For C&I, the government has a focus on the food manufacturing sector, accommodation and food services, SMEs and permitted industry with actions to work with large retailers and supply chains, promote eco-innovation and set an example through the public sector 		<ul style="list-style-type: none"> Although there is less data on the success of these initiatives, Wales provides a good example of a holistic approach to waste avoidance across different sectors This approach could be relatively easily implemented as part of an integrated waste strategy

* Volume or weight based charging is the norm in most countries for C&I and C&D waste streams, including Australia

Sorting and collections: Greater separation of materials is a feature of all high performing countries, with a range of options

Degree of change required:  Little  Medium  High  Very high

Approach	Examples / details	Outcome	Change required	Comment on transferability
Wales Blueprint 	<ul style="list-style-type: none"> In 2011, Wales introduced a Collections Blueprint that sets out best practice collections practice and infrastructure. Focus of the Blueprint is strong separation by households and further kerbside sort to produce higher quality recyclates 	<ul style="list-style-type: none"> It has been adopted by 11 of 22 local authorities in Wales Blueprint is at least cost competitive with other approaches, and generally leads to improved recycling performance The focus on separation at source results in a higher material quality with less contamination 		<ul style="list-style-type: none"> 3 bin system used in majority of councils across Victoria Moving to new sorting and collections approach would require <ul style="list-style-type: none"> Clear instructions for councils Significant new education for consumers accompanied by incentives to adopt Investment in new collections infrastructure
High source separation 	<ul style="list-style-type: none"> South Korea has a system where most materials are separated at source Differences between houses and apartments; but paper, plastic, glass bottles, metals and vinyls and food waste are usually separated Compliance through EPR by online data reporting on sales, imports, waste collected and recycled 	<ul style="list-style-type: none"> Separation process incentivised by PAYT on residual stream has underpinned significant improvement in recycling rate from 23% to 59% through the last 20 years Focused manufacturing and established recycling through EPR has enhanced sorting and collection contributing to increased recycling rate 		<ul style="list-style-type: none"> More granular separation at the source would require transition from paid kerbside collection of recyclables to a free drop off point collection system Payment system based on generated residual waste would encourage greater recyclables separation at the source EPR could be structured to enhance greater separation and collection as well as for the development of the recycling end markets
Container deposit scheme 	<ul style="list-style-type: none"> South Australian CDS started in 1977 Containers are sorted by material type at the depot; glass containers are sorted by colour and sold for reprocessing; aluminium, steel, liquid paperboard and plastic containers are recycled through end markets sourced by the scheme operator 	<ul style="list-style-type: none"> \$60m refunded in 2017-18; 603m containers (43kt) recovered; return rate of 76.9% Reduced litter Strong end markets for higher quality recycle, eg recycled glass provided by two major glass re-processors located in South Australia: Amcor and Owen Illinois 		<ul style="list-style-type: none"> Victoria Parliamentary motion for CDS was defeated in 2018 Suitable land for roll out of CDS would be needed for implementation Agreement with main container producers also key to implementation

Recycling: improvements in recycling rates can be stimulated by new funding streams, bans on landfill or systems of producer responsibility

Degree of change required:  Little  Medium  High  Very high

Approach	Examples / details	Outcome	Change required	Comment on transferability
Supporting local governments to procure new infrastructure 	<ul style="list-style-type: none"> The Waste Infrastructure Procurement Programme (WIPP) supported local authorities in Wales to procure long-term contracts for the treatment of food and residual waste Welsh Government guided local authorities through a consistent project development and procurement process; it also provided financial support of 25% of gate fees, and in some cases made capital contributions 	<ul style="list-style-type: none"> It has been adopted by 11 of 22 local authorities in Wales Blueprint is at least cost competitive with other approaches, and generally leads to improved recycling performance The focus on separation at source results in a higher material quality with less contamination 		<ul style="list-style-type: none"> Victoria already has some similar programs in place, including the Resource Recovery Infrastructure Fund WIPP provides a model for a more assertive investment by government in infrastructure development and operation over the long term, providing ongoing subsidies for gate fees, and using that investment to drive improvements in waste management practices
Landfill bans 	<ul style="list-style-type: none"> Germany implemented landfill bans on untreated municipal waste starting in 1993, with municipalities given a 12 year adjustment period to development new infrastructure to address the bans Local governments, who provide much of the waste management infrastructure in Germany, were given significant freedom over the technologies employed 	<ul style="list-style-type: none"> Germany has seen the share of MSW landfilled decrease from 39% to 1% of between 1996 and 2006 A study on the impact of landfill ban commissioned by the Federal Environment Agency in 2005 found that €20 billion had been invested in modern waste treatment and recycling plants since 1993 and up to 15,000 permanent jobs had been created 		<ul style="list-style-type: none"> Victoria is about to introduce its first landfill ban for e-waste Germany's experience demonstrates that bans with strong enforcement can drive significant declines in MSW landfill, but the emphasis on mandating performance in Germany may be eased by the public ownership of much of the infrastructure
Extended producer responsibility (EPR)   	<ul style="list-style-type: none"> Germany has introduced a number of regulations to make producers accountable for the collection, sorting and recycling of packaging from their products and which has led to the creation of a dual waste collection system Jurisdictions including the Netherlands and Switzerland also have a number of EPR initiatives which look to address problematic waste streams such as waste electrical and electronic equipment (WEEE) Several other jurisdictions including Canada, UK, Japan, Sweden, Slovakia and Belgium also use a range of mandatory EPR initiatives to address problematic waste streams including WEEE, oil, packaging waste and end-of-life tyres 	<ul style="list-style-type: none"> Germany has recycling rates for packaging have increased dramatically from 38% to 76% between 1991 and 2016 Nevertheless, Germany has experienced some freeriding in the system where some producers have not fulfilled their product responsibilities, and it has not led to waste avoidance The Netherlands White and Brown Goods Decree was passed in 1998 and made it mandatory for retailers to take back old electrical and electronic waste in exchange for new ones and included recycling and reuse targets for different products with the program continuing to meet the EU target of 4kg WEEE per person per year since 2001 Similarly, Switzerland's ordinance "The Return, the Taking Back and the Disposal of Electrical and Electronic Appliances" has seen a 73% recycling rate for e-waste with extensive nationwide coverage (500 collection centres) and requirements for retailers to take back e-waste from consumers free of charge 		<ul style="list-style-type: none"> Learnings from Germany and other jurisdictions show that more producer responsibility is possible when using a mandatory approach and can drive strong improvements in reuse and recycling of packaging, but such systems can be costly and quite complex to manage EPR schemes work most effectively at the national level so Victoria would be better placed advocating for a Federal EPR initiative for national consistency. In the first instance, a scheme could potentially target specific problematic waste streams (such as WEEE)

Recycling: improvements in recycling rates can be stimulated by new funding streams, bans on landfill or systems of producer responsibility

Degree of change required:  Little  Medium  High  Very high

Approach	Examples / details	Outcome	Change required	Comment on transferability
Plastics tax 	<ul style="list-style-type: none"> The UK Government announced a plastic packaging tax on the production and import of non-recyclable plastic packaging that will come into effect in 2022 to incentivise the use of more recycled plastics and reduce plastic waste 	<ul style="list-style-type: none"> The tax was in response to high levels of plastic packaging waste which predominantly came from new, not recycled plastics The policy should help shift economic incentives for production towards greater use of recycled plastics and help reduce plastic waste 		<ul style="list-style-type: none"> The UK's plastic tax highlights more radical responses to increase recycling of plastics and reduce plastic waste Although a similar initiative would likely have to be carried out at Federal level, Victoria could still play an active advocacy role




Recovering organics / food waste: South Korea represents a good example of an end to end system targeting households and SMEs

Degree of change required:  Little  Medium  High  Very high

Approach	Examples / details	Outcome	Change required	Comment on transferability
End-to-end system targeting households and small business 	<ul style="list-style-type: none"> ▪ Separate urban food waste collection started in 2005, with ban on direct land-filling of urban food waste ▪ Pay as you throw system (weight-based) was extended to food waste in 2013 ▪ Collection technology enabling PAYT (RFID), and advanced treatment technologies employed to reduce volume ▪ Established end-markets for animal feed, compost and biogas 	<ul style="list-style-type: none"> ▪ Very high recovery rates with >90% of food waste diverted from landfill ▪ PAYT system targets behavior change, incentivising avoidance ▪ Significant cost-efficiencies for collection in combining household and small business food waste ▪ System prioritises highest-value recovery and this is enabled by the separate collection of food waste, i.e. energy and nutrient recovery using anaerobic digestors ▪ Advanced processing technologies including using insect-based processing 		<ul style="list-style-type: none"> ▪ Several key elements of this system could be transferred, including: a charging system to incentivise avoidance, separate food waste collections, and landfill bans to stimulate investment in innovative processing technology ▪ A pay for service system requires new infrastructure and strong compliance ▪ The collection of food organics combined with garden organics (FOGO) limits end use ▪ Current regulation may be a barrier for reuse as animal feed
Organics infrastructure progression 	<ul style="list-style-type: none"> ▪ Wale's Wise about Waste strategy set targets for local authorities to reach 40% recycling and composting of MSW by 2009-10, including at least 15% composting; landfill targets were also set out by the EU ▪ In order to reach these composting and landfill targets local authorities initially used infrastructure such as open vessel composting, but have recently shifted towards anaerobic digestion (AD) for food waste 	<ul style="list-style-type: none"> ▪ Wales was able to quickly achieve and maintain a strong composting system for organic waste in the 2000s ▪ A government funding programme from 2008 then supported a transition to AD for food waste, but composting market has remained robust ▪ There are currently seven food organic projects under the programme, which are supporting local authorities in diverting food waste from landfill using efficient composting technologies 		<ul style="list-style-type: none"> ▪ Learnings from Wales show that organics processing can be developed through strong targets, supported by infrastructure procurement to transition to better practice processing facilities such as AD for the food waste fraction ▪ Outlining the infrastructure that the government would help procure also provided more control and consistency when transitioning to AD for food waste and this approach could be adopted by Victoria

Waste-to-energy (WtE): higher value material recovery should be considered when considering investment in WtE

Degree of change required:  Little  Medium  High  Very high

Approach	Examples / details	Outcome	Change required	Comment on transferability
<p>Slow and careful update of WtE</p> 	<ul style="list-style-type: none"> Unlike many European states, Wales deferred investing in WtE, first prioritising improvements in recycling and composting during the 2000s In 2008, the Welsh Government began providing financial support to local authority consortiums to procure anaerobic digestion (AD) facilities for food waste It assessed need for thermal WtE for residual waste, and supported a large incinerator with a capacity of 350,000t built in Cardiff that came online in 2014, and one further thermal WtE plant is finishing construction in the north of Wales 	<ul style="list-style-type: none"> AD facilities have proved a success in Wales generating energy and reducing emissions and supporting a move towards better practice treatment of organics The Cardiff incinerator has helped the local authorities meet recycling and landfill targets, but waste volumes will likely not meet expected levels and government will have to make up the shortfall There has also been some public backlash to the new facility over pollutants and fumes 		<ul style="list-style-type: none"> The Welsh experience shows that AD is an effective approach for dealing with food organics, which is a waste stream that Victoria is currently trying to better address Victoria is similarly well positioned as Wales because it has not yet invested in WtE and has the opportunity to first drive down its residual waste and consider the role of non-thermal WtE technologies such as AD Greater separation of food waste and investment in AD technology would be required
<p>Feed-in tariffs for AD</p> 	<ul style="list-style-type: none"> UK's feed-in tariffs (FIT) provided payments to households and community groups for the generation of renewable electricity Anaerobic digestion (AD) technologies were included in the scheme and saw increased take up and awareness of the technologies both commercially and on farms Other renewable technologies such as solar panels saw strong take up under the scheme 	<ul style="list-style-type: none"> 167 AD plants were installed between 2010 and 2015 AD accounted for 14% of the total energy generation from installations under the FIT scheme in 2012 There was particularly strong take up of AD facilities commercially and on farms (for smaller scale use) The scheme increased awareness and take up of AD (with support from other AD programs) and has helped the UK remain a leader in AD technologies 		<ul style="list-style-type: none"> Incentives such as FITs can help promote awareness and take up of WtE initiatives such as AD and could be particularly effective in providing WtE facilities on farms in rural Victoria Other policies should also be used to support take up of these facilities, and a more targeted approach may be preferable if waste management is the focus and not renewable energy in general

Waste-to-energy (WtE): setting appropriate regulatory standards is an important precursor to WtE development

Degree of change required:  Little  Medium  High  Very high

Approach	Examples / details	Outcome	Change required	Comment on transferability
<p>High regulatory standards for WtE</p> 	<ul style="list-style-type: none"> In 2015, the NSW Energy from Waste Policy Statement set stringent requirements for thermal treatment of waste with energy recovery These requirements include ensuring that higher order opportunities for the use of the waste have been exhausted, meeting thermal efficiency and resource recovery criteria and demonstrating protection of air quality and human health 	<ul style="list-style-type: none"> There have been no new waste to energy facilities approved in NSW since the policy was introduced This is likely due to both a lack of clear social license for WtE in NSW and difficult complying with the requirements set out in the Energy from Waste Policy 		<ul style="list-style-type: none"> Victoria could easily set out high standards for WtE facilities similar to NSW to ensure that other resource recovery opportunities and community wellbeing are not compromised Learnings from NSW also show that criteria prioritising material recovery and the community may limit investment in WtE facilities

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Wales: Targets and collections

South Korea: Organics and overall recycling

Germany: Overall recycling, landfill bans and EPR

Netherlands: Circular economy and waste-to-energy

South Australia: Strategy and licensing

New South Wales: Strategy and Alternative Waste Treatment

Additional deep-dives

Waste avoidance

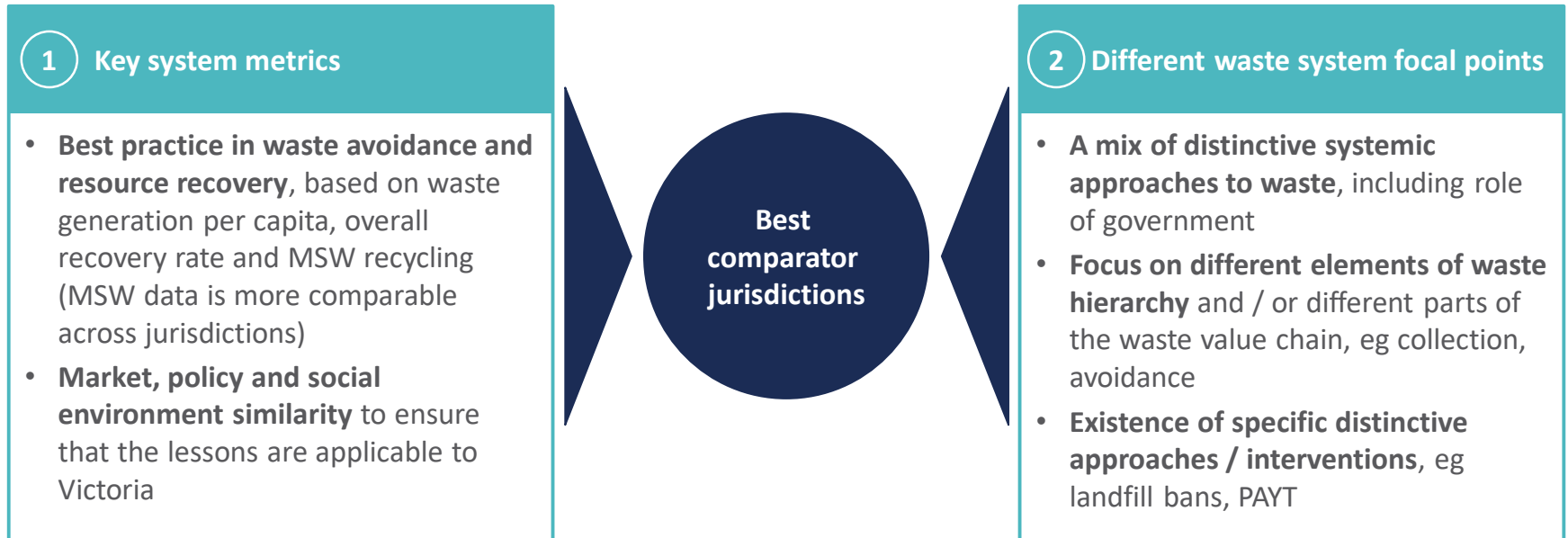
Responses to China's National Sword Policy

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Bibliography

We used key metrics and different system focal points to determine the best international comparison jurisdictions for Victoria

Criteria for determining best international comparison jurisdictions

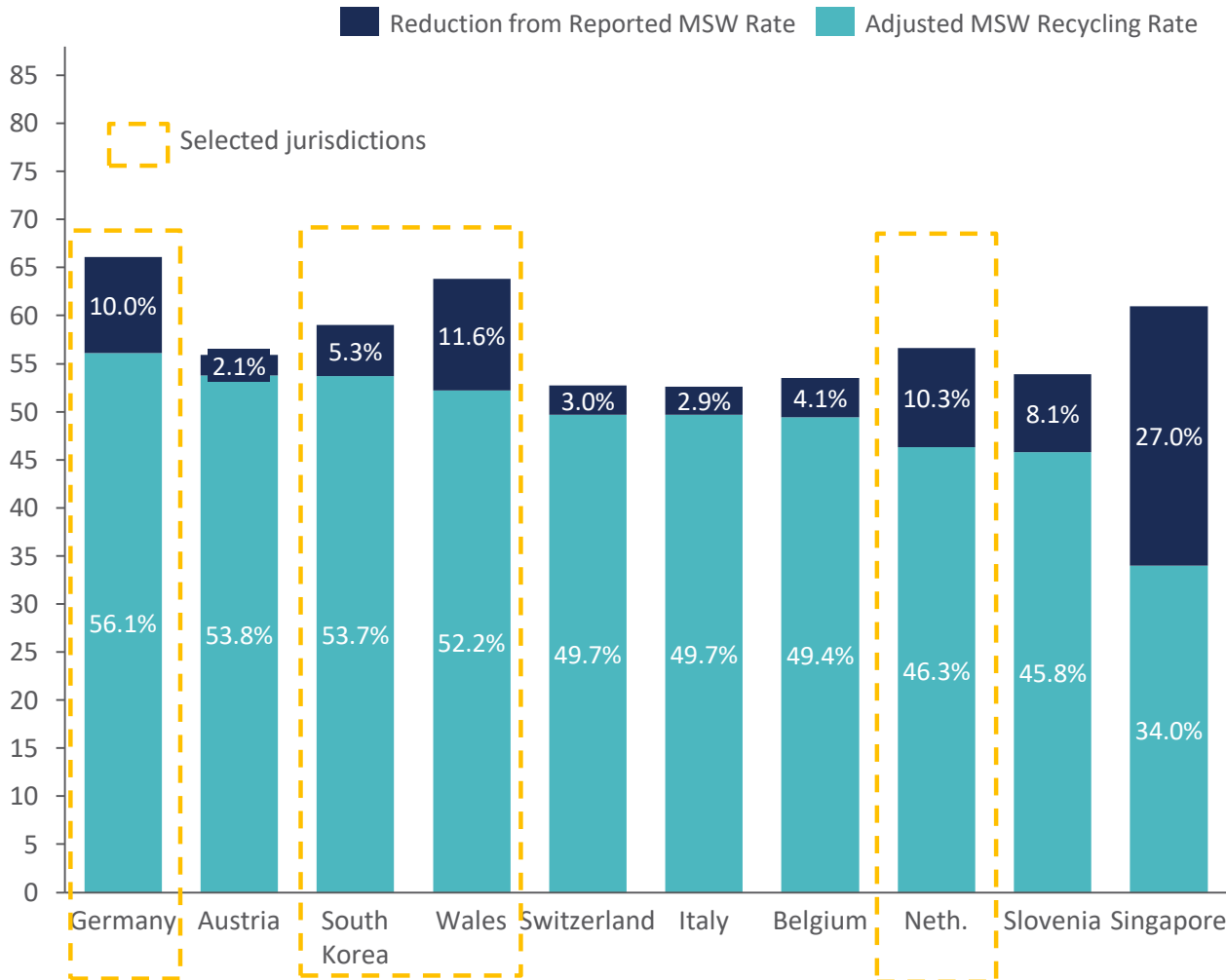


Rationale

- Analysis of key metrics provides a useful screen to identify potential jurisdictions
- However, it still leaves a significant number of potential jurisdictions and there are also data quality and depth issues that limit the rigour of the metrics-based selection alone
- Considering the focal points of the different waste systems ensures that the range of jurisdictions selected demonstrate a diversity of approaches to waste and provide potential for contrasting lessons for Victoria

1 All of the selected international jurisdictions have strong MSW recycling rates even after standardisation

Top 10 global jurisdictions – Adjusted MSW Recycling Rate %













Notes on MSW recycling rates and reasons for use of this statistic

- Comparing waste data across jurisdictions is difficult because of the **lack of robust jurisdictional data and consistent definitions**
- MSW chosen over total waste** as appropriate comparator statistics as:
 - Many jurisdictions do not report C&I or C&D waste statistics**
 - No robust international standardisation of C&I and C&D**
- Recycling rate preferable** to recovery rate as recovery usually includes energy recovery, which can mask poor recycling rates
- MSW recycling rates themselves** though suffer from problems – hence adjusted recycling rates included (see note below)

Note: Primary adjustments made to standardise data: removing C&D waste (e.g. Rubble), Non-'household-like' C&I, Overcounting MBT inputs, Wood incinerated rather than recycled, Undercounting of processing rejects
 Source: Eunomia, Recycling who leads the world, 2017

2 Different waste approaches: We also chose jurisdictions on the basis of different relative strengths across value chain

Waste focus	Jurisdictions with strong performances
Waste avoidance	<i>No outstanding jurisdiction identified</i>
Sorting & collection	 Wales  Germany
Recycling overall	 Germany  South Korea  Switzerland
Recycling organics	 South Korea  Taiwan
Waste-to-energy	 Netherlands  Denmark  Sweden







Jurisdictions with strong performances in focal areas were identified from 3 sources

- **Expert interviews**
- Scanning available **recycling, landfill diversion and waste to energy metrics**
- Review of existing **waste management academic literature**

In total, we analysed 4 international, 2 Australian jurisdictions and completed additional deep dives on three topics

Comparison jurisdictions

Additional deep dives

		MSW recycling rate (%)*	System focal points / reasons for selection	Area	Jurisdiction/s
International	Wales	 63	Recycling targets, Collections Blueprint, organics infrastructure, supporting local procurement & waste to energy approach	Waste avoidance	Multiple
	South Korea	 59	Volume based charging, high source separation, end to end food waste system	Responses to China Sword	Multiple
	Germany	 68	Mandatory landfill bans and comprehensive EPR scheme	Waste-to-energy	Multiple
	Netherlands	 57	Weight based charging and sustainable circular procurement		
Australia	South Australia	 54	Clear licensing regime, early and effective container deposit scheme		
	NSW (select elements)	 42	Clear strategy and policies, high regulatory standard for waste to energy		

Victoria has a 40% MSW recycling rate for comparison

* MSW recycling rate chosen as MSW statistics are most robust for comparison across jurisdiction, but other waste streams are included in this assessment. Rates differ slightly from Eunomia estimates quoted later in this report as years and inclusions are slightly different;

Source: Welsh Assembly Government, EuroStat, OECDStat, National Waste data 2016-17, NSW EPA, WARR Strategy progress

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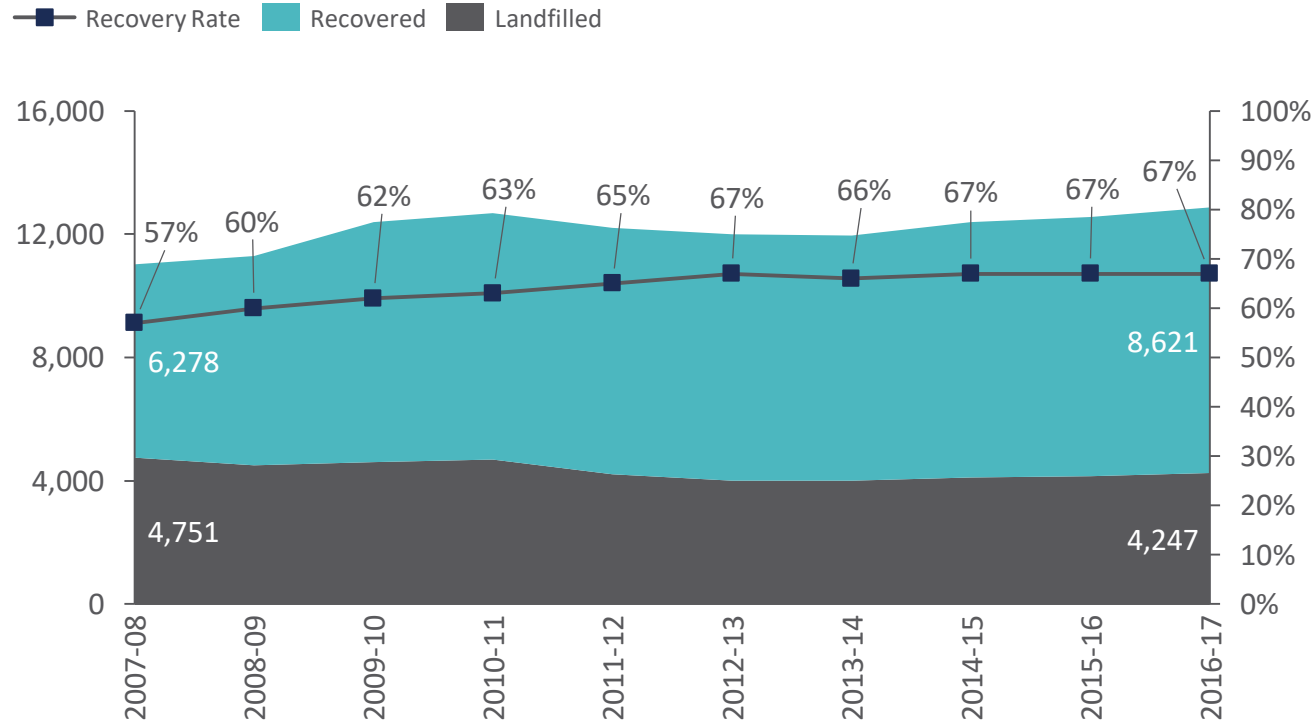
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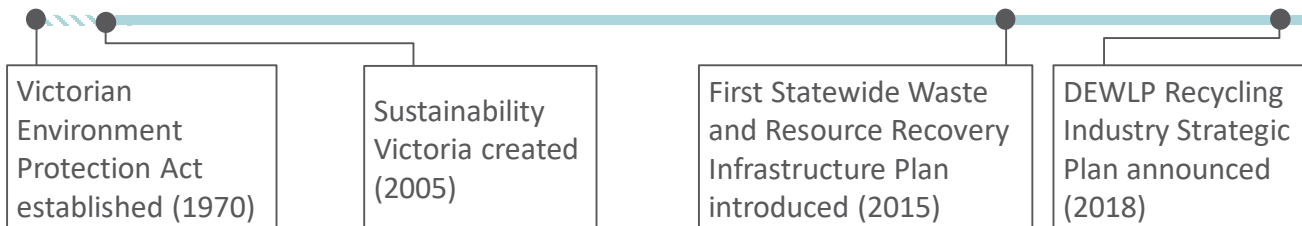
Victoria recovers around two-thirds of its total waste, which is a relatively strong performance by Australian standards

Trend in waste managed in Victoria 2007-08 to 2016-17, tonnes ('000); diversion rate of solid waste, %*



Key strengths

- High rate of C&D recycling (~80%)
- Overall Victoria has second highest rate of recycling nationally
- Landfills bans on “Category A” waste (i.e. paint, industrial transformers)
- Landfill levies apply to all waste streams
- Approx. 70% of households have access to kerbside garden waste collection
- Strong culture around recycling practices



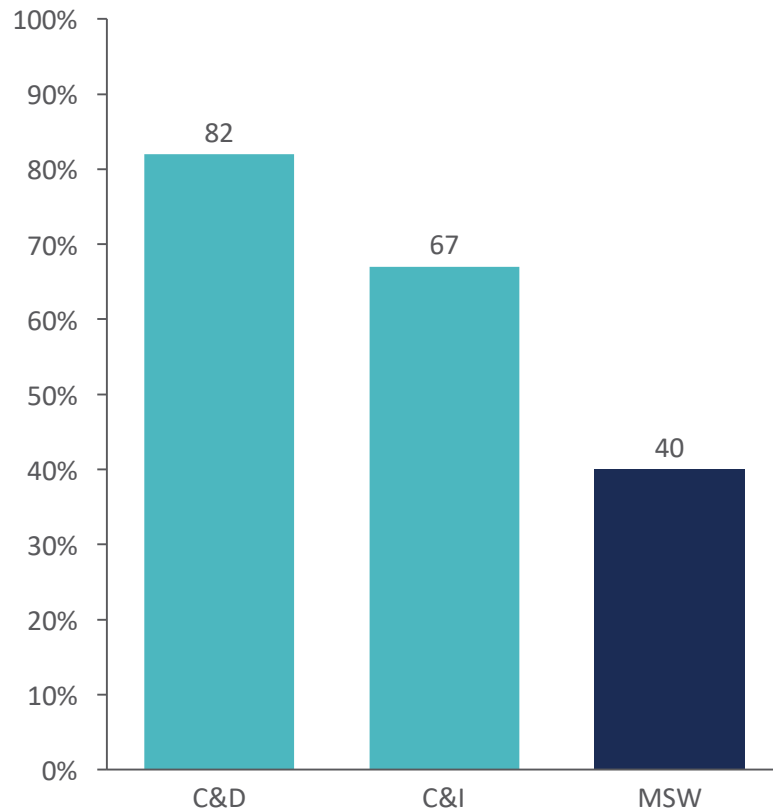
Note: Victoria Auditor General has pointed out that the recovery rate reported by Victoria may have inflated actual recovery rates so that true performer is actually much lower.

Source: Victorian Recycling Industry Annual Report 2016-17; Victorian Auditor General Report 2019

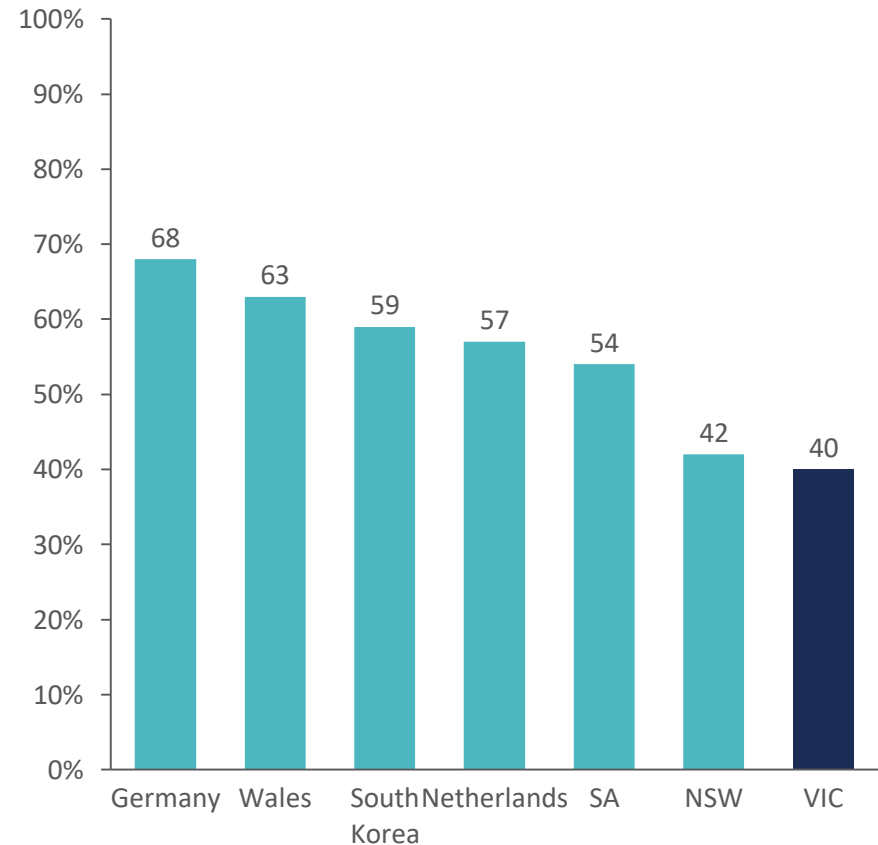
But while Victoria performs well on C&D and C&I, MSW recycling rates are low and lag both other states and international jurisdictions

Breakdown of waste generation and recycling rates in Victoria, 2015-16, %

Recycling rate by stream (%)



MSW recycling rate by jurisdiction, latest data, %



Notes: Only 2015-16 data available—Victorian Recycling Survey 2016-17 does not include detailed breakdowns of waste streams by C&D, C&I or MSW

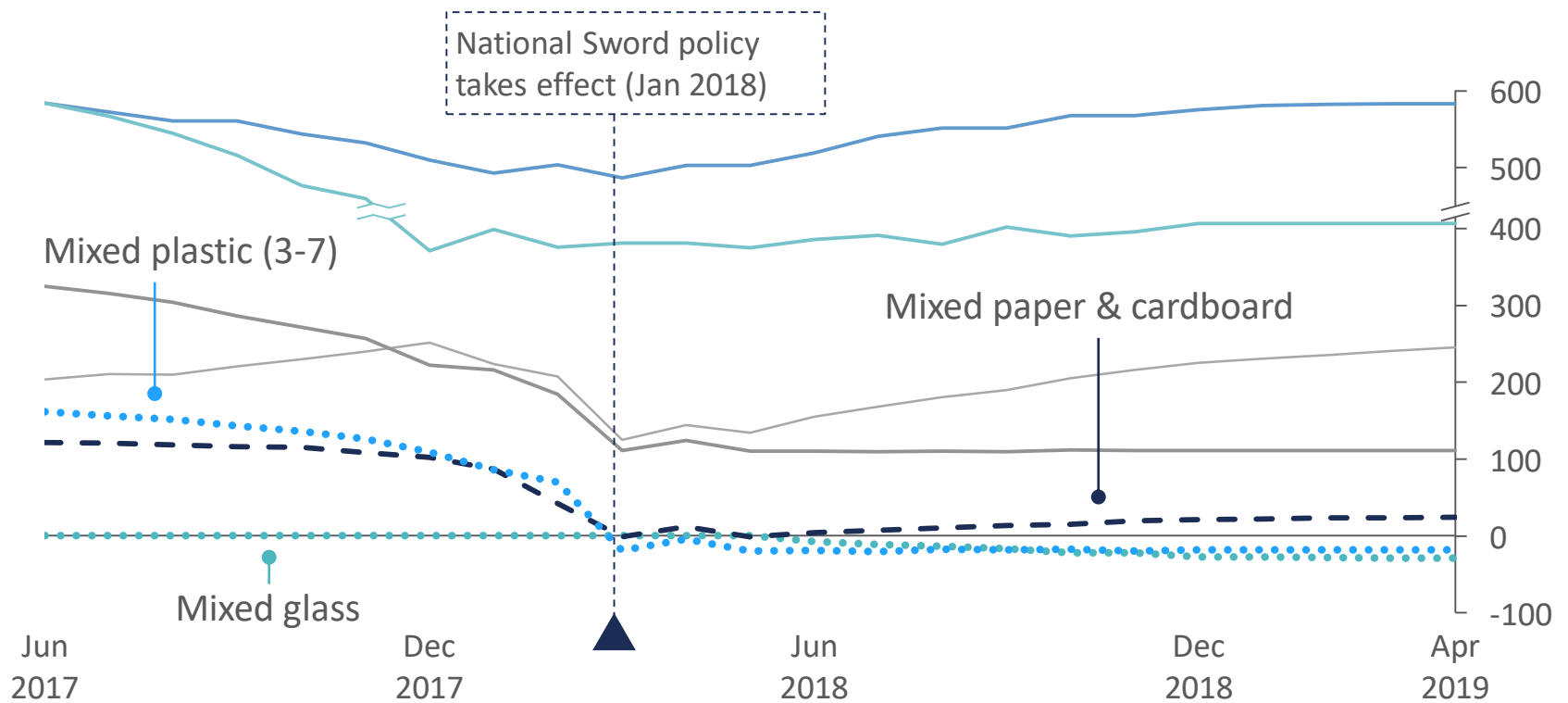
Source: Statewide Waste and Resource Recovery Infrastructure Plan, pp.83-87; Welsh Assembly Government, EuroStat, OECDStat, National Waste data 2016-17, NSW EPA, WARR Strategy progress

China's National Sword policy has also crashed prices of key end markets

Recovered kerbside materials commodity values, 2017-19

\$/tonne


- Glass - Mixed
- Fibre - Mixed paper & paperboard
- Plastic - Mixed (3-7)
- Fibre - Old corrugated cardboard
- Plastic - Mixed (1-7)
- Plastic - HDPE (2)
- Plastic - PET (1)



Notes: Eunomia 2017; latest available MSW data: 2015-16 (VIC), 2016 (S. Korea), 2016-17 (SA), 2017 (NSW, Netherlands, Germany), 2017-18 (Wales).

Victoria's system has strong cultural practices around recycling and reasonable infrastructure

Overall	<ul style="list-style-type: none"> Victoria's diversion rate has improved over time, but has flattened over recent years Parts of key infrastructure are outdated / inefficient; end markets for plastics, paper and glass in trouble Most people want to recycle, but more possible on avoidance, collection and incentives esp. re organics
System performance	<ul style="list-style-type: none"> Total waste recycling rate: 67% MSW recovery rate: 40% Total waste generation per capita: 2.1t

	Overall performance	Key features	Key challenges*
 Sector dynamics		Private sector operates majority of market, with some local govt control; consolidated firm structure across most of value chain	Market concentration in some waste and recovery services leads to low incentives to improve; contract structures for local councils; EPA focused on control of waste according to risk
 Infrastructure / Tech		Kerbside garbage and recycling; 630+ recovery and residual waste facilities	Some recycling/processing facilities outdated or inefficient; commingled recycling bins present contamination challenges
 End markets		Established end markets for C&D waste and metals; but underdeveloped in plastics, glass and organics	Reliance on export markets; low prices for plastics, paper/cardboard, glass ; limited market for food organics ; limited waste to energy capture
 Policy Enablers		Range of policy approaches incl: Waste levy, local government contracts; Recycling Infra Fund plus range of enabling approaches	Strategic planning and targets are lacking; patchy waste data and reporting ; Local govts often cost-focused and lack incentives to change; incentives for streamlined collection limited; few mandatory government policies e.g. wide-ranging landfill bans;
 Culture		Strong support for recycling practices for environmental and waste reduction reasons	Few incentives to change consumer and business behaviour to avoid and reduce contamination of waste streams

■ Indicates strong performance
 ■ Indicates some issues
 ■ Indicates major deficiencies

* Discussion with key experts suggest there are important improvements in discussion on several of these challenges (e.g. licensing approach)

Victoria's policy system utilises a range of approaches to drive system performance

■ Indicates key policy

	Avoidance (incl. re-use)	Collection	Sorting & recovery	Recycling & reprocessing	Disposal
Informing	<i>Love Food Hate Waste</i> community & business campaign to reduce food waste	Council campaigns to reduce waste contamination (i.e. how to recycle posters)		Public messaging to encourage continued recycling following impact of China Sword	EPA Victoria campaign to reduce illegal C&D waste dumping
		Annual collection of waste data through SV & EPA: Vic waste data portal			
Financing		Resource Recovery Infrastructure Fund or RRIF (\$22.5M total) available across the value chain, primarily collection, sorting and recycling / reprocessing (early focus MRFs, recent focus processing).			
Incentivising		Infrastructure grants under the RRIF (grants of \$40-\$500K under Round 4) designed to expand recovery and recycling operations and assist development of end markets develop in wake of China Sword. \$37m in additional funding under RISP to help system post-China Sword			Landfill levy Victoria to encourage waste reduction
		Local government contracts worth \$145m support the development of critical infrastructure across collection and recycling system			
		Existing product stewardship schemes (eg Redcycle, Mobile Muster) and championing Paintback		Through <i>Vic Mkt Development strategy</i> using a range of tools incl. finance, information, procurement to help develop end markets	
Mandating	Single-use plastic bag ban in Victoria from November 2019	Annual SV reports on local government kerbside recycling services		SV currently developing revised product specifications for public procurement (e.g. roadbase)	Landfill standards and bans of some goods e.g. some hazardous and e-waste
		Land use and zoning rules for waste sites			
		Licenses for multiple waste management actors and sites e.g. composting, waste to energy			
Enabling		Joint procurement support for councils under Waste and Resource Recovery Groups			
		Collaboration to increase food and organics collection through MWRRG training for metropolitan and regional councils			
		SV support for development of Regional Implementation Plans for waste and resource recovery infrastructure			
		SV-supported investment facilitation service			

Notes: Abbreviated summary – does not include all policy levers

Sources: National Waste Report 2018; Senate, Never Waste a Crisis, 2017; SV, Vic SWRRIP, 2018, interviews with experts

Victoria's waste sector is a mix of public and private actors, with 3 large firms responsible for the majority of municipal processing

Actor	Description of role
<p>Government</p>	<ul style="list-style-type: none"> • DELWP playing key planning and strategy role; EPA Victoria & local councils regulate and Sustainability Victoria has a primarily project delivery focus; EPA approach is risk-based. Few mandatory policies geared to promote sector-wide change (i.e. EPR) • Local government responsible for procuring waste management and recycling services; councils typically contract collection to large firms i.e. SOLO and Cleanaway; some drop-off centres are council-owned. Contracts often very long time periods (e.g. 15 years) • Council contracts driven mostly by cost factors because of rate-capping: end markets and sustainability factors are given lower-order consideration due to lack of incentives
<p>Private sector</p>	<ul style="list-style-type: none"> • Large companies operate most collection; recycling and recovery facilities under contract from councils; smaller firms involved in some collection activities • Metropolitan MRFs are highly concentrated: three companies process the majority of metropolitan waste (SKM, Visy, PolyTrade) • Compliance issues identified with some key MRFs, caused in part by insufficient technology for sorting, collapse of key end markets (creating stockpiles of paper, plastics, glass), and instances of poor management • C&I and C&D sector is highly competitive, with low barriers to entry; waste trading is commonplace; some illegal dumping in the C&D sector
<p>Households / businesses</p>	<ul style="list-style-type: none"> • Strong general support for recycling and recovery from both households and businesses, though MSW recovery rates remain low compared to key jurisdictions • Households do not play a significant role in source separation of recyclables as most kerbside collection is comingled. Limited collection of food waste and usually not separately from garden organics • Households have few incentives to reduce waste and no container deposit scheme • Strong uptake of garden organics, though food organic collection lags behind

Infrastructure & technology in Victoria is fit for purpose but outdated in parts, and is not geared to quality product needs in end markets

Value chain				
	Collection	Sorting & recovery	Recycling & reprocessing	Disposal
Types of infrastructure / tech in use	<ul style="list-style-type: none"> ▪ Kerbside garbage collection (97% of households); commingled recycling for (96%); and kerbside garden waste (70%) ▪ Kerbside FOGO¹ collection (limited) ▪ Commercial collection services (skips, hoppers/ trailers) ▪ Waste drop-off & hard waste collection 	<p>401 recovery facilities statewide, including:</p> <ul style="list-style-type: none"> ▪ Material recovery facilities (21) ▪ Drop-off centres (36) ▪ Resource recovery centres (transfer stations) (282) ▪ Bulk haul consolidation centres (9) ▪ Specific recovery centres i.e. for C&D or scrap metal (53) 	<p>160 recovery facilities, including:²</p> <ul style="list-style-type: none"> ▪ Glass fines benefaction ▪ Concrete/brick recycling ▪ Rubber recovery ▪ Plastics reprocessing (incl. new advanced <i>plastics recycling facility in Somerton</i>) ▪ Organics recycling (aerobic and anaerobic composting, water) ▪ Thermal desorption for hazardous waste ▪ E-waste recycling (incl. batteries) 	<ul style="list-style-type: none"> ▪ Landfill (72 landfills operating: 47 licensed, 25 landfills exempt from licensing)
Key challenges	<ul style="list-style-type: none"> ▪ Commingled recycling limits reprocessing uses ▪ Limited collection of food organics ▪ Limited separation at source increases contamination 	<ul style="list-style-type: none"> ▪ High dependence on MRFs, despite some outdated infrastructure and ongoing compliance problems ▪ Location of facilities 	<ul style="list-style-type: none"> ▪ Lack of suitable reprocessing capacity, especially in paper, plastics and organics ▪ Infrastructure gaps anticipated across many reprocessing streams 	<ul style="list-style-type: none"> ▪ Limited landfill capacity, especially in metropolitan Melbourne ▪ WtE discussion paper but no comprehensive waste to energy policy or infrastructure

Notes: ¹ FOGO is combined food and garden organic materials ² Many facilities process one or more material streams; Somerton facility will have capacity to process 70,000 tonnes of plastic each year, or 10% of all plastic waste generated across Victoria

End markets for metals and C&D waste work relatively well— but there are gaps in plastics, glass, paper & organics

- Indicates strong end market
- Indicates satisfactory end market
- Indicates major challenges

	Plastics	Metals	Glass	Paper and cardboard	Organics	Masonry, soil, aggregates
End market status	●	●	●	●	●	●
Description of market	Markets for some types of plastic are strong domestically (PET and HDPE). One-third of plastics are sorted into mixed plastic, which has limited value	Recovered aluminium attracts high prices and has been relatively stable. Market for C&D metal recycling is also strong.	End markets typically split into glass cullet for glass manufacturing, and glass fines (which compete with sand).	Most paper is sorted into a single 'mixed paper' product. Australian paper mills cannot accept more of this product.	Used mostly for composting and animal feed purposes; other applications incl. waste to energy or biofuels.	Usually generated by C&D activity. Applications include aggregate, concrete reuse, housing. Prices have been stable or increased over time.
Significant market issues	Price for mixed plastics has dropped from \$250/t to below \$0/t. 50% of mixed plastics were exported before Nation Sword policy introduced. Reliance on international export markets, limited markets for flexible plastics.	Market functions well but is heavily reliant on international export markets for processing of MSW	The value of mixed recycled glass is very low. Collection practices increase contamination (i.e. mixing coloured glass), which limit potential uses. Prone to stockpiling when prices are low.	Reliance on international export markets. Exports have reduced by two-thirds, price for mixed paper dropped from \$225/t to effectively \$0/t	Market is under-developed. Key issues include infrastructure location & quality, and voluntary manufacturing and product standards.	Market functions well, but there are few incentives to transition from use of virgin materials in construction; proximity to facilities a major factor in this

Note: End market for plastics may improve following opening of Somerton advanced plastics recycling facility; Some issues around illegal dumping in C&D waste stream

SOURCE: Stakeholder interviews; Sustainability Victoria: Recovered Resources Market Bulletin March 2019; Victorian Statewide Waste and Resources Recovery Infrastructure Plan 2015-16; Victorian Market Development Strategy for Recovered Resources 2016, p.11 (organics), p.12 (masonry etc.)

Strong cultural and behavioural norms in favour of recycling in Victoria

	Description of recycling / recovery norms	Key reason for performance
Household / Communities	<ul style="list-style-type: none"> • 95% of Victorians agree that recycling is important • Kerbside recycling is an entrenched practice, with strong community expectations around provision of commingled recycling bins • Some issues around contamination of household recycling • More to do on waste avoidance practices 	<ul style="list-style-type: none"> • Long-term norm around recycling • Environmentally aware population • Commingled recycling • Avoidance behavior is long-term strategy
Business	<ul style="list-style-type: none"> • 8 in 10 SMEs view reducing waste and increasing recycling as a key to being a sustainable & ethical business • High proportion of C&I (67%) and C&D (82%) waste is recycled 	<ul style="list-style-type: none"> • Strong market for recycled C&D waste • Good C&I recycling infrastructure provision in metropolitan areas
Government	<ul style="list-style-type: none"> • Highly engaged public sector • Comprehensive strategic planning around recycling and recovery sector • Development of Victorian Government Social Procurement Framework, with strong emphasis on sustainability 	<ul style="list-style-type: none"> • Actionable strategic plans for infrastructure and end market development, dedicated sustainability agency

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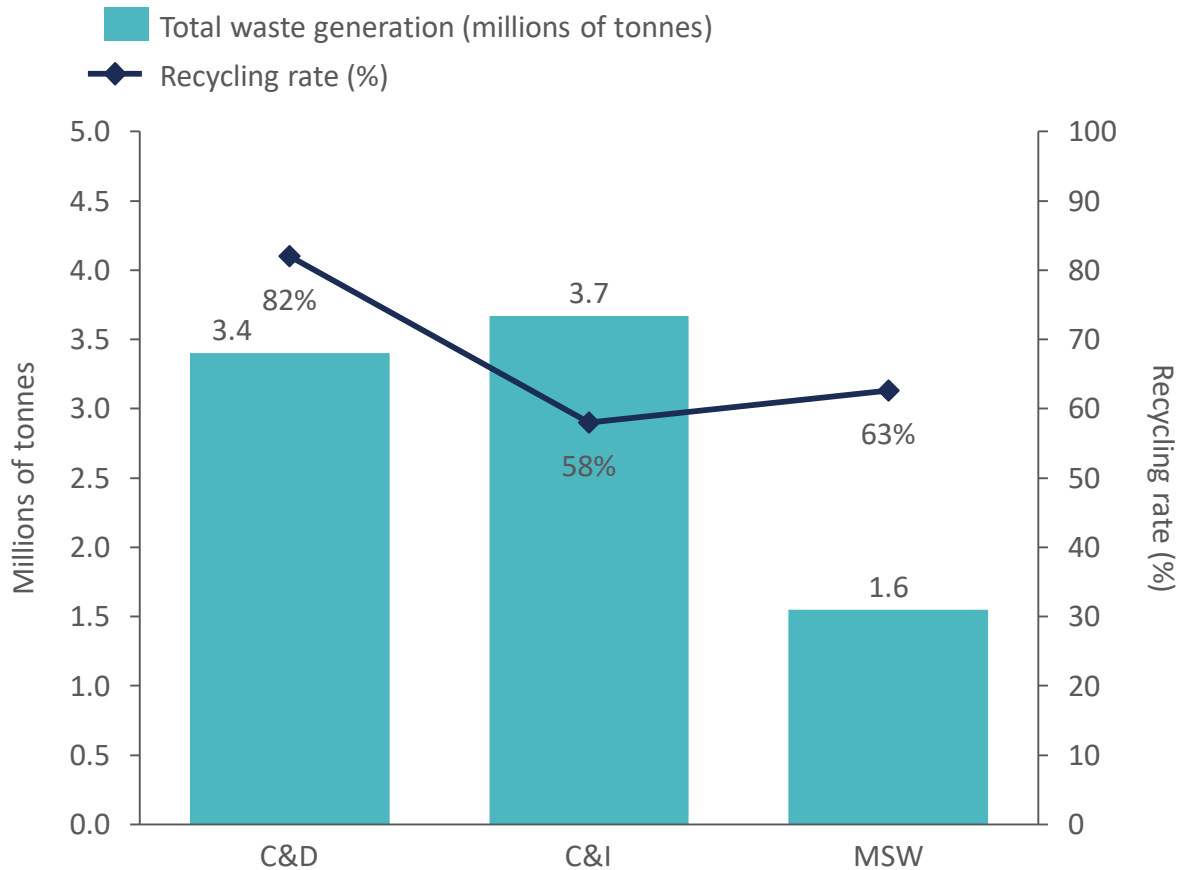
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Bibliography

Wales has exhibited strong recycling performance for C&D and MSW waste streams in particular

Breakdown of waste generation and recycling rates in Wales

Wales waste generation and recycling rates by waste stream (millions of tonnes, %)



Key highlights

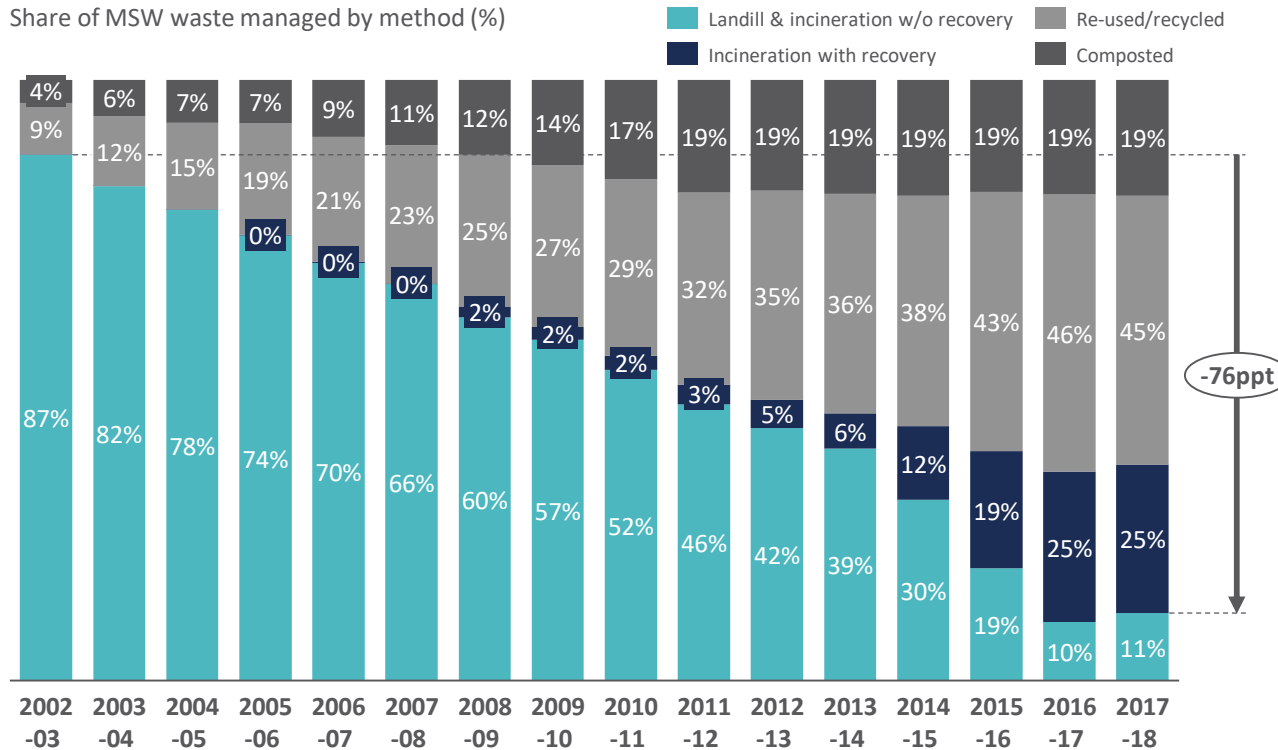
- Wales generated **3.4 million tonnes** of waste for **C&D**, **3.7 million tonnes** of waste for **C&I** and **1.6 million tonnes** of MSW (using 2012-13 data for C&D, 2012-13 data for C&I and 2017-18 data for MSW)
- C&D** waste made up **~39%** of total waste generation, while **C&I** and **MSW** made up **~43%** and **~18%** respectively
- Based on the most recent data from StatsWales and Natural Resources Wales, Wales' **recycling rates** sit at:
 - 82% for C&D waste (2012-13)***
 - 58% for C&I waste (2012-13)**
 - 63% for MSW (2017-18)**

Notes: Total waste generated not calculated due to inconsistent years: C&D data from 2012-13, C&I data from 2012-13, MSW data from 2017-18; measuring waste in tonnes as opposed to other methods such as cubic metres will increase the size of C&D waste due to high-density materials such as concrete; * based on waste generated, excluding hazardous waste and naturally occurring soils and stones
Source: StatsWales, Natural Resource Wales

Over the past 15 years Wales has reduced its share of MSW going to landfill to just ~10%

Landfilling of municipal solid waste has declined by 76ppts over 15 years

Share of MSW waste managed by method (%)



Wise About Waste Strategy (2002-2010)

Waste Infrastructure Procurement Programme (2008-)

Towards Zero Waste Strategy (2010-present)

Collections Blueprint (2011-present)

Cardiff incinerator fully operational (2014)

Underpinned by landfill and recycling rate targets (2002-2050)

Further described in deep dives

Key takeaways






- Landfill and incineration w/o recovery has seen a **76 percentage point decrease** between 2002-03 and 2017-18, driven by the **Landfill Allowance Trading Scheme & landfill taxes** (to implement the EU Landfill Directive and support strong **Recycling Targets**)
- Recent increases in **incineration with recovery** due to operation of **large Cardiff incineration plant** from early 2013-14
- Strong composting-specific targets and **separation of food organics** led to a **15 percentage point increase in composting** between 2002-03 and 2011-12

Notes : Based on MSW statistics from StatsWales, excludes small % of waste not categorised
 SOURCES: Welsh Assembly Government, StatsWales, Wales Audit Office, expert interviews

Drivers summary: Wales has become a leader in recycling through strong targets and a consistent policy approach

■ Indicates strong performance
■ Indicates some issues
■ Indicates major deficiencies

Overall	<ul style="list-style-type: none"> • Second highest recycling rate in Europe for MSW, currently sitting at 62.7% • Towards Zero Waste strategy with statutory recycling target for 2025 (70%) for each waste stream • Strong culture of separation at source, robust collection and excellent performance in organics, though other end markets less well developed
System performance	<ul style="list-style-type: none"> • Total waste generation per capita: 2.8t per year* • Overall recovery / recycling rate: 72% / 68%* • MSW recovery / recycling rate: 87% / 62.7%

Overall performance	Description	Key strengths
Sector dynamics 	<div style="text-align: center;">●</div> <p>Competitive sector and links to broader UK market have enabled strong investment</p>	<p>Local authorities have been supported to form consortiums to more effectively negotiate deals with private sector and mission driven organisations such as WRAP Cymru have been established</p>
Infrastructure / Tech 	<div style="text-align: center;">●</div> <p>Modern infrastructure including new collection trucks, organics treatment and some WtE</p>	<p>Sophisticated collection trucks that can collect 9 different waste streams, and network of anaerobic digestion</p>
End markets 	<div style="text-align: center;">●</div> <p>Well developed end markets for organics and metals, but little local reprocessing of plastics – reliant on international markets</p>	<p>Strong organics markets, development of brokerage services for end markets and funding programs for businesses</p>
Policy Enablers 	<div style="text-align: center;">●</div> <p>Statutory recycling rate targets to drive performance, infrastructure investment and long term strategies</p>	<p>Clear direction and targets for Welsh local authorities and businesses linked to funding support</p>
Culture 	<div style="text-align: center;">●</div> <p>Strong culture of sorting recycled products means less co-mingling of materials and overall waste generation</p>	<p>Simple and convenient methods made available for people to sort and dispose of waste, as well as consumer engagement programs and a strong Welsh national identity of distinctiveness</p>

Notes: *using 2012-13 data and Natural Resource Wales definitions of recovery and recycling; waste generation per capita & overall recovery based off most recent figures for MSW (2017-18), C&D (2012-13) and C&I (2012-13); recovery rate includes all MSW, C&D and C&I which is reused/recycled, composted or WtE; recycling rate includes all MSW, C&D and C&I which is reused/recycled or composted (excluding hazardous waste and naturally occurring soils and stones), MSW recovery rate includes municipal waste which is reused/recycled, composted or WtE; MSW recycling rate includes reuse/recycling and composting
 Sources: Welsh Assembly Government, EuroStat, expert interviews, StatsWales, Natural Resources Wales

The Welsh sector operates similarly to Victoria, with local authorities contracting with the private sector for waste services

Actor	Description of role	Key differences to Victoria
Government	<ul style="list-style-type: none"> • Four levels of government involved in waste management in Wales – EU, UK, Welsh and local authorities • Welsh Government has principal responsibility since Devolution for funding and strategy for waste management within Wales • Local authorities (22 in total) contract for waste collection and treatment, including long term contracts to support infrastructure development • Welsh Government is also the main funder of waste management, providing grants to local authorities that cover about 85% of the cost of services 	<ul style="list-style-type: none"> • Additional layer of government in the EU (currently), which has been a driver of change with some strong policy interventions, e.g. EU Landfill Directive
Private sector	<ul style="list-style-type: none"> • Private waste management firms are typically contracted out for the provision of processing / disposal facilities by local authority consortia / individual local authorities • Diverse range of market participants, including UK and EU firms 	<ul style="list-style-type: none"> • Sector appears to be less concentrated than Victoria
Households / businesses	<ul style="list-style-type: none"> • Responsible for appropriate disposal and high degree of sorting of materials, though there is some variation in practices between different local authorities 	<ul style="list-style-type: none"> • Greater degree of source separation of waste gives households and businesses more responsibility
Other	<ul style="list-style-type: none"> • Mission driven organisations such as WRAP Cymru provide Wales-specific support on behalf of the Welsh Government including its Collaborative Change Programme for local authorities as well as other initiatives to support Wales' resource management and re-use sectors 	<ul style="list-style-type: none"> • Does not appear to have a mission driven organisation similar to WRAP Cymru

The Welsh Government has used a broad range of policy tools, both mandating performance and providing incentives and financing

■ Indicates key policy

	Avoidance (incl. re-use)	Collection	Sorting & recovery	Recycling & reprocessing	Disposal
Informing	Road map for reuse	Collections Blueprint			
	Consumer engagement programs / campaigns (e.g. Love Food, Hate Waste)				
	Quarterly data from WasteDataFlow, reports and sector plans (C&D, C&I, MSW etc.)				
	Towards Zero Waste Strategy				
Financing			Circular Economy Fund (£6.5m)		
			Waste Infrastructure Procurement Programme		
Incentivising	5 pence charge for single use plastic bags (2010)				Landfill tax – increased by £8 increase per annum from 2009-10 (48 pounds) to 2014-15 (80 pounds)
	UK plastic packaging tax (effective 2022)				
Mandating	Waste Prevention Programme	Mandatory provision of separate collection for paper, metal, plastic and glass for businesses from 2015			EU Landfill Directive
			Statutory recycling targets (£200 penalties per tonne under target)		
			Landfill Allowances Scheme (LAS) – to support UK compliance with EU Landfill Directive to reduce BMW to landfill		
Enabling	Sector plans to support Towards Zero Waste (e.g. MSW, C&I, C&D)	Household Waste Recycling Centres and bring sites for households and businesses			
	Eco-design initiatives including design for deconstruction (D4D) which considers materials used in building	Collaborative Change Programme – working with local authorities to implement Collections Blueprint			
Operating/ contracting		Local authorities contract private sector for collection and recovery, some ownership by local authorities of organics reprocessing infrastructure			

Deep dive: Wales uses recycling targets to drive long term focus on waste management improvement



Summary

- Wales has used a series of recycling targets as pillars of its waste management strategies since 2002, providing a strong focus around which to structure its other policies and driving continuous improvement in waste system performance

Description

Phase 1: 2002-10

- Wales' first waste management strategy, **Wise about Waste (2002)**, was developed partly in response to the 1999 EU Landfill Directive, which set limits on BMW to landfill
- Wise about Waste set target for local authorities to **reach 40% recycling and composting of MSW by 2009-10**, including at least 15% recycling and 15% composting
- Local authorities received **special grant funding to improve their collection infrastructure** and support for contracting with private sector

Phase 2: 2010-

- In 2010, new waste management strategy **Towards Zero Waste** was introduced, with new statutory targets that apply to all waste streams (MSW, C&I and C&D):
 - 2025: **Recycling rate of 70%** (90% for construction)
 - 2050: Aspirational recycling rate of 100%
- Local authorities that do not meet targets can be **fined £200 per tonne**
- It also includes a **target to reduce waste by 1.5%** per year across all sectors to 2050
- Five sector plans (e.g. municipal, C&I, C&D...)** were developed to outline how each sector will meet the statutory targets

Results

- Recycling targets have largely been met (see next slide), but the target for waste prevention has been harder to achieve
- Where local authorities have not met their targets, fines have generally been waived
- The introduction of prompt, quarterly data reports by local authorities on the provision and performance of waste collection and treatment have assisted in ensuring local authorities are meeting targets¹
- Inclusion of a composting target likely slowed the uptake of WtE in Wales and has led to Wales' historically strong performance on organics

Applicability to Victoria

- Victoria does not currently have a recycling or recovery target in order to drive overall system performance and supporting funding priorities
- Experience of Wales demonstrates that targets can be useful in maintaining long term focus, but to be effective they need to be accompanied by funding streams, detailed sector planning and a rigorous data collection approach to ensure targets can be met

Notes: Wales currently allows incinerator bottom ash to be included in its recycling figures, which is not allowed in England or the EU

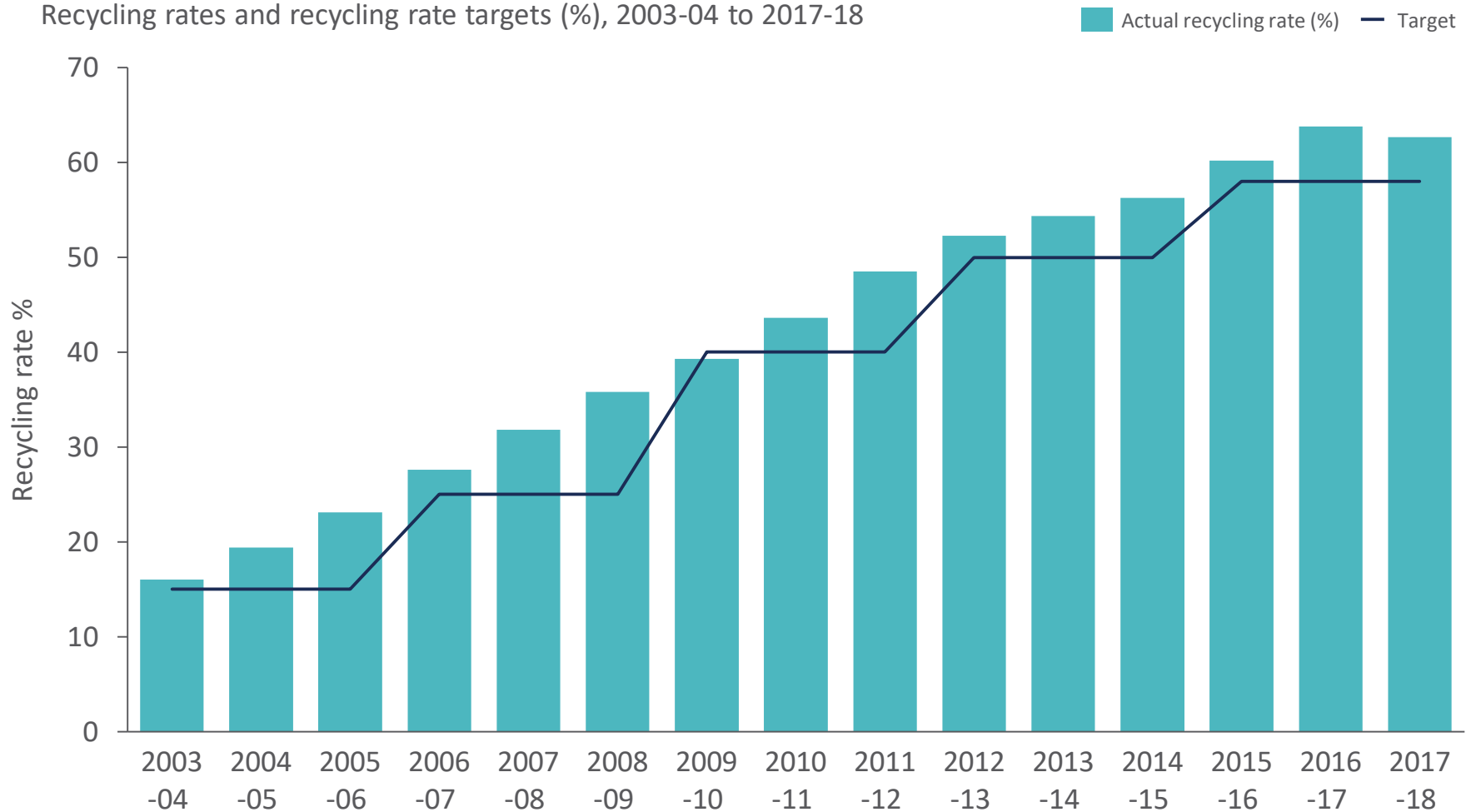
SOURCES: StatsWales, Welsh Assembly Government, expert interviews;

¹<http://www.wastedataflow.org/documents/guidancenotes/Wales/OtherGuidanceNotes/LAS%20LART%20Reporting%20Protocol.pdf>

deep dive (cont): The targets have clearly been a key driver of improvements in municipal recycling rates since 2003-04

Municipal waste recycling rates in Wales

Recycling rates and recycling rate targets (%), 2003-04 to 2017-18

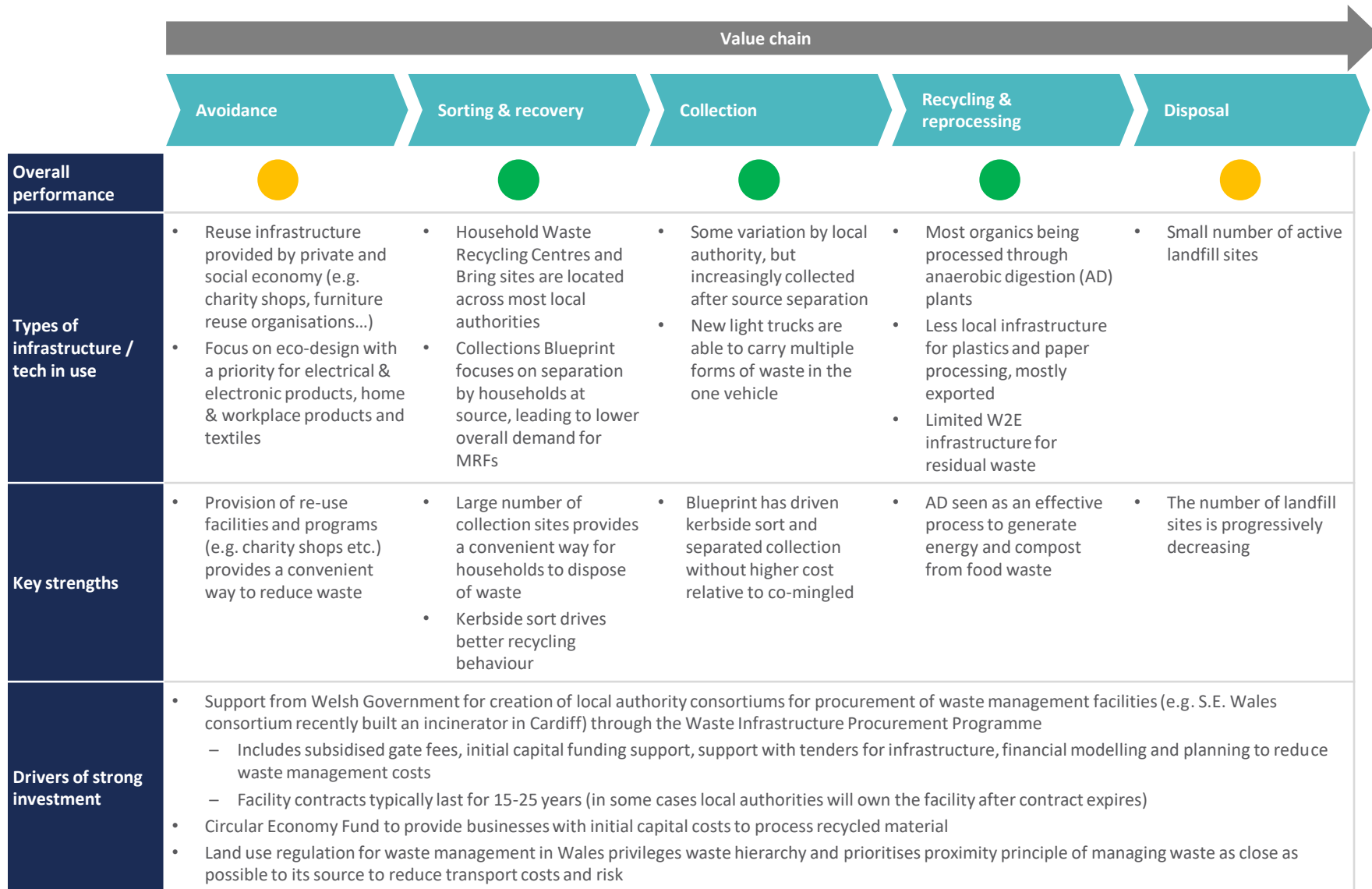


Notes: Recycling rate includes waste that is reused, recycled and composted

SOURCES: Welsh Assembly Government, Wales Audit Office, expert interviews, StatsWales

Infrastructure generally strong, especially in collection and organics, with less local reprocessing of plastics and paper

- Indicates strong tech / infrastructure
- Indicates satisfactory tech / infrastructure
- Indicates tech / infrastructure deficiencies



Deep dive: Stimulating private sector investment through support for local authorities to procure infrastructure needs

Summary	<ul style="list-style-type: none">• The Waste Infrastructure Procurement Programme (WIPP) has supported local authorities to procure long-term contracts and achieve economies of scale for the treatment of food and residual waste, ensuring modern waste management infrastructure to meet Wales' recycling targets
Description <ul style="list-style-type: none">• WIPP was launched in 2008 to help local authorities more effectively procure treatment capacity• Welsh Government supports local authorities by guiding them through a consistent project development and procurement process, and use of standard contract to increase market certainty and clarity• It also provides financial support of 25% of gate fees, and in some cases has made capital contributions• Areas of infrastructure focus have been:<ul style="list-style-type: none">– Food waste treatment (partly to address immediate need to divert BMW from landfill to meet EU Directive)– Treatment of residual waste	Results <ul style="list-style-type: none">• There are currently ten projects in WIPP, involving 19 out of 22 local authorities in Wales• Investment enabled through WIPP has helped drive down landfill usage in Wales, with only ~25% of Landfill Allowance used by local authorities in 2016-17• Aggregation of local authorities into consortium has ensured projects are large enough to attract competitive interest, averaging over 30 bidders per project, reducing costs – local authorities outside WIPP are experiencing higher residual waste treatment costs and are more reliant on landfill• Involvement of Welsh Government enables it to ensure infrastructure investment meets high standards and aligns with national policy priorities (e.g. AD for food waste)
Applicability to Victoria	<ul style="list-style-type: none">• Victoria already has some similar programs in place, including the Resource Recovery Infrastructure Fund administered by Sustainability Victoria; and some of the functions performed by the Metropolitan Waste and Resource Recovery Group• WIPP provides a model for a more assertive investment by government in infrastructure development and operation, providing ongoing subsidies for gate fees, and using that investment to lift waste management standards

Deep dive: Wales' Collections Blueprint provides guidance to local authorities on best practices for collection and sorting



Summary

- The Welsh Government has developed a Collections Blueprint for local authorities that provides guidance on best practices to improve collection and sorting systems, and funds authorities to undertake economic modelling to test the Blueprint against other system options

Description

- The Collections Blueprint was first released in the Welsh Government in 2011 as part of the Municipal Sector Plan to **support the Towards Zero Waste strategy**
- It outlines **best collection infrastructure and practices** to achieve high rates of quality recycling, along with significant cost reductions and improved sustainability
- One aim of the Blueprint was to **improve recycling behaviour and reduce residents' confusion** by providing a consistent approach across local authorities
- The focus of the Blueprint is **strong separation by households and further kerbside sort** to produce higher quality recyclates
- The Blueprint is being implemented through a **Collaborative Change Programme** in which the Welsh Government funds local authorities to evaluate their collection services – including modelling the performance of the Blueprint against other options

Results

- The Collections Blueprint has so far been **adopted by 11 of 22 local authorities in Wales**
- While **some local authorities were initially resistant**, the Collaborative Change Programme has increased openness
- Assessment has generally found that the Blueprint is at **least cost competitive with other approaches**, and generally leads to improved recycling performance
- The focus on separation at source results in **a higher material quality** with less contamination



Kerbside collection in Conwy



Single-pass vehicles in Anglesey

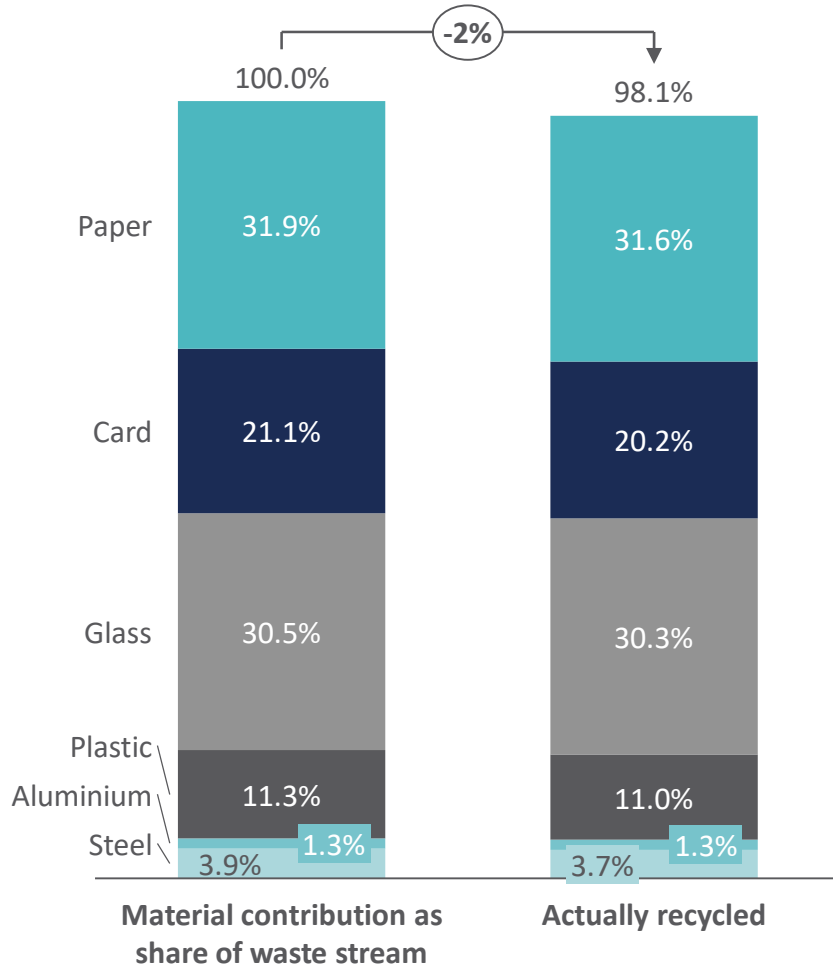
Applicability to Victoria

- Victoria does not currently drive a single approach for consistent sorting and collection practices across local governments
- The Welsh Government has managed to get more than half of its local authorities to adopt collection best practices through close collaboration between the two bodies as well as funding to investigate the economic viability and recycling outcomes of new best practices for each local authority
- Success will depend on the overall cooperation between Government and local authorities, Government's willingness to fund economic modelling as well as local authorities' willingness to adopt new collection processes

Deep dive (cont): Analysis for the Blueprint has shown that co-mingled waste collection leads to greater loss of material due to contamination

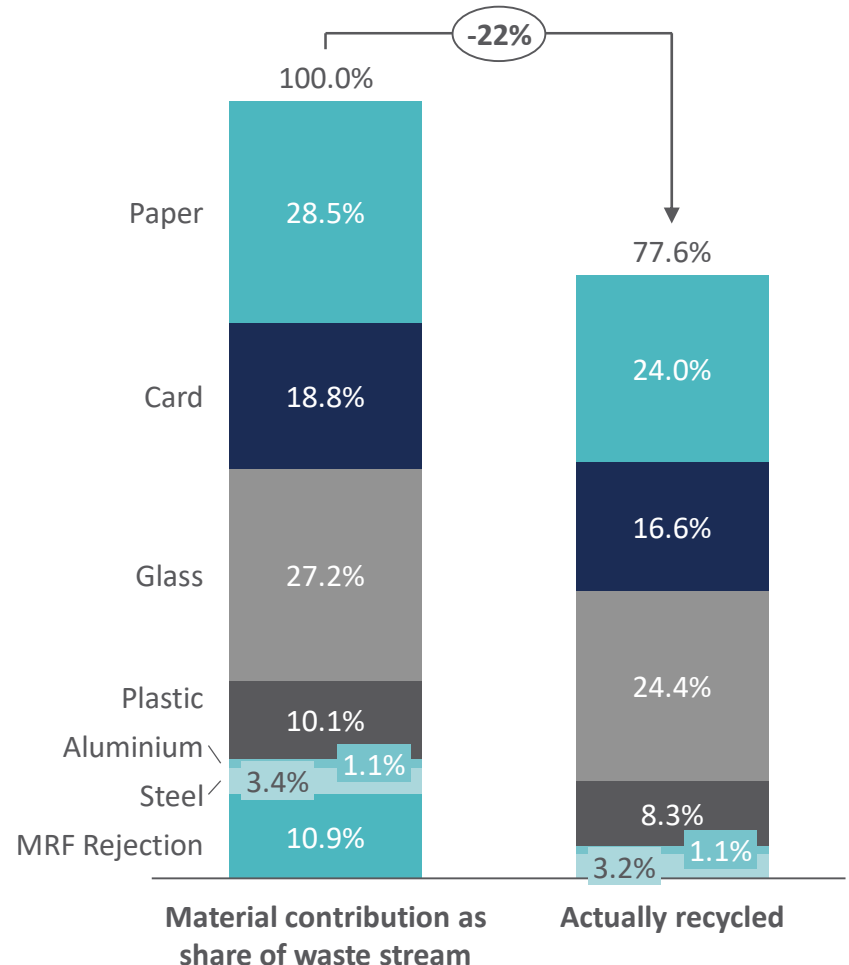
Source separated contamination rates

% of material contribution vs. recycled



Co-mingled separated contamination rates

% of material contribution vs. recycled



Notes: Data based on 2014-15 numbers

SOURCES: Eunomia

Deep dive: Wales has recently established thermal WtE facilities, following utilisation of other approaches such as AD



Summary	<ul style="list-style-type: none"> The Welsh Government has provided financial support to local authority consortiums to procure infrastructure to meet recycling and landfill targets This has seen the take up of waste to energy facilities to deal with residual MSW; however a priority was initially put on anaerobic digestion (AD) over incineration Wales local authorities have recently built a large incinerator in Cardiff in response to waste and recycling targets with construction beginning on a second incinerator in North Wales
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Description	Results
<ul style="list-style-type: none"> The Welsh Government's Waste Infrastructure Procurement Programme (WIPP) provided financial support to local authorities to procure the necessary infrastructure to meet recycling and landfill targets and included AD facilities for organics and incineration facilities for residual waste AD infrastructure was prioritised by the Welsh Government who were providing the funding and economic modelling was done prior to the program to identify the ideal waste management systems to provide funding for — Waste to energy solutions were chosen over mechanical biological treatment (MBT) facilities due to additional treatment of residual waste from MBT In 2010 the Cardiff City Council granted planning permission for an incinerator in Trident Park which was fully operational by 2014 The facility was procured by the Welsh Government (who pledged ~£100m over 25 years) and a consortium of five local authorities and would be built by Viridor, a private recycling company from the UK under a 25 year contract The facility has 350,000 tonnes of capacity and receives residual waste from the South East Wales consortium and other local authorities and businesses in the region The take up of incinerator technologies required R1 energy efficiency requirements set out by the EU to be met 	<ul style="list-style-type: none"> The Cardiff facility generates 250GWh of electricity or enough energy to power ~68,500 households So far Cardiff has been able to meet recycling and landfill targets with support from incineration facilities for residual waste; however, too much dependence on these facilities could mean Cardiff finds it challenging to meet future recycling targets — Cardiff could face finest of £10.45m between 2019 and 2025 if no improvement is made on 2016/17 recycling performance The Cardiff facility has faced recent challenges including lower energy generation due to lower calorific value from waste; and which may mean the capacity of the plant is increased The incinerator has seen some backlash from the community following concerns of pollutants and fumes from the facilities

Applicability to Victoria	<ul style="list-style-type: none"> Victoria does not currently have any large scale waste to energy facilities Learnings from Wales show us that waste to energy facilities can provide a solution for residual waste, but that other solutions for waste treatment further up the waste hierarchy should be prioritised in order to minimise dependence on this technology Despite the take up of waste to energy facilities, best practice standards for these technologies were still ensured
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Notes:

SOURCES: expert interviews, industry reports, Viridor

Agenda

Objectives and introduction to project

Summary of findings

Selection of jurisdictions

Overview of Victorian system

Jurisdictional case studies

Wales: Targets and collections

South Korea: Organics and overall recycling

Germany: Overall recycling, landfill bans and EPR

Netherlands: Circular economy and waste-to-energy

South Australia: Strategy and licensing

New South Wales: Strategy and Alternative Waste Treatment

Additional deep-dives

Waste avoidance

Responses to China's National Sword Policy

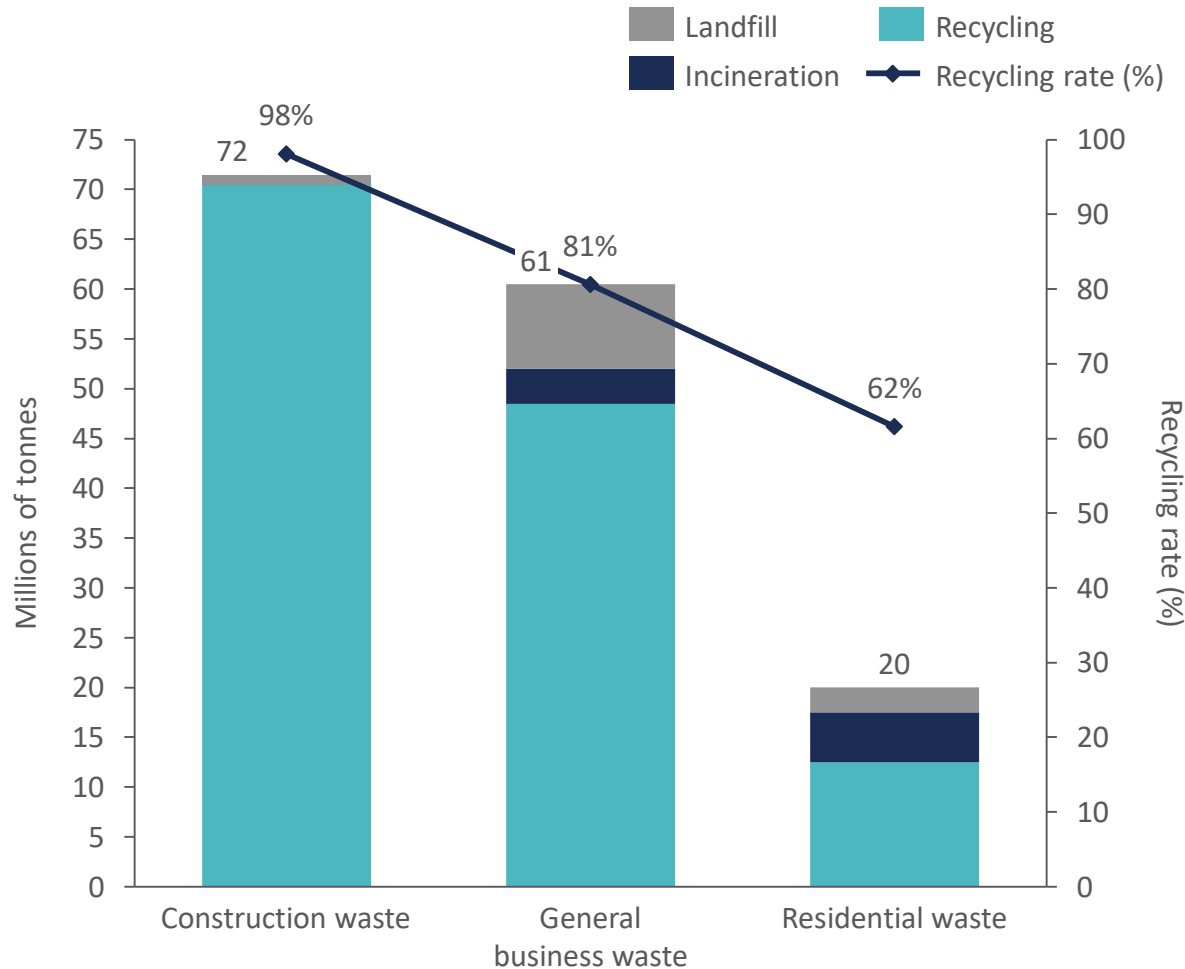
Waste-to-energy

Bibliography

Korea achieves high recycling rates across all waste streams

Breakdown of waste generation and recycling rates in South Korea, 2017

Waste generation by waste stream (millions of tonnes, %)



Key highlights

- South Korea generated a total of 151 million tonnes of waste in 2017
- Construction waste made up ~47% of total waste generation, while general business and residential waste made up ~40% and ~13% respectively
- According to the Ministry of Environment and Korean Environmental Institute’s Waste Report, as of 2017, South Korea’s recycling rates sit at:
 - 62% for residential waste
 - 81% for general business waste
 - 98% for construction and demolition waste
- While most of the waste going to landfill is from businesses, most of the waste used for incineration comes from residential waste

Notes: Residential waste includes municipal wastes, business waste (for businesses that generate less than 300kg/day), and construction waste resulting from households

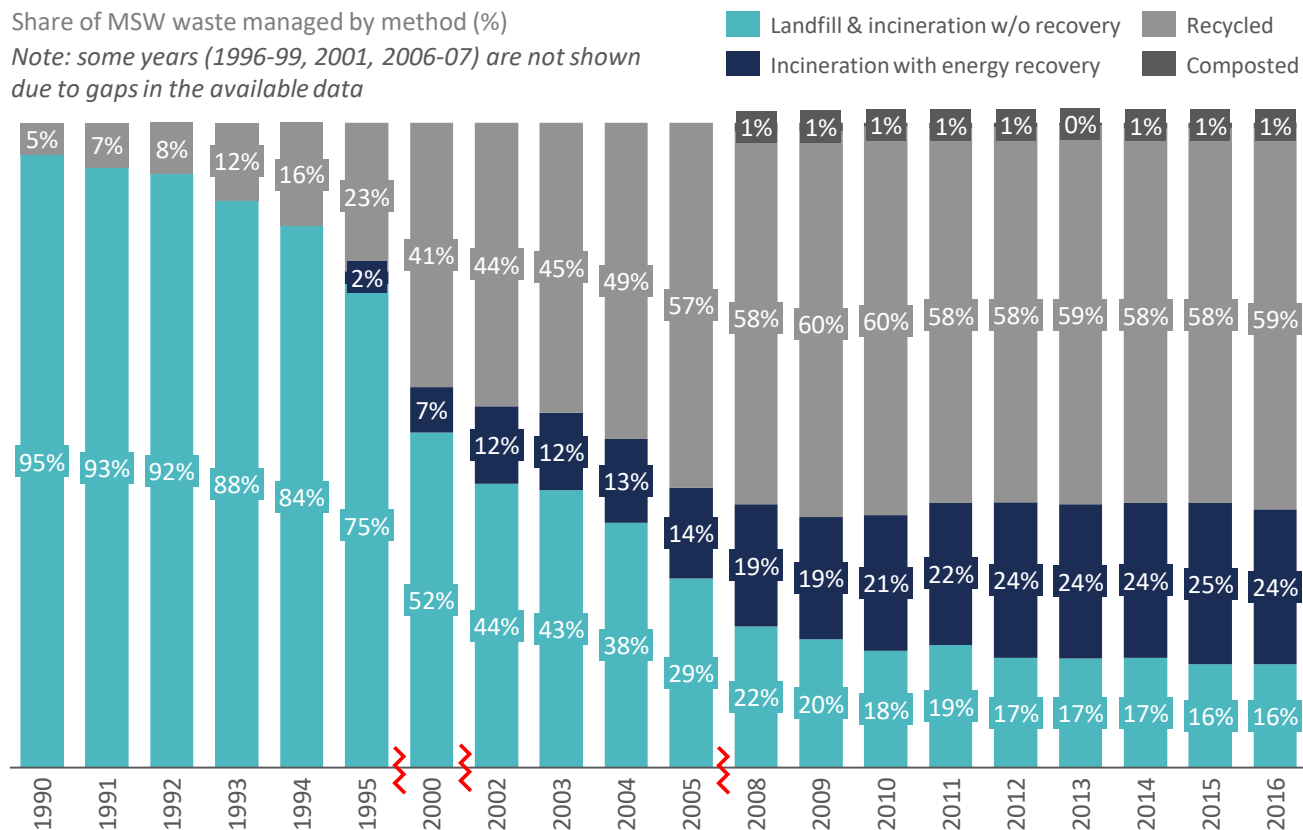
SOURCE: Ministry for Environment and Korea Environment Institute (2018), [2017 Status of Waste Generation and Disposal in Korea](#) (in Korean)

Over the last 25 years, South Korea has become one of the world's best MSW recyclers

Management of municipal waste in South Korea

Share of MSW waste managed by method (%)

Note: some years (1996-99, 2001, 2006-07) are not shown due to gaps in the available data



1990s: Focus on Reduce, Recycle, Safe disposal
VBWF (1995)

2000s: Focus on Reduce, Recycle, Safe disposal & Energy recovery
EPR (2003)

Focus on energy recovery from solid recovered fuel as substitute for fossil fuel and biogas

Key takeaways

- South Korea substantially transformed its waste system over the last 25 years from reliant on landfill and incineration w/o recovery to achieving a very high **MSW recycling rate of ~ 60 %**
- Significant reduction in waste to landfill from is attributable to an integrated waste management approach, including:
 - **Volume-Based Waste Fee (VBWF)**, and
 - **Extended Producer Responsibility (EPR)**
- Energy recovery has become an increasing focus since the 2000s, and its current **Waste to energy** policy (2008-2020) is aligned with renewable energy strategy

Note: Municipal waste in South Korea includes both household waste and commercial waste for small businesses (those that produce less than 300kg/day of waste)

South Korea's recycling success through integrated policy and legal framework

- Indicates strong performance
- Indicates some issues
- Indicates major deficiencies

Overall	<ul style="list-style-type: none"> S. Korea has some of the highest recycling rates in the world across all 3 waste streams, and 90+ % food waste recovered Integrated waste management policy with clear targets & strong mandatory approach: volume-based waste fee (VBWF) system for mixed waste, extended producer responsibility (EPR), food waste ban to landfill, and eco-industry parks to mine urban resources
Performance of the system	<ul style="list-style-type: none"> Total waste generation per capita: 2.71t per year MSW landfill diversion rate / recycling rate: 86% / 59.2%

	Overall performance	Key features	Key strengths
 Sector dynamics	●	Combination of public and private ownership; strong investment in eco-innovation from public and private sector	Clearly defined responsibilities of national, local govt and other stakeholders, e.g. local govt responsible for residual, private sector responsible for recyclables
 Infrastructure / Tech	●	Source separation supports efficient channelling to recycling, online trading for recyclables, WtE and landfill; tracking systems for I and C&D; recycling system for end of life vehicles (ELV) and WEEE, eco-industry parks	Establishment of eco-industry parks integrating recycling, energy recovery and waste disposal aligned with circular economy agenda
 End markets	●	Established markets for recyclables and energy (district heating); focus on growing energy recovery (solid recovered fuel (SRF) to substitute fossil fuel) and biogas from organics	Strong manufacturing base creating demand for recyclables; established markets for food waste (feed, compost and energy)
 Policy Enablers	●	Volume-based / weight-based waste fee system for mixed waste and food waste, EPR system, ban of food waste to landfill, reporting of littering	Integrated policy and legal framework supporting 'Comprehensive Plans in Waste Management'
 Culture	●	Strong culture of recycling supported by appointed champions and incentivised citizen reporting on performance	Waste management approach engages all stakeholders, e.g. jobs for elderly

Government plays a significant role in the South Korean system as both policy setter and operator

Actor	Description of role	Key differences to Victoria
Government	<ul style="list-style-type: none"> Central government sets overall policy framework, and provides local govt with guidelines and support (including financial) for research and technology development for MSW treatment Local govt responsible for implementation of MSW management, including collection and treatment of residual waste 	<ul style="list-style-type: none"> Stronger leadership from national government enabled by legislation
Private sector	<ul style="list-style-type: none"> Private sector is responsible for collection, trading and treatment of recyclables Manufacturers are required to design products/parts that can be easily reused or recycled 	<ul style="list-style-type: none"> Mandatory EPR policies in effect from 2003, currently applies to 27 products
Households/ businesses	<ul style="list-style-type: none"> Households and businesses responsible for source separation and disposal Incentivised reporting on illegal dumping Businesses responsible for hazardous and industrial waste disposal 	<ul style="list-style-type: none"> Higher degree of source separation due to free recyclable waste collection Volume (residual) and weight (organics) based fee incentivise separation
Other	<ul style="list-style-type: none"> KORA (Korea Resource Circulation Service Agency) overseas EPR policies, implementation, recycling of EPR packaging, container (glass bottles) deposit legislation and reuse/deposit management system Allbaro – online waste management and reporting system Korean Environment Institute (KEI) – government sponsored research institute researching and assessing environmental policies 	<ul style="list-style-type: none"> KORA is similar type of agency as Sustainability Victoria/APCO Online reporting system provides a transparent data collection system from waste discharge to final treatment Specialised research institute for development and assessment of policies

South Korea has a strong integrated policy framework encouraging waste avoidance and recycling (I/II)

Indicates key policy

	Avoidance (incl. re-use)	Sorting & recovery	Collection	Recycling & reprocessing	Disposal
Informing	<ul style="list-style-type: none"> Education on reducing packaging Reduction of food waste (“Food Table with Less Waste”) 	<ul style="list-style-type: none"> Education in schools on sorting practices 		<ul style="list-style-type: none"> Promoting recycling targeting households and businesses 	
Financing			<ul style="list-style-type: none"> Long-term low-interest loans for private investment Public/private ownership with co-finance from central and local govt (WtE) 		<ul style="list-style-type: none"> Central government support for infrastructure construction and technology
Incentivising	<ul style="list-style-type: none"> Volume based waste fee system (purchase of disposable plastic bag) 	<ul style="list-style-type: none"> Volume and weight based fees incentivise source separation 		<ul style="list-style-type: none"> Waste Deposit System Extended Producers Responsibility System 	

South Korea has a strong integrated policy framework encouraging waste avoidance and recycling (II/II)

Indicates key policy

	Avoidance (incl. re-use)	Sorting & recovery	Collection	Recycling & reprocessing	Disposal
Mandating	<ul style="list-style-type: none"> Restriction and prohibition on targeted disposable products (e.g., single use plastics) 	<ul style="list-style-type: none"> Mandatory bag characteristics – local govt can enforce compliance, prosecute for illegal dumping and incineration Comprehensive Measure for Reducing Food Waste regulates sorting and collection 	<ul style="list-style-type: none"> Waste Cleaning Act regulates collection protocols, e.g. time and mode of collection 	<ul style="list-style-type: none"> A raft of overarching or product/sector specific Acts supporting EPR, e.g. The Promotion of Saving and Recycling of Resources Act, The Act on the Resource Circulation of Electrical and Electronic Equipment 	<ul style="list-style-type: none"> The Framework Act on Resource Recirculation (enabling CE)
Enabling	<ul style="list-style-type: none"> Upcycling Centers with training rooms, reuse sharing markets 	<ul style="list-style-type: none"> Technical support for waste management facilities, including in supporting eco-industrial park development program 			<ul style="list-style-type: none"> Zero Waste to Landfill by 2025
Operating / contracting		<ul style="list-style-type: none"> MUDs independently sign contracts with recycling companies 		<ul style="list-style-type: none"> End market growth with preferred purchase of recycling products by public institutions Operation of recycling centers 	<ul style="list-style-type: none"> Development of eco-industrial parks

Deep dive: Pay-as-you-throw (PAYT) has been a central aspect of South Korea's policy framework to reduce waste to landfill

Summary

- Pay-as-you-throw (PAYT) through a volume-based waste fee has been in place in South Korea since 1995, with households and small businesses required to purchase plastic bags for disposal of residual; the approach was extended to food waste in 2013 with a weight-based fee
- It has been a key driver of improvement in recycling rates in South Korea

Description

- A volume-based waste fee (VBWF) for residual waste was implemented nationwide in 1995, with the policy targeting households and small businesses producing less than 300kg of waste per day
- Households and small businesses purchase standardised plastic bags sold by local governments; mixed or residual waste is placed in the bag for collection; and recyclables are dropped off at public drop off points or collected for free
- This creates a strong economic incentive for households and small businesses to recycle as much as possible to minimise the cost of purchasing bags
- Waste management champions are appointed at collection points and citizens are encouraged to report any illicit practices
- Separate urban food waste collection started in 2015, with direct land-filling of food waste generated in urban areas banned
- Then in 2013 the PAYT system was extended to food waste, with weight-based waste fees used to encourage households to minimise food waste – sometimes this is done using RFID equipped public food waste bins



Standard bags for general waste

Public drop off point for recyclables



RFID-based public food waste collection bins

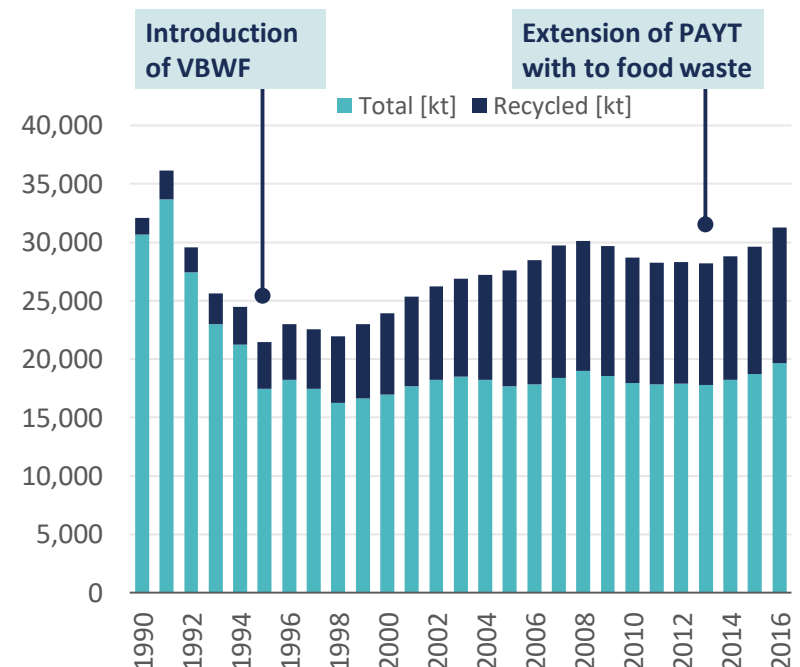
Deep dive (cont): Pay-as-you-throw (PAYT) has been a central aspect of South Korea's policy framework to reduce waste to landfill

Results

- The VBWF is regarded as having been successful in reducing waste and increasing recycling performance in South Korea
- However, there was already a positive trend in recycling observed prior to 1995, and reductions in waste generation impacted by other factors (e.g. household income, dietary changes, new heating systems)
- Further analysis highlights the importance of other complementary measures to improve recycling performance and minimise generation, e.g. mandatory EPR from 2003 created demand for recycle, landfill ban for food waste in 2005 and then PAYT for food waste in 2013 leading to >90% diversion for food waste
- Shift towards using RFID enabled central drop off point for food waste has generated cost savings on collection

Municipal waste in South Korea

Total waste volumes generated and recycled, kilotonnes, 1990-2016



Applicability to Victoria

- PAYT model for households (volume or weight based) could be applied in Victoria but implementation is likely to be costly and complex as it involves a significant shift in the overall sorting and collection process
- Success in the introduction of PAYT seems to be linked to good source separation practices (which are not currently present in Victoria) and strong compliance and enforcement, as there is significant capacity for abuse of the system

Deep dive (cont): South Korea's end-to-end system supports world leading recovery of food waste – Seoul focus

Results

Food waste generation in South Korea (2018) was **130 kg per capita with management costs equiv. ~ 970 million AUD**; **62.5% of the total food waste is from MSW**, 62% of this is from households and the remaining 38% from small business.

Separation

- **Separate urban food waste collection started in 2005**, with direct land-filling of food waste generated in urban areas banned
- Then in **2013 the volume-based pay as you throw system was extended to food waste**, with weight-based waste fees used to encourage households to minimise food waste
- **Food waste is either separated into pre-paid bags or bins** (identified using e.g. RFID tags or payment certificates), or disposed at public collection points and tracked using personal identification cards

Collection and pre-treatment

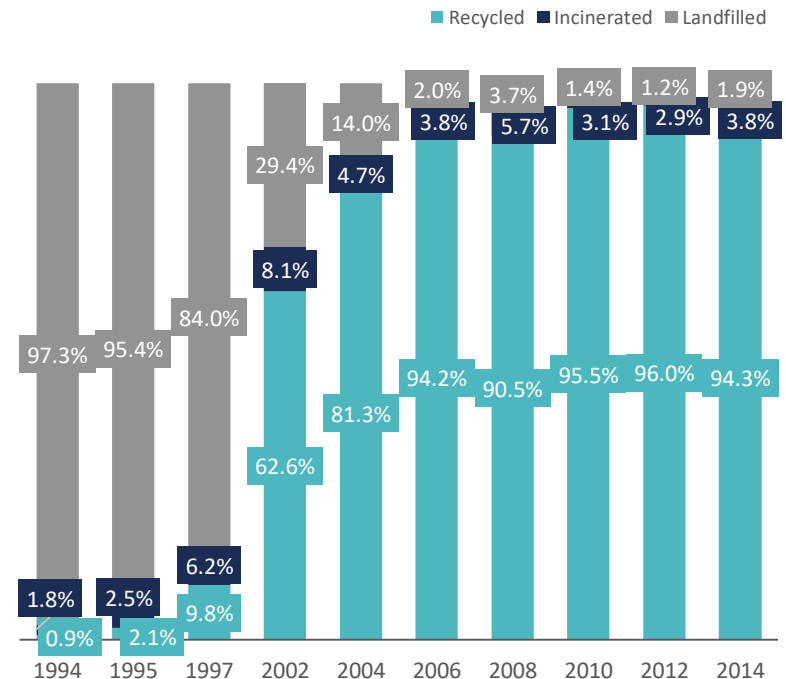
- **Food waste is collected from designated public drop-off points or door-to-door** (daily) by a responsible 'collecting agency'. **It is transported to processing facilities** (66% of the collection and disposal contracts are private, 34% are publicly owned and operated) ^a;
- **New developments** (e.g. Songdo City^c) **are installing underground vacuum systems and a number of pre-treatment technologies** (e.g. dryers, dehydrators and fermentors) are being deployed to reduce volume and transport costs at the source.

Processing

- Collected food waste is processed into with the **majority turned into compost (33%) and animal feed (48%)** ^a. Treating waste water generated during processing is also a major part of the processing step
- **Advanced processing technologies include using insect-based processing** – insects feed on waste and also produce valuable by-products (i.e. fertiliser, animal feed)

Food waste in South Korea

Breakdown of food waste recycled, incinerated and landfilled, 1994-2014



Applicability to Victoria

Victoria has not yet made strong in-roads into diversion of food waste, so the South Korean system offers several lessons:

- **Separation of food waste and strong compliance systems** have been key to success of food waste system (combining small business and household organics also makes sense)
- **Landfill bans in Korea** were also an important catalyst for treatment of food waste
- **End markets have now developed** to process and recover the food waste; leading to further technology advances
- **Pay-as-you-throw model for household food waste (weight based) would be costly** to implement but appears to have succeeded in reducing overall waste and considering that almost half of the residual waste is food waste, the impact would be significant.

Strong upstream infrastructure in sorting and recovery in South Korea supports downstream performance in recycling



● Indicates strong tech / infrastructure
 ● Indicates satisfactory tech / infrastructure
 ● Indicates tech / infrastructure deficiencies

Deep dive: Eco-Industrial Park Development Program to transform industry towards a circular economy

Summary

- The National Eco-Industrial Park (EIP) Development Program (Phase 1 commenced in 2005) is a 15-year program to retrofit and revitalise existing industrial complexes, including old waste treatment and disposal infrastructure, to become hubs for circular economy activity in South Korea

Description

- The Eco-Industrial Park Development Program was established in the context of decades of industrial development, aging infrastructure, adverse environmental impacts, waste and opportunity to 'mine' urban resources
- It is aligned with South Korea's industry policy agenda from the 2000s to promote high-tech, green and innovative industry
- The vision is an industrial ecosystem where resource use is optimised, and waste minimised by reusing waste from one business as feedstock for another co-located business – so called 'industrial symbiosis'
- There are four key elements that characterise the approach of the Program:
 1. Exploiting the diversity of South Korea's industrial sector
 2. A high level of regulatory and institutional support
 3. Strong financial support in the form of research funding and economic incentives for business to participate in pilot projects to leverage private investment for scale-up
 4. Distribution of Parks across regions to engage local stakeholders, encourage participation

Results

- In first phase (2005-2010) the Program developed 116 projects at 5 pilot sites and 7 industrial complexes. The Program was expanded to 46 industrial complexes in the second phase (2010-2015) and was stopped by the end of 2016 due to the EIP R&D policy change.
- The projects secured involvement from a diverse range of industries, including chemicals, petrochemicals, textiles, metals, pulp and paper, waste industries
- Projects involved by-product reuse, energy recovery (waste heat from incineration, biogas from AD), and wastewater reuse.
- The projects generated a range of economic and environmental benefits in 11 years and included 436 research and business development feasibility studies of industrial symbiosis. 235 projects have been commercialised and are presently in operation.
- Investment in the Program from Research fund from Ministry of Trade, Industry and Energy (US\$81mil.) and from private sector (US\$761.3mil.) resulted in an economic benefit of US\$2.4bil., reduction of 8.5mil t CO_{2eq}, GHG emissions and generation of 992 new jobs.

Applicability to Victoria

- The ASPIRE pilot project demonstrates potential for waste exchanges to play a role addressing waste management challenges in industry in Victoria
- However, Victoria has less industrial diversity and smaller scale industries than South Korea, which may reduce the potential of the Eco-Industrial Park Model
- Establishing appropriate controls for handling by-products and developing new standards and guidelines for new products using waste will support uptake

Deep dive (cont.): Eco-Industrial Park Development Program to transform industry towards a circular economy

Example



- A key recent example of an eco-industrial park in the context of the waste industry is the establishment of an inter-jurisdictional treatment facilities for recycling, waste disposal and energy recovery
- Sudokwon Landfill Corporation operated as a sanitary landfill until 2000 and has since been transformed into the Dream Park involving the restoration of landfill to green space incl. collection of landfill gas for energy, water treatment, ecological restoration, recreational facilities, research centre

Deep dive: South Korea response to *China Sword*

Summary

- Recycled plastic price dropped due to China Sword causing an increase in imports to Korea by 211% (predominantly PET bottles used for textile manufacturing) as well as a decrease in exports (57%)
- Response comprised interventions across the whole value chain, including design standards, bans, public acquisition of collection and procurement policy

Description

South Korea's central government introduced 'Comprehensive Recycling Waste Management Plan 2018' addressing waste at all stages of lifecycle, with targets to reduce plastic waste generation by 50% and increase the recycling rate to 70%:

Production Stage

- All drinking PET bottles produced must be of clear, uncoloured type, including a recyclability rating by 2020
- Increasing number of plastic packaging types that must be recycled from 43 (2018) to 57 (2020) and 63 (2022)

Distribution/Consumption Stage

- Reduction of consumption of single use cups in coffee shops by 35% and increase recycling rate to 50% by 2022
- Reduction of net vinyl plastic bag consumption by 35%
- Ban plastic bag use and double packaging in supermarkets
- New guidelines for delivery packages (the average Korean receives 44.8 packages per year, which is the highest in the world)

Discarding Stage

- Reduction of residual waste in recycling material from 38.8% (2016) to below 10% by 2022 via increase in waste sorting stations and "sorting guide" volunteers at apartments
- Enforcement of mandatory contracts and reporting of recycling at apartments

Collection/Sorting Stage

- Increase publicly operated collection from 29% (2015) to 40%

Recycling Stage

- Monitor recycling markets, establish pre-emptive response programs and establish funding for market stabilisation.

Applicability to Victoria

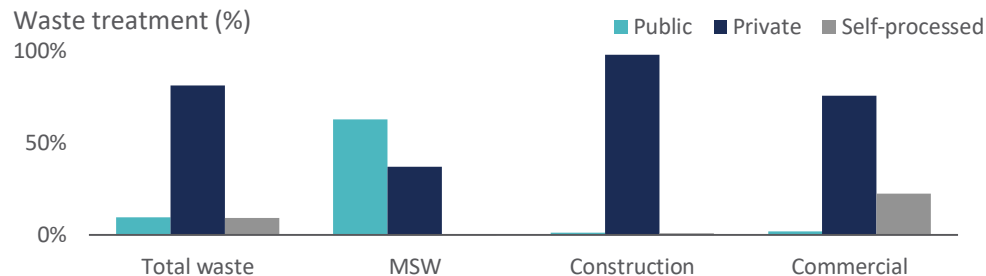
- Similar approaches are already under consideration in Australia in the the context of the 2025 National Packaging Targets, but in general governments in Australia have not been as rapid or as aggressive in their response to China Sword
- These policies would represent a significant strengthening of the policy response in Victoria, and would need to be implemented progressively given lack of existing framework for recycling targets and product bans

End markets: Korea has well established end markets enabling successful recycling

Detail/description

Waste treatment is dominated by the private sector

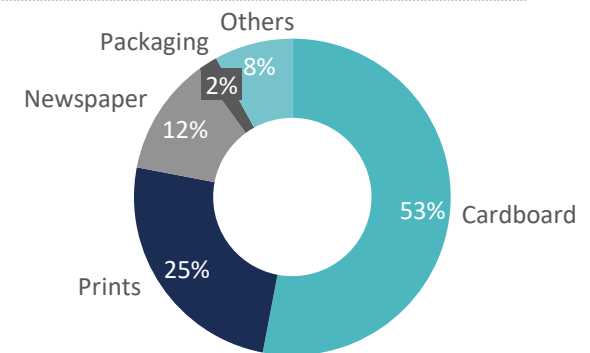
- Korea's established **industrial base and targeted levers enable strong end markets**
- **Mandatory EPR scheme requiring recycled content is a key lever** – for example, specific requirements on production to facilitate recycling in 'Comprehensive Recycling Waste Management Plan 2018', e.g. PET bottles must be clear



- Breakdown in ownership in public, private and self-processing of MSW, construction and commercial waste generated in 2016 in South Korea
- Self-processing refers to inhouse waste management

Paper and cardboard

- **Paper production** has been declining in the recent years due to decreased demand for printed material (e.g. newspaper)
- Manufactured paper contains **more than 80% of recycled content** (81.2% in 2015) predominantly sourced in Korea
- Older people play a significant role in paper and cardboard collection, which they sell to collectors who sell on to paper manufacturers
- **Packaging material** production has increased due to the growth of online purchasing; Packaging material contains **75-80% recyclable material**



Production ratio by type of paper in 2015.
Source: Korea Paper Manufacturers Association

Glass

- **The recycling rate of glass was in 2014 74%.** The use of glass is decreasing and is being replaced by plastic composites.
- **Most of the collected recycled glass bottles (97%) are used for glass bottle manufacturing** (bottles have 70-80% recycled content) and only 3% is cleaned and reused
- Glass bottles are sorted by colour (35% of collected glass is clear, 20% is brown and 45% is green); Contamination with ceramics (10%) is an issue in MUDs
- Glass prices remained stable over the past ten years. Glass recycling is subsidised by the government (3c/kg)

End markets: Korea has well established end markets enabling successful recycling

Detail/description

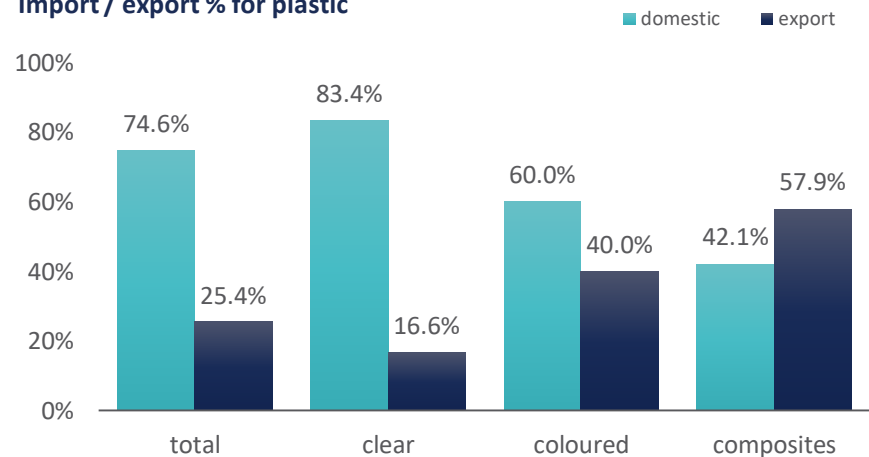
Metals

- There is **strong local demand for scrap metal** with **72% of the scrap metal used in domestic reprocessing sourced in country**;
- The market is dominated by **two major companies that take 60% of collected scrap metal**; smaller Korean steel companies rely entirely on domestic scrap metal collection and are vulnerable to the market prices dictated by the two dominant companies;
- Most of the collected scrap is (93%) is iron.** The remaining 7% of the collected scrap metal is composed of aluminium (24.6%), copper (15.4%), lead (8.6%), zinc (40.8%) and nickel (10.6%); in 2014, manufactured steel had 36% recycled content
- Considering **containers, 80% of metal cans are recycled**, 64.5% as iron and 35.5% as aluminum. Iron is used by one of the dominant Korean steel companies. 70% of the aluminum is recycled by a large aluminum recycler (largest in the world) producing flat-rolled aluminum products used in automotive industry.

Plastics

- The recycling rate for PET is 79%**, 59.9% of PET on the market is clear, 33.8% is coloured and 5.3% are a composites;
- PET is recycled into flakes** (75% for domestic use and 25% exported to China)
- Recycled PET flakes used in the domestic market are predominantly clear (83%), **while flakes exported to China are predominantly composites (58%)**

Import / export % for plastic



Impact of China's National Sword policy on end markets

- Before the ban, Korea was exporting 15,000 tonnes of plastics per month to China**; The export dropped to 2,000 tonnes per month after the ban.
- An increase of import of plastic scraps from Japan (10kt/month), USA (4kt/month) and Thailand (2kt/month), caused a drop in prices for recyclables collected domestically, **making it economically unattractive to receive the plastic waste generated locally.** Waste started to pile up on the streets and recyclers started exporting plastics illegally to the Philippines.
- Government intervened by **implementing strong policies to address the collapsing recycling market, including prioritizing clear PET manufacturing and import, due to the established clear PET home end markets** (see graph above).

Agenda

Objectives and introduction to project

Summary of findings

Selection of jurisdictions

Overview of Victorian system

Jurisdictional case studies

Wales: Targets and collections

South Korea: Organics and overall recycling

Germany: Overall recycling, landfill bans and EPR

Netherlands: Circular economy and waste-to-energy

South Australia: Strategy and licensing

New South Wales: Strategy and Alternative Waste Treatment

Additional deep-dives

Waste avoidance

Responses to China's National Sword Policy

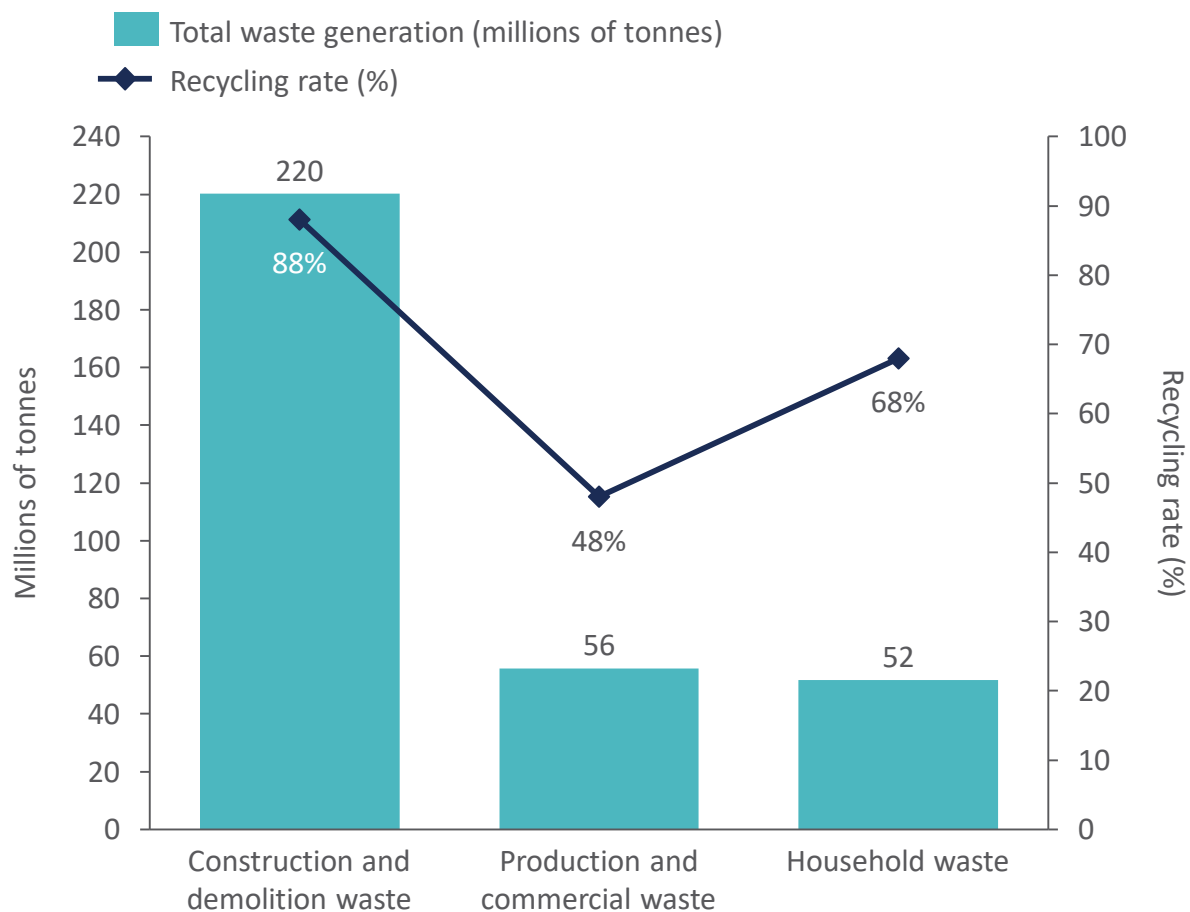
Waste-to-energy

Bibliography

Germany has a strong overall recycling rate of 78%, and has been particularly effective in recycling household and construction waste

Breakdown of waste generation and recycling rates in Germany

German waste generation and recycling rate by streams (millions of tonnes, %)



Key highlights

- Germany generated a total of **328 million tonnes of waste** in 2017 (excluding waste from extraction processing of mineral resources) and had an **overall recycling rate of 78%**
- Construction and demolition** waste made up **~67%** of total waste generation, **while production & commercial and household** waste made up **~17% and ~16%** respectively
- According to the Federal Statistical Office and Eurostat, as of **2017**, Germany's **recycling rates** sit at:
 - 88% for construction and demolition** waste
 - 48% for production and commercial** waste
 - 68% for household** waste

Notes: excludes waste from the extraction and processing of mineral resources, household waste also includes household-like commercial waste; measuring waste in tonnes as opposed to other methods such as cubic metres will increase the size of C&D waste due to high-density materials such as concrete

Source: Federal Statistical Office, BMU, EUROSTAT

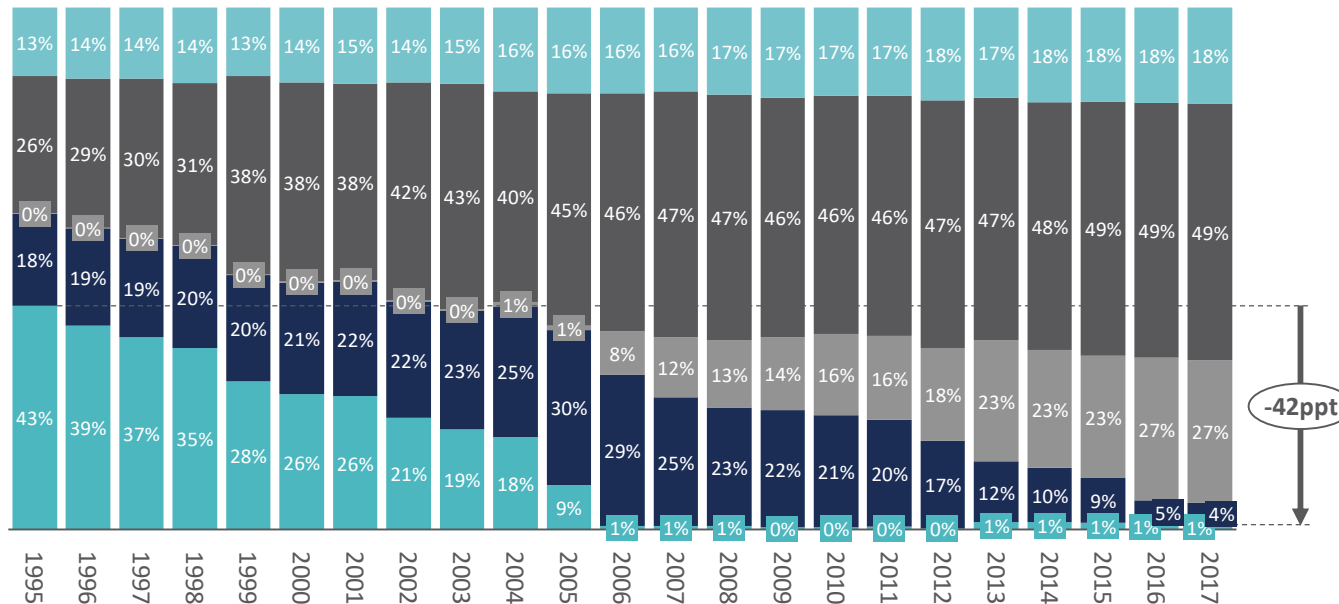
Germany has seen a 42 percentage point decrease in MSW landfill between 1995-2017

Further described in deep dives

MSW waste treatment in Germany 1995-2017

Share of MSW waste treatment (%)

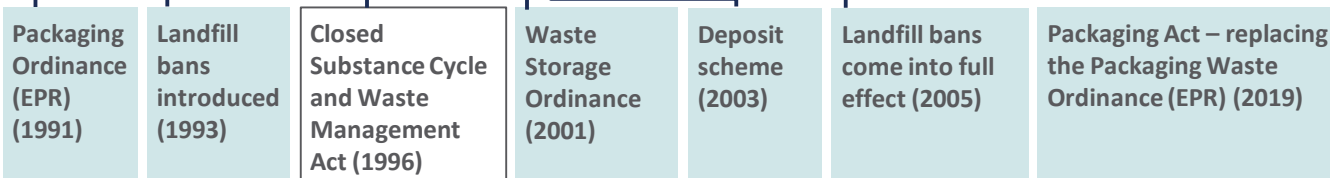
■ Disposal - landfill and other
 ■ Recovery - energy recovery
 ■ Recycling - composting and digestion
■ Disposal - incineration
 ■ Recycling - material



-42ppt

Key takeaways

- Germany has **consistently achieved MSW recycling rates over 60%** since the mid 2000s, with a combination of composting, digestion and material recycling
- Only **~1% of MSW goes to landfill**, with another 4% disposed of through incineration
- Landfill bans coming into full effect in 2005 led to a **rapid decline in landfill and initially an increase in incineration**, then a shift to energy recovery from 2006
- Incineration**, either for disposal or energy recovery, currently accounts for **~31% of Germany's MSW treatment**








Notes: Includes hazardous waste; Eurostat 'incineration of MSW (w/o energy recovery) includes treatment for disposal (e.g. mechanical biological treatment (MBT)); waste generated by pre-treatment processes such as MBT includes waste partly ending up in incineration and partly in landfill (but being reported as all incinerated)

Sources: BMU, EUROSTAT, UBA, EU, industry reports

Germany has used landfill bans and strong producer responsibility to drive high recovery and recycling rates

● Indicates strong performance
● Indicates some issues
● Indicates major deficiencies

Overall	<ul style="list-style-type: none"> • Strong recycling and recovery rates of waste since the mid 2000s • Landfill bans on un-treated MSW (introduced landfill limiting policies in 1990s) have been effective at first driving recycling then reducing reliance on landfill for residual waste • Extended producer responsibility (EPR) has been embedded in Germany's waste management systems
System performance	<ul style="list-style-type: none"> • Total waste generation per capita: ~4t/year • Overall recovery / recycling rate: 81% / 78% • MSW recovery / recycling rate: 95% / 68%

	Overall performance	Description	Key strength
Sector dynamics 	●	Strong oversight from the Federal government, heavy role for local government as owner/operator and a dual system for producer packaging and MSW	Producers and retailers are responsible for the collection and recycling of their packaging waste, creating a dual waste management system for MSW and commercial waste with a focus on EPR
Infrastructure / Tech 	●	Use of WtE and mechanical biological treatment facilities (MBT) as well as infrastructure to separate out waste at source	Incineration and MBT facilities have been central in diverting Germany's MSW from landfill as well as a deposit scheme for refillable drinks packaging
End markets 	●	While EPR has promoted some development of end markets, still a heavy reliance on exports of plastic	Producer responsibility has made the producers more liable for products at the end of their life cycle
Policy Enablers 	●	Bans on landfilling, producer responsibility and a circular economy focus have been key policy drivers	Germany has tended to mandate approaches to waste management with less reliance on financing and incentives (e.g. landfill taxes)
Culture 	●	Strong focus on source separation and perception of waste as a potential resource as well as EPR and political backing	Strong recovery and recycling of products (especially packaging) as well as a focus on waste to energy through incinerators

Notes: Recovery includes WtE, composting and recycling; recycling rate includes recycling and composting
 Sources: UBA, BMU, industry reports, EU, EUROSTAT

Germany's dual waste management system has separate collection, sorting and recycling for private sector and local authority waste

Actor	Description of role	Key differences to Victoria
Government	<ul style="list-style-type: none"> • National Ministry of Environment sets priorities, drafts national legislation and oversees strategic planning and information • Waste management plans are produced at a regional level by Federal States (16 in total) • Local authorities often own and operate significant parts of the MSW collecting, sorting and processing infrastructure through municipal companies 	<ul style="list-style-type: none"> • Germany faces an additional layer of government in the EU which has been a key driver of change (and which Germany plays a central role in as a member) • Local governments own and operate more infrastructure than in Victoria
Private sector	<ul style="list-style-type: none"> • Since the 1990s, the private sector is responsible for the collection, sorting and recycling of its packaging waste • Businesses must adhere to a number of producer responsibility ordinances which promote waste avoidance and recycling targets • The collection, sorting and recovery of producer packaging waste was initially run under a monopoly provider, but opened the market up to competition in 2005 	<ul style="list-style-type: none"> • Victoria's private sector currently has less accountability for its packaging waste compared to Germany where producers must collect, sort and recycle their packaging
Households / businesses	<ul style="list-style-type: none"> • Households are responsible for sorting their recycling and waste appropriately (including pay per throw initiatives which are based on weight and composition of waste) 	<ul style="list-style-type: none"> • Victorian households are also responsible for correctly sorting and recycling their waste however do not have a direct cost for how much waste they generate
Other	<ul style="list-style-type: none"> • Der Grüne Punkt – Duales System Deutschland GmbH was the first Producer Responsibility Organisation (PRO) for packaging in Germany; and was created by industry following the Packaging Ordinance in 1991 and provides collection, sorting and recycling of household packaging • In 2001, the market was open to competition meaning other companies could provide waste services for packaging, and Der Grüne Punkt – Duales System Deutschland GmbH has been competing with national systems since 2006 	<ul style="list-style-type: none"> • Victoria does not currently have a PRO for packaging as seen in Germany

Deep dive: Extended producer responsibility in Germany has seen the development of a dual system for waste management



Summary

- Germany has introduced a number of regulations to make producers accountable for the collection, sorting and recycling of packaging from their products and which has led to the creation of a dual waste collection system
- A new Packaging Act has been introduced in 2019 replacing the old Packaging Ordinance
- All actors (including online retailers) who have packaged products on the German market and which end up as waste with consumers are subject to the Packaging Ordinance and Packaging Act

Description

1991 Packaging Ordinance

- The 1991 Packaging Ordinance governs that manufacturers and distributors **collect, sort and recycle packaging waste from their products**

Development of dual waste management system

- In response, the German Packaging industry set up the **Duales System Deutschland (DSD)** to **manage this waste** under a 'voluntary agreement' instead of the Packaging Ordinance imposing duties for every producer and distributor
- This meant packaging waste was **managed in a separate stream from household waste** in a '**Dual**' System where the packaging industry had full responsibility over control of costs as well as setting up and organising the system (see diagram)
 - In 2001 the packaging recovery market was opened to competition where multiple waste management systems could provide collection services for producers
- The packaging industry had **requirements** for compliance including coverage, communication, **coordination with local authorities**, documentation and verification as well as **recycling and recovery targets** for packaging waste by material

New Packaging Act of 2019

- In 2019, Germany introduced a new **Packaging Act** to **replace the Packaging Ordinance**

- This new act **increases the scope of products** covered (e.g. shipment & online packaging), and the foundation of a **Central Packaging Registry** to avoid freeriding and conformity in abiding with product responsibilities with companies facing **finest of up to €200,000** and **prohibition from selling goods** in Germany
- The Act will also see **increases to recycling targets** (including significant increases in plastic recycling) and **monetary incentives** for **ecological packaging** in accordance with their recycling capability



Deep dive (cont.): Extended producer responsibility in Germany has seen the development of a dual system for waste management

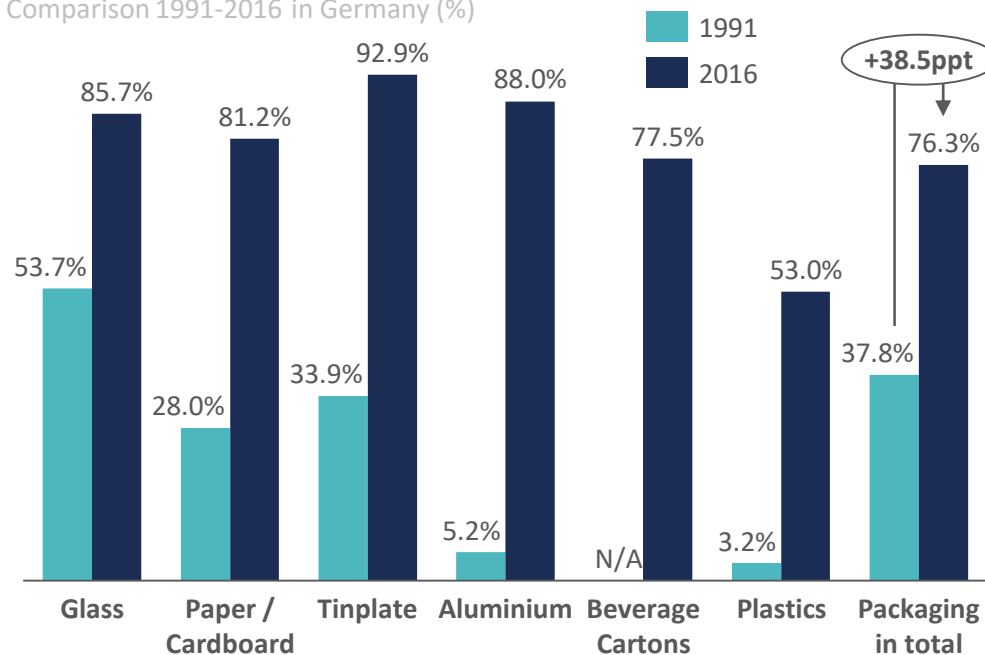


Results

- EPR policy has led to the **development of a dual waste management system** where producers bare the responsibility of their packaging
- EPR policy has also led to the **introduction of new systems** (such as a refundable deposit scheme)
- **14% of raw materials** used by the Germany industry **are recovered from waste**
- This has seen **recycling rates** for packaging increase from **38% to 76%** between 1991 and 2016 (see graph)
- Nevertheless, there has been some **freeriding** in the system – whereby some producers have **not fulfilled their product responsibilities**
- There have also been **no significant provisions** set up in the Packaging Ordinance or the DSD **for the avoidance of packaging waste** and has consequently seen levels of packaging consumption in Germany remain **one of highest in Europe**
- The costs of this dual management system have also seen **higher costs for consumers**

Recycling rates of sales packaging

Comparison 1991-2016 in Germany (%)



Applicability to Victoria

- Victoria does not currently have a dual waste management system in place where producers are responsible for their packaging waste
- Learnings for Germany show us that introducing more producer responsibility is possible and can drive strong improvements in reuse and recycling of packaging
- The introduction of such a system in Victoria would need to consider the associated costs and complexities of establishing new systems including costs surrounding enforcement and increased costs on consumers

Infrastructure & technology in Germany leans heavily on incineration and MBT facilities with declining landfill sites



Overall performance	●	●	●	●	●
Types of infrastructure / tech in use	<ul style="list-style-type: none"> German Government will measure resource use in product designs (according to the EU Ecodesign Directive of 2009) Pay per throw initiatives based on weight and material type are used in some counties with barcode identification and weighing technology 	<ul style="list-style-type: none"> Collection systems vary by local authority with the primary system used involving a mixture of door to door separate collection of paper, bio-waste, co-mingled plastic & metal and bring points for glass Separate collection systems are in place for packaging waste 	<ul style="list-style-type: none"> Significant levels of MSW is treated in mechanical biological treatment (MBT) facilities A large amount of sorting also occurs during collections with separate bins Packaging is sorted and recovered separately by producers under EPR ordinances 	<ul style="list-style-type: none"> MSW residual and food organic waste is managed by the municipal sector while a separate collection, sorting and recycling system is used to collect producer packaging Biodigesters are used for food waste management 	<ul style="list-style-type: none"> Declining number of landfill sites following landfill bans WtE plants are used to treat residual MSW which has been sorted to remove organics and recyclable material
Key strengths	<ul style="list-style-type: none"> Strong EPR initiatives dating back to 1991 (e.g. Packaging Ordinance) to improve accountability around producer packaging A waste prevention programme was also introduced in 2013 	<ul style="list-style-type: none"> Introduction of deposit scheme for refillable drinks packaging (~98.5% of refillable bottles returned by customers) Consistency of scheme across country (same bin colour and signage for HHs & businesses) 	<ul style="list-style-type: none"> Introduction of separate bio-waste collection may see a decrease in the use of MBT and composting plants in the med-long run as more bio-waste is directed to fermentation and composting plants 	<ul style="list-style-type: none"> Producer responsibility organisations in place for packaging covers all costs of collection and treatment for relevant waste streams (with high recycling/re-use/recovery rates) 	<ul style="list-style-type: none"> Landfill bans on untreated landfill waste dating back to 1993 (fully effective in 2005) Strong take up of incineration / WtE technology post-landfill bans
Drivers of strong investment	<ul style="list-style-type: none"> The German government used less economic incentives when implementing the landfill ban – instead providing ample time for new supporting infrastructure investments and allowing municipalities to choose infrastructure to meet landfill ban requirements Local authorities often own and operate significant parts of the MSW collecting, sorting and processing infrastructure through municipal companies and other similar schemes such as Build, Own, Operate, Transfer schemes (BOOT) and public-private partnerships (PPP) 				

■ Indicates strong tech / infrastructure

■ Indicates satisfactory tech / infrastructure

■ Indicates tech / infrastructure deficiencies

Notes:

Sources: Northern Ireland Assembly, BMU, UBA, industry reports

Deep dive: Landfill bans in Germany have driven significant declines in MSW landfill



Summary

- Germany implemented landfill bans on un-treated municipal waste starting in 1993 which came into full effect from 2005 forcing municipalities to shift their waste management practices accordingly

Description

Introduction of landfill bans in 1993

- Initiatives banning certain types of **un-treated municipal waste** from landfill were **introduced in 1993** through **strict landfill admission criteria on residual municipal waste**
- Municipalities were given a **12 year** adjustment period to develop new infrastructure to address the bans
- Because of the significant biodegradable content in MSW – **all residual MSW had to be treated** (via incineration or otherwise) in order to comply with the landfill criteria
- Criteria included a ban on waste that was **separately collected** or which **contain recoverable materials** or in which **the total organic carbon** exceeded a threshold (to **limit natural organic landfill**) in which case waste must be pre-treated to reach acceptable values
- Importantly, the “Technical Instructions” outlining landfill restrictions on MSW were **not legally binding** at that point in time

Waste Storage Ordinance (WSO) introduced in 2001

- In **2001-02** **landfill restrictions were made legally binding** under the WSO. This saw the **waste management industry invest** more actively in **additional treatment facilities (e.g. incineration and Mechanical Biological Treatment (MBT)*)**
- Notably, municipalities who were implementing changes had **significant freedom** over the technologies employed to **meet the landfill ban requirements** (given they met standards)
- In 2005 landfill bans on un-treated residual household and industry waste came into full effect and have been rigorously enforced since through state environmental authorities

Nature of the landfill bans

- Germany has typically preferred **mandated regulation** as opposed to economic instruments (e.g. landfill taxes). Importantly, no **specific financial instruments/programs** for infrastructure were explicitly provided to support landfill bans (which were primarily financed through municipal fees)
- Landfill bans were made in **parallel with other regulations** to increase waste recycling and reuse of materials (e.g. the 1991 Packaging Ordinance which requires producers to take back used packages from their products)

Notes: Mechanical Biological Treatment plants separate metallic waste and high heat value waste for energy recovery, while the remaining landfill waste undergoes biological treatment before being deposited at landfill sites (with low levels of residual biological activity)

SOURCES: BMU, industry reports

Deep dive (cont.): Landfill bans in Germany have driven significant declines in MSW landfill



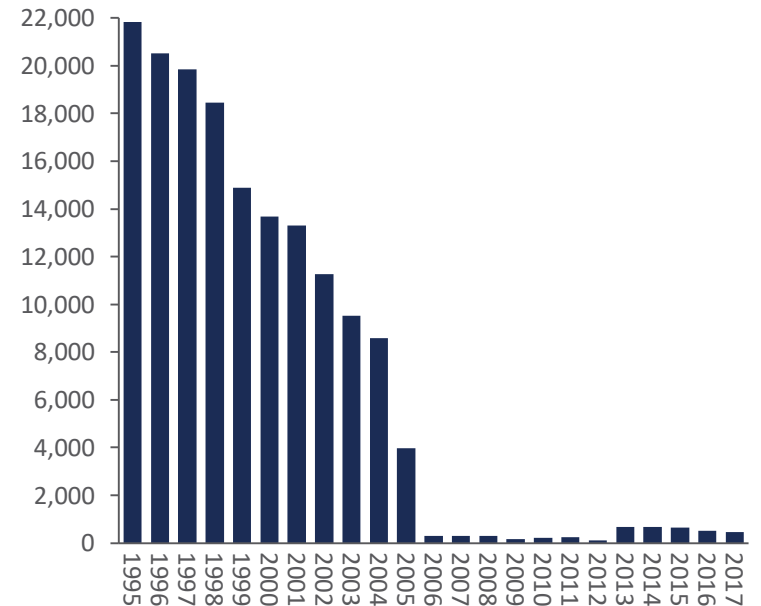
Results

- Germany has seen **MSW landfill's percentage decrease** from **39% to 1% of between 1996 and 2006**
- Landfill bans on untreated waste have had a **positive effect on separate collection** with increased cooperation between public waste management authorities and Duales System Deutschland (DSD) (who are in charge of collecting waste packaging from HHs in light of extended producer responsibility ordinances)
- Methods for pre-treatment including **incineration and MBT** have **reduced the amount of waste** sent to landfill by **more than 90%**. However the take up of MBT has also seen a lot of biowaste being processed in MBT as opposed to other methods such as anaerobic digestion and composting
- A study on the impact of landfill ban commissioned by the Federal Environment Agency in 2005 found that **€20 billion had been invested in modern waste treatment and recycling plants** since 1993 and up to **15,000 permanent jobs** had been created
- There have been some attempts to **illegally ship untreated waste** or **mislabelling of MBT waste** in order to deal with untreated waste. However this has been limited through strong enforcement such as fines and even imprisonment

MSW landfill between 1995-2017

Thousands of tonnes

■ Disposal - landfill and other



Applicability to Victoria

- Although Victoria currently have landfill levies and limited landfill bans (e-waste), they **do not have strict landfill bans** on un-treated MSW
- Germany's landfill ban demonstrates that significant declines in **MSW landfill can be achieved** if municipalities have enough **flexibility to meet targets, strong enforcement and appropriate supporting policies**
- Special consideration should be given to how municipalities are meeting these landfill bans to avoid **unintended responses** (e.g. significant increases in the number of incineration and MBT facilities) as well as the **allotted time** given to implement the landfill bans (12 years)

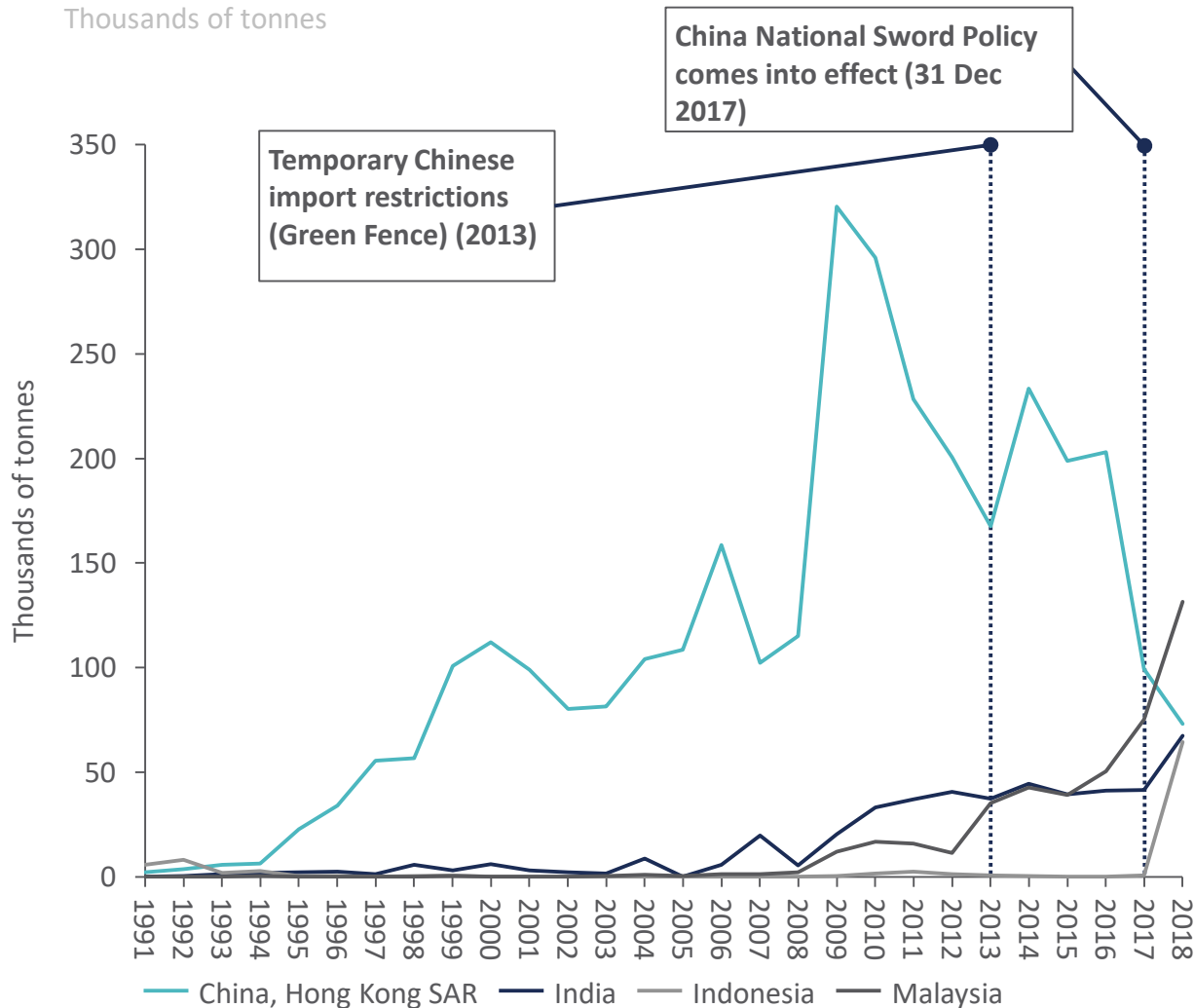
Notes: Numbers taken from EUROSTAT and include

SOURCES: EUROSTAT, BMU, industry reports

The China National Sword Policy has seen a Germany's plastics exports shift from China to other Asian countries

Germany plastic waste exports to China and neighboring countries 1991-2018

Thousands of tonnes



Key takeaways

- Germany has seen a **~64% decline in plastic exports to China & Hong Kong between 2016 and 2018** (post-National Sword Policy)
- Germany exported **~200 thousand tonnes** of plastic to **China & Hong Kong in 2016** and **~70 thousand tonnes to China & Hong Kong in 2018**
- This has seen a considerable **increase in plastics exported to alternative countries** by Germany (e.g. Malaysia, Indonesia and India)
- In 2019 Germany introduced a new Packaging Act for producers which included significant **increases in recycling targets for plastic packaging** (from 36% to 63% by 2022)

Germany has a policy system that utilises a range of approaches with a strong focus on mandates

Indicates key policy

	Avoidance (incl. re-use)	Collection	Sorting & recovery	Recycling & reprocessing	Disposal
Informing	Eco-labelling to better inform consumers	Supervision at the point of collection (stickers for wrong materials, fines...)	Optimisation of demolition / dismantling of buildings for recovery and treatment of building materials		
	Information campaigns on public on waste prevention (e.g. "Too Good of the Bin")				
	EU Ecodesign Directive (2009) (German Gov. will measure resource use in product design)	Closed Cycle Management Act saw the introduction of a nationwide "uniform recycling bin"			
	National waste prevention programme (2013)				
Incentivising (financial incentives)	Pay per throw (cost per consumer is calculated by weight and waste type)				
	Monetary incentives for ecological packaging under the 2019 Packaging Act	Deposit scheme for refillable drinks packaging (mandatory one-way deposit scheme in 2003)			
Mandating	Packaging Ordinance in 1991 (producer responsibility) as well as additional ordinances for other products (collection and recovery of packaging)			EU legislation under the Waste Framework Directive sets the policy framework and targets for recycling in Germany	Landfill ban on untreated residual MBW (fully implemented in 2005)
	2019 Packaging Act to replace and improve the Packaging Ordinance				
	Closed Substance Cycle and Waste Management Act 1996 extended producer responsibility	The Commercial Wastes Ordinance introduced mandatory separate collection of paper, board and cardboard, glass, plastics, metals, wood, textiles, biowaste and other production specific waste fractions			
		WFD requires separate collection of waste and systems for paper, metal, plastic and glass in 2015	Committed to recovering all MSW by 2020		
	Circular Economy Act 2012 to collect biowaste separately (effective 2015)				
Enabling		Use of different colour coded bins for collection of materials			
		Resource Efficiency Programme (ProgRes) which includes making production and consumption more efficient			
Operating / contracting	Duales System Deutschland (DSD) established following 1991 Packaging Ordinance and is responsible for collection and recycling of packaging from private households and similar institutions				
Local authorities often own and operate significant parts of the MSW collecting, sorting and processing infrastructure through municipal companies and similar schemes such as public-private partnerships and build, own, operate, transfer (BOOT) schemes					

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New South Wales: Strategy and Alternative Waste Treatment

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Waste avoidance

Responses to China's National Sword Policy

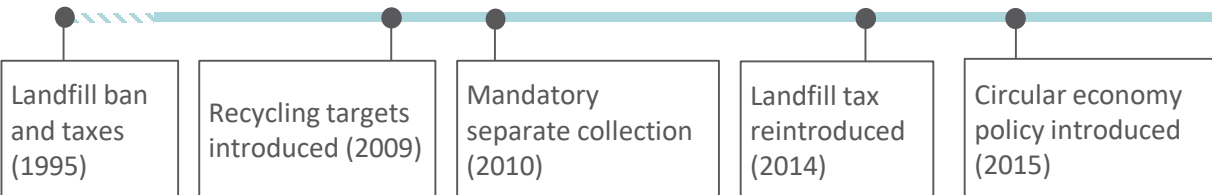
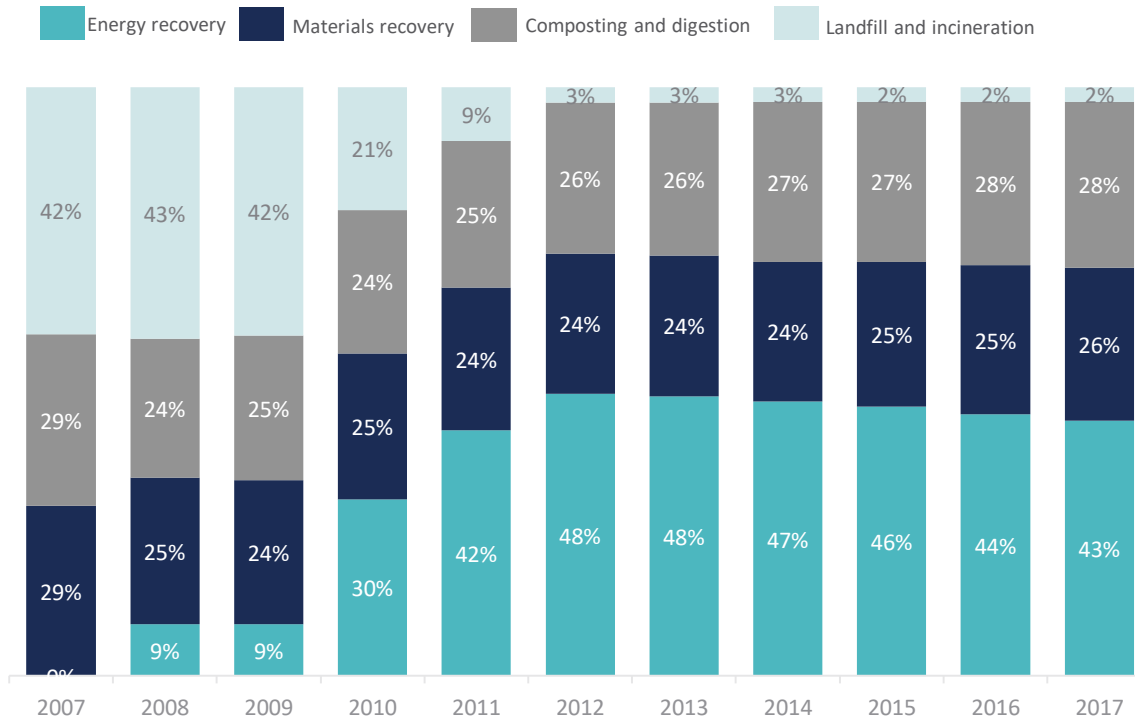
Waste-to-energy

Bibliography

The Netherlands has seen a 40% reduction in MSW landfill between 2009 and 2017

Annual management of waste by method

Breakdown of Netherlands MSW waste management (%)








Key highlights

- **High diversion from landfill** owing to incineration and energy recovery
- **MSW recovery is low**, and per-capita generation is high by European standards
- **Landfill ban** and to a lesser extent **mandatory collection** have been key drivers for the energy recovery sector
- New policy (2015) focus on transition to **circular economy** aims to support growth in materials recovery, but has not yet had a meaningful impact on material recovery rates;
- There is a major focus on the **agri-food sector** as a priority sector for the 'circular bioeconomy', which may further develop local organics end markets and improve organic waste recovery
- Constrained **landfill and incineration capacity** also supports shift to increased material recovery

Netherlands achieves a high recovery rate with a high reliance on efficient energy recovery

- Indicates strong performance
- Indicates some issues
- Indicates major deficiencies

Overall	<ul style="list-style-type: none"> High recovery rate of 97.3%, incorporating best-available-technology for incineration with energy recovery, however the country is in a transition period as elements of the circular economy are implemented for the waste management sector Wide ranging mandatory landfill bans incentivising privately-operated downstream resource recovery
System performance	<ul style="list-style-type: none"> Total waste generation per capita: 2.52 Recovery / recycling rate: 97.3% MSW recovery / recycling rate: 56.6%

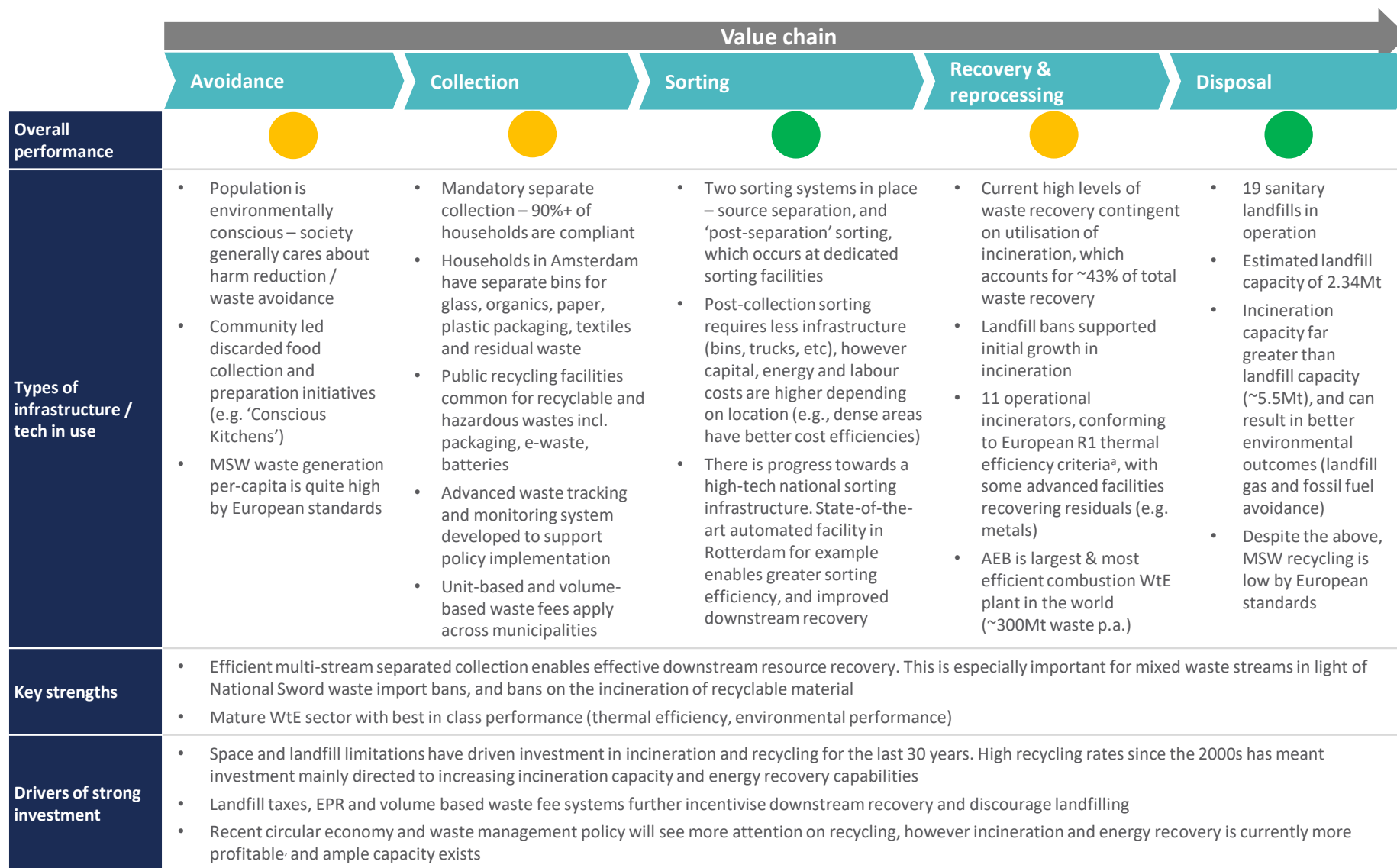
	Overall performance	Key features	Key strengths
Sector dynamics 	●	Resource recovery dominated by private sector; Collection, sorting and disposal government owned	High landfill taxes incentivise private resource recovery performance
Infrastructure / Tech 	●	Some high-tech automated sorting; Landfill disposal only as a last resort, incineration/WtE for non-recyclables	Landfill capacity is heavily constrained (~2.34 Mt of capacity) due to public concerns and lack of available space
End markets 	●	Top 10 global exporter of recycle. Netherlands imports some waste for reprocessing to higher grade for export – industry is very sensitive to global material markets	EPR schemes for some products (e.g. packaging) encourages quality recycle downstream, although influence on recycling rate unclear compared to other measures (e.g., landfill ban) uncertain
Policy Enablers 	●	Landfill minimisation is the primary waste management policy driver; Landfill bans, taxes and mandatory separation support downstream recovery	Recent waste management policies are based on principles of circular economy; Increases in recycling capability aligns with increases in landfill taxes
Culture 	●	Separating waste is most popular environmental measure; 90%+ Dutch people separate household waste either at source or at drop-off facilities	Efficient upstream collection enables effective downstream resource recovery (e.g., removing recyclables from incineration feedstock)

Netherlands is a primarily government-run system for collection and disposal, and privately-run downstream recovery

Actor	Description of role	Key differences to Victoria
Government	Government primarily owns and operates MSW management infrastructure, and owns/operates C&D management and recovery infrastructure	Higher degree of government ownership and operation of front-end collection and sorting for MSW; incinerators are also primarily government owned and operated
Private sector	Private sector primarily owns and operates the resource recovery infrastructure, and owns and operates C&I management including recovery	Private sector provides recovery services and has a capacity that exceeds domestic requirements
Households / businesses	Households/businesses are required to separate waste through mandatory separation regulations (in effect from 2010)	Mandatory separation regulations; culture of recycling aligned with concern for environment
Other	Some NGOs/mission-based organisations operate in the waste avoidance/down-stream recovery sectors (e.g. <i>Plastic Soup Foundation</i> , who are reducing plastic waste in the oceans through litter clean ups and plastic-free campaigns, and <i>Lena-Library</i> who are reducing textile waste through whole-chain initiatives)	

Infrastructure & technology in the Netherlands has a strong focus on source separation and waste to energy technologies

- Indicates strong performance
- Indicates some issues
- Indicates major deficiencies



Notes: ^aThe R1 thermal efficiency criteria applies to all European thermal energy recovery facilities. To meet the criteria, facilities must operate at high levels of net energy efficiency

Sources: Coccon (2018). Landfill Management in the Netherlands, prepared for Rijkswaterstaat Environment and European Union European Regional Development Fund; European Environment Agency (2013). Municipal waste management in the Netherlands; European Investment Bank (2017). Access-to-finance conditions for investments in bio-based industries and the blue economy, prepared for DG Research and Innovation, European Commission; Gradus, R.H.J.M.; Nillesen, P.H.L.; Dijkgraaf, E.; van Koppen, R.J. (2017). A cost-effectiveness analysis for incineration or recycling of Dutch household plastic waste, *Ecological Economics* 135, 22-28; Malinauskaite, J. et al. (2017). Municipal solid waste management and waste-to-energy in the context of the circular economy and energy recycling in Europe, *Energy* 141, 2013-2044; Ministry of Infrastructure and Water Management (2018). [Elements of Dutch Waste Management](#)

End markets: the Netherlands is using existing advanced industries to create new material and resource recovery markets

Detail/description

Overall context

- The waste and recycling market in the Netherlands is **dominated by private firms**:
- 785 companies (most SMEs) engaged in downstream treatment and recycling of solid/liquid wastes (2014)
- 155 metal recyclers, 60 plastic recycling businesses (mainly SMEs)
- The **Netherlands is in the top 10 of global exporters of recyclate** and a leading waste importer in Europe with 14% of total in-country waste derived from imports (2012). A proportion of imported waste is processed to a higher-grade for 're-export'

Actions taken to develop market

- **Landfill bans and taxes** have been a significant historical driver for developing the waste to energy sector in the Netherlands. Recent moratoriums on incineration capacity will likely lead to development of alternative landfill diversion pathways
- **New Circular Economy policy** aims for the reuse and recycling of renewable resources where possible. The agri-food sector is a priority sector for the future circular economy with a focus on using biological resources to produce food, feed, bio-based products and bioenergy
- The existing **advanced chemical processing and agri-food industries is an important enabler** because there are ample market opportunities for valorisation of organic wastes for different end-uses, particularly bio-based fuels and materials.
- **'Plastic Pact NL'** (February 2019) supports collective action towards a circular economy for plastic with the goal to reduce plastic consumption and increase recycling. The voluntary pact commits industry stakeholders (signatories) to reduce plastic consumption by 20% by 2025, 70% of single use plastic is to undergo 'high-quality recycling' and that new plastic products be 100% recyclable
- Netherlands was one of the first jurisdictions to commit (in Feb 2019) to the initiative with more than 70 businesses and environmental organisations signed up

Impact of actions

- The resource recovery sector in the Netherlands is **heavily reliant on incineration and energy recovery**.
- A freeze on new incinerator capacity may incentivise new material end markets as incineration capability diminishes and landfills are already constrained

Netherlands has a policy system that utilises a range of approaches to drive optimal system performance

	Avoidance (incl. re-use)	Collection	Sorting	Recovery & reprocessing	Disposal
Informing	Advanced waste tracking and monitoring system for policy compliance				
Financing				European Investment Bank has provided financing (421-mil EUR) across 3 incinerator projects Financial support (gov and industry) for advances in resource recovery in the bioeconomy	
Incentivising (financial incentives)		Recycling/removal tax on new electronic and household goods funding improved collection systems		Financial support (gov and industry) for advances in resource recovery in the bioeconomy	Multiple taxation instruments (landfill tax, incineration tax) and disposal fees (PAYT)
Mandating		Mandatory separate collection since 1994, and mandatory municipal recycling centres		Stringent incinerator standards – EU efficiency standards (R1), and air pollution standards	Local bans on material to landfill, stringent landfill standards
Enabling	Product stewardship across several product categories e.g. packaging, WEEE	Producer responsibility for EoL vehicles, paper and cardboard, WEEE, batteries, tyres, glass, packaging		Moratorium on incinerator capacity expansion since 2002 Mature industries (WtE, advanced manu., chemical processing) enable advanced resource recovery	Moratorium on landfill capacity expansion since 1995 enables reinvestment in materials/energy recovery
Operating / contracting	Collection system (from the household to MRFs) is government owned and operated. Publicly owned collection system has been shown to be more (financially) efficient compared to private collection				

■ Indicates key policy

Sources: Coccon (2018). Landfill Management in the Netherlands, prepared for Rijkswaterstaat Environment and European Union European Regional Development Fund; Coresten, M.; Worrell, E.; Rouw, M.; van Duin, A. (2013). The potential contribution of sustainable waste management to energy use and greenhouse gas emission reduction in the Netherlands, *Resources, Conservation and Recycling* 77, 13-21; Dijkgraaf, E.; Gradus, R. (2017). An EU recycling target: what does the Dutch evidence tell us?, *Environmental Resource Economics*, 68 501-526; European Commission (2019). The Environmental Implementation Review 2019 – County Report The Netherlands, European Union; European Environment Agency (2013). Municipal waste management in the Netherlands; European Investment Bank (2017). Access-to-finance conditions for investments in bio-based industries and the blue economy, prepared by DG Research and Innovation, European Commission; Gradus, R.H.J.M.; Nillesen, P.H.L.; Dijkgraaf, E.; van Koppen, R.J. (2017). A cost-effectiveness analysis for incineration or recycling of Dutch household plastic waste, *Ecological Economics* 135, 22-28; Ministry of Infrastructure and Water Management (2018). [Elements of Dutch Waste Management](#)

Deep dive: Using circular public procurement in the Netherlands has promoted development of end markets



Summary

- The Dutch Government and local governments have shifted from **green public procurement towards circular procurement**, including products as services (e.g. leasing models) in order to promote the development of a circular economy, including stronger end markets

Description

- Green public procurement (GPP) sets out to stimulate local markets to provide more sustainable products and services by **leveraging the purchasing power of public organisations, with a strong focus on energy efficiency and reducing greenhouse gas emissions**
- There is a strong focus on energy efficiency and reducing greenhouse gas emissions in GPP, likely due to initiatives such as these being low hanging fruit
- GPP has had success globally, particularly in **transport, infrastructure and catering sectors.**
- Circular public procurement (CPP) is a recent extension of GPP to include more circular economy concepts into procurement decision making to boost local markets; under CPP, there is **more of a focus on preferencing products as services, e.g., leasing lighting fixtures**
- There are a range of different circular procurement models including:
 - **'System level'**: product service systems, public private partnerships, cooperation with other organisations (sharing and reuse), leasing
 - **'Supplier level'**: Supplier take back systems, design to disassembly, reparability of products, product reuse
 - **'Product level'**: products disassembled after use, material/energy/nutrient recovery, promotes resource efficiency during the use cycle
- **In 2013 the Dutch Government established the Circular Procurement Green Deal** to accelerate transition to the circular economy, bringing together 45 public and private parties to conduct pilot CPP initiatives
- Over three years, 80 CPP pilots were conducted, and lessons shared amongst participants; this success led Dutch government to place special emphasis on circular procurement for its 2016 **'Roadmap to a Circular Economy', with the aim of raising the proportion of circular procurement for government purchases to 100% by 2020**

Deep dive (cont.): Using circular public procurement in the Netherlands has promoted development of end markets



Results

- Progress towards meeting CPP goals in the Netherlands are not yet tracked; however the number of examples of CPP in the Netherlands indicate that progress is being made

Example 1: Brummen Town Hall



- **Aim:** Design and build new Town Hall so that it can be disassembled and recycled in 20 years
- **Approach:** Product service model – Town Hall designed for disassembly with take-back condition in procurement contract
- **Results:** Brummen Town Hall is 30% cheaper than two comparable town hall projects; 95% of the design consists of components that can be disassembled and reuse

Example 2: Energy efficient street lighting in the City of Rotterdam



- **Aim:** Improve the quality of day- and night-time public space in Rotterdam; upgrades must improve maintenance efficiency, reduce energy consumption and light pollution; all individual lights should be removable and replaceable
- **Approach:** Strong tender requirements for design, robustness, durability, and reuse of the materials of fixtures; only highly-efficient LED lamps permitted; standardisation in equipment to achieve more efficient maintenance
- **Results:** New lighting fixtures outperform previous lighting system in cost, energy performance, and in lighting efficiency. Estimated 1,252 tonnes of CO2-e saved

Example 3: Textiles made from recycled fibres for the Ministry of Defence



- **Aim:** Increase circularity of MoD textiles sourcing by requiring use of recycled textiles; towels and overalls must contain at least 10% recycled post-consumer textile fibres and demonstrate this through microscope testing
- **Approach:** Pilot project with no price limit
- **Results:** 34% of recycled fibres in towels, 14% of recycled fibres in wash cloths; use of recycled materials resulted in 25% price increase compared to previous contract

Applicability to Victoria

- Victoria is already pursuing a sustainable procurement approach based on the environmental objectives in the state's Social Procurement Framework and work under the Recycling Industry Strategic Plan
- Sustainability Victoria supports state and local governments to consider sustainability during procurement
- Incorporating more circular business models into procurement requirements to provide demand signals into the recycling and resource recovery system could be an extension of this approach

Deep dive: The Netherlands has sophisticated and efficient waste-to-energy infrastructure



Summary

- The Netherlands has developed a **highly sophisticated and efficient waste-to-energy (WtE) infrastructure** as an alternative to landfill since the 1990s, with WtE an important component of its **renewable strategy, supplying both electricity and district heating**; however, as it seeks to move to a circular economy **there will need to be a stronger focus on WtE as part of an integrated resource recovery system**

Description

- Lack of space for landfilling and landfill restrictions** have historically encouraged growth in the incineration market
- Currently, there are **11 operational incinerators in the Netherlands**, 10 of which are publicly owned and operated
- These incinerators are **amongst the most efficient in the world**, conforming to stringent EU and Dutch thermal efficiency and air pollution standards
- There is also **significant demand for district scale heating in the Netherlands**, and with current renewable energy policy including the phasing out of gas combustion for thermal energy by 2060, incinerators are playing an important role

Results

- WtE is used to manage about 43% of Netherlands' MSW**, down from a peak of 48% in 2013
- WtE provides approximately 12% of the total renewable energy supply** in the Netherlands; considering the high proportion of fossil fuels used, this represents a potentially significant reduction in both fossil fuel derived CO₂-e emissions, and landfill gas emissions.
- However, **WtE has low priority on the waste hierarchy and in the circular economy agenda**, and a moratorium on new incineration capacity and bans on waste that can be incinerated are in place in an effort to expand local material recovery markets and capacities
- WtE facilities are starting to transition towards holistic resource recovery** rather than traditional landfill avoidance and energy recovery only, with advanced WtE facilities that can extract valuable material from the residual ash, including metals, granulates, and rare earths
- For example, **the AEB incinerator in Amsterdam is the world's largest and most efficient (~30%) WtE incinerator**, with a typical throughput of 4,400t/day and annual production of ~1-million MWh of electricity
- Fly and bottom ashes are now treated and valuable metals and rare earths are recovered**; an anaerobic digester is also co-located, with the site also treating biomass and wastewater sludge to produce biogas and nutrients



AEB facility, Amsterdam

Applicability to Victoria

- Energy recovery is a **possible pathway for treating problem wastes**, including mixed streams which are difficult to recycle, and the Netherlands represents global best practice for energy and resource recovery from incineration
- Energy recovery could be part of the transition towards **Victoria's renewable energy target of 50% by 2030**
- However, Victoria needs to ensure that **investment in WtE infrastructure supports integrated resource recovery** and doesn't disadvantage higher value uses of waste streams

Deep dive: Netherlands is moving towards a circular bioeconomy



Summary

- **Strong government and private sector support**, both financial and industry-research network building, underpins a strategy for a 'circular bioeconomy' with the chief goal of achieving **better utilisation of biomass as alternative to fossil fuels** for materials, chemicals and energy
- Transforming the **agri-food sector** is a **priority in the transition to the circular economy**. Importantly, the already mature industry for bio-materials and bio-fuels provides a stable platform for resource recovery from organic waste

Description

- The 'bioeconomy' refers to the sector of the economy producing food, feed, bio-based products, and bioenergy. The 'circular bioeconomy' aims to close the loop for the entire biomass supply chain through **better utilisation of biomass in the transition away from fossil fuels**
- The **existing advanced chemical and fuel processing industries and advanced material sector in the Netherlands is a critical enabler** and key to this focus on bio-based materials and energy production from organic materials and waste residues.
- **Turnover for the entire bioeconomy in 2016 was around 120-billion EUR**, with 21-billion EUR coming from bio-based materials and energy directly. In 2016 alone, **200-million EUR was invested in circular bioeconomy** research and development through tax reductions, subsidies and financial support from the private sector.
- **Residues and wastes from the agri-food sector are already treated for resource recovery**, meaning this mature and advanced sector is well equipped to maximise resource recovery from organic wastes.

What is being done?

- **Clear agenda setting:** Framework on the Biobased Economy (2012); circular economy policy (2015); Sustainable biomass and bioenergy in the Netherlands (2016); 'Transition Agenda' (roadmaps for industries including biomass and food)
- Dutch government **supports innovation and commercialisation of concepts** to improve circularity and biomass 'cascading'
- **Multiple collaborative research centres and industry clusters operating**, e.g.: Carbohydrate Competence Centre, Biotech Campus Delft, Centre of Expertise Biobased Economy
- **Key government bodies include Ministries of Infrastructure and Water, Economy Affairs and Climate Policy, and Agriculture**
- Dutch government provides financial supports transition to **circular bioeconomy through tax benefits, innovation credits and grants**
- Other funding and support comes **from National Organisation for Scientific Research, Netherlands Enterprise Agency, Top Consortium for Knowledge and Innovation**

Deep dive (cont.): Netherlands is moving towards a circular bioeconomy

The Dutch Experience

Example 1: Biobased Delta – innovation and support network

- **Aim:** Biobased Delta is an alliance of Dutch provinces, businesses and knowledge centres in the delta region of North Brabant, Zeeland and South Holland;
- **Approach:** It provides networks and support for initiatives using biomass as raw material in the chemical, construction and packaging industries. An ‘agrochemical coalition’ has been set up, linking agricultural and horticultural firms and the chemical industry
- **Results:** Products already commercialised: Bioashphalt, fibre-based building materials, street furniture, and a biobased viaduct

Example 2: Green Chemistry Campus, Bergen op Zoom – business accelerator for biobased innovations

- **Aim:** Hub brings together entrepreneurs, government and knowledge institutes working on scaling up new sustainable materials and chemicals for the packaging industry
- **Approach:** Renewable raw materials and resources from organic MSW and wood residues key focus; Hub offers access to state of the art facilities and financial, marketing and technological support
- **Results:** Successful innovations: Elephant grass grown on reclaimed land for biobased building material and plastics, Mobile pyrolysis plant for converting waste biomass to liquid fuel and fertilizers, Biorizon – production of bio-based aromatics for the chemical industry

Applicability to Victoria

- Victoria has a large agricultural sector with 29,661 businesses employing 87,564 workers
- Agriculture Victoria already works with industry on research, development, and commercialisation of new technology and processes
- Building new innovation networks and policy frameworks, and developing an ICT strategy to harness technological and scientific advances are already a part of the Agriculture Victoria Strategy (2017)

Agenda

Objectives and introduction to project

Summary of findings

Selection of jurisdictions

Overview of Victorian system

Jurisdictional case studies

Wales: Targets and collections

South Korea: Organics and overall recycling

Germany: Overall recycling, landfill bans and EPR

Netherlands: Circular economy and waste-to-energy

South Australia: Strategy and licensing

New South Wales: Strategy and Alternative Waste Treatment

Additional deep-dives

Waste avoidance

Responses to China's National Sword Policy

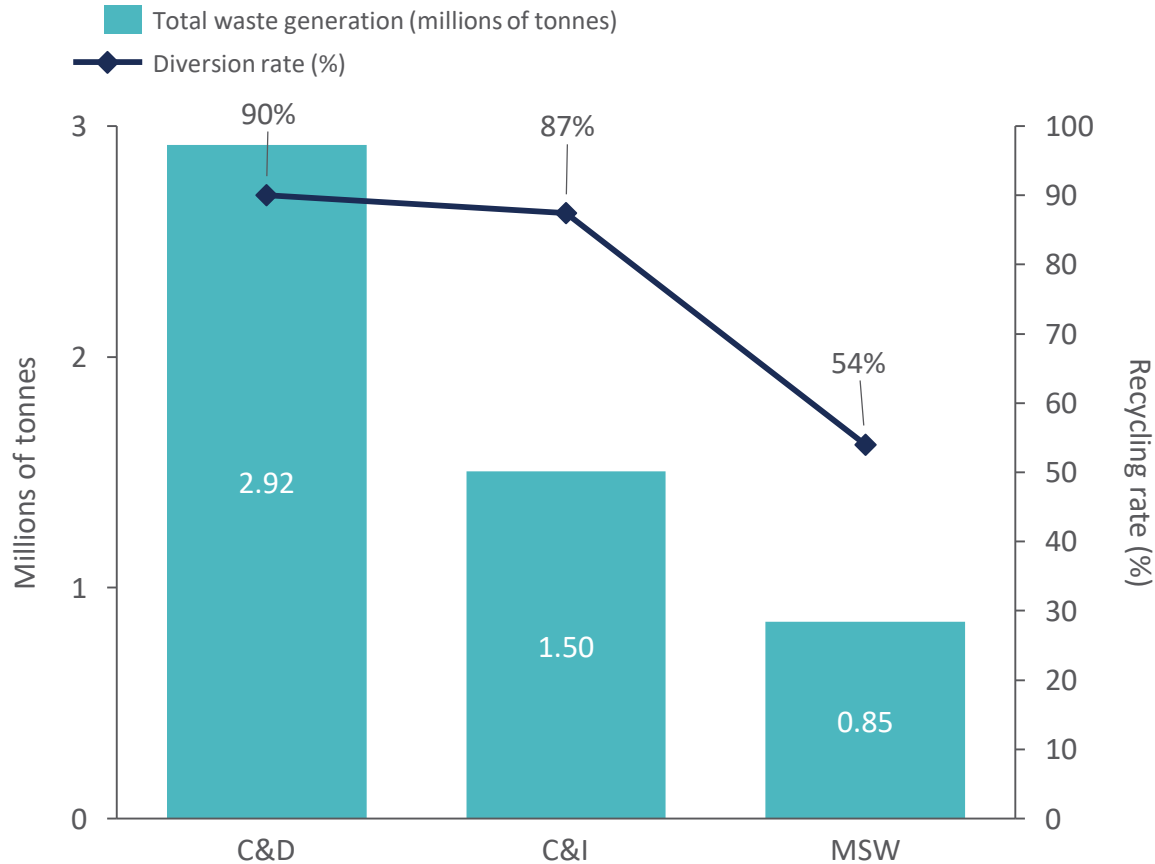
Waste-to-energy

Bibliography

In 2016-17 South Australia produced 5.3 million tonnes of waste, with strong recovery rates across all waste categories

Breakdown of waste generation and recovery rates in South Australia, 2016-17

South Australian waste generation and recovery rate by streams (millions of tonnes, %)

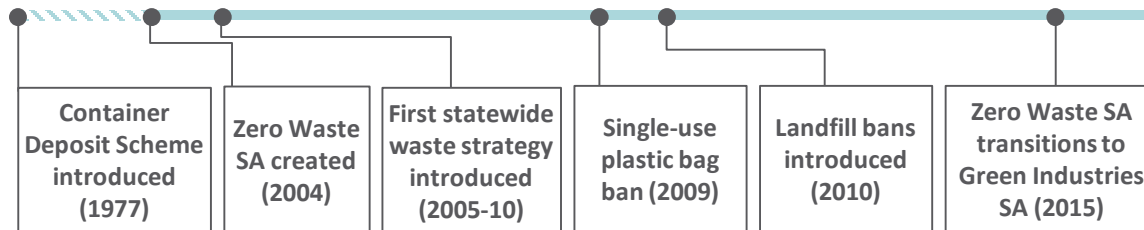
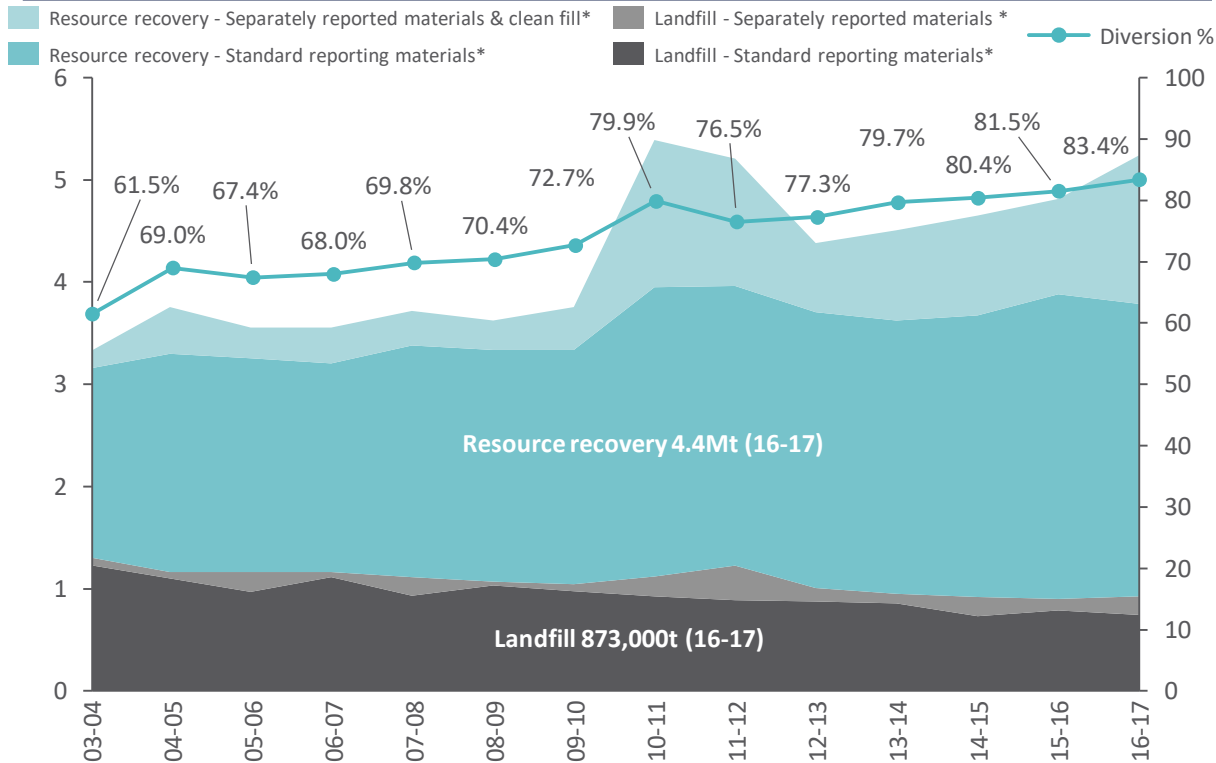


Key highlights

- South Australia generated a total of 5.3 million tonnes of waste in 2016-17
- Construction and demolition waste made up ~55% of total waste generation, while commercial & industrial waste and household waste made up ~28% and ~16% respectively
- According to South Australia's 2016-17 Recycling Activity Survey, SA's recycling rates were:
 - 54% for household waste
 - 87.4% for commercial and industrial waste
 - 90% for construction and demolition waste

South Australia's landfill diversion rate has increased from 61.5% in 2003 to 83.4% in 2016

Trend in South Australian resource recovery and landfill disposal (T and diversion %) 03-4 –16-17



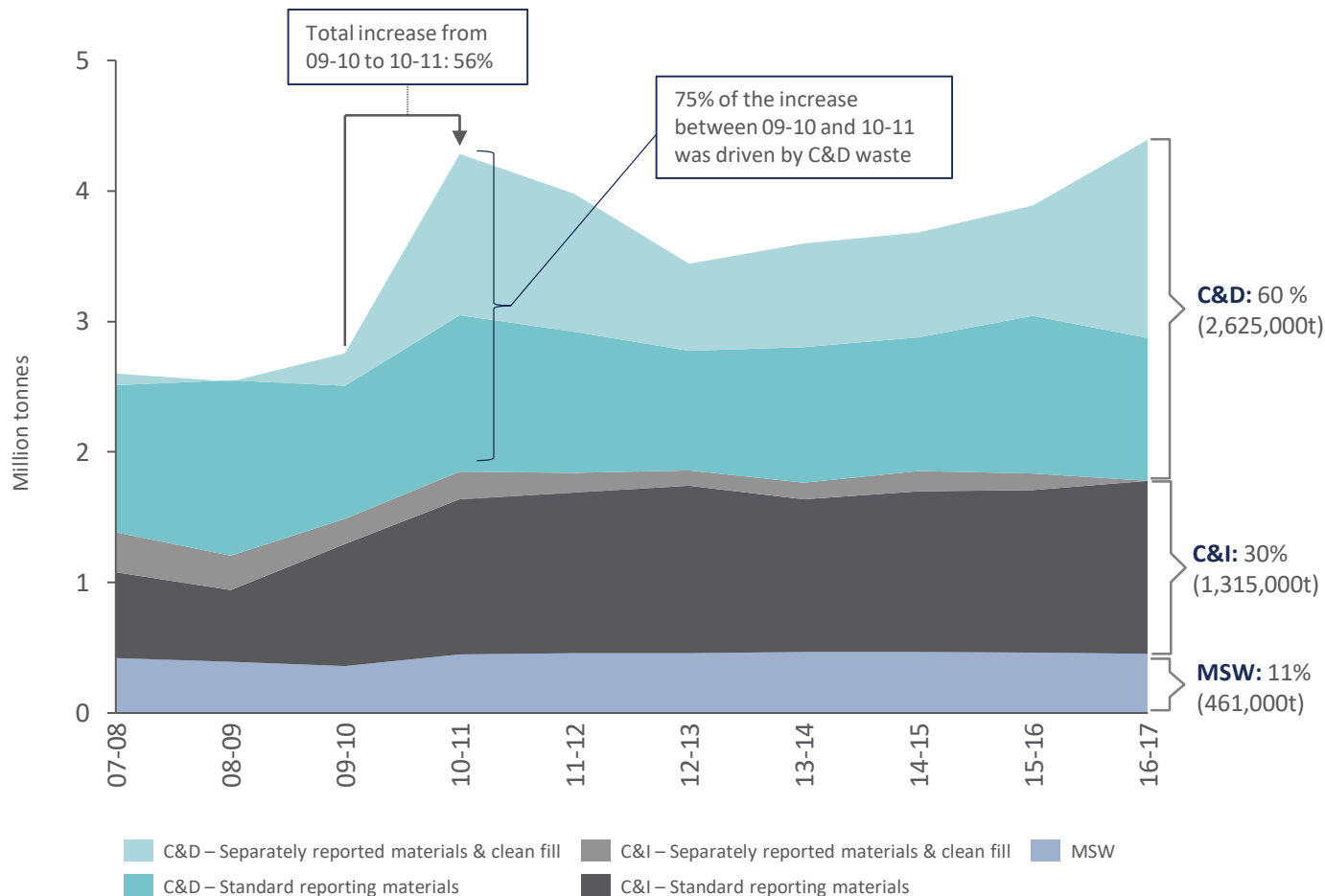
Key takeaways

- South Australia has the highest landfill diversion rate nationally (83.4%)
- Successful integrated policy approach across SA Government, led by Green Industries SA has been main driver
- SA faces similar end market challenges to Victoria in paper & cardboard, glass and plastic
- Key policy enablers include infrastructure grants, landfill bans, single-use plastic bag bans, and a container deposit scheme

Notes: *Resource recovery and landfill figures include **standard reporting materials** (metals, organics, cardboard & paper, glass, plastics and masonry) and **separately reported materials** (clay, fines, soil, sand, rock and rubble), as defined by the Commonwealth Department of the Environment and Energy. Standard reporting materials can fluctuate significantly across reporting years and between states and territories, for example due to large infrastructure projects. The diversion rate above includes standard and separately reported materials as this is the standard method for comparison across jurisdictions.

But most of the increase in South Australia's diversion rate has been driven by shifts in C&D and C&I (initial view)

Contribution to resource recovery in SA by source sector for 2016-17 and trend since 2007-08



Key takeaways

- Clay, fines, rubble and soil increased >400% (or an additional 1m tonnes) between 09-10 and 10-11, due to a number of large transport and infrastructure projects*
- >300,000 tonnes of recovered industrial organic materials (from wine and meat processing) were counted in 2010-11, following reporting changes in 2008-9
- Municipal waste recovery has remained relatively constant, with no major increase in recovery rates since 2007-08

Notes: This slide shows data beginning in 2007-08 for resource recovery—not total waste. *Major capital works projects underway in SA in 2009-10 include the new Royal Adelaide Hospital, desalination plant, Adelaide Oval, light rail system and convention centre; construction of the Northern Connector and Darlington upgrade account for the second major increase in C&D waste recovery beginning in 2015-16

Source: South Australia Recycling Activity Report 2010-11 p.25, p. 14; South Australia Recycling Activity Survey 2016-17, Figure 2.3; Spoehr (2017), "The Search for an economic solution for South Australia", *The Conversation*

South Australia has high landfill diversion rates (esp. for C&D waste), with a strong regulatory environment and culture of recycling



Indicates strong performance













Indicates some issues



Indicates major deficiencies

Overall	<ul style="list-style-type: none"> Highest landfill diversion rate in Australia Strong regulatory environment, including bans on several types of landfill (2010) and single-use plastic bags (2009) Long-term institutional and cultural norms driven by creation of Zero Waste SA (2004) – now Green Industries SA
System performance	<ul style="list-style-type: none"> Per capita total waste: 2.1t Total waste recovered (%) / recycled (%): 83.4% / 81.6% MSW total waste generated / recovered (%): 853,000 tonnes / 54% Emissions from waste sector¹: 1.07 Mt CO₂-e

	Overall performance	Key features	Key strengths
Sector dynamics 		Large firms contracted to municipal councils for collection and disposal; some smaller operators in C&D collection. High barriers to entry in most sectors apart from C&D collection due to strong regulation	Strong regulatory environment driven by the SA EPA; licensing of major infrastructure providers reduces compliance issues (transfer stations and small MRF operators not licensed in Victoria); different construction standards allow greater use of C&D waste in road base
Infrastructure / Tech 		Container Deposit Scheme depots, three-bin system in metro areas, some waste to energy operations; well-developed plastic reprocessing facilities	CDS depots facilitate sorting of glass & other waste streams ; 30% of councils accept mixed FOGO in green bins; 2 major glass reprocessors in SA (Amcor & Owen Illinois); Hypothecation of waste levy has led to steady funding source
End markets 		87% of recovered materials are reprocessed within SA, but National Sword policy has affected markets for paper & cardboard, plastics and glass	Higher prices than national average for recycled glass due to CDS sorting; 1/3 of plastic generated in SA is reprocessed locally
Policy Enablers 		Waste reduction targets; landfill levy and bans; container deposit scheme; plastic bag ban; infrastructure loans scheme	Integrated policy approach led by Green Industries SA; landfill bans in place since 2010, plastic bag bans; well-established CDS
Culture 		Strong culture of recycling with trend towards waste avoidance driven by Green Industries SA; community resource recovery projects	Container deposit scheme a key driver of behaviour ; developing infrastructure to support waste avoidance; long-term public education campaigns; industry outreach

Notes: Emissions figure from 2016. Per capita waste figure is for standard reporting materials only. Total waste recovered/recycled figure includes both standard and separately reported materials.

SA's waste sector is run similarly to Victoria's with a comprehensive approach to recovery / recycling

Actor	Description of role	Key differences to Victoria
Government	<ul style="list-style-type: none"> ▪ At a state level, similar to Victoria: dedicated agency focused on sustainability (Green Industries SA); EPA SA has responsibility for CDS regulation and licensing of landfills and other waste infrastructure ▪ Local government responsible for procuring waste management and recycling services on similar basis to Victoria 	<ul style="list-style-type: none"> ▪ Comprehensive government approach with small differences <ul style="list-style-type: none"> – Stricter licensing requirements – Wide range of different government levers: waste levy hypothecation; CDS, liaison with business; greater focus on organics – Different standards specifications allow greater use of C&D waste in road base
Private sector	<ul style="list-style-type: none"> ▪ Large companies operate most collection, recycling and recovery facilities; “super collectors” manage overall contracts for CDS depots; smaller firms involved in C&D collection market 	<ul style="list-style-type: none"> ▪ More compliance issues; more business dialogue with government; more robust end markets for glass and organics
Households / businesses	<ul style="list-style-type: none"> ▪ Households and businesses play strong role in collection and sorting through CDS ▪ Strong general support for recycling and recovery 	<ul style="list-style-type: none"> ▪ Long-term container deposit scheme has encouraged behavioural change and broader recycling practices

SOURCE: National Waste Report 2016; SA Government Submission to 2017 Senate Inquiry, *Never Waste a Crisis*; Federal Department of Sustainability, Environment, Water, Population and Communities & Queensland Department of Environment and Resource Management (2011) *Construction and Demolition Waste Status Report*, p. 146

South Australia has a highly integrated policy system that drives a coordinated approach across government and industry

Indicates key policy

	Avoidance incl. re-use	Collection	Sorting & recovery	Recycling & reprocessing	Disposal
Informing	<ul style="list-style-type: none"> Community & business campaigns to encourage avoidance 	<ul style="list-style-type: none"> Community & bus. campaign to reduce waste contamination e.g. Recycle Right 		<ul style="list-style-type: none"> Economic analysis on potential benefits of food waste recycling 	
Financing	<ul style="list-style-type: none"> Shared spaces infrastructure grants program focusing on the upper part of the waste hierarchy 	<ul style="list-style-type: none"> Collection of waste data via Green Industries SA and EPA SA, including waste audits Benchmarking of green industries to determine size of sector in SA 		<ul style="list-style-type: none"> Market development grants program to encourage end market growth 	
		<ul style="list-style-type: none"> Infrastructure grants and loans across the value chain, with a particular focus on developing end markets for plastic, paper & cardboard and glass in response to China's National Sword policy Kerbside Performance Plus (Food Organics) Incentives Program to assist councils with diversion of food waste 			<ul style="list-style-type: none"> Landfill levy
Incentivising (financial incentives)		<ul style="list-style-type: none"> Support for commercialisation of technological innovations related to waste and resource recovery systems 			
Mandating		<ul style="list-style-type: none"> Local government service obligations for kerbside collection 	<ul style="list-style-type: none"> Licensing of sorting, recovery, recycling and reprocessing actors 		<ul style="list-style-type: none"> Landfill bans for recycled glass, plastics, paper and cardboard, e-waste and others
		<ul style="list-style-type: none"> Land use and zoning rules as defined by EPA SA 			
Enabling	<ul style="list-style-type: none"> Investing in online platforms to map waste avoidance and collaborative consumption 	<ul style="list-style-type: none"> Support development of statewide and regional infrastructure plans with distinct targets CEO and government roundtable to discuss policy priorities 			
Operating / contracting		<ul style="list-style-type: none"> Local government contracts for delivery of waste management and recycling services support the development of critical infrastructure across collection and recycling system 			

Note: Abbreviated summary – does not include all policy levers

SOURCE: National Waste Report 2018; Senate, Never Waste a Crisis, 2017; SV, Vic SWRRIP, 2018, interviews with experts; Green Industries SA Business Plan 2018-19

South Australia has strong reprocessing capabilities in most end markets, but China Sword has affected plastics, glass paper/cardboard

Detail/description

Overall situation

- Well-established reprocessing capabilities for most materials
 - Approx. 87% of materials reprocessed in South Australia; 6% processed interstate; 6 % exported
 - Tonnes of material sent overseas has increased from 210,000 in 2015-16 to 274,000 in 2016-17 (an increase from 5% to 6%)
- All masonry materials and the majority of organics and glass are reprocessed in SA
- The end market for green organics (used for soil conditioner, mulch) and other organics (i.e. for fat commodities, meat & bone meal) is strong, with demand often exceeding supply
- 99.7% of cardboard & paper and the majority of metals 75.9% are sent interstate
- Approx. 37% of plastics are reprocessed in SA, though high power and utility costs have challenged viability of some operators

Actions taken to develop market

- Three key actions taken to develop end markets:
 - Infrastructure grants to support maintenance and construction of recycling and reprocessing infrastructure
 - Loan scheme to support projects with large capital requirements
 - Market development grants to increase the quality and market demand for recyclable materials and recycled content products

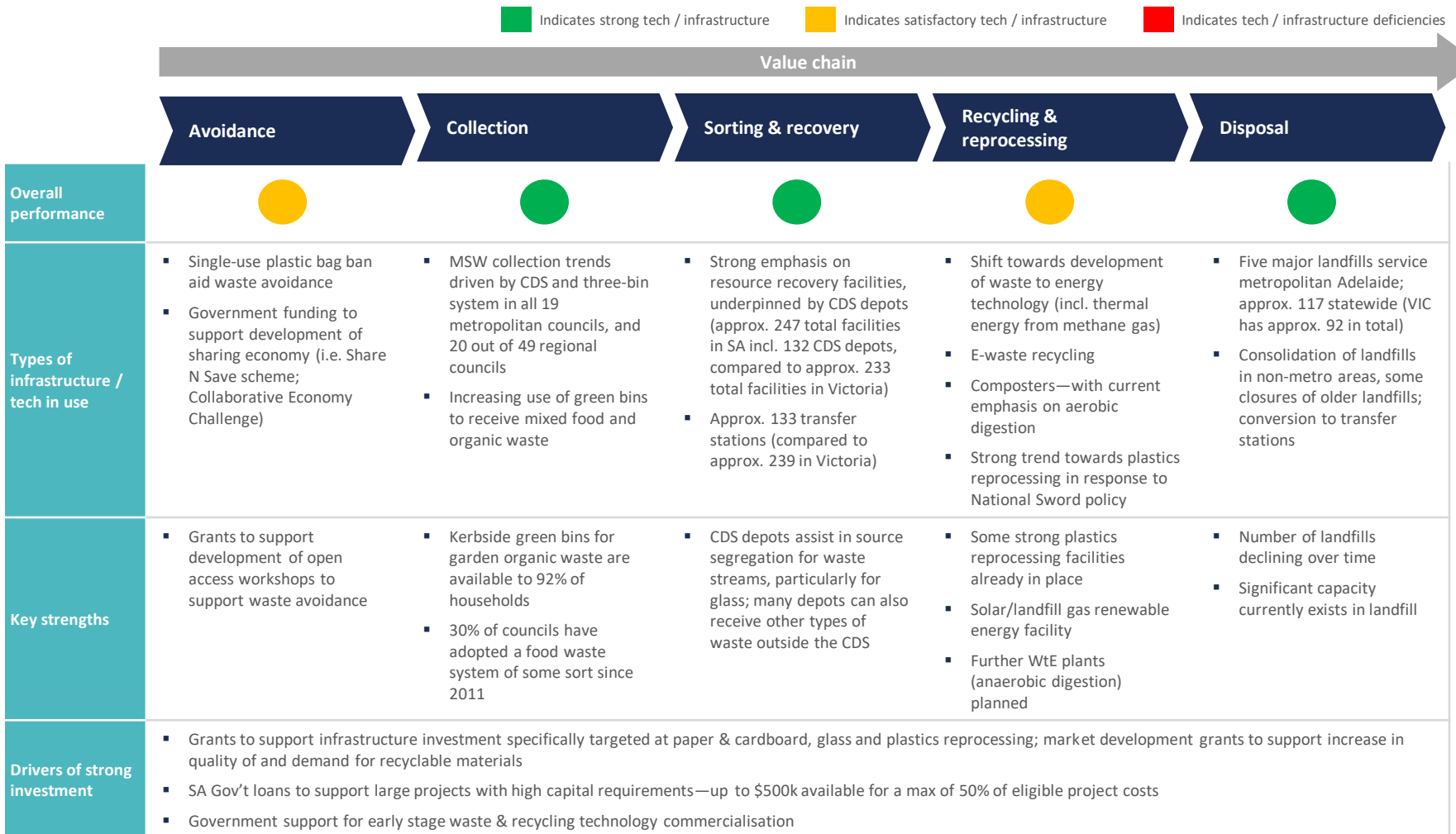
China sword effect/response

- China's National Sword policy affected South Australia's end markets for plastic, paper & cardboard and glass
- The South Australian Government responded with a \$12.4 million support package to investment in reprocessing and local re-use, and well as sorting and processing to enhance the quality of recovered materials in target sectors

Notes: Figures drawn from South Australia's Recycling Activity Survey 2016-17 (finalised March 2018)

SOURCE: South Australia's Recycling Activity 2016-17; Green Industries SA Business Plan 2018-19; Austr

South Australia has strong collection, sorting & recovery infrastructure, and is building further capability in reprocessing



Notes: Numbers of landfills, resource recovery facilities and transfer stations drawn from National Waste Report 2013 (latest figures available)

SOURCE: Stakeholder interviews; Review of South Australia's Waste Strategy 2011-2015, p.12; Australian Government: Analysis of Australia's municipal recycling infrastructure capacity, p.7; National Waste Reporting 2013: South Australia Jurisdictional Waste Profile 2013; NAWMA Strategic Plan 2018-2025; BioGass Projects: DeLorean Energy Anaerobic Digestion Facility; SA Government Submission to Federal Senate Inquiry; Green Industries SA Business Plan 2018-19

Deep dive: Zero Waste Act 2004¹ set up an integrated approach to waste management

<p>Summary</p>	<ul style="list-style-type: none"> Zero Waste Act in SA was an integrated waste approach that combined policy, funding, targets, regulation in a comprehensive framework Many but not all elements have since been replicated by Victoria and other Australian states 	
<p>Description</p>	<p>Results of 2004 Act and subsequent Waste strategies</p>	<p>Key elements of Zero Waste Act 2004:</p> <ul style="list-style-type: none"> First State wide integrated strategy on waste based on waste hierarchy principles Set short and long term targets for waste avoidance and landfill diversion <ul style="list-style-type: none"> 2006 targets: 25% kerbside waste recycled 2014 targets: Reduce waste to landfill by 25% Set initial waste levy and provisioned for 50% of waste levy for investment Set up Green Industries SA as an independent corporate entity Standardised kerbside collection approach (to 3 bin model – \$8m funding) Strategy for food and electronic waste Significant grants for infrastructure investment <p>Results of 2004 Act overall</p> <ul style="list-style-type: none"> Closure of the largest landfill in Adelaide (Wingfield 700k T p.a.) Landfill diversion has increased from 62% - 83% Resource recovery has doubled from 2MT in 2004 to over 4 MT in 2016 Since 2003, \$107 million of waste levy funds have gone into programs and projects <p>2010-15 Waste Strategy</p> <ul style="list-style-type: none"> The 2011–2015 Waste Strategy primarily focussed on two major objectives: <ul style="list-style-type: none"> To avoid or reduce the amount of overall waste To maximise the useful life of materials by making them last longer through re-use and recycling. <p>2015 – 2020 Waste Strategy</p> <ul style="list-style-type: none"> Landfill diversion targets have moved progressively upwards and now stand at (for metropolitan Adelaide): <ul style="list-style-type: none"> C&D target:90%. C&I target: 80%, MSW: 70% Avoidance: 5% reduction per person
<p>Applicability to Victoria</p>	<ul style="list-style-type: none"> Overall, many elements of policy framework have been incorporated into Victoria (e.g. separate organisation, additional funding for infrastructure, standardized collection etc) Victoria could extend its current approach through the adoption of recycling / avoidance targets, cemented funding; and adopting even more innovative approaches e.g. incubation of start-ups, landfill bans, EPRs etc 	

Notes: Subsequently renamed Green Industries Act

SOURCE: Review of Zero Waste Strategy 2011-15, National Waste Report, 2018; Senate Inquiry, SA government submission

Deep dive: South Australia's Container Deposit Scheme has helped improve source separation of waste streams in the state

Summary

- SA's Container Deposit Scheme has increased source separation of waste streams, reduced environmental damage from litter, and underpinned behavioural shifts
- The scheme is currently being reviewed; a final report is due in mid-2019

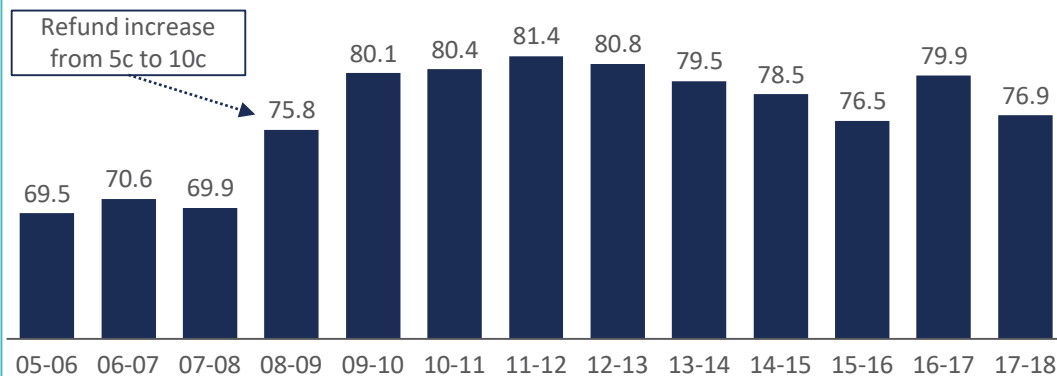
Description

- CDS commenced in 1977
- The **SA EPA administers the scheme**, but does not have any direct involvement in the collection of containers or recycling of materials, which is the responsibility of industry
- Collection and recycling process is handled by private companies called **"super collectors"**, who enter into contractual arrangements with both collection depots and beverage suppliers; there are 4 super collectors in SA
- Beverage suppliers** must ensure they have effective waste management arrangements for return and recovery of containers sold in SA, and must ensure containers are recyclable
- Containers are **sorted by material type at the depot**; glass containers are sorted by colour and sold for reprocessing; aluminium, steel, liquid paperboard and plastic containers are recycled through end markets sourced by the super collector

Results

- \$60m refunded in 2017-18; 603m containers (43kt) recovered; return rate of 76.9%
- Strong end markets for recycled glass provided by two major glass reprocessors located in South Australia: Amcor and Owen Illinois
- Australian jurisdictions with CDS have a lower level of bottles and cans in their litter streams: in 2017-18, SA had 2.8% of CDS items in their litter, compared to 6.5% in VIC
- Experts also believe that globally, jurisdictions with CDS have higher recovery rates of aluminium, plastic and glass than those that do not

Beverage container return rates, %



Applicability to Victoria

- Note that CDS scheme was defeated in Vic Parliament in 2018, but Vic Gov continues to look at models in other jurisdictions
- Other Australian jurisdictions have introduced container deposit schemes: Northern Territory (2012); New South Wales (2017); Queensland (2018); and ACT (2018). Western Australia is due to implement a scheme in 2020.
- One potential challenge is the rollout of container deposit facilities and the availability of suitable land

SOURCE: Stakeholder interviews; EPA South Australia: Improving South Australia's Recycling Makes Cents: A scoping paper to review SA's container deposit scheme; EPA SA website: Container Deposits; Bragge et al (2016) "Container deposit schemes work: so why is industry still opposed?", *The Conversation*

Deep dive: South Australia’s licensing and enforcement mechanisms have facilitated strong compliance from stakeholders

Summary

- South Australia’s EPA has a range of powers to investigate and remediate illegal dumping and other illicit practices, including environment protection orders, clean-up orders, expiations and prosecution
- In the 2018 Senate inquiry into the waste and recycling industry, South Australia has attributed its licensing of all landfills as a potential driver for less concerning levels of inappropriate landfilling alleged in other states

Description

- **South Australia’s EPA regulates the waste and resource recovery industry** through the provisions of the **Environment Protection Act 1993**
- As of 2016, more than **400 licenses** are held under the Environment Protection Act for waste or resource recycling activities, comprising a mix of **waste transfer, waste disposal and resource recovery activities as well as 650 waste transporter licenses**
- The EPA has a range of powers when investigating illegal waste activities including **environment protection orders, clean-up orders, expiations and prosecution**
- There are also particularly **stringent requirements** surrounding **stockpiling of recyclables in resource recovery facilities**
- The EPA also **intends to attach standard license conditions** requiring **regular, periodic reporting** to the EPA of **data on material flows** at facilities for **all resource recovery facilities**

Results

- South Australia’s **licensing and enforcement mechanisms** have allowed for **strong compliance** from waste stakeholders and a **disincentive to engage in illegal waste activities**
- In 2016, a waste company’s failure to comply with environmental protection orders led to the **state’s first jail sentence for an environmental offence**
- The **2018 Senate inquiry** ‘Never waste a crisis: the waste and recycling industry in Australia’ also mentions that **South Australia’s licensing of all landfills** within the state has led to **less concerning levels of inappropriate landfilling** alleged in other states

Applicability to Victoria

- Victoria’s enforcement and licensing is currently more relaxed relative to South Australia and has faced challenges with waste stockpiling and fire risks according to reports although the system is likely to change
 - The Victorian Auditor General notes that Victoria’s more moderate enforcement regime has led to waste problems and recommended increased enforcement of stockpiling regulations
- Learnings from South Australia show that effective licensing and enforcement mechanisms can reduce illegal waste activities and encourage compliance from waste stakeholders
- Standard license conditions around regular, periodic reporting to the EPA of data on material flows may also provide more clarity on the overall state of the waste management system

Agenda

Objectives and introduction to project

Summary of findings

Selection of jurisdictions

Overview of Victorian system

Jurisdictional case studies

Wales: Targets and collections

South Korea: Organics and overall recycling

Germany: Overall recycling, landfill bans and EPR

Netherlands: Circular economy and waste-to-energy

South Australia: Strategy and licensing

New South Wales: Strategy and Alternative Waste Treatment

Additional deep-dives

Waste avoidance

Responses to China's National Sword Policy

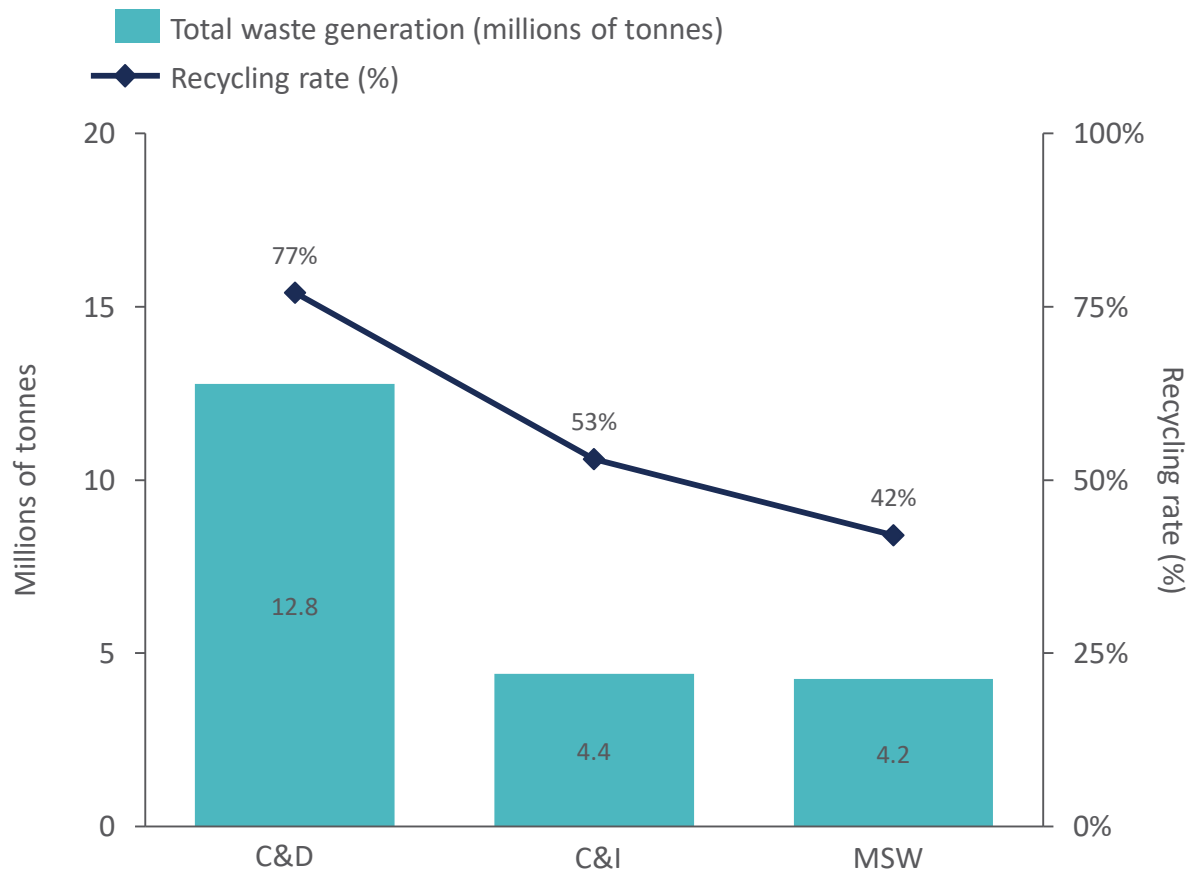
Waste-to-energy

Bibliography

NSW has the 3rd highest recycling rate in Australia, and is above the national average—but behind state targets

Breakdown of waste generation and recycling rate in NSW, 2017

Waste generation and recycling rate by waste stream (millions of tonnes, %)



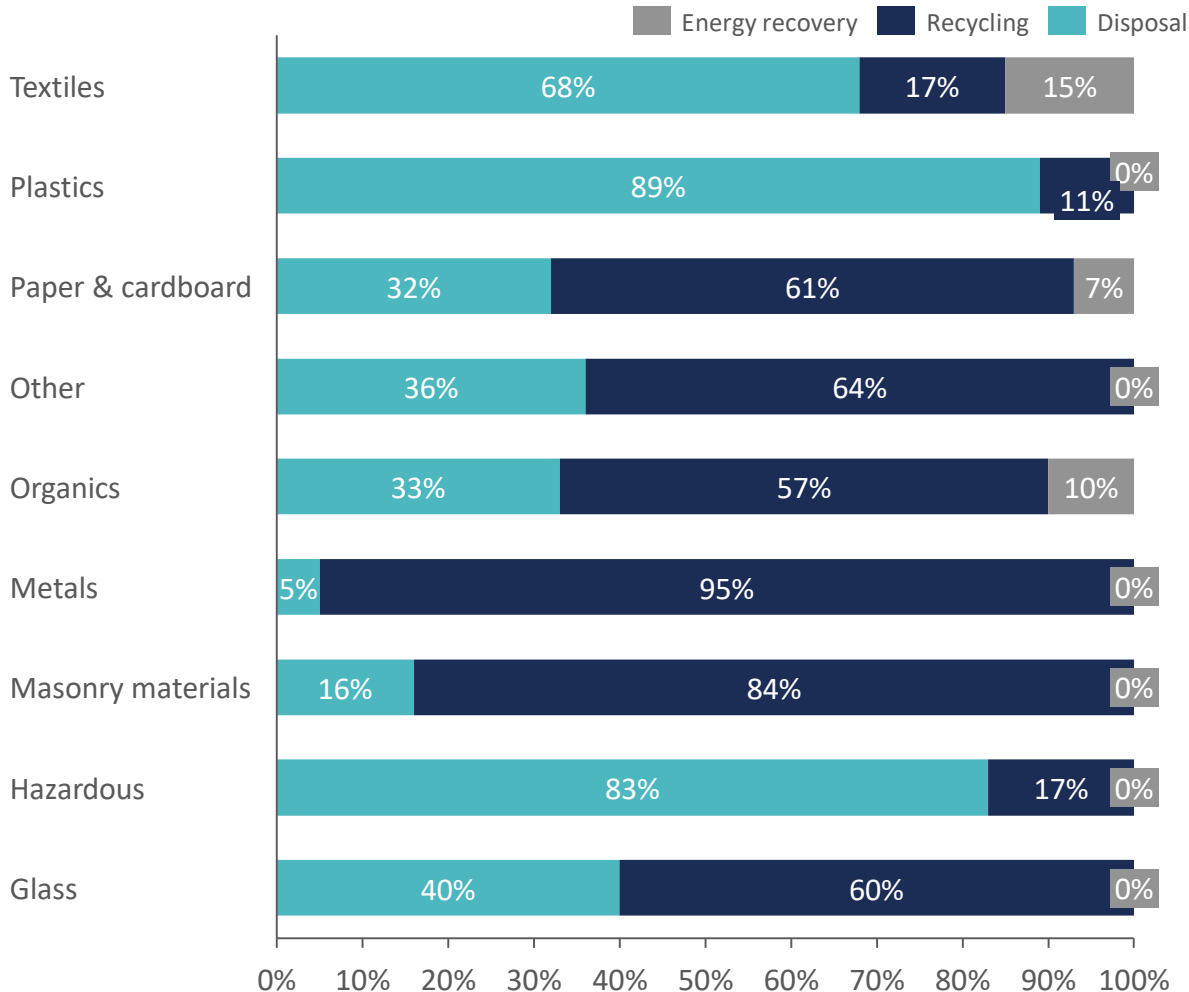
Key highlights

- Waste Avoidance and Resource Recovery (WARR) Strategy sets targets for 2021/22 on stream specific recycling rates¹**
 - MSW: 70% recycling
 - C&I: 70% recycling
 - C&D: 80% recycling
- Recycling rates in 2017/18 were **42% for MSW, 53% for C&I, and 77% for C&D**
- MSW recycling has been steady over the last 3-4 years, while **C&I recycling has increased from 47% in the same period**
- C&D recycling is high**, owing to the large amounts of masonry materials recycled
- Total waste diversion has increased from **63% in '15/16 to 65% in '17/18**, primarily driven by increased construction activity
- NSW EPA is developing a **new 20-year waste strategy** to create a long-term vision for waste recovery aligned with NSW circular economy policy

Reliance on landfill for key waste materials highlights shortcomings in recovery systems in NSW

Fate of waste by material category, 2017

Breakdown of NSW waste management for total waste stream (%)



Key highlights

- Plastics recovery rates are very poor considering high values for clean streams; Collection inefficiencies and the lack of infrastructure and end markets (e.g. for soft plastics) is part of the problem
- Metals achieve very high rates of material recovery; Data indicates that C&D recovers almost 100% of metal likely owing to a strong and mature scrap metal market
- There is potential for improved recovery of glass with better collection and sorting strategies (e.g., separate glass collection at kerbside, container deposits)
- Textiles (including rubber), organics and paper are wastes that are processed for energy recovery, but currently only at a very small scale; NSW lacks mature WtE market

Note: The impact of National Sword is not shown in this data (2017)

NSW sector operates with high level government direction and oversight, with local authorities contracting private sector for collection

Actor	Description of role
Government	<ul style="list-style-type: none"> • Sector regulated by the NSW Environment Protection Authority, with other government agencies such as Office of Environment and Heritage playing a role (e.g., OEH'S <i>Sustainability Advantage program</i>) • NSW EPA role mainly focused on regulation and setting strategic objectives for the waste sector • Local government responsible for procuring waste management and recycling services; community recycling centres operated by councils with oversight from the EPA
Private sector	<ul style="list-style-type: none"> • Large waste management contractors largely operate the collection infrastructure • Private sector also operates the container deposit scheme (<i>Return and Earn</i>), with NSW EPA oversight • Material recycling facilities owned and operated by large waste management companies, e.g. SUEZ and Veolia
Households / businesses	<ul style="list-style-type: none"> • Targeted investment in reducing household food waste (e.g. through <i>Love Food, Hate Waste</i>) has had a marked impact on reducing per-capita MSW generation • <i>BinTrim</i> program offers support to businesses to reduce waste going to landfill, and encourages investment in recycling and source separation capabilities
Other	<ul style="list-style-type: none"> • Zero Waste Network is a peak body representing Australian community recycling enterprises, with the mission of providing support to community recycling initiatives • NSW community recycling initiatives include: CitizenBlue (CDL operator, with mission of reducing ocean plastic waste); The Bower (waste minimisation through reuse/repair); Reverse Garbage (waste minimisation through reuse)

NSW has a range of approaches, most important is the *Waste Less, Recycle More* program that is funded by the waste levy

Indicates key policy

	Avoidance (incl. re-use)	Collection	Sorting	Recovery & reprocessing	Disposal
Informing	<ul style="list-style-type: none"> Love Food, Hate Waste (LFHW) is part of the <i>Waste Less, Recycle More (WLRM)</i> initiative funded via the NSW Waste Levy. LFHW provides grant funding and support for initiatives aimed at food waste avoidance 	<ul style="list-style-type: none"> Councils across the state actively inform residents about correct disposal and separation of waste at the household level. E.g., City of Sydney's <i>Garbage Guru</i> app 		<ul style="list-style-type: none"> WARR reporting (Waste and Resource Reporting) monitors council recovery and disposal rates against targets Waste Levy (POEO Act) requires monthly reporting for waste operators WARR 2017-18 progress report prioritises responding to National Sword through simplifying the planning process for new recycling infrastructure 	
	<ul style="list-style-type: none"> <i>Bin Trim</i> program implemented by NSW EPA provides assistance to businesses to reduce waste generation, and implement better waste practice, e.g. assistance for establishing contracts for waste collection 				
Financing	<ul style="list-style-type: none"> WLRM a key funding initiative, providing \$337-million in funding over 4 years from 2017-21. Funding targeted across the entire waste value chain, from waste avoidance and littering reduction, to downstream waste infrastructure. Key funding priority areas are council waste recovery, illegal dumping prevention, managing problem household waste, and organics infrastructure 				
Incentivising	<ul style="list-style-type: none"> <i>Bin Trim</i> program provides rebates of up to \$50,000 for businesses installing recycling equipment. 	<ul style="list-style-type: none"> NSW container deposit scheme in place (since 2017), used for disposal of glass, plastic (PET and HDPE) and some paper packaging for downstream recovery. CDS produces a much 'cleaner' waste stream, which incentivises efficient downstream recovery of waste material 			<ul style="list-style-type: none"> Waste Levy is a disincentive for landfill disposal and stockpiling. WLRM funding is derived in part from Waste Levy revenue
Mandating		<ul style="list-style-type: none"> The <i>Protection of the Environment Operators Act (1997)</i> is key piece of environmental legislation affecting the waste management sector in NSW POEO Act sets standards and regulations for environmental protection, air and water quality, and licensing related to the treatment / disposal of waste 		<ul style="list-style-type: none"> <i>Energy from Waste Policy Statement (2015)</i> lays the foundation for WtE policy in NSW that will not undermine existing recovery operations 	<ul style="list-style-type: none"> Mandatory reporting (monthly) of waste treated and stockpiled by waste operators is used to track progress towards WARR targets and for Waste Levy compliance
Enabling	<ul style="list-style-type: none"> NSW Circular Economy Policy Statement, <i>Too Good To Waste</i> (Feb 2019) is a high-level overarching policy considering whole value-chain 				
Operating / contracting	<ul style="list-style-type: none"> <i>National Sword</i> response saw \$47 million invested into LGA waste management, including responsible/green procurement 				

Deep dive: NSW's Waste Avoidance and Resource Recovery Strategy has clear targets and is implemented with waste levy revenues

Summary

- Key to the NSW approach is the Waste Avoidance and Resource Strategy that sets a clear and overarching vision for the waste industry with quantifiable targets
- WARR is implemented through the Waste Less, Recycle More program supported by the state's waste levy – the highest in Australia

Description

- The Waste Avoidance and Resource Recovery Act (2011) is a key regulation in NSW setting out the **WARR strategy**. This key strategy is prepared **every 5 years** and is the responsibility of NSW EPA (along with the primary responsibility for waste regulation), the most recent was released Dec 2014
- The **strategy is underpinned by a clear vision¹ and quantifiable targets** for 2021-22:^a
 - Reduce waste generation per person (no target)
 - Increase recycling rates (70% for MSW, 70% for C&I and 80% for C&D)
 - Increase landfill diversion to 75%
 - Establish 86 drop-off facilities to manage problem waste (e.g. paint, gas bottles, batteries)
 - Reduce litter by 40% (by number) by 2017 down from 2012
 - Reduce incidents of illegal dumping by 30% (by incident) by 2017 down from 2011
- Implementation of the **WARR strategy is supported by the Waste Less, Recycle More (WLRM) grants and funding initiative that is funded by the waste levy²** and led by NSW EPA. This is currently in a second (extension) phase with \$337 million committed over 4 years from 2017-21:^{3,b}
- **Progress towards WARR targets is reported every two years under the WARR Act**. Data for monitoring progress is obtained through council self-reported data on waste generation and recovery, and through mandatory reporting obligations for waste operators (e.g., landfills, transfer stations etc.) set by the Protection of the Environment Operations Act (1997).
- Funding and grants for 2017-21 span 9 main areas, the largest packets are directed to support LG Waste and Resource Recovery (\$70 m), Illegal Dumping (\$65 m), Household Problem Waste (\$57 m), Waste and Recycling Infrastructure Fund (\$48 m), and a separate Organics Infrastructure Fund (\$35.5 m) – making the **infrastructure funding allocation about a quarter of the total package**
- **NSW's performance is primarily attributed to the state's waste levy that funds the implementation of the WARR strategy**

Notes: ¹ The overarching objectives are to improve human and environmental health by reducing the adverse environmental impact of waste management, maximise resource use efficiency, and support a productive NSW economy; ² Licensed waste facilities pay the levy set out in the Protection of the Environment Operations (Waste) Regulation 2014; ³ Total commitment over 9 years to 2021 will be \$802 million

SOURCE: ^a <https://www.epa.nsw.gov.au/your-environment/recycling-and-reuse/warr-strategy>;

^b <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/waste/waste-less-recycle-more-2017-21-brochure-160538.pdf>;

^c <https://www.parliament.nsw.gov.au/lcdocs/inquiries/2436/Final%20-%20Report%2028%20March%202018.pdf>

Deep dive: NSW is progressing towards meeting WARR targets, but still has work to do particularly with MSW and C&I streams

Results: Current progress towards targets

Key result area	Target (2021/22)	Progress (2017/18)
Avoid and reduce waste generation	Reduce waste generation per capita (from 2012/13 baseline of 2.34 tonnes per person)	<ul style="list-style-type: none"> - Total waste generated per capita is 2.69 t/capita, and has been rising primarily driven by increase in construction activity and C&D waste - Steady reduction in MSW from 0.57 to 0.53 t/capita between '14/15 and '17/18, driven primarily by reductions in household food waste
Increase recycling	Increase recycling rates for: MSW (70%); C&I (70%); C&D (80%)	<ul style="list-style-type: none"> - Current recycling rates are 42% for MSW, 53% for C&I and 77% for C&D - MSW recycling rate steady, but large increase in C&I recycling from 47% in '15/16 - C&D recycling high and generally increasing, however a spike in contaminated soil disposed to landfill in '17/18 pushed down the recycling rate for that year
Divert more waste from landfill	Increase the diversion rate from 63% to 75%	<ul style="list-style-type: none"> - Current diversion rate is 65%, increasing from 63% in '15/16 - Diversion is primarily driven by C&D diversion, which accounts for a large proportion of total diverted waste on a mass basis
Manage problem wastes better	86 drop-off facilities or services	<ul style="list-style-type: none"> - This target was met in 2017/18, with 87 community recycling centres operational - 62% of NSW households have access to a community recycling centre - A record 2,022 tonnes of problem waste was collected through these centres
Reduce litter	Reduce litter items by 40% by 2016/17, and then continue to reduce to 2021/22	<ul style="list-style-type: none"> - Litter items had reduced by almost a third between '11/12 and '17/18, however the target was not reached by the '16/17 timeframe

Applicability to Victoria

- As recently highlighted in the Victorian Auditor-General's report, Recovering and Reprocessing Resources from Waste (June 2019), Victoria lacks a 'statewide policy or plan to manage waste'
- This brief overview of the NSW approach provides an example of a coordinated approach underpinned by a rolling 5-year strategy with clear and quantifiable targets

Deep dive: Alternate/advanced waste treatment (AWTs) in NSW are one example of alternative processing technology

Summary

- Alternative or ‘advanced’ waste treatment plants process mixed waste streams by removing organic and recyclable materials for recovery;
- This is an important processing technology in NSW, with about a fifth of residual waste generated treated at AWTs enabling high MSW recovery rates

Description

What is an alternate/advanced waste treatment (AWT) facility?

- AWTs are sorting and **recovery facilities that process mixed waste streams**. AWTs reduce the amount of mixed waste that goes to landfill by first sorting, and then recovering materials in the mixed waste stream. Some AWTs also stabilise waste stream to reduce landfill gas emissions
- In comparison to material recycling facilities (MRFs), AWTs are typically **smaller in scale** with more **manual sorting** owing to the nature of the mixed waste stream. AWTs are often referred to as ‘dirty MRFs’ due to the lower levels of sorting efficiency, and greater energy and cost requirements per tonne of waste treated

What technologies do AWT facilities use?

- Historically, AWTs have been defined as any technology which presents an alternative to landfill—typically mechanical-biological treatment (MBT), waste to energy, or a combination.
- MBTs perform multiple processes in the treatment of mixed waste. Waste is first separated into organic waste, recyclable waste (e.g., glass, metal etc.), and non-recyclable waste. Recyclable wastes are sorted and cleaned for further downstream recovery. The organic fraction is either treated to produce compost, or treated through a digestion process to produce biogas and nutrients
- In countries where energy recovery is mature, MBTs also separate out a fuel stream from the mixed waste, which then is treated in an energy recovery process. Given the small scale of MBTs, alternative energy conversion processes to incineration are often used, such as pyrolysis
- As of 2015, there were 6 AWT facilities in NSW alone, servicing the greater Sydney area, and the far north coast (Coffs Harbour). The average recovery efficiency (proportion of throughput that is recovered) of AWTs in NSW is approximately 53%
- As of 2015, 20 councils across NSW divert a portion of their residual waste stream to AWT—23% of total residual waste generated. However, further increases may be limited by the high cost of transporting of waste from LGAs that are not in close proximity to AWTs
- Growth in AWTs was likely due to the waste levy that has increased over the same timeframe, as AWTs target the proportion of waste stream that is typically destined for landfill disposal.

Deep dive (cont.): Alternate/advanced waste treatment (AWTs) in NSW are one example of alternative processing technology

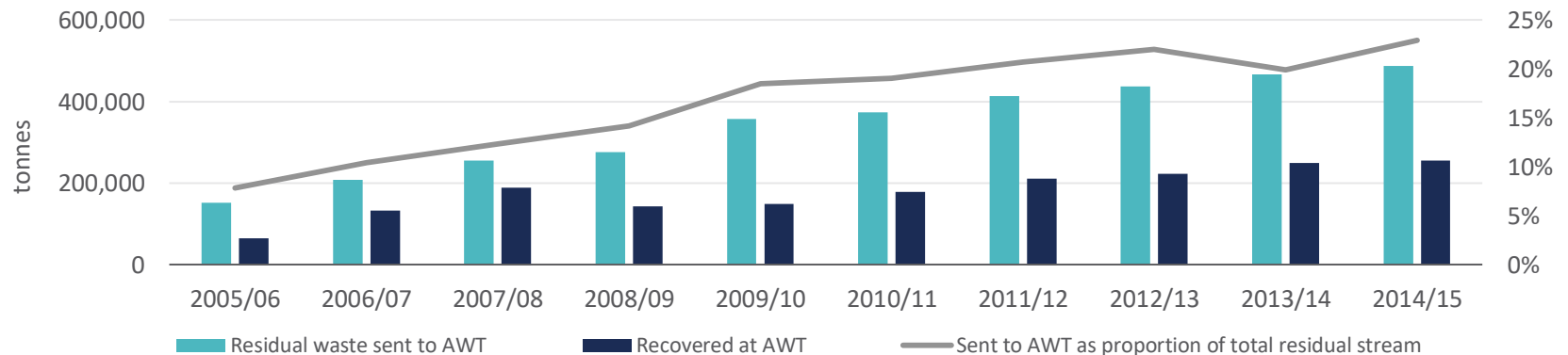
Description

AWTs in NSW – recent examples and developments

- 'Global Renewables UR-3R' at Eastern Creek, Sydney is a \$100-million AWT facility built in 2004, and is the largest AWT facility in the southern hemisphere, treating approximately 200,000 tonnes of household waste a year
- In 2018 – NSW EPA announced a ban on compost applied to land derived from mixed waste. The effects of this decision have yet to emerge, however it is likely the decision will impact AWT facilities where compost is a primary output as is the case with the Global Renewables site at Eastern Creek
- Despite the ban on compost derived from mixed waste, AWTs still present the only real alternative to landfill disposal of the residual stream in NSW, given the current state of the waste management sector



Global Renewables AWT facility, Eastern Creek Sydney



Applicability to Victoria

- **AWT processing of residual waste is not pursued in Victoria**, with no operational AWT facilities.
- **AWT offers a recovery pathway for the residual stream in Victoria for areas where organics are not separated** from household waste but is probably not the optimal pathway for Victorian waste
- However, **if organics were separated from household waste, higher recycling rates probably achievable**. For this reason, AWTs are an alternative, but probably not the optimal alternative for Victoria.

Deep dive: Energy recovery policy in NSW is a good example of a WtE policy that does not undermine existing resource recovery

Summary

- **The NSW Energy from Waste Policy Statement (2015)** sets requirements for the thermal treatment of waste with energy recovery
- The Policy's principal aims are to ensure that **energy recovery does not harm communities**, and that higher value resource recovery outcomes are maximised by ensuring **existing resource recovery is not undermined by energy recovery**
- Despite the policy and alignment with the waste hierarchy/CE agenda, **no WtE infrastructure has been built in NSW** (though the policy is only one of the drivers of the current situation)

Description

NSW energy from waste policy

- The NSW Energy from Waste Policy Statement (2015) sets out the policy framework and criteria that will apply to all facilities in NSW proposing to thermally treat waste (or waste derived fuels) for the recovery of energy. Key to this policy is that **energy recovery in NSW must not undermine existing resource recovery, and that air quality and human health are protected.**
- The policy establishes a two-tiered framework separating the requirements for low-risk waste types proposed for energy recovery from all other waste types. Materials that pose little human or environmental risks are categorised as eligible waste fuels, and facilities proposing to treat these waste types must demonstrate that no higher order reuse/recovery opportunities exist for the waste (e.g., biomass, forestry residues, waste oil, and source separate garden waste)
- Facilities proposing to treat non-eligible waste fuels such as **municipal solid waste, must meet technical, thermal efficiency, and resource recovery criteria to be eligible to operate.** The technical criteria are based on requirements in the Protection of the Environment Operations (Clean Air) Regulation 2010. Thermal efficiency criteria is loosely based on international best practice, with proposed NSW facilities required to **recover at least 25% of energy generated must be captured as electricity**
- **The resource recovery criteria is a multi-tiered criteria** designed to minimise the amount of recyclable wastes that may be thermally treated. Depending on the source of the waste and the degree to which it is pre-sorted, a percentage of the residual waste stream will be eligible for thermal treatment. For example, a facility treating waste from a council that does not separate dry recyclables, will be eligible to treat only 25% of the residual fraction of waste
- Despite progress towards energy recovery policy in NSW, **there has been no new energy from waste facilities approved in NSW.** This has largely been due to lack of social license for energy recovery in NSW, and proposals for new facilities failing to comply with EPA and Department of Planning guidelines. The NSW policy by itself is not an enabling mechanism for energy recovery given these other issues

Applicability to Victoria

- **NSW energy recovery from waste policy is aligned with waste management best practice and energy recovery best practice**, ensuring environmental and public health risk is minimised and material recovery is prioritised.
- **The resource recovery criteria set out in the NSW policy could be considered for Victorian waste to energy policy** aligned with circular economy policy objectives

Agenda

Objectives and introduction to project

Summary of findings

Selection of jurisdictions

Overview of Victorian system

Jurisdictional case studies

Wales: Targets and collections

South Korea: Organics and overall recycling

Germany: Overall recycling, landfill bans and EPR

Netherlands: Circular economy and waste-to-energy

South Australia: Strategy and licensing

New South Wales: Strategy and Alternative Waste Treatment

Additional deep-dives

Waste avoidance

Responses to China's National Sword Policy

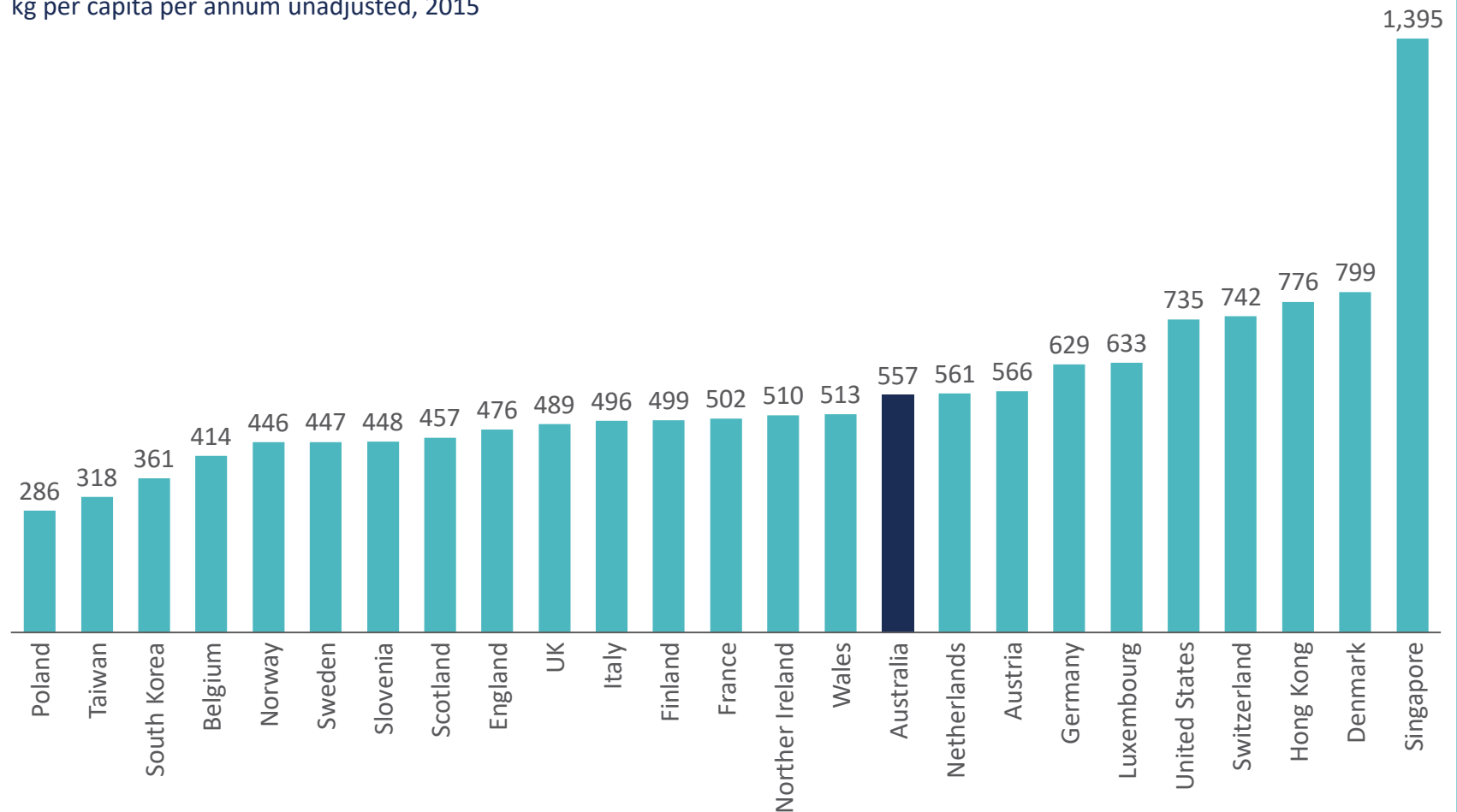
Waste-to-energy

Bibliography

There are a wide range of values for household waste per capita across OECD jurisdictions, with Australia in middle of range

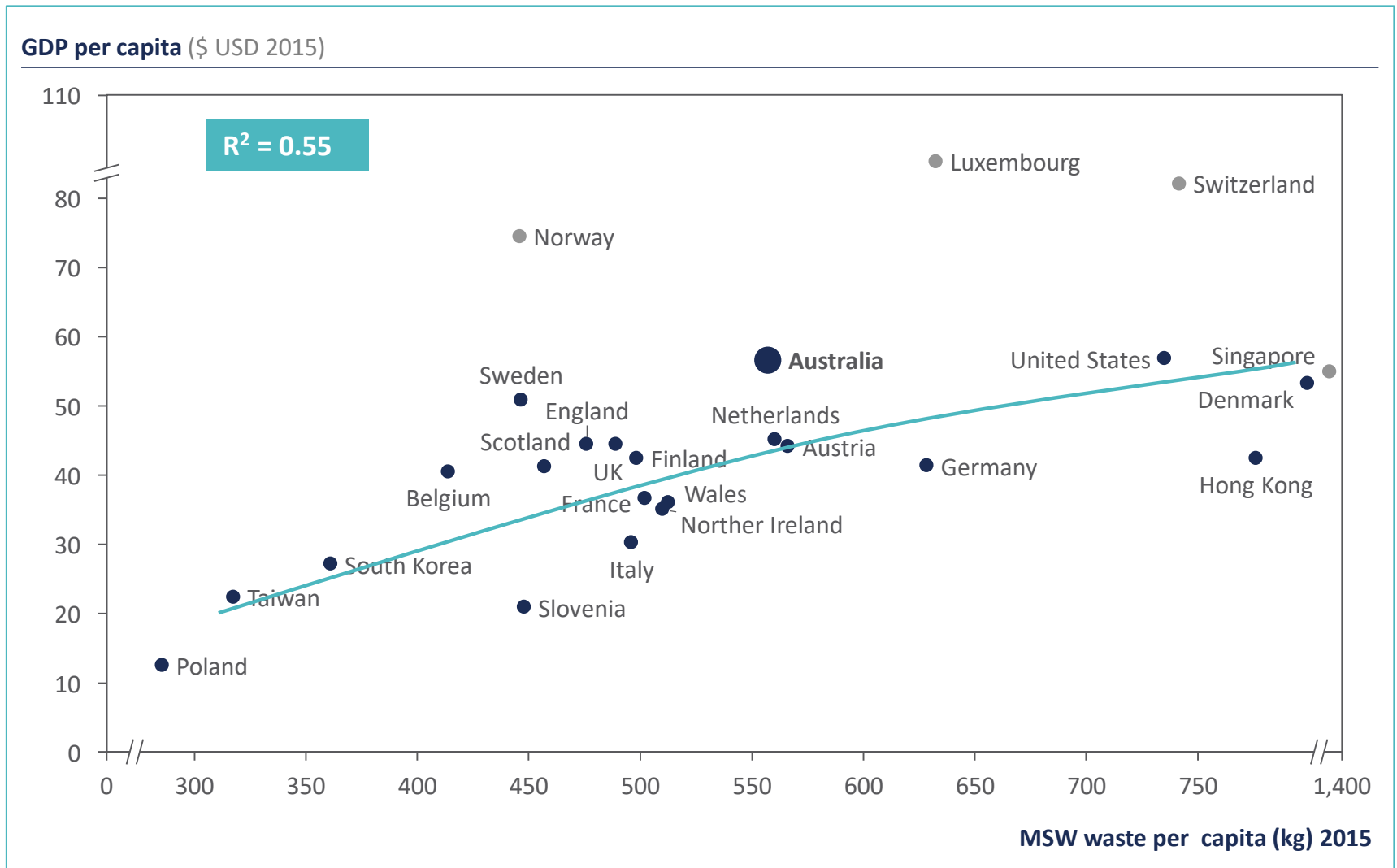
MSW waste generation across OECD nations

kg per capita per annum unadjusted, 2015







When GDP per capita is taken into account, Australia performs relatively well against other countries

● Not included in correlation analysis as jurisdiction is an outlier








International evidence suggests most effective and frequently applied prevention policy measures are a range of complementary policies

 Estimated reduction in household waste: High, medium, low

Category	Policy approaches	Estimated impact of individual policy	Enabling conditions
Household behaviour	Direct variable household charging and financial incentives		<ul style="list-style-type: none"> More acceptable in areas where greater source separation is norm Need to consider a range of container types, sizes and materials targeted for separate collection More acceptable if done by a private waste management Feedback about system needs to be provided to residents Literature suggests that stakeholders deem public to be in opposition to charging more so than public actually are.
	Waste collection scheme design (e.g. alternate weekly collection, residual bin size)		<ul style="list-style-type: none"> Firm enforcement policy Excellent and consistent recycling service (full range of materials collected, available to every household) Close work with local schools High quality communications and calendars to residents, using national branding Support from residents and elected members Cross party support
	Education campaign	 <i>Essential component</i>	<ul style="list-style-type: none"> Provide specific tips on how to reduce or prevent waste; Encourage people to try new activities that break into routine or unconscious habits; Make the results of taking action more visible (e.g. by encouraging people to monitor their own waste production)

International evidence suggests most effective and frequently applied prevention policy measures are a range of complementary policies (cont.)

 Estimated reduction in household waste: High, medium, low

Category	Policy approaches	Estimated impact of individual policy	Enabling conditions
Producers and retailers	Extended produced warranties and responsibility		<ul style="list-style-type: none"> Re-framing existing packaging regulations to include higher targets Labelling of products for durability Addressing at a national level for compliance
	Reducing quantities of junk mail		<ul style="list-style-type: none"> Activist campaigns on limiting junk mail Opt-out option for households Suppression of inaccurate/out-of-date records
Municipal waste management	Municipals targets for waste prevention & levy		<ul style="list-style-type: none"> Start with targets and then move to levies if necessary Range of initiatives needed to support targets Synergy with home composting policy
	Home composting incentivised		<ul style="list-style-type: none"> Including home composting in composting targets Opt-in home composting scheme Regular contact and feedback Instructions in how to make and use compost Access to face-to-face local advisers
	Stimulating re-use of durable goods		<ul style="list-style-type: none"> Need to raise the social acceptability of second hand goods Infrastructure for a network of re-use centres Financial support to third sector organisations – reuse credits or similar plus start up and development finance
	Restrictions on landfill	tbd	<ul style="list-style-type: none"> Similar to waste prevention levy

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Deep-dive: China's National Sword policy has seen significant changes in plastic waste exports dynamics

Summary

- The China National Sword Policy came into effect at the start of 2018 and banned imports 24 kinds of solid wastes as well as improved standards for contamination levels
- A number of jurisdictions have been caught flatfooted and have been to shifting plastic exports to other Asian and lower-income countries while other longer-term solutions and policies are put in place

Results

- Since 1992 China has imported a **cumulative 45% of global plastic waste exports**
- China has been **increasing its restrictions** on plastic waste imports **since 2007** and implemented the **“Green Fence” program in 2013** which was a **10-month policy** and set the initial **standards for lower contamination levels for recycling**
- The **China National Sword policy** came into force at the **start of 2018** which saw a strict ban on **24 kinds of solid waste** and **improving standards for contamination levels**
 - This included bans on **unsorted waste paper** and **waste textile materials** as well as **unsorted mixed plastics, post-consumer plastics** and a **0.5% contamination limit** on imported loads with tight enforcement
 - **Plastic exports** to China were **significantly affected** due to previously **lower standards for plastic waste** (e.g. mixed and unclean plastics) and being a key target in the crackdown. Exports moved to other SE Asian countries but these countries now also banning importation of mixed plastics
 - Significant crackdowns on waste material imports **began at the start of 2017** including **increasing importing fees** and **tougher enforcement**
- Other initiatives following this have included **Blue Sky 2018** which involved a strong **crackdown on illegal waste imports** and **enforcement of new import restrictions**
- The key exporters have been **higher income countries** such as those in the OECD who have accounted to **70% of plastic waste exports** in 2016 – predominantly to lower income countries in South East Asia and Pacific
- By 2030, it is estimated that **111m tonnes of plastic waste** will be **displaced** in light of China's new stance of plastic waste*




Plastic imports to China have declined 79% between 2016 and 2018

Thousands of tonnes, imports to China, Hong Kong SAR



Notes: Based on “waste, parings and scraps of plastic” imports for China, Hong Kong SAR; Hong Kong is included as it is a key entry point for Chinese imports; * under a 100% import ban of plastic waste

Deep dive: A survey of jurisdictions shows investments in end market development and EPR are common responses to National Sword

Jurisdiction	Plastic waste exported (tonnes)	Response summary	Response detail
 South Korea	~130,000 tonnes of plastic waste were exported to China in 2017	Reducing overall consumption of plastic waste and increasing consistency of plastic packaging and plastic recycling rates	<ul style="list-style-type: none"> Introduced a 'Comprehensive Recycling Waste Management Plan 2018' with targets to reduce plastic waste generation by 50% and increase the recycling rate to 70% Consistent type and colouring of PET bottles by 2020 and an increase in the number of recyclable plastic packaging types (63 types by 2022) Reductions in coffee cups and plastic bag usage, as well as new guidelines on delivery packages Improved initiatives for sorting to reduce recyclables in residual waste to 10% by 2022 Establishment of programs and funding for stabilising recycling markets
 Germany	~340,000 tonnes of plastic waste were exported to China in 2017	Increasing accountability of producers for plastic waste through EPR initiatives.	<ul style="list-style-type: none"> A considerable share of plastic exports has now been diverted to other Asian countries such as Malaysia and Indonesia In 2019, Germany introduced the Packaging Act which looked to improve producer responsibility and increase recycling rates for plastic packaging in particular (and may not be entirely in response to China Sword) Where EPR is an established approach then there are important additional levers available to support a response to market collapse Producers will now have to meet a recycling target of 63% for mechanical recycling (plastic) by 2022; up from 36% under the old recycling targets Other packaging waste materials will also have to adhere to new, higher recycling rates as well
 European Union	~1.93m tonnes of plastic waste were exported to China in 2017	Increasing re-use and recycling of plastics and a movement towards a circular economy	<ul style="list-style-type: none"> The European Commission released a Plastics Strategy which involves a number of pledges from industry By 2030 all plastic packaging on the EU market will be recyclable, single-use plastics will be reduced and intentional use of microplastics will be restricted The Commission will improve certainty in end markets by working with the European Committee for Standardisation and industry to develop quality standards for sorted plastic waste and recycled plastics The Commission is also launching an EU-wide pledging campaign to ensure that by 2025, 10m tonnes of recycled plastics will find their way into new products on the EU market (with 60 pledges as of October 2018)

Deep dive (cont.): A survey of jurisdictions shows investments in end market development and EPR are common responses to National Sword

Jurisdiction	Plastic waste exported to China (tonnes)	Response summary	Response detail
 UK	~400,000 tonnes of plastic were exported to China and Hong Kong in 2016	Introduction of a plastic packaging tax that will come into effect in 2022	<ul style="list-style-type: none"> The UK Government announced a plastic packaging tax on the production and import of plastic packaging that will come into effect in 2022 <ul style="list-style-type: none"> The tax was in response to high levels of plastic packaging waste and the majority of this being new, not recycled plastic as well as China Sword policy which emerged during the consultation process for the tax The policy should ideally help shift economic incentives for production towards greater use of recycled plastics and help reduce plastic waste
 South Australia	~4,000 tonnes of plastic and ~17,000 tonnes of paper & cardboard were exported to China in 2016-17*	Increased funding to improve infrastructure and quality of recycled materials as well as develop local markets	<ul style="list-style-type: none"> The South Australian Government responded with a \$12.4m support package for investment in reprocessing and local re-use as well as sorting and processing to enhance the quality of recovered material in target sectors <ul style="list-style-type: none"> Key initiatives include \$5.8m will be for infrastructure grants for local government and industry to build recycling and reprocessing capacity, \$5m to increase local remanufacturing/reprocessing and \$300,000 for market development grants for increased quality and demand for recyclables
 New South Wales	~43,000 tonnes of plastic were exported to China in 2016-17*	Increased funding to support increased recycling and end markets as well as initiatives for longer-term responses	<ul style="list-style-type: none"> The NSW Government and EPA have responded by working closely with councils, regional waste groups and industry to improve and strengthen recycling systems <ul style="list-style-type: none"> This included a \$47m support package funded under the 'Waste Less, Recycle More' initiative to help with council kerbside recycling, tendering of processes for increased recycling capacity, improved quality of recyclable materials and increased the production and use of recycled products A inter-governmental taskforce will also be created to progress a longer-term strategic response to National Sword with a 'whole-of-government' approach Temporary increases in stockpiling have also been allowed to avoid recyclables going to landfill subject to specific safety criteria
Applicability to Victoria	<ul style="list-style-type: none"> Victoria does currently have some responses to the China National Sword Policy to address end markets and processing capabilities Although results are not yet conclusive on the effectiveness of these policies, a survey of jurisdictions shows us: A range of responses have looked to address China's National Sword policy with particular focus on improved processing and development of end markets and increased accountability around plastic packaging (including a plastics tax in the UK) South Korea's response was particularly extensive with plastic recycling targets, increased consistency of plastic packaging, reduced plastic consumption as well as improved processing and development of end markets 		

Notes: *includes materials exported from each jurisdiction, not waste generated in the jurisdiction

SOURCE: NSW EPA, blue environment, Sustainability Victoria, Liberal SA, BBC, GOV.UK

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Although a number of best practice jurisdictions use WtE, several considerations should be accounted for if it is implemented

	Description of lesson	Examples
Anaerobic digestion (AD)	An effective method for processing organics	 Wales have effectively implemented AD infrastructure in order to meet landfill allowance and composting targets
	Policy to support take up of AD	 The UK used feed-in tariffs (FIT) to increase awareness and take up of AD infrastructure  The Welsh Government provided funding and technical support for the procurement of AD facilities
Incineration	Prioritising infrastructure higher on the waste hierarchy	 The Welsh Government ensured technologies such as AD were procured first over incineration facilities  NSW's energy from waste policy ensures higher quality material recovery is not undermined by WtE
	High standards for incineration facilities	 NSW has put in place requirements to ensure WtE facilities meet strict requirements for efficiency and minimisation of pollutants to surrounding communities
	The costs of 'lock-in'	 Denmark, which has one of the largest incineration capacities introduced a "Recycle more – incinerate less" strategy in 2013, but has currently seen minimal results and are currently building a new incineration facility
Other	Other WtE technologies such as thermal processing (e.g. gasification and pyrolysis) can also be used to process tyres and other waste streams and generate storable, transportable fuels	 One pyrolysis facility is located in Queensland and processes ~16,000 tonnes of tyres per year with outputs focussed on oil and char  Gasification was considered in Wales, however was not chosen in the end due to being a relatively new technology

WtE can provide solutions for treating waste but challenges can arise with lock-in and limited higher value uses for waste

Case study	Details	Outcome	Implications for Victoria
<p>Highly efficient WtE facilities</p> 	<ul style="list-style-type: none"> ▪ Lack of space for landfilling has driven Netherlands' take up of incineration ▪ 10 out of the 11 incinerators are publicly owned and operated ▪ Netherlands' incinerators are some of the most efficient in the world conforming to EU and Dutch standards for efficiency and pollution ▪ Incinerators currently playing an important role in providing district scale heating and reducing gas combustion for thermal energy 	<ul style="list-style-type: none"> ▪ Netherlands currently manages 43% of its MSW through WtE facilities and provides ~12% of the total renewable energy supply ▪ Netherlands' AEB incinerator in Amsterdam is the world's largest and most efficient WtE incinerator ▪ Incineration facilities are moving towards holistic resource recovery where materials can be recovered from residual ash 	<ul style="list-style-type: none"> ▪ WtE can provide an effective solution for treating waste especially when high standards for efficiency and pollution are in place and could help address other targets such as for renewable energies ▪ Victoria would need considerable investments in WtE to generate these benefits and should not be done at the expense of higher value uses for waste recovery
<p>Smaller scale WtE facilities with large capacity</p> 	<ul style="list-style-type: none"> ▪ Denmark currently has one of the highest WtE capacities in Europe ▪ Denmark's WtE story dates back to 1903 and have been using incineration for district heating since the 1960s – typically with smaller scale facilities ▪ The country is currently trying to reduce its dependence on WtE including a 'Recycling more – incinerate less' waste strategy 	<ul style="list-style-type: none"> ▪ In 2012 Denmark had an incineration capacity of 400kg per capita with the sector providing 5% of the country's electricity ▪ Despite trying to move away from incineration, the number of plants has not dropped since 2013 and has only marginally reduced incineration rates for MSW ▪ A new, large plant is currently being built near Copenhagen with a capacity of 400,000t 	<ul style="list-style-type: none"> ▪ Denmark shows that although WtE does have the ability to operate at a smaller scale, there are significant challenges with 'lock-in' to WtE which can limit initiatives higher up on the waste hierarchy ▪ Denmark's strong history in incineration and government owned approach likely means that public acceptance of WtE is higher relative to Victoria

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