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Waste Avoidance and Resource Recovery Strategy 2030 vision

This *State waste infrastructure plan: Western Australia* (infrastructure plan) is a critical deliverable and supporting document of the *Waste Avoidance and Resource Recovery Strategy 2030* (waste strategy) (Waste Authority 2019). It will guide the decisions and investments for waste and resource recovery infrastructure required to achieve the waste strategy objectives and targets.

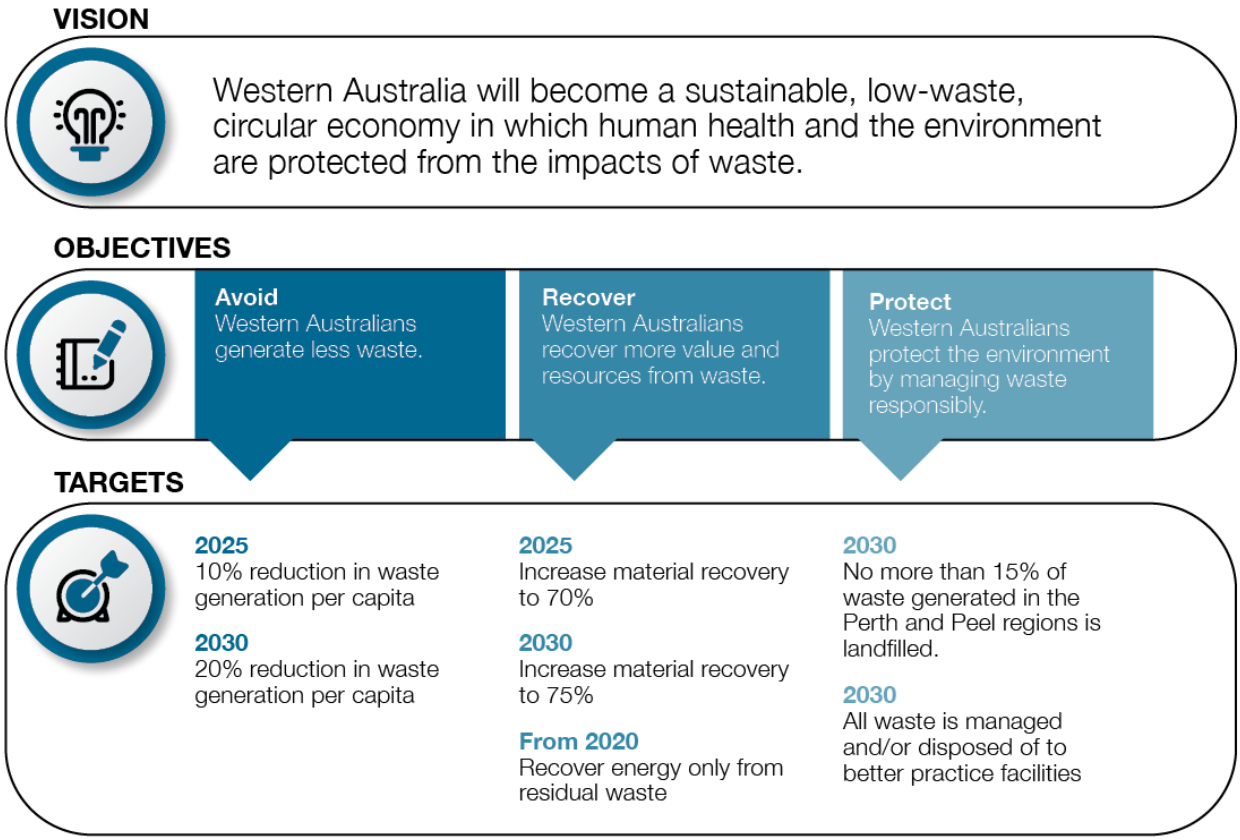


Figure 1 Objectives and targets of the Waste Avoidance and Resource Recovery Strategy 2030

The waste strategy vision is:

> "Western Australia will become a sustainable, low-waste, circular economy in which human health and the environment are protected from the impacts of waste."

Moving towards a circular economy

A circular economy is a system that provides an economic, environmental and social structure for reducing the impacts of waste. It is a regenerative system where resources are used and reused efficiently, decreasing waste generation, disposal and pollution. It aims to keep products and materials in circulation for as long as possible, ultimately commodifying materials that traditionally would be considered as 'waste'.

The infrastructure plan seeks to contribute to building a circular economy in Western Australia by recognising waste management as an essential service, strategically locating waste infrastructure for optimal resource utilisation, emphasising resource recovery, and advocating for better practices in waste facilities. Together, these principles aim to transition Western Australia towards a more resource-efficient and sustainable future, minimising waste and maximising resource value.

The waste hierarchy plays a critical role in a circular economy. Starting with waste avoidance as the preferred option, followed by reuse, recycling, recovery of energy and, finally, disposal to landfill. It aims to minimise environmental impacts and conserve primary resources at every stage.

This infrastructure plan aligns with the *Waste Authority business and action plan 2023–24.* It prioritises the actions and requirements to achieve the waste strategy's 'Recover' and 'Protect' objectives by providing recommendations for resource recovery infrastructure to meet the 2030 recovery targets.

Actions itemised under headline strategy 6 of the *Waste Authority business and action plan 2023–24* include:

- **6.1 Finalise the state waste infrastructure plan:** Finalise the state waste infrastructure plan in consultation with State Government agencies, local government
- **6.2 Further investigations arising from state waste infrastructure plan:** Scope priorities and opportunities related to waste infrastructure identified in the state waste infrastructure plan, develop them into actions and incorporate them into the waste strategy.
- **6.3 Develop Western Australian Planning Commission (WAPC) position statement for waste infrastructure:** Work with the Department of Planning, Lands and Heritage (DPLH) to develop the necessary planning instruments and guidance for local government and developers to facilitate appropriate siting and design of waste facilities (including landfills).
- **6.4 Explore options for improving waste infrastructure planning:** Investigate options for developing a needs-based approach to planning and environmental and licensing approval of new landfills and other waste infrastructure which supports the state waste infrastructure plan, in consultation with DPLH.

The infrastructure plan reflects research and stakeholder feedback. It compares projected waste volumes with existing licensed capacities for waste and recycling infrastructure to predict infrastructure capacity, gaps, risks and opportunities in 2030 and 2050.

The Department of Water and Environmental Regulation (the department) is in the process of developing sectoral emissions reduction strategies (SERS) to transition to a net zero emissions economy by 2050. The circular economy plays a key role in reaching this target as it emphasises diverting waste materials from landfills, thus reducing landfill gas emissions. The section details the process by which landfills contribute to climate change.

Principles to guide waste and resource recovery infrastructure

The five principles adopted by the infrastructure plan, outlined in Figure 2, provide ongoing guidance for stakeholder planning and decision-making in line with the vision, objectives and targets of the waste strategy. The following sections describe each principle and explore how a principle might be applied to planning and decision-making.

The principles provide a foundation for Western Australia's circular economy. An emphasis on strategically locating waste infrastructure ensures that resources are optimally utilised and regenerated, minimising environmental harm. While the principles acknowledge the reduced but ongoing need for landfills, the focus is on ensuring that even these are sustainable and cater to unavoidable wastes.

The drive to increase resource recovery capacity, both by enhancing existing facilities and developing new ones, is at the heart of the circular economy, ensuring that waste is not just discarded but repurposed and reused. Lastly, the push for better practices in waste facilities ensures that the entire process, from collection to disposal, adheres to standards that promote sustainability, resource recovery and environmental protection. Together, these principles lay the groundwork for Western Australia's transition to a more sustainable, low-waste, and circular economy.

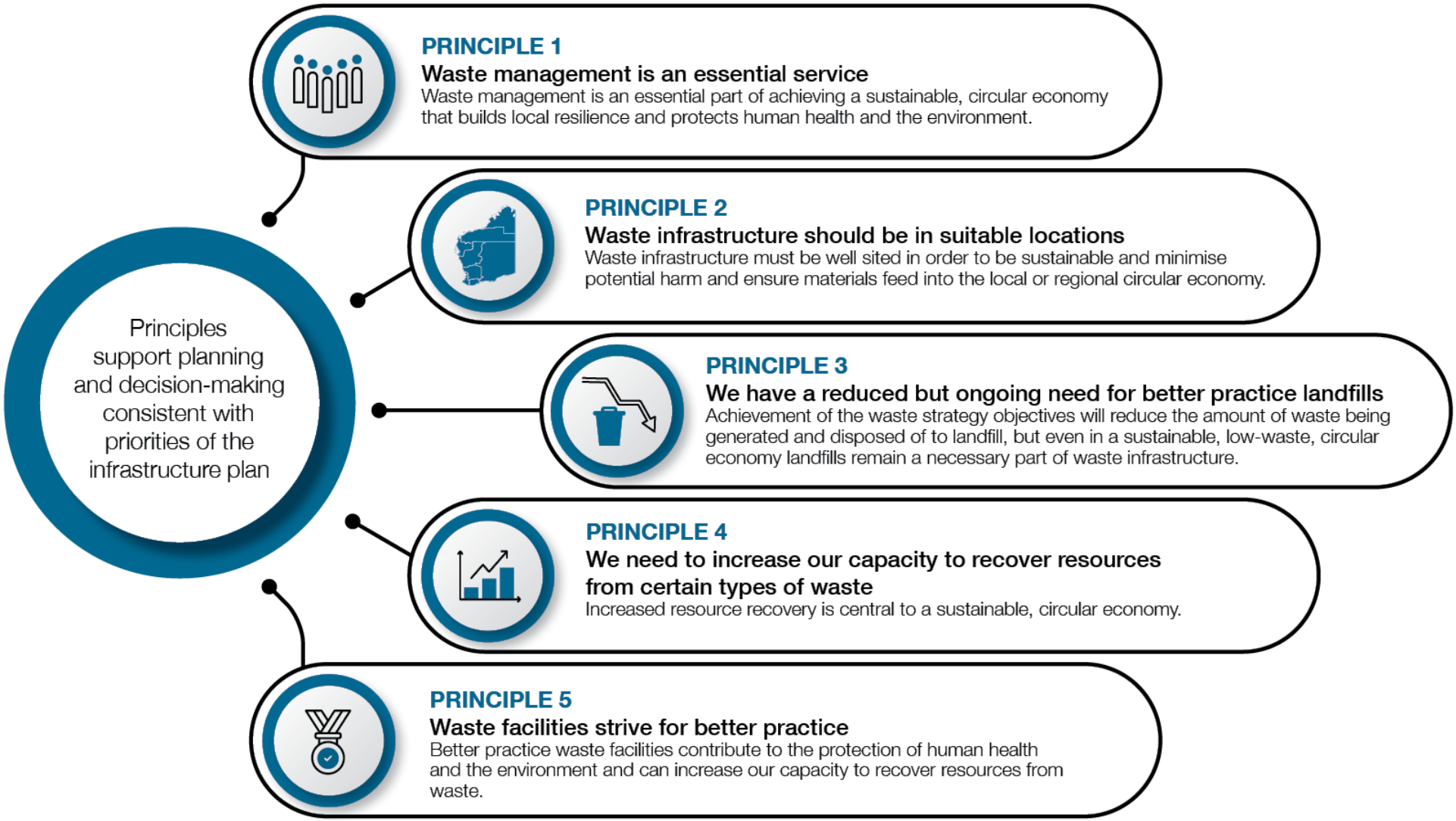


Figure 2 Five principles for planning and decision-making for waste and resource recovery infrastructure

Principle 1: Waste management is an essential service

Waste management is an essential part of achieving a sustainable, circular economy that builds local resilience and protects human health and the environment.

Waste management is an essential service because of its critical role in safeguarding public health and the environment. Resource recovery is an essential part of the transition to a circular economy and the reduction of greenhouse gas emissions.

While some essential services, such as energy and water, can be standardised to some extent – making state-level management more feasible – waste management often involves more local considerations. Factors such as waste composition, economies of scale, transport distances, community expectations and local priorities can vary greatly across the state, necessitating tailored solutions for waste management at a local or regional level.

Recent natural disasters and the COVID 19 pandemic highlight the challenges of providing waste services during a crisis and the need for more equitable access to waste services, especially to vulnerable communities.

This principle should be used to guide planning and decision-making by all stakeholders. When this principle is applied, outcomes include:

- recognition by government that resource recovery and waste management are essential services like water, energy and transport
- consideration and integration of planning for resource recovery and waste management services and infrastructure across all government planning authorities, with all communities planned with waste management and resource recovery in mind
- prioritisation of local waste management solutions where feasible, so waste services can be accessed by all communities
- government support of a sustainable waste industry through procurement, market development, policy and regulation
- planned contingency capacity within the resource recovery and waste infrastructure network
- adoption of better practice management by the resource recovery and waste sector which results in reduced risk of emergencies and disruptions
- implementation of disaster waste planning across the state.

Principle 2: Waste infrastructure should be in suitable locations

Waste infrastructure must be well sited in order to be sustainable, minimise potential harm and ensure materials feed into a local or regional circular economy.

The siting of waste facilities is critical to their sustainability. The infrastructure plan considers waste generation in each region and current and planned infrastructure to identify future needs. These needs may be met through the expansion of the capacity of existing facilities and/or development of new facilities.

When considering expanding or developing capacity, it is also important to consider that the grouping of processes may result in:

- increased viability of projects
- reduced energy and resource use per unit
- improved logistics
- improved environmental indicators
- improved support supply chains
- the creation of end markets that feed into a local/regional circular economy.

It may be more efficient to expand existing infrastructure or develop new infrastructure at the site of facilities that cease operations or are close to the end of their life. Given the need for continuing monitoring/ management, landfills may be considered as possible locations for new processing or recycling facilities as their volume decreases or their capacity is exhausted.

Suitable locations for new infrastructure will be identified through appropriate engagement with the existing local and State Government planning systems and adequate public consultation.

This principle should be used to guide planning and decision-making by all stakeholders. When this principle is applied, outcomes include:

- adoption of integrated planning across all levels of government that aligns with the principles in the infrastructure plan, supporting a statewide waste infrastructure system that effectively manages Western Australia's waste
- adoption of strategic land use planning to prevent incompatible activities near resource recovery and waste management facilities that could affect their operating life and functionality
- prioritisation of local waste management solutions where feasible, so waste services can be accessed by all communities
- placement of waste facilities in appropriate land use zones with adequate separation between waste facilities and sensitive land uses to:
  - maintain the social licence to operate
  - minimise the risk of operational disruptions
  - protect human health, the environment and the amenity of the location from the potential impacts of the waste infrastructure
  - enable safe access to and from the facility
- minimise distances to waste sources and end markets

Principle 3: We have a reduced but ongoing need for better practice landfills

Achievement of the waste strategy objectives will reduce the amount of waste being generated and disposed of to landfill, but even in a sustainable, low waste, circular economy landfills remain a necessary part of waste infrastructure.

Landfills will be important for the provision of the following:

- safe waste management in locations where no other viable options exist
- an alternative facility when other facilities may be shut down because of unforeseen events
- management of large volumes of waste from natural disasters
- an energy source, by capturing biogas through highly efficient gas capture systems, reducing methane emissions
- safe disposal of certain wastes for which no viable recycling or further processing is feasible, such as industrial biproducts and hazardous waste.

This principle is an opportunity to guide planning and decision-making for all stakeholders. When implemented, outcomes include:

- recognition by decision-makers, the waste industry and broader community, that landfills will continue to play a key role in integrated waste management
- development of landfills only if needed, and where they complement resource recovery activities
- availability of adequate, well-located support facilities to service landfills e.g. transfer stations
- regionalisation of landfill capacity, where practical, and development at a scale that supports implementation of better practice
- support for remote communities to site, design and manage landfills in a way that protects human health and the environment
- compliance of all new and existing landfill facilities with licence conditions and better practice standards, through implemented better practice in landfill siting, design and management practices
- adoption of post-closure planning for end-of-life landfills to support better practice.

Principle 4: We need to increase our capacity to recover resources from certain types of waste

Increased resource recovery is central to a sustainable, circular economy.

Infrastructure development should consider:

- all waste strategy targets and priority materials
- product stewardship schemes
- the impact of waste export bans and state disposal bans e.g. e-waste
- infrastructure requirements for implementing the waste strategy and supporting action plan e.g. FOGO recovery
- the development of infrastructure to promote outcomes in accordance with waste hierarchy and circular economy principles.

This principle should guide planning and decision-making for all stakeholders. When applied, outcomes include:

- recognition of the significant investment in, and advancement of, our existing waste infrastructure network to achieve waste strategy objectives and targets
- recognition of key waste infrastructure projects as state significant projects and attributed the relevant support and prioritisation
- creation of demand for reused, recycled and recovered materials and products though robust and sustainable markets
- a clear understanding among the waste industry and infrastructure developers of the State's waste infrastructure priorities
- support for the waste industry and infrastructure developers to develop the infrastructure needed by government policies, programs, procurement and regulation, with investment in infrastructure for priority material and facility types encouraged.

Principle 5: Waste facilities strive for better practice

Better practice waste facilities contribute to the protection of human health and the environment and can increase our capacity to recover resources from waste.

The waste strategy outlines the target that by 2030 all waste is managed and/or disposed of to better practice facilities. Meeting this target requires the department and the Waste Authority to develop better practice guidelines that set benchmarks to be met by the waste industry. The following guidelines/standards are already in place:

- Guideline: Better practice organics recycling (Department of Water and Environmental Regulation)
- Better practice FOGO kerbside collection guidelines (Waste Authority)
- Guidelines for local government kerbside and drop-off services (Waste Authority)

Where better practice guidelines are not yet available, compliance with applicable regulations, licence conditions and industry-recognised international guidelines can be used.

Consideration of better practice when developing and operating waste facilities ensures the production of high-quality recycled materials capable of competing with primary resources.

Infrastructure plan modelling shows that some regions may have sufficient capacity of a facility type; however, these facilities may not align with this principle. Consequently, these facilities may need to be upgraded or replaced in the future (examples of this can be found in the Landfill capacity lifetime assessment to 2030 and 2050 section). Some facilities may be at risk if they cannot meet, or operate viably under, better practice standards.

This principle should guide planning and decision-making for all stakeholders. When applied, outcomes include:

- compliance of all existing and new waste infrastructure to relevant better practice guidelines, with consideration of the time and resources required for this transition
- support of facilities to make continuous improvements to their operations
- increased source separation, and reduced contamination, through implementation of better practice waste collection
- adoption of policies or incentives to encourage innovative solutions for better waste management, including new technologies
- regulation, compliance and enforcement of better practice standards to create an ‘even playing field’ for facility developers and operators, and ensure all facilities are meeting these standards
- production of high-quality materials, resulting from better practice standards and regulations, that are in demand and reduce the reliance on primary resources, thus supporting a circular economy.

Objectives

The infrastructure plan has the overarching objective to:

> "Provide a long-term information framework and principles to guide decision-making for the planning and development of waste and resource recovery infrastructure in Western Australia."

To support this objective, the infrastructure plan:

- provides and applies the five key decision-making principles for stakeholders to use when planning for, developing, and approving waste facilities in line with the vision, objectives and targets of the waste strategy
- provides an evidence base for stakeholders to understand and plan for the provision of waste services and investments in infrastructure needs and identified priorities across Western Australia.

Objective framework

Inclusive of the overarching objective, the infrastructure plan aims to achieve the objectives set out in Table 1.

Table 1 Objectives of the infrastructure plan

Objectives of the infrastructure plan
1. Provide a long-term information framework and principles to guide decision-making for the planning and development of waste and resource recovery infrastructure in Western Australia.
2. Identify the waste infrastructure needs, priorities and investment opportunities over the next 10 years that align with the waste strategy and associated action plan.
3. Provide a basis for further integration of waste with the Western Australian land use planning system to enable appropriate and essential waste and resource recovery infrastructure development.
4. Guide future infrastructure development, including informing the investigation of a 'needs-based' approach to new landfills and prioritised waste and resource recovery infrastructure.
5. Promote better practice and improve standards for the establishment and operation of waste infrastructure.

Living plan

It is proposed the infrastructure plan is reviewed to ensure it remains responsive to changes in communities, environments and economies. The iterative approach outlined in Figure 3 allows for reviews every five years to ensure alignment with and support for current waste strategy objectives and targets and other relevant strategies.

It is expected that these reviews will provide insights into:

- existing and planned waste and resource recovery infrastructure
- current and future waste material generation and flows
- identified infrastructure needs and priorities
- progress towards objectives and targets
- region-specific waste and resource recovery infrastructure characteristics, challenges, opportunities and needs.

Region-specific investigations may include a broader look at waste management challenges and opportunities created by local mining and agriculture industries, in addition to the municipal solid waste, construction and demolition waste, and commercial and industrial waste streams.

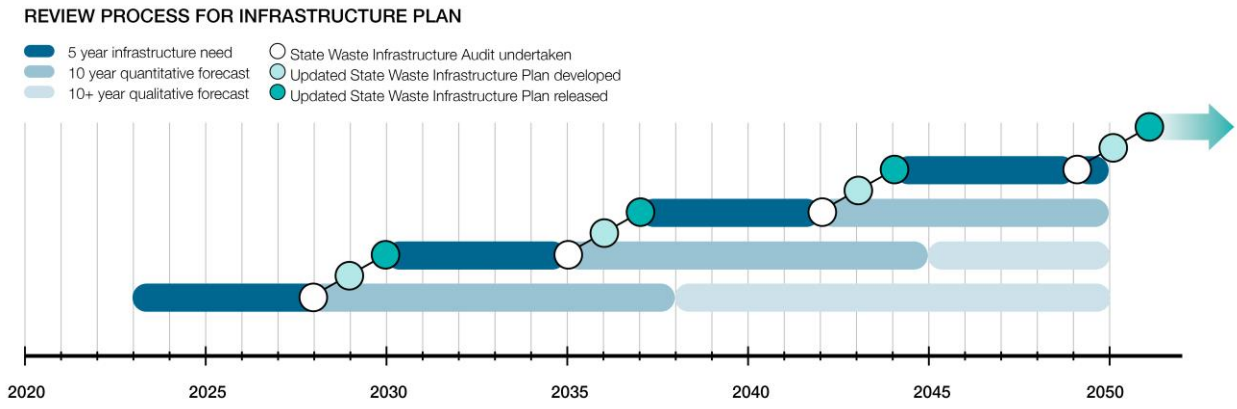


Figure 3 A five-year iterative process for the infrastructure plan

These reviews will include consultation with key stakeholders to ensure that updates to the plan incorporate feedback from these parties, identified in the Stakeholder engagement section below.

Stakeholder engagement

Waste and resource recovery services and infrastructure in Western Australia is managed across a range of stakeholders including local government, skip bin operators and waste transporters, private operators and multinationals.

Recognising the broad range of stakeholders involves a consultative and collaborative approach. The infrastructure plan builds on previous consultation and work by the department, which is highlighted in Figure 4.

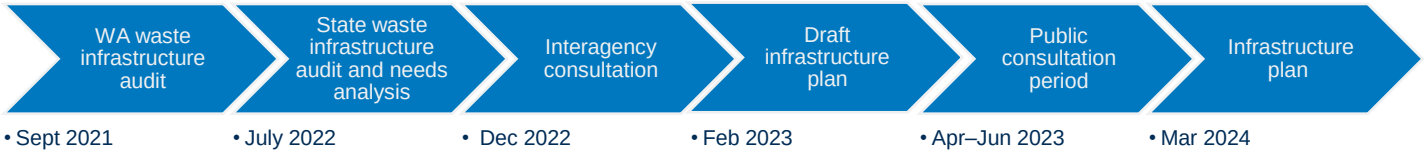


Figure 4 Infrastructure plan development timeline

Stakeholder use of the infrastructure plan

The infrastructure plan will assist various stakeholders by outlining Western Australian priorities (including priority materials and infrastructure gaps) per region as well as a statewide summary.

> **"Waste is everybody's business"**
>
> (Waste Authority, 2019)

Table 2 identifies stakeholders and outlines their respective roles in supporting the infrastructure plan.

Table 2 Audiences of the infrastructure plan

Audience	Role	Key organisations
Australian Government	• Policy/legislative adviser • Strategy • Funding • Waste producer	• Department of Climate Change, Energy, the Environment and Water • Australian Competition and Consumer Commission • Clean Energy Finance Corporation
State Government agencies	• Policy/legislative adviser • Strategy • Funding • Waste producer • Waste service provider (REMS landfills)	• Department of Water and Environmental Regulation • DevelopmentWA • Department of Planning, Lands and Heritage • Department of Transport • Public Transport Authority

Audience	Role	Key organisations
		• Department of Local Government, Sport and Cultural Industries • Department of Communities • Infrastructure Western Australia • Department of Finance • Department of Primary Industries and Regional Development
Waste and resource recovery regulatory agencies	• Policy/legislative adviser • Strategy • Regulation • Compliance and enforcement	• Waste Authority • Environmental Protection Authority Western Australia • Department of Water and Environmental Regulation
Product stewardship bodies	• Policy/legislative adviser • Strategy • Funding	• Australian Packaging Covenant Organisation • Department of Climate Change, Energy, the Environment and Water • Australian Competition and Consumer Commission • Tyre Stewardship Australia • Western Australia Return Recycle Renew Limited (WARRRL)
Local governments	• Waste service provider • Waste producer	• Western Australian Local Government Association • Local governments • Department of Local Government, Sport and Cultural Industries
Business and industry general	• Waste producer	• Australian Industry Group • Chamber of Commerce and Industry Western Australia
Waste and resource recovery industry associations	• Policy/legislative adviser • Strategy	• Waste Recycling Industry Association of Western Australia • Waste Management and Resource Recovery Association Australia

Audience	Role	Key organisations
Waste and resource recovery industry	• Waste service provider • Waste producer	• Waste and recycling businesses (this includes waste transporters, skip bin operators as well waste management companies) • WorkSafe Commissioner • Charity sector/charity waste operators
Charity sector, clothing recyclers and social enterprises	• Support landfill diversion activities	• Charitable Recycling Australia (formerly NACRO) • Charity stores and op shops • Clothing recyclers • Social enterprises
Finance, insurance or auditing bodies	• Funding • Insurance • Waste producer	• Clean Energy Finance Corporation • Insurance Council of Australia • Banks/financial institutions
Community	• Waste producer • Alternative waste service provider (e.g. community-based composting, repair cafes, men's sheds)	• Local government • Community groups and advocacy groups (e.g. those representing Indigenous or culturally and linguistically diverse peoples)
Manufacturers	• Waste producer • Procurement of recycled content	• Australian Industry Group • Chamber of Commerce and Industry Western Australia • Stewardship Centre of Excellence
Innovators/disruptors	• Innovation • Disruption or new business models	• Not a specific stakeholder group • May include research organisations, manufacturers, business and industry
Research organisations	• Research • Career pathways	• Universities and TAFEs • CSIRO • Australian Research Council • Cooperative Research Centres

Scope

The infrastructure plan focuses on resource recovery, disposal and consolidation facilities needed to manage waste arising from three waste sectors in Western Australia:

- municipal solid waste (MSW)
- commercial and industrial waste (C&I)
- construction and demolition waste (C&D).

It articulates the need for new infrastructure by 2030 but does not detail collection mechanisms or any specific technology.

The document is not intended as a detailed analysis to identify specific areas of potential investment. It is intended as a high-level analysis to identify the key priorities for development.

A broad-brush approach has been utilised to provide a holistic view of MSW, C&I and C&D waste management across the entire state of Western Australia. This provides a consistent basis for the development of strategies and priorities, and encourages collaboration among different regions, local governments and stakeholders, leading to more effective waste management strategies and outcomes.

The infrastructure plan offers an initial overarching framework at a state level, representing the first step in guiding stakeholders towards achieving the waste strategy's objectives. Importantly, the responsibilities arising from the recommended infrastructure needs in the infrastructure plan are not expected to be immediately absorbed or actioned by stakeholders. For instance, the infrastructure plan focuses on recommending infrastructure but does not address, or imply responsibility for, collection mechanisms.

Methodology

The infrastructure plan relies on 2020 baseline waste generation, infrastructure and demographic data to project waste volumes in 2030 and 2050, consistent with all waste strategy targets, and identifies the infrastructure needs to support these according to the model developed for the *State Waste Infrastructure Needs Analysis* (Talis unpublished).

The estimation of when each type of facility will be required to be fully operational necessitates consideration of several assumptions, including:

- current capacity of facilities in 2020, their ability to expand and their remaining operational life
- planned capacity of known new developments yet to be permitted, built and/or commissioned
- additional waste and resources to be generated that will require additional capacity by 2030
- the time required to plan, design, seek and obtain approval for, build and commission each type of facility
- an economically viable minimum capacity for each new facility type.

These assumptions and the methodology used to determine any gaps between existing infrastructure and the projected infrastructure needs in 2030 are described below. This includes data sources, infrastructure types and classifications, waste generation projection, infrastructure capacity and capacity needs and more detail on the key assumptions used to assess capacity need.

Data sources

Data for the infrastructure plan was obtained from the following sources:

- *Western Australia Waste Infrastructure Audit Report* (ASK Waste Management unpublished)
- *State Waste Infrastructure Needs Analysis* (Talis unpublished)
- Ongoing State Government infrastructure programs, including the Recycling Modernisation Fund and Food Waste for Healthy Soils Program.

The data obtained from these sources and used in the infrastructure plan are:

- the active waste facilities in Western Australia by facility type, location, licensed capacity and remaining capacity
- population and waste generation by type for 2020 and projected for 2030.

The infrastructure plan relies on the material and waste flows by region and by facility type provided in the above sources.

For consistency, the infrastructure plan adopts the same facility types used in the original sources. Notably, the data sources relied on for the infrastructure plan are more recent and based on a greater number of facilities than was published in the *Waste and recycling in Western Australia 2019-20* (DWER 2021).

Because of discrepancies in data sources relied upon in the infrastructure plan and other reports published by the department, there are common data variations that are less than 5 per cent. This level of variation was considered appropriate, presenting only a low risk to the validity of conclusions made by the infrastructure plan. In cases where variations exceed 5 per cent when compared with the department's publications, further explanation is provided.

Infrastructure types and classification

Resource recovery infrastructure has been grouped into broad categories comprising material recovery, energy recovery and treatment facilities, consistent with the *State Waste Infrastructure Needs Analysis* (Talis unpublished) (Table 3). These facilities are the final processing point for the waste materials described. For a full list of materials relating to each facility type, see the Treatment pathways section (Table 5).

Table 3 Material recovery and energy recovery facility types

Recovery facility type	Description
C&D recovery facility	Facilities for processing and recovery of C&D materials into useable products, generally recycled building products.
Cardboard and paper recovery facility	Facilities for the processing of cardboard and paper materials into recycled products. Facilities process baled materials from material recovery facilities, and clean paper and cardboard streams from source separation collections or community drop-off facilities.
Materials recovery facility (MRF)	Facilities for the collection, aggregation, sorting and baling of recyclable packaging and paper (predominately commingled

Recovery facility type	Description
	kerbside recycling and mixed industrial recycling), before distribution to a final reprocessor.
Food organics and garden organics (FOGO) recovery facility	Facilities for the processing of mixed FOGO and/or food waste into usable products. FOGO recovery facilities have been separated from other organics facilities that predominantly accept green waste. This type of facility includes FOGO waste generated from the MSW stream, and C&I food waste (such as wastes from food processing). This type of facility is considered a final processing point of these waste materials. These facilities are licensed as Category 67A prescribed premises only under the *State Waste Infrastructure Needs Analysis* (Talis unpublished) modelling (Category 67A premises process FOGO, although it may be accepted at and transferred through Category 61A and 62 facilities).
Organics recovery facility	Facilities for the processing of garden organic waste (or 'green waste', not including food waste) into usable products. Facilities may range in size from small-scale regional operations to large industrial facilities handling significant tonnes in metropolitan areas. This subcategory exists to identify facilities that predominantly accept green waste, wood processing waste, etc. and may not be suitable to accept materials containing food waste. This type of facility is considered a final processing point of these waste materials. These facilities have Category 67A, 61 and/or 61A licensing under the *State Waste Infrastructure Needs Analysis* (Talis unpublished) modelling.
Plastic recovery facility	Facilities for the processing of plastic materials into useable products. Feedstock may include source separated containers collected through the container deposit scheme and mixed plastics from MRFs.
Scrap metal recovery facility	Facilities that either consolidate and prepare scrap metal and e-waste materials for transportation to downstream markets, or act as final processing points for conversion into usable products.
Rubber/tyre recovery facility	Facilities for the processing of rubber and tyre materials into useable products. Also includes regional consolidation facilities that prepare rubber for efficient transportation to a reprocessing facility through baling or shredding. There are two facilities that process tyres with the rest being consolidation, predominantly landfills.
Specialist recovery facility	A range of facilities that specialise in the treatment of unique waste materials such as hazardous, textiles and mattresses.
Waste-to-energy facility	Facilities for energy recovery using high-temperature processes, including incineration, pyrolysis and gasification to

Recovery facility type	Description
	convert residual waste into energy. Incineration involves the controlled combustion of waste, pyrolysis utilises heat in the absence of oxygen to break down waste, and gasification converts waste into a combustible gas. These methods aim to generate heat, electricity or fuel from waste materials whilst reducing their volume. Waste-to-energy can be classified as materials recovery only when the bottom ash produced from the process is recycled and reused.
Bioenergy recovery facility	Facilities for converting organic waste into energy (biogas) through anaerobic digestion. Anaerobic digestion involves the breaking down of organic matter in the absence of oxygen to produce biogas.

Bioenergy facilities have not been included in the infrastructure plan but could be a viable solution for regional areas where infrastructure would be needed to process any biomass that may be available. These facilities also contribute to increasing energy from waste capacity, diverting material from landfill, and achieving the State goal of net zero emissions by 2050.

Material streams that flow into the facilities listed above are further described in Table 5. These include glass, and e-waste and batteries:

- Glass containers collected through containers for change go to WA Glass where they are processed and then sent to a furnace in South Australia for bottle manufacture.
- Glass recovered by MRFs is typically crushed for use in construction projects.
- Other glass volume flows through C&D facilities.
- E-waste and batteries are included within scrap metal waste flows.

Landfill facilities

Landfill disposal facility types are categorised in Table 4. These facilities are the final disposal point for the waste materials described.

Table 4 Landfill disposal facility types

Landfill disposal facility type	Description
Inert landfill (Class I) Putrescible landfill (Class II and III) Secure landfill (Class IV) Intractable landfill (Class V)	Landfill for the acceptance of wastes for disposal as defined by the department's Landfill Waste Classification and Waste Definitions 1996 (as amended 2019). These facilities are considered a final disposal point.
Remote Essential and Municipal Services landfill	Landfills delivered by the Department of Communities' Remote Essential and Municipal Services (REMS) program, as part of its waste management services to Aboriginal communities. Typically, the REMS-managed landfills are small, are not registered or licensed, and have minimal or no infrastructure (such as fencing or weighbridges).

Consolidation facilities (transfer stations)

As volumes of materials grow, some consolidation centres may evolve to include processing of one or more materials. In regions where there is insufficient volume to meet the defined threshold for new facility development, consolidation centres are noted for development within the infrastructure plan and an additional need is identified in the regional summary. Consolidation facilities may be co-located on or as part of other facility types such as landfills.

Treatment pathways

The *State Waste Infrastructure Needs Analysis* (Talis unpublished) assumes several treatment pathways to determine how different material types are treated under the infrastructure types and classifications described above. Material treatment pathways are tailored to each region; however, the material types and facilities they are generally treated in are described in Table 5.

Table 5 Treatment pathways for material types

Expected facility for treatment	Material type
Bottom ash recovery facility	Waste-to-energy bottom Ash and metals
C&D recovery facility	Bitumen
	Bricks
	Concrete
	Contaminated soil (excluding Class IV/V)
	Furniture
	Glass – construction
	Glass – other
	Glass packaging – mixed
	Mixed C&D waste
	Mixed inert waste
	Plasterboard
	Rubble/aggregate <150mm
	Rubble/aggregate >150mm
	Sand / soil

Expected facility for treatment	Material type
	Urban wood, timber, sawdust (also C&D waste)
Cardboard paper recovery facility	Cardboard/paper packaging
	Liquid paperboard (LPB)
	Magazines
	Mixed paper/cardboard
	Mixed plastic packaging
	Old newsprint (ONP)
	Paper – mixed
	White office paper
Class IV disposal facility	Class IV Waste
	Fly ash
	Waste-to-energy fly ash
Class V disposal facility	Class V waste
FOGO recovery facility	FOGO from municipal sources
	Food waste, green waste and other organic waste from C&I sources
	Food waste
Inert landfill	Asbestos
	C&D Recovery Facility Residual
MRF	Commingled recycling
	Mixed industrial recyclables
Organic recovery facility	Agricultural waste (excluding manure)
	Biosolids
	Fats and grease

Expected facility for treatment	Material type
	Forestry waste
	Garden waste
	Manures
	Other organic materials
Plastic recovery facility	Hard plastic (not packaging)
	HDPE (2)
	PE-LD/LLD (4)
	PET (1)
	Plastics – other or mixed
	PP (5)
	PS (6)
	PS-E (6)
	PU (7)
	PVC (3)
Putrescible landfill	Waste-to-energy/putrescible waste
Rubber/tyre recovery facility	Foam rubber
	Other rubber, including conveyor belts
	Tyres
Scrap metal recovery facility	Batteries
	Electric and electronic goods
	Metals - ferrous steel – non-packaging
	Metals - ferrous steel – packaging
	Metals – non-ferrous – aluminium – non-packaging
	Metals – non-ferrous – aluminium – packaging

Expected facility for treatment	Material type
	Metals – non-ferrous – other metals
	Whitegoods
Specialist waste treatment	Clinical waste
	Fluorescent lights
	Household chemicals
	Household hazardous waste
	Paint
	Waste Oil
Textile recovery facility	Carpets
	Leather
	Mixed textiles
	Nylon (7)
Waste-to-energy/putrescible landfill	Mixed putrescible waste – (C&I)
	Mixed putrescible waste – domestic (household)
	Treatment residual

Waste generation projections

The infrastructure plan presents waste generation, flows and treatments for 2020, 2030 and 2050. Waste generation projections were obtained from the *State Waste Infrastructure Needs Analysis* (Talis unpublished). The *State Waste Infrastructure Needs Analysis* modelled waste generation, recovery and landfill using a baseline model which applied waste and recycling data collected under regulation through to the State Government's Waste Data Online (WDO), waste levy data, *State Waste Infrastructure Audit* (ASK Waste Management unpublished), annual compliance reports and ABS export data. This waste generation data was projected to 2030 by adjusting for population growth and the waste strategy targets. A summary is presented in Table 6.

Table 6 Waste generation and projection data sources and methods

Year	Source	Methodology used for projections
2020 baseline	Western Australia Waste Infrastructure	Not applicable

Year	Source	Methodology used for projections
	Audit Report, ASK Waste Management Consultancy Services (2021)	
2030 projections	State Waste Infrastructure Needs Analysis, Talis Consultants, prepared for Department of Water and Environmental Regulation (2022)	Uses population growth to extrapolate generation. Applies waste strategy targets for achieving reduction on the 2014-15 per capita waste generation rate of 2.4 tonnes, including the 2030 target of a 20 per cent reduction on the 2014–15 value, equating to a target annual per capita rate of 1.9 tonnes. The annual 1.9 tonnes per capita rate has been carried through to 2050.
2050 projections*		

* Waste material flows are not quantified in the infrastructure plan for 2050, as they cannot be reliably estimated over this timeframe.

Because of the reliance on 2020 baseline waste generation data, there are discrepancies when compared to other baseline and projection figures published by the department. Most notably, other publications have relied on the 2014-15 baseline waste generation rate to project a reduced waste generation target of 1.96 tonnes per capita. The method used in the infrastructure plan results in a projected waste generation target of 1.92 tonnes, which is a discrepancy of less than 5 per cent.

Inter-regional waste flows and impact on regional projections

In 2020, waste flows between regions for processing were identified. In analysing those flows, two types of flows were identified:

- Type I flow – flows that left the origin region even though there was available infrastructure to manage it
- Type II flow – flows that left the origin region because of a lack of infrastructure to locally manage it.

The infrastructure plan considers Type II flows when proposing infrastructure need for 2030. The flows are used, along with the changes in waste and resources projected to be generated in a region for 2030, to establish a need for infrastructure to service a region. An important consideration in the infrastructure plan is that waste flows in the absence of specific regulatory instruments are subject to market factors.

Estimating infrastructure capacity

For the purposes of this plan, the facilities that are predicted to be operational by 2030 comprise the existing facilities, minus any specified for closure, plus proposed facilities.

Modelling undertaken through the *State Waste Infrastructure Needs Analysis* used facility throughput capacities and life expectancy to determine future infrastructure capacity needs. These facilities and throughputs were sourced from works approvals, licences for the relevant facilities, and Waste Data Online. The modelling assumes that facilities will provide all waste services as listed within their licences and/or works approvals and will operate to their full production or design capacity.

Documented licensed capacity may not accurately reflect the practical 'on-the-ground' capacity, particularly evident in cases for organics and FOGO processing, and other waste types such as tyres. For instance, organics processors might possess licenses allowing them to accept FOGO, but logistical or operational constraints could render them unwilling or unable to accommodate it effectively. This discrepancy highlights the importance of considering operational realities beyond licensed capacity. As private operators, whether these capacities are made available will also be dependent on the commercial strategies of each facility and company.

Estimating infrastructure capacity constraints

An estimation of infrastructure capacity constraints is provided for Western Australia and each region to assist those planning waste and resource recovery infrastructure to understand regional infrastructure development priorities. The change in waste generation between 2020 and 2030 was assumed to occur linearly, as was the change in infrastructure capacity between 2020 and 2030, accounting for the planned opening and closure of facilities. By assessing waste generation estimates against infrastructure capacity limits, it was possible to estimate the year when capacity constraints may occur. This year is indicated on infographics (such as Figure 16) using the following legend:

- capacity constraints likely (indicated by the year capacity constraints are estimated)
- possible capacity constraints (estimated using the year capacity constraints are estimated and the planning timeframe for new infrastructure)
- sufficient capacity
- surplus capacity
- no infrastructure, with the need for consolidation centres indicated where relevant.

Key assumptions used for assessing infrastructure needs

The infrastructure plan adopts the following key assumptions from the *Waste Infrastructure Audit Report* (unpublished) and *State Waste Infrastructure Needs Analysis* (unpublished):

- current licensed capacity of facilities in 2020, their ability to expand and their remaining operational life
- planned capacity of known new developments yet to be permitted, built and/or commissioned
- the additional waste and resources to be generated that will require additional facilities in 2030.

The infrastructure plan applies additional assumptions with respect to identifying need:

- the time required to plan, design, seek and obtain approval for, build and commission each type of facility
- an economically minimum viable capacity for each new facility type
- facility lifetime.

Planning timeframe for new infrastructure

When planning for additional infrastructure or expanding existing facilities, additional capacity is necessary where projected waste generation is close to or surpasses projected waste processing capacity.

Figure 5 highlights that decisions will need to be made in advance of reaching the maximum projected capacity, so that any new or additional facilities can be planned, approved, constructed and in operation before capacity is reached.

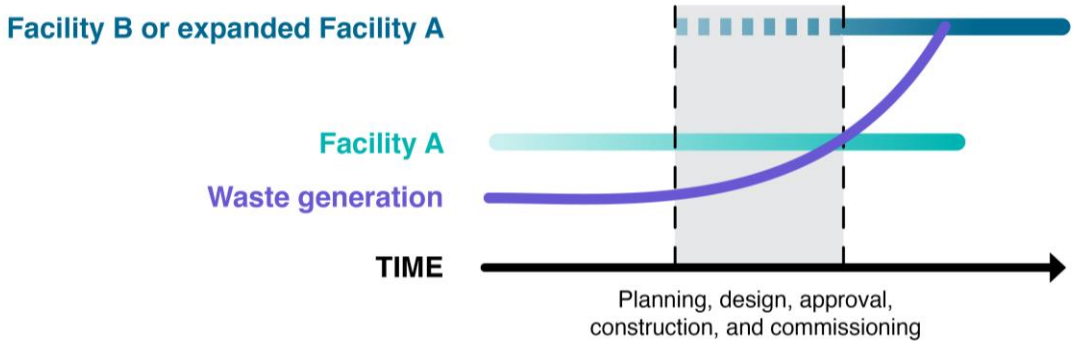


Figure 5 How new infrastructure timelines must be considered when determining infrastructure capacity

Depending on the facility type, more time may be needed to develop the business case, and for planning, design approval, construction and commissioning. Indicative timeframes considered for the completion of these processes are given in Table 7. These timeframes may vary depending on the specific project's sensitivities, complexity, approval requirements, planning requirements, and the quality and scope of the subjected application.

Table 7 Estimated time for planning different waste and resource recovery facility types

Facility types	Estimated time for planning, approval, development and commissioning
C&D recovery Material recovery Plastic recovery Rubber/tyre recovery Scrap metal recovery	3–5 years
Cardboard and paper recovery Organics recovery FOGO Specialist bottom ash recovery Specialist recovery	5–7 years
Waste-to-energy Landfill	7+ years

Market viability and critical mass

The development of sustainable waste processing infrastructure requires a range of pre-conditions to be met including:

- availability of feedstocks
- robust and proven technology
- availability of suitably skilled personnel to operate the facility
- demand for products from the process and markets to take the outputs at known price/cost

- suitable locations
- well-defined regulatory framework
- availability of funding to develop the needed infrastructure.

To be economically viable, facilities require a minimum critical mass of waste within a catchment area that allows transportation to the processing facility at a reasonable cost. If that critical mass is not achievable within the catchment area (or the transport costs are too high to achieve it by extending the area), the material will need to be consolidated and transported to a facility that has achieved the necessary scale.

The infrastructure plan adopts a minimum critical mass to indicate the need to plan for the development of new processing infrastructure in a region. The proposed minimum critical mass values are based on typical capacities for processing using available commercial technology. They reflect the current distribution of licensed facility capacities in Western Australia and input from industry. These values can vary based on:

- regional differences for market costs for energy, labour and materials
- access to markets for final materials produced
- available technologies, and returns on investment at different capacities
- the location of additional processes at the same site
- the sources and cost to finance the project by the developer.

Where the generated volume is below the defined critical mass, the infrastructure plan identifies a need for the development of consolidation centres. Indicative critical mass considered for development of new facility types are provided in Table 8.

Table 8 Minimum critical mass for different waste and resource recovery facility types

Facility	Minimum critical mass
C&D recovery	30,000 tonnes/year
Cardboard and paper recovery	200,000 tonnes/year
Materials recovery	20,000 tonnes/year
FOGO recovery	20,000 tonnes/year
Organics recovery	6,000 tonnes/year
Plastic recovery	10,000 tonnes/year
Rubber/tyre recovery	10,000 tonnes/year
Scrap metal recovery	50,000 tonnes/year
Specialist recovery	5,000 tonnes/year
Waste-to-energy	300,000 tonnes/year
Specialist bottom ash recovery	50,000 tonnes/year

The above values are indicative and are not intended to cover all possible locations, processes and technologies. There may be processes that are viable at lower throughputs, depending on process and technology used. For example, for waste-to-energy facilities,

there are a range of technologies that can generate power from waste at lower scales such as anaerobic digestion.

Minimal viable throughput

The concept of employing small-scale, modular or mobile waste facilities holds promise for regions where waste streams may not meet the minimum critical mass to warrant the construction of large-scale facilities. This idea may be considered to efficiently cater to waste management requirements whilst avoiding the necessity of transporting waste over considerable distances to large-scale recovery facilities. Embracing localised waste solutions offers multiple advantages, including reduced transportation costs, reduced environmental impact from transportation, and the potential to engage local communities in waste management practices. Although the infrastructure plan provides an overarching statewide strategy, subsequent work at the individual region level may explore small-scale or mobile facilities to tailor waste management solutions to the specific needs of regions, enhancing both sustainability and efficiency.

Additional considerations for minimal viable throughput include:

- not all processes are available in a modular configuration
- centralising in larger facilities normally achieves economies of scale and may result in better environmental controls, economic viability and ability to meet better practice standards
- they require the availability of a skilled workforce as well as end markets for recovered streams and/or infrastructure for using or further processing outputs.

Lifetime of facilities

The infrastructure plan considers the life of facilities when assessing the capacity remaining within a region. Where this was unknown for an existing facility, an industry average between 15–25 years was applied, depending on the type of facility. Landfills are treated differently, whereby the lifetime is based on estimated available capacity, derived from the *Western Australia Waste Infrastructure Audit Report* (2021), and the projected quantity of waste that they will receive over the period of the infrastructure plan.

Limitations

Desktop analysis

Desktop analysis was used in the development of this infrastructure plan as it provides a robust starting point for creating a comprehensive statewide framework. This method allows for the collation and assessment of existing data and resources, offering a foundational understanding of waste management across Western Australia. By employing desktop analysis, the plan can efficiently identify overarching priorities and key areas for development while ensuring a holistic view of the state's waste management landscape.

Desktop analysis offers the flexibility to create tailored strategies and solutions that align with the unique needs and capacities of each region within the state. However, desktop analysis does have limitations. One major concern is the potential lack of real-world validation, as desktop analysis relies on data available from various data sources, as outlined in the Data sources section. This can result in a disconnect between theoretical findings and the practical complexities faced on the ground. For example, the use of licence capacities in the *State Waste Infrastructure Needs Analysis* modelling results in the capacity of facilities not accurately reflecting the actual waste volumes and types currently being accepted by a facility.

Region-specific analysis

Desktop analysis can overlook the intricate local contexts and nuances of different regions, as it tends to provide a generalised overview. This can limit the effectiveness of proposed solutions, missing valuable insights and perspectives that can be crucial for successful waste management strategies. The infrastructure plan will be used as a guiding document from which action plans can be developed, such as region-specific plans. Such plans will be guided by the principles and objectives of the infrastructure plan but will incorporate on-site analysis local perspectives.

Interstate treatment of unprocessed waste

Unprocessed waste does not include those materials that are received, sorted and consolidated in Western Australia and then sent out of the state (interstate or overseas) for final processing. The model has considered these materials to be recovered, regardless of their treatment in the final destination. Key materials affected by this modelling approach include glass, scrap metal and paper and cardboard.

While unprocessed waste requires further exploration in future work, modelling determined about 1 per cent of material generated in Western Australia was sent interstate for treatment in 2020. The modelling shows the amount of waste transferred interstate will decrease.

Updates to capacity

The *State Waste Infrastructure Needs Analysis* uses 2015–16 as a baseline for modelling and future projections. The data used was obtained in 2019–20 and subsequently inferred to provide a 2015 baseline, which was extrapolated to provide 2030 and 2050 state waste infrastructure capacities and needs. Additional infrastructure and capacity have been introduced in Western Australia since 2019. Where a change to infrastructure capacity has occurred between 2019–20 and 2023–24, and this change has significantly affected the

State Waste Infrastructure Needs Analysis (Talis unpublished) outcome, specific facilities have been incorporated into the infrastructure plan. These changes are summarised in Table 9.

Table 9 Capacity added post 2019–20 by facility type

Facility type	Capacity added (tonnes)	Location (region)	Reason
FOGO recovery	200,000	Perth	Capacity to be added through funding from the Food Waste for Health Soils Program
	100,000	Peel	
	75,000	Wheatbelt	
Rubber/tyre recovery	90,000	Perth	Capacity to be added through funding from the Recycling Modernisation Fund

Since 2020, licences and work approvals have been granted by the department to the waste and resource recovery facilities listed in Table 10. These facilities have not been considered in the modelling of the infrastructure plan as they were approved after data was obtained in 2019–20 (see Appendix for a full list of facilities included in the 2019–20 modelling).

Table 10 Facility licences and works approvals granted since 2020

Facility type	Facility name	Location
CDS* consolidation and landfill (Category 63 and 64)	Minesite Recycling Pty Ltd	Goldfields
Asphalt manufacturing and consolidation centre	Albany Asphalt Plant	Great Southern
Landfill (Category 63)	GoGo Station Inert Landfill	Kimberley
Landfill (Category 63) and consolidation centre including used trye storage	Broome Regional Resource Recovery Park	Kimberley
Scrap metal recovery facility	Enecell Resource Recovery Solutions	Perth

Facility type	Facility name	Location
Scrap metal recovery facility and consolidation centre	Keppel Holdings	Perth
Used tyre storage	Elan Energy Matrix Pty Ltd Tacoma Facility	Perth
Plastic consolidation and recovery facility	D & M Waste Management	Perth
Scrap metal recovery facility	King Scrap Metal	Perth
Consolidation centre and landfill (Category 63)	Peel Landfill Facility	Peel
CDS consolidation and pyrolysis plant	Collie Pyrolysis Plant	South West
Consolidation centre	Veolia Port Hedland Waste Transfer Station	Pilbara
Landfill (Category 64)	Badgingarra Waste Facility	Wheatbelt
Landfill (Category 89)	Popanyinning Waste Management Facility	Wheatbelt
Landfill (Category 89)	Shire of Koorda Landfill	Wheatbelt
Landfill (Category 64)	Fernview Landfill	Wheatbelt
Consolidation centre	BMT Australia Pty Ltd	Perth
Consolidation centre	Cleartech Transfer Station	Perth

Facility type	Facility name	Location
Consolidation centre	Drainflow	Wheatbelt
Scrap metal recovery facility	FTR Operations	Perth
Organics recovery facility	Wannamal Rd Organics Pty Ltd	Wheatbelt
Consolidation centre	Brajkovich Landfill & Recycling Pty Ltd	Perth
Consolidation centre	Cockburn Resource Recovery Park	Perth
Consolidation centre	Wattleup Sand Supplies	Perth
CDS consolidation and landfill (Category 63 and 64)	Minesite Recycling Pty Ltd	Goldfields
Asphalt manufacturing and consolidation centre	Albany Asphalt Plant	Great Southern

*container deposit scheme

Material stream exclusions

Some material streams are excluded from the *State Waste Infrastructure Needs Analysis* or the infrastructure plan because of a lack of suitable data. The material streams excluded are controlled waste, liquid waste, and waste generated and treated or disposed of on-site for mining, agricultural or industrial operations.

Community recycling centres and container deposit scheme return locations have also been excluded from the modelling undertaken for this infrastructure plan. Despite this, it is recognised that the management of these materials is integral to the infrastructure plan. They play an important role across the waste industry, including in the transition to a circular economy.

Community recycling centres

Community recycling centres are facilities that offer a variety of reuse, recycling and waste drop-off services to the community. These facilities provide collection points close to their point of waste generation, often co-located with existing facilities such as landfill, and are important public-facing infrastructure to assist in the transition to a circular economy.

Community recycling centres have not been considered within this infrastructure plan as insufficient data was available to enable consideration of their capacity and future need. Further auditing of the locations, quantities and type of materials managed, and secondary treatment pathways is required to fully understand the importance of community recycling centres and to identify and address future need.

This infrastructure plan focuses on facilities that are either the final processing or disposal point for materials. Waste materials will often be collected and consolidated at a facility prior to transfer to a recovery or disposal facility.

The existing regional consolidation facilities, all other types of transfer stations, bulking facilities and community recycling centres/container deposit scheme return locations have been excluded from any assessment of existing capacity and from the maps. This is because of a lack of consistent data on the locations, quantities and type of materials managed, and secondary treatment pathways, particularly for unlicensed facilities. This network of facilities requires separate analysis.

These facilities play a crucial role in communities by serving as vital intermediaries in the waste management process. They enable efficient collection and consolidation of waste from local areas, reducing the need for long-haul transportation to distant disposal sites. This not only minimises transportation costs but also lowers the associated carbon emissions, contributing to environmental sustainability. Additionally, waste transfer stations provide a convenient drop-off point for residents and businesses, encouraging responsible waste disposal practices. Overall, these facilities enhance the effectiveness of local waste management, promoting cleaner and healthier communities while optimising resource recovery efforts.

It is acknowledged that these facilities play a vital role in Western Australia's transition to a circular economy; however, their analysis requires region-specific investigation which is considered as an area for future works.

Container deposit scheme

The Western Australian container deposit scheme (CDS) had only recently been introduced when the *State Waste Infrastructure Needs Analysis* modelling was undertaken and has not been factored into the modelling used for the infrastructure plan. It will need to be incorporated into future iterations of the plan.

Recycling and processing facilities that target glass, aluminium and plastics (e.g. MRFs) may receive CDS materials, but the infrastructure plan does not differentiate them from the facilities that receive materials from other sources.

Additional scenario-based modelling undertaken through the *State Waste Infrastructure Needs Analysis* indicated that the CDS could divert up to 10 per cent of material treated through MRFs. If so, there is a potential reduction of 69,000 tonnes of material treated through MRFs, with a proportionate increase in material flowing to glass recovery, paper and cardboard recovery and plastic recovery facilities. These facilities have sufficient capacity to treat material under this scenario. Future iterations of the infrastructure plan may consider the expansion of the CDS to accept a wider range of container types, thus increasing recycling capacity and capability. Future work should seek to verify the diversion of material from MRFs and update assumed treatment pathways for more accurate modelling of state waste infrastructure capacity and needs.

The *Western Australia Return Recycle Renew annual report 2021-2022* (2023) provides the most recent data on the CDS in Western Australia. It accounts that the CDS collected more than 50,000 tonnes in containers. About 84 per cent of these containers were processed and/or reused within Australia, signifying a substantial contribution to domestic recycling and

resource recovery efforts. Notably, about 82 per cent of the collected materials were glass, which underwent processing in Western Australia and then sent to South Australia for bottle manufacturing.

It should be noted that the new facilities developed for processing these containers are accounted for in the infrastructure plan in Table 10, illustrating the commitment to incorporate recent waste management developments that enhance resource recovery within the state.

Remote Essential and Municipal Services landfills

Waste infrastructure planning for REMS landfills is important; however, not enough data is currently available to incorporate REMS landfills into the infrastructure plan's modelling.

A total of 109 REMS landfills across different regions have been mapped in the infrastructure plan (ASK Waste Management unpublished) but these landfills are not licensed as Category 64 or 89 prescribed premises, leaving gaps in information about received volumes, remaining capacities and operational aspects. Consequently, the infrastructure plan omits the modelling of future capacity for these landfills.

Many communities have access to these simple landfill facilities, which generally consist of a fenced area with a landfill trench in place; some do not have fencing.

The Department of Communities funds 19 Aboriginal corporations to deliver municipal services, along with 16 community corporations to deliver municipal services to 33 communities. Additionally, the Department of Communities funds three regional Aboriginal corporations to deliver municipal services to 134 communities, as follows:

- Kimberley region: 95 communities
- Pilbara and Mid-West Regions: 25 communities
- Goldfields region: 14 communities.

The Department of Communities provides guidelines for municipal waste services, including the REMS landfills operations, with guidance available online for planning, operating and maintaining and monitoring these sites. The guidelines provide reasonable support to manage the landfill site to minimise potential environmental impacts, minimise health and safety risks, encourage recycling, and to make the most efficient use of resources on site.

Given the reliance on landfill as a treatment in remote areas of Western Australia, and the large number of communities relying on these landfills, the inability to capture REMS landfill capacity presents a serious limitation for the *State Waste Infrastructure Needs Analysis* (Talis unpublished) and the infrastructure plan. Future iterations of the infrastructure plan should assess options for improving waste generation and infrastructure needs in remote Aboriginal communities to ensure adequate access to services and investigate a rural landfill risk assessment of REMS landfills.

Other material considerations

Consideration of e-waste and emerging waste

There is considerable concern, expressed by stakeholders, about possible impacts of rapidly increasing volumes of e-waste and new types of waste such as solar panels and batteries from e-vehicles and power storage.

The *State Waste Infrastructure Needs Analysis* modelling includes batteries and other e-waste under a scrap metal recovery treatment pathway. At this stage, insufficient data is available to include detailed modelling of the facilities required for the management of newer waste types such as solar panels and large batteries. This plan recognises the challenges

likely to arise from these waste streams given the rapid increase in material, their likely wide geographic distribution, the risk of handling and storage, and the lack of established infrastructure. A preliminary assessment of e-waste and other emerging waste is presented in the Emergence of new waste streams section.

Asbestos

Asbestos waste will continue to need safe disposal in all regions. The *State Waste Infrastructure Needs Analysis* modelling includes asbestos disposal in REMS, inert landfill treatment pathway, and in Category 89 putrescible landfills. The lifetime capacity of inert landfills is explored more in the Landfill capacity lifetime assessment to 2030 and 2050 and Regional summaries sections.

The state of waste in 2020

Waste generation and flow

In 2020, 5.896 million tonnes of waste was generated with Western Australia and the annual per capita generation was 2.2 tonnes. Of the waste generated, 55 per cent of the material was recovered and only a small amount of material was transferred to other states or exported overseas (Figure 6).

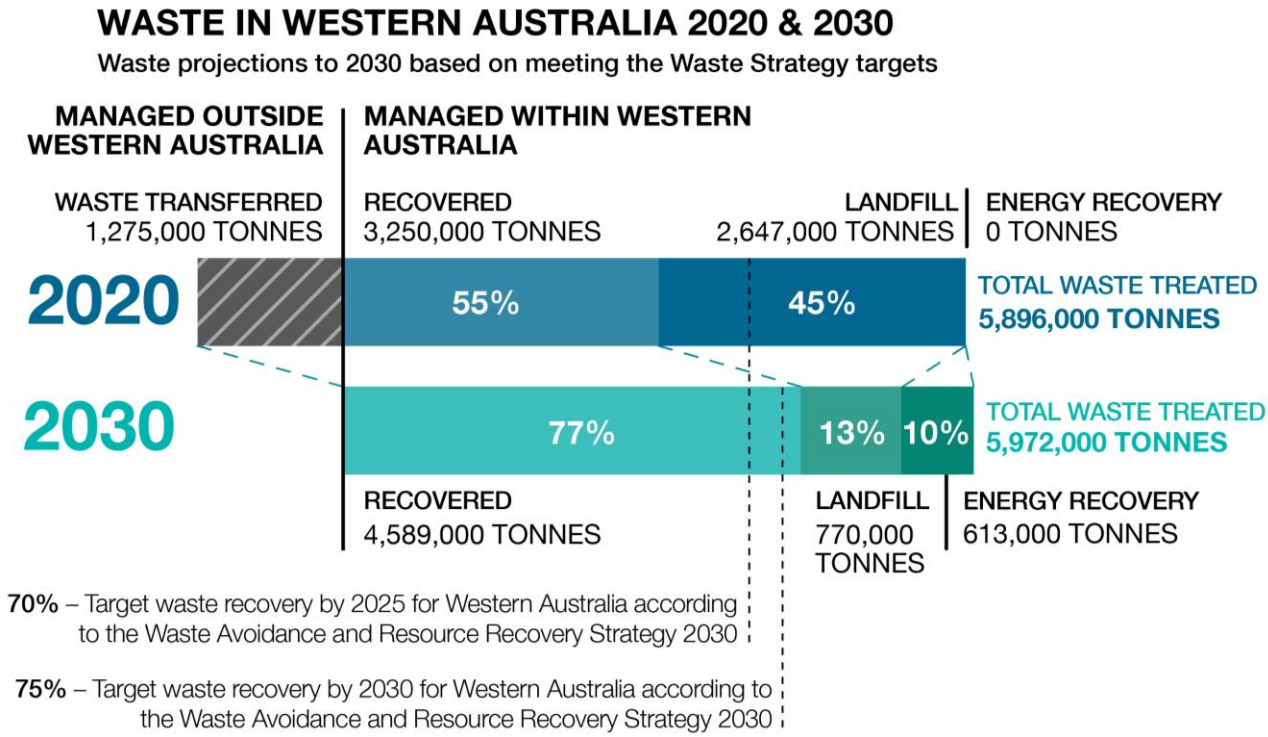


Figure 6 Waste generation, waste management and treatment 2020

Waste generation, classified by its origin, comprised:

- MSW (1.38 million tonnes or 23 per cent)
- C&I (1.83 million tonnes or 31 per cent)
- C&D (2.69 million tonnes or 46 per cent).

Waste recovery rates varied based on its origin in the following manner:

- MSW (30 per cent recovered)
- C&I (55 per cent recovered)
- C&D (80 per cent recovered).

C&D has the largest contribution to the state's generation rate and is already achieving the 2030 waste strategy target of 80 per cent recovery.

Flows and origin and destination of waste are shown in Figure 7 and Figure 8.

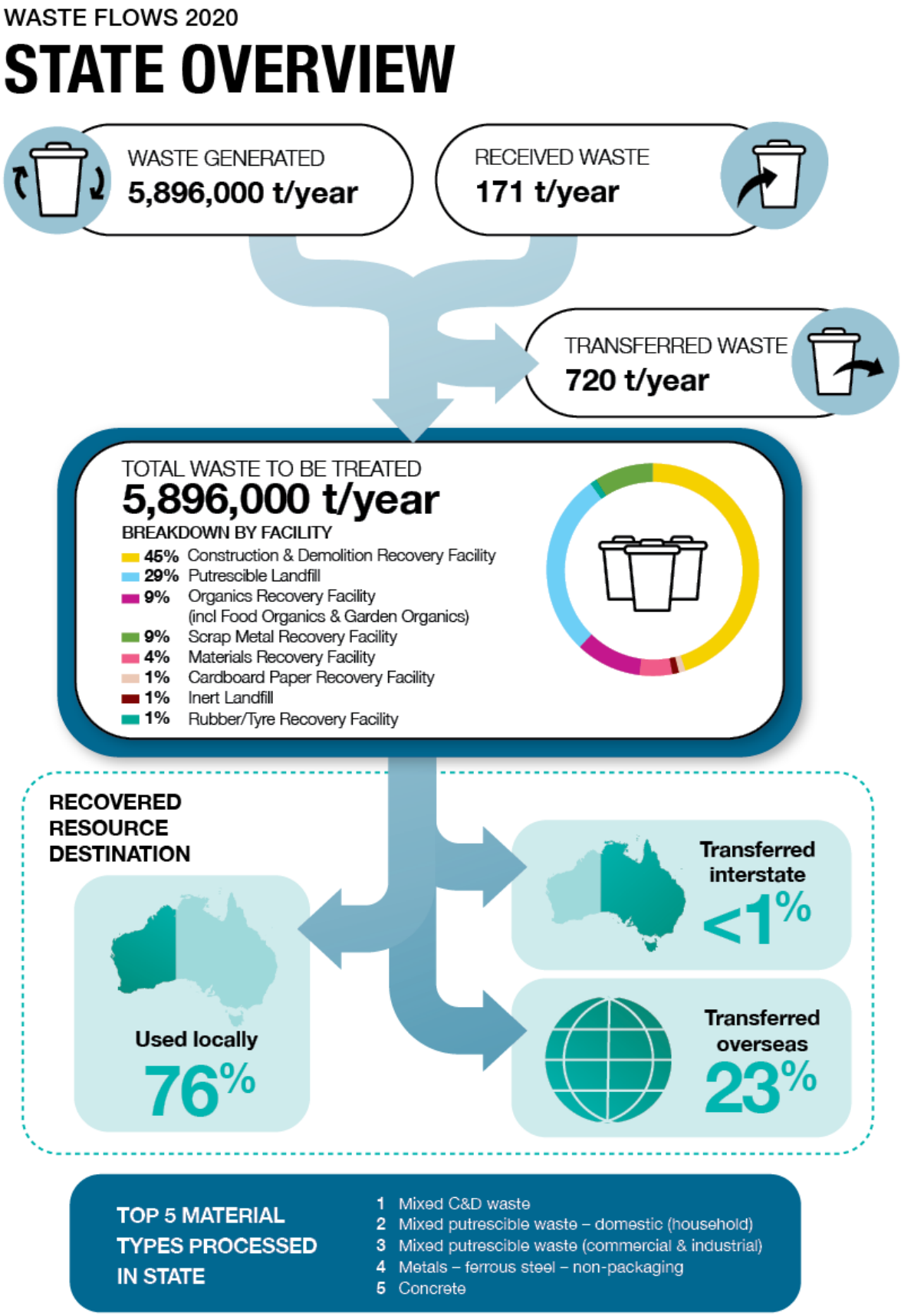


Figure 7 Waste generated, transferred and received (tonnes) in Western Australia in 2020

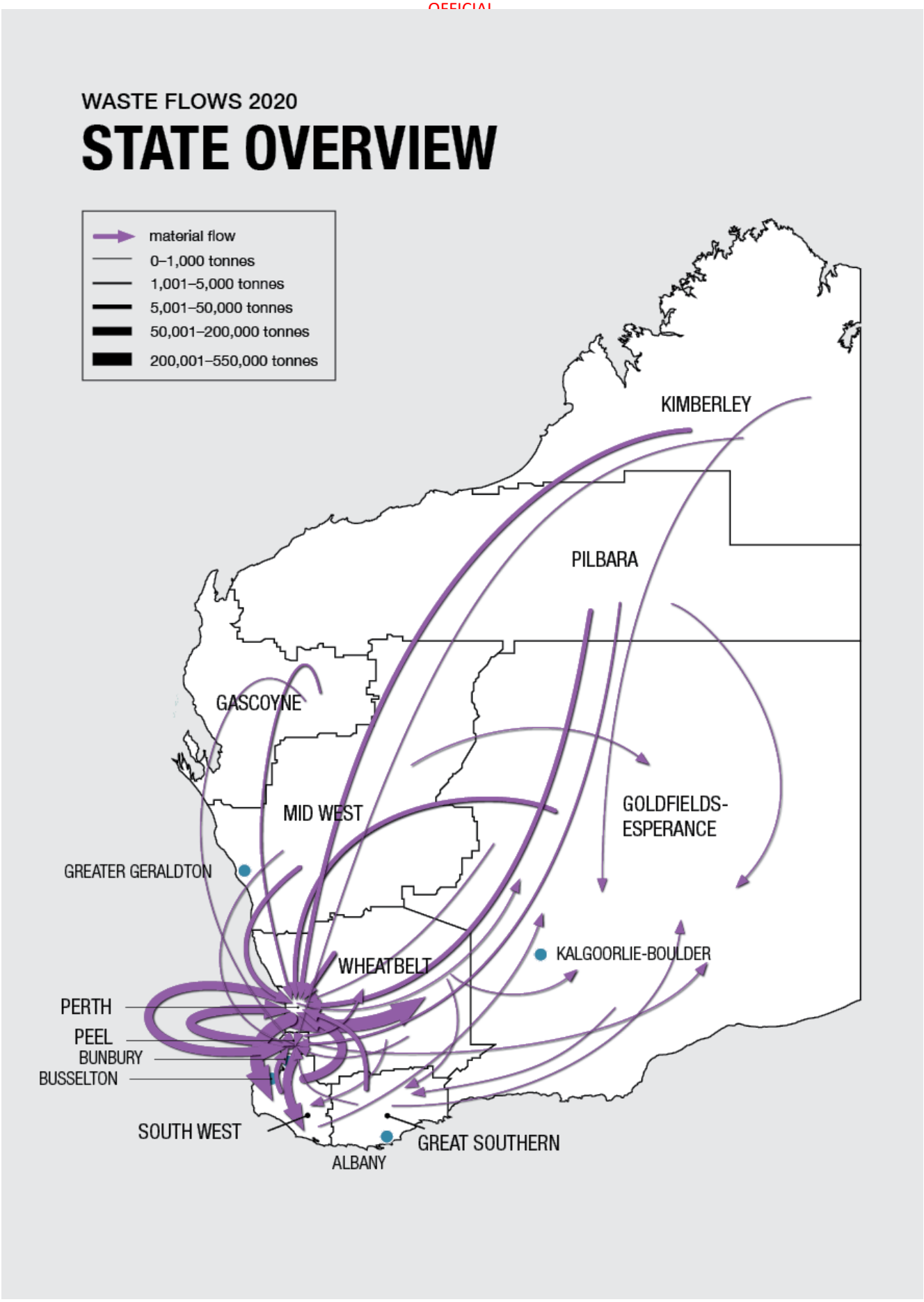


Figure 8 State overview of waste flows in 2020

Significant improvement is required in MSW recovery, especially for major regional centres which collectively have a recovery rate of 14 per cent – well below the 2030 waste strategy target of 60 per cent. Improvements are also needed in Perth and Peel, as these regions currently recover 36 per cent of MSW, with a 2030 target of 70 per cent. Statewide recovery of C&I waste also needs to increase, from the current recovery rate of 55 per cent to the 2030 target rate of 80 per cent.

Recovery rates for MSW, C&D and C&I streams have been sourced from the *State Waste Infrastructure Needs Analysis* and vary from data published in the *Waste and recycling in Western Australia 2019-20* by greater than 5 per cent. Variations are because of different methodologies used to classify waste sources. For example, MSW recovery rates for different regions can either consider only the waste generated and treated in that region, or also consider cross-regional waste transfers for treatment or disposal. Similarly, waste tonnages can change 'source' when passing through a treatment facility. An example is contamination in municipal recycling can be classified as C&I when it leaves an MRF. The infrastructure plan also considers a greater range of waste facilities and sources than are included in the *Waste and recycling in Western Australia 2019-20.*

The classification of waste by its source region, flows in and out of Western Australia and the percentage of waste managed by facility type used for treatment are presented in Figure 7.

The analysis of waste generation, management by facility type within each region and flow between regions (Figure 9) indicates:

- Perth generates the highest volume of waste, producing 73 per cent of the total for the state.
- Three regions (Perth, South West and Peel) generate 85 per cent of the state's waste.
- Most of the waste transferred out of all regions goes to Perth, where it is treated. This represents less than 10 per cent of the total volume treated in Perth
- The largest transfers to Perth are from South West and Peel, representing 67 per cent of the total.

Recovered resource destination

Recovered materials must be transported to an end market for reuse in most cases. The total quantity of transferred material is accounted for in the throughput of recovery and consolidation facilities analysed by the *State Waste Infrastructure Needs Analysis*.

Analysis from other sources published by the department were relied on for data of recovered resource destination (DWER 2021 and DWER 2022). More than three quarters (76 per cent) of recovered resources in Western Australia are circulated back into the economy through local markets, primarily C&D material. The remaining 24 per cent is largely transported overseas (23 per cent) for reuse, with some material being sent interstate (1 per cent).

There are opportunities to strengthen local recovered resource market demand and capacity. This can decrease the reliance on overseas and interstate transportation and improve the overall circular economy standing of the state if resources are reused locally.

Region of destination – waste received by region from region of origin (tonnages 2019–20)	Region of origin – waste transferred out of the region (tonnages 2019–20)										
	Perth	**Peel**	**South West**	**Gascoyne**	**Goldfields-Esperance**	**Great Southern**	**Kimberley**	**Mid West**	**Pilbara**	**Wheatbelt**	**Received Total**
Perth	0	136,000	91,000	1,500	15,600	10,700	6,900	12,600	43,700	20,000	338,000
Peel	64,400	0	16,950	500	900	300	100	400	3,250	300	87,100
South West	242,500	91,000	0	0	0	0	0	0	0	500	334,000
Gascoyne	0	0	0	0	0	0	0	0	0	0	0
Goldfields-Esperance	100	0	50	0	0	0	0	0	50	0	200
Great Southern	0	0	0		500	0	0	0	0	200	700
Kimberley	0	0	0	0	0	0	0	0	0	0	0
Mid West	0	0	0	0	0	0	0	0	0	0	0
Pilbara	0	0	0	0	0	0	0	0	0	0	0
Wheatbelt	511,000	5,000	0	0	0	0	0	0	0	0	516,000
Transferred Total	818,000	231,000	108,000	2,000	17,000	11,000	7,000	13,000	47,000	21,000	1,275,000

Figure 9 Waste generated, transferred, and received (tonnes) by region in Western Australia in 2019–20

Waste and resource recovery facilities

The location and type of current and planned infrastructure comprising registered, licensed, unlicensed and approved facilities were identified in the *Western Australia Waste Infrastructure Audit Report.* In 2020, Western Australia had 431 waste facilities including:

- 225 licensed facilities (facilities with an existing prescribed premises licence)
- 96 registered facilities (Category 89 landfills)
- six unlicensed facilities (operational facilities that do not have an existing prescribed premised licence)
- 109 landfills in Aboriginal communities that are operated under the REMS program.

As shown in Figure 10 and Figure 11, the distribution of facilities is centred around major urban and population centres, with REMS distributed throughout regional Western Australia.

The *Western Australia Waste Infrastructure Audit Report* (ASK Waste Management 2021) identified proposed facilities or facilities under construction including:

- two waste-to-energy facilities
- 29 works approvals for new facilities
- seven projects funded under the Recycling Modernisation Fund
- three projects funded under the Food Waste for Healthy Soils Program.

Western Australia's current and proposed waste and resource recovery infrastructure is concentrated near the state's activity centres (population centres and industrial centres).

The Perth region accounts for the bulk of waste generated in the state and, as such, economies of scale and local economies have driven further diversification and expansion of the sector in the Perth region.

CURRENT AND PLANNED INFRASTRUCTRE

STATE OVERVIEW

Current and planned infrastructure represents registered, licensed and approved facilities on the Western Australia Waste Infrastructure Register through the State Waste Infrastructure Audit

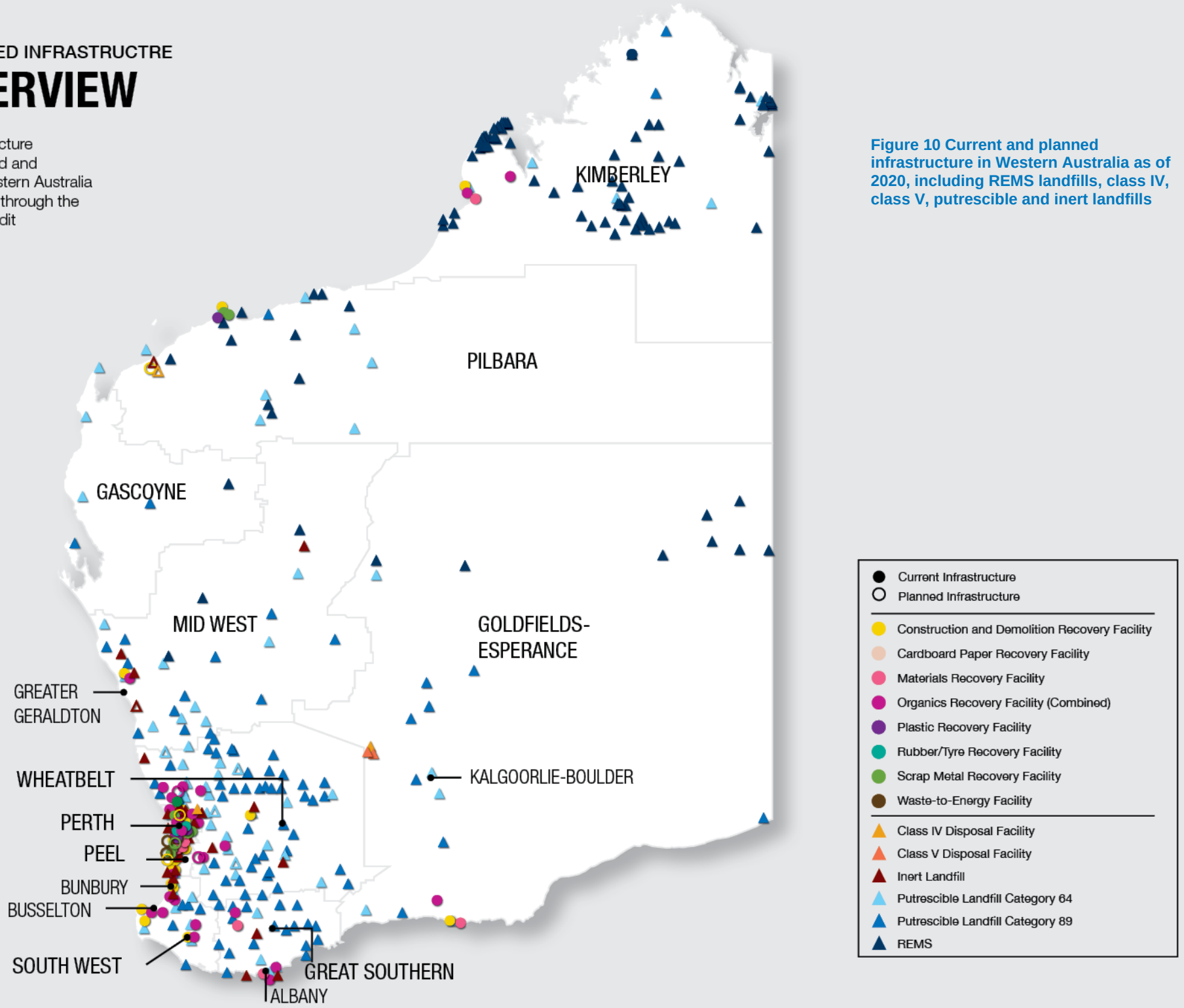


Figure 10 Current and planned infrastructure in Western Australia as of 2020, including REMS landfills, class IV, class V, putrescible and inert landfills

Resource recovery facilities

Resource recovery infrastructure is located throughout regions near the state's major population and industrial centres. The concentration of resource recovery activity takes place in the Perth region. Proximity to major generation sources and additional material received from other regions results in efficiencies and economies of scale for resource recovery activities in the Perth region.

Barriers to infrastructure development in other regional areas may include:

- insufficient or inconsistent access to suitable feedstock quantities
- a greater distance to offtake markets
- limited transportation infrastructure.

Development of waste infrastructure in the regions will be critical to achieving all waste strategy targets. The introduction of new collection services and the increase of material consolidation from less densely populated areas can help generate the necessary material quantities to justify new waste facilities. These facilities should be planned near major regional transportation networks that combine road, rail and port facilities.

CURRENT AND PLANNED RECOVERY INFRASTRUCTRE

STATE OVERVIEW
(EXCLUDING LANDFILL)

Current and planned infrastructure represents registered, licensed and approved facilities on the Western Australia Waste Infrastructure Register through the State Waste Infrastructure Audit

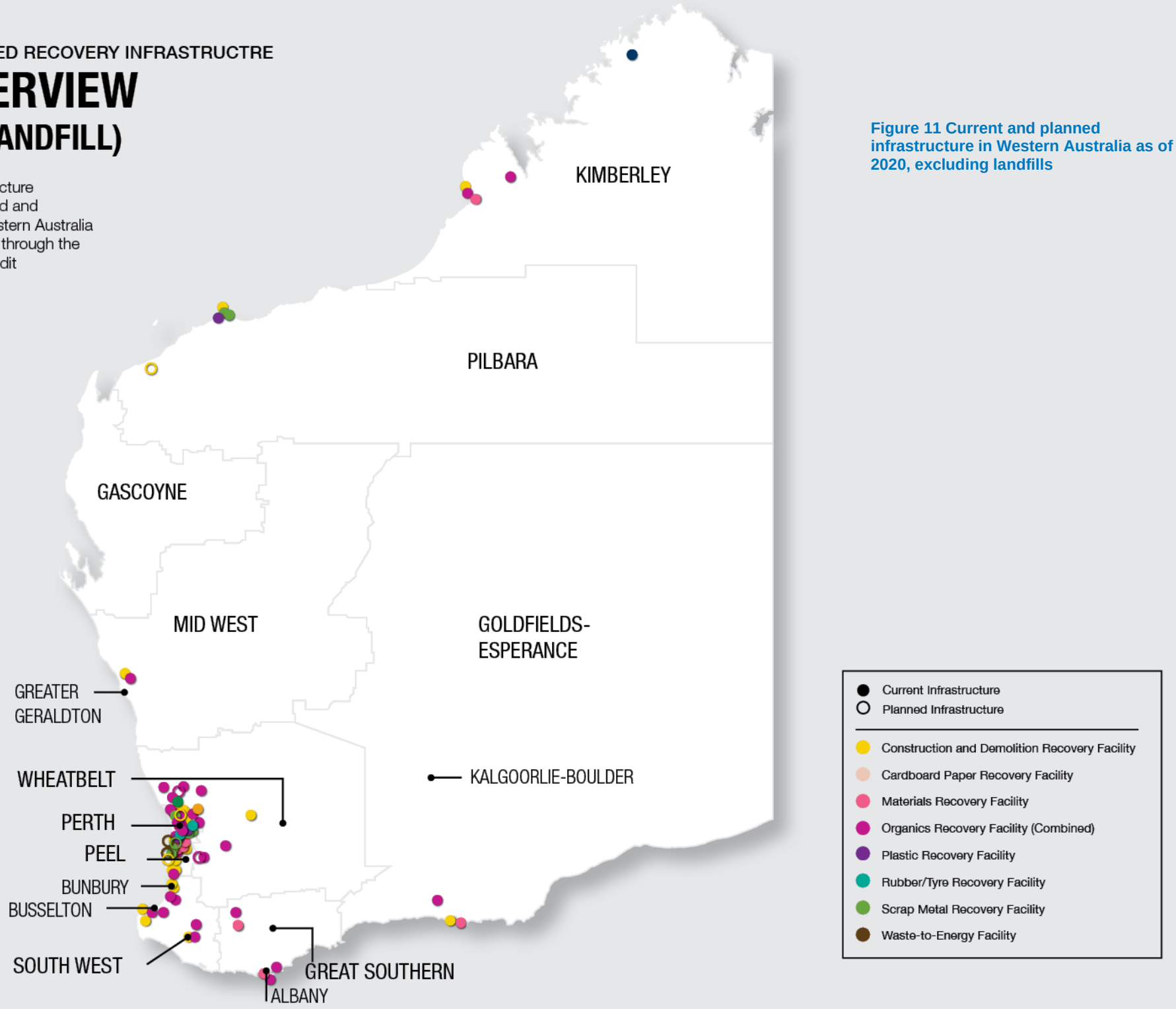


Figure 11 Current and planned infrastructure in Western Australia as of 2020, excluding landfills

Projections for 2030

In this section of the infrastructure plan, estimates of 2030 waste volumes across different regions are presented, along with an evaluation of the adequacy of existing infrastructure to effectively manage the projected waste quantities and meet the waste strategy's 2030 'Recover' targets.

This analysis primarily focuses on addressing resource recovery needs and assumes that waste avoidance targets will be addressed and met concurrently through other strategic actions and initiatives.

Projected waste generation for Western Australia

A comparison of 2020 waste generation and treatment with that projected for 2030 is shown in Figure 14. The infrastructure plan waste forecast modelling assumes that all waste strategy targets are met by 2030, which includes:

- a waste reduction target of 20 per cent
- a materials recovery target of 75 per cent
- no more than 15 per cent of waste generated in Perth and Peel region is landfilled
- a MSW materials recovery target of 70 per cent in the Perth and Peel regions, and 60 per cent in major regional centres
- a C&I materials recovery target of 80 per cent
- a C&D materials recovery target of 80 per cent
- all waste resource recovery facilities adopt better practice.

By achieving the waste strategy targets, Western Australia's waste generation will be about 5.972 million tonnes in 2030, or 1.88 tonnes per capita. The total generation is similar to 2020's total of 5.896 million tonnes, despite an expected population growth of 16 per cent, as shown in Figure 14.

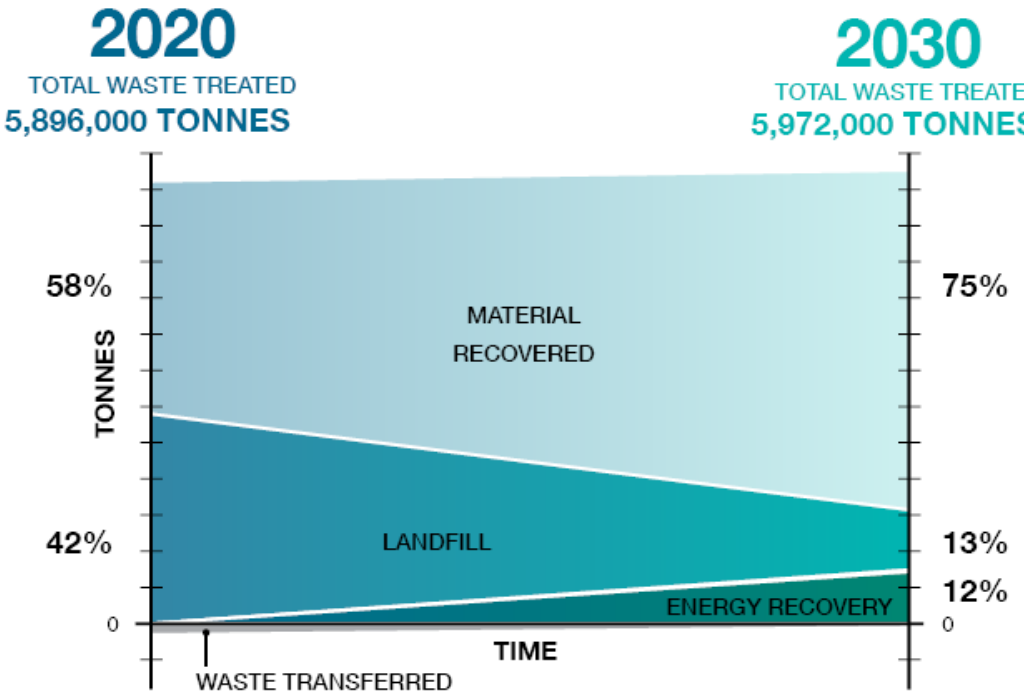


Figure 14 Western Australia's 2030 waste projection summary

The implementation of kerbside collection systems for source separated MSW FOGO in the Perth and Peel regions is a key activity through which Western Australians can recover more value and resources from waste and reduce greenhouse gas emissions. However, decision-makers must consider that modelling in the *State Waste Infrastructure Needs Analysis* assumes that regional centres will achieve a 60 per cent recovery rate for MSW, and that there is an opportunity for municipal FOGO collections in some regions.

It is projected that MSW would represent 28 per cent of the material generated in Western Australia, with C&D representing 40 per cent and C&I representing 32 per cent. This is demonstrated in Figure 15.

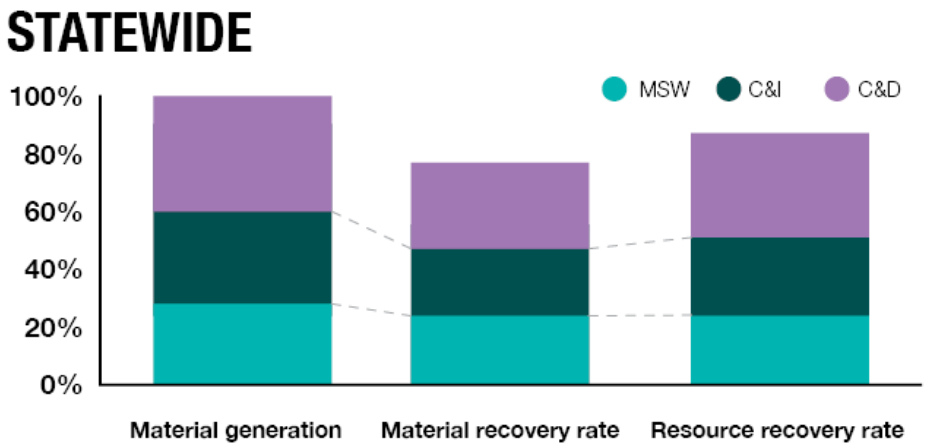


Figure 15 Projected material generation in Western Australia in 2030

Modelling under the *State Waste Infrastructure Needs Analysis* results in a material recovery rate of 75 per cent for Western Australia, rising to 89 per cent for resource recovery including waste-to-energy treatment. To achieve this material recovery rate, 65 per cent of MSW generated in 2030 must be recovered, along with 80 per cent of C&I waste and 80 per cent of C&D waste.

A summary of the waste generation, inter-regional flows and treatment is shown in Table 11. The waste generated by region is a critical consideration when assessing how Western Australians could recover more value and resources from waste. The infrastructure plan considers these trends when identifying the need for future infrastructure. It is important to note that the infrastructure plan employs a consistent statewide methodology for evaluating regional capacity needs. While this approach provides a unified framework, it acknowledges the potential limitations in capturing region-specific nuances and disparities. However, it serves as a foundational guide, providing a basis for the development of tailored regional plans that can address unique characteristics, challenges and priorities in a more detailed and context-sensitive manner.

A detailed discussion is provided for each region in the Regional summaries section.

Table 11 Waste generation, inter-regional flows and treatment summaries by region for 2030

Region	Waste generation, inter-regional flows and treatment summaries for 2030
Perth	Modelling to achieve all waste strategy targets in 2030 found Perth would generate 4,335,000 tonnes of waste, similar to 2020 quantities. Materials received into and transferred out of the region need to change significantly to support the waste strategy targets, with the phase-out of all material transfers out of the region, and an increased capacity for material received (531,000 tonnes). This will result in an increase of the total tonnes treated in Perth by 26 per cent. Infrastructure and strategic initiatives will increase the Perth material recovery rate from 66 per cent to 82 per cent. Based on current, planned and approved infrastructure in 2020, Perth will have a surplus processing capacity of 2,423,000 tonnes for C&D material, 183,000 tonnes for organic material, and 180,000 tonnes for scrap metal material. This surplus capacity can support the capacity needs of other regions, such as the 52,000 tonnes needed for C&D capacity in the Peel region. A more efficient consolidation and transport network will enable this support. Based on current, planned and approved infrastructure in 2020, Perth requires the following additional capacities to meet the waste strategy targets in 2030: • 254,000 tonnes of additional recovery capacity is needed in FOGO facilities, which may be alleviated to 110,000 tonnes by transporting material to the Peel and Wheatbelt regions, which have surplus capacity of 69,000 and 75,000 tonnes, respectively. A preliminary analysis of spare FOGO capacity in Category 67A facilities identified the need may be entirely alleviated by sharing capacity across the Perth, Peel, South West and Wheatbelt regions. • 291,000 tonnes of additional recovery capacity is needed in carboard and paper facilities. • 33,000 tonnes of additional recovery capacity is needed in MRFs. • 73,000 tonnes of additional recovery capacity is needed in waste-to-energy facilities.
Peel	Modelling to achieve all waste strategy targets in 2030 found the Peel region would generate (291,000 tonnes) similar quantities compared with 2020. Waste and materials received into and transferred out of the region are projected to change more significantly, with a decreased rate of material transferred out (112,000 tonnes) and a complete phase-out of material received into the region. Lower rates of material transferred out of the region will increase the total tonnes treated in Peel by 25 per cent. Infrastructure and strategic initiatives will increase the Peel resource recovery rate from 50 per cent to 84 per cent.

Region	Waste generation, inter-regional flows and treatment summaries for 2030
	Based on current, planned and approved infrastructure in 2020, Peel requires the following additional capacities to meet the waste strategy targets in 2030: • 51,500 tonnes of additional recovery capacity is needed for C&D, which is sufficient to allow for an additional facility.
Pilbara	Modelling to achieve all waste strategy targets in 2030 found the Pilbara region would generate (271,000 tonnes) and transfer out of the region (51,000 tonnes) similar quantities compared with 2020. Increases in local infrastructure capacity will increase the Pilbara resource recovery rate from 46 per cent to 58 per cent. Based on current, planned and approved infrastructure in 2020, the Pilbara requires the following additional capacities to meet the waste strategy targets in 2030: • 38,000 tonnes of additional recovery capacity is needed for C&D, which is sufficient to allow for an additional facility. • 26,000 tonnes of additional recovery capacity is needed for organics, which is sufficient to allow for the development of a new organics recovery facility and a FOGO recovery facility. More than half of the organics feedstock (52 per cent) is estimated to consist of MSW, indicating that there may also be a need for FOGO recovery in the region. • 7,000 tonnes of additional consolidation capacity is needed for MRFs.
Kimberley	Modelling to achieve all waste strategy targets in 2030 found the Kimberley region would generate (67,000 tonnes) and transfer out of the region (7,000 tonnes) similar quantities compared with 2020. Additional infrastructure planning and waste strategy initiatives will increase the Kimberley resource recovery rate from 13 per cent to 27 per cent. Based on current, planned and approved infrastructure in 2020, the Kimberley requires the following additional capacities to meet the waste strategy targets in 2030: • 13,500 tonnes of additional recovery capacity is needed for organics recovery, which is sufficient volume for the development of a new organics recovery facility but not enough for a FOGO recovery facility. A high percentage (69 per cent) of the organics feedstock is predicted to consist of MSW, indicating that there may also be a need for FOGO recovery in the region. This may be achieved through the extension or expansion of existing organics facilities to be able to accept FOGO.

Region	Waste generation, inter-regional flows and treatment summaries for 2030
	• 3,000 tonnes of additional consolidation capacity is needed for scrap metal. • 1,000 tonnes of additional recovery capacity is needed for C&D waste, which may need to be consolidated and transferred out of the region if it is not viable to increase the capacity of recovery infrastructure. • Minimal consolidation capacity may be needed for rubber tyre material, with less than 1,000 tonnes of feedstock projected.
South West	Modelling to achieve all waste strategy targets in 2030 found the South West region would generate (467,000 tonnes) and transfer out of the region (148,000) larger quantities of waste compared with 2020 to meet MSW material recovery targets. However, the reduction in putrescible waste imports from other regions means the total waste treated in the South West will decrease by about 51 per cent. This shift, along with the addition of new infrastructure, will increase the South West resource recovery rate from 49 per cent to 81 per cent. Based on current, planned and approved infrastructure in 2020, the South West requires the following additional capacities to meet the waste strategy targets in 2030: • 72,000 tonnes of additional consolidation capacity is needed for scrap metal recovery, which is sufficient to allow for the development of a new recovery facility. • 64,000 tonnes of additional consolidation capacity is needed for an MRF, which is sufficient to allow for the development of a new recovery facility; however, transferring material to Perth for recovery and access to end markets may be more viable. • 8,000 tonnes of additional consolidation capacity is needed for rubber/tyre recovery, which may be sufficient for the development of a new recovery facility. • 92,000 tonnes of additional recovery capacity is needed for waste-to-energy, which is not sufficient to allow for a new facility; however, residual waste may potentially be consolidated and transported to Perth for processing. Alternatively, regional growth in the Bunbury and Busselton centres may make development of a South West waste-to-energy facility possible, particularly given the constraints on putrescible landfill capacity in the region. If a waste-to-energy facility is developed, an additional 18,000 tonnes of bottom ash will need to be processed locally or consolidated and transported to Perth.

Region	Waste generation, inter-regional flows and treatment summaries for 2030
Great Southern	Modelling to achieve all waste strategy targets in 2030 found the Great Southern region would generate (92,000 tonnes) a similar quantity of waste compared with 2020. New consolidation infrastructure developments could significantly increase the rate of waste transferred out of the region (27,000 tonnes) for recovery. This will result in a 25 per cent net decrease in the quantity of waste treated in the Great Southern region. This shift and other waste strategy initiatives will increase the Great Southern resource recovery rate from 23 per cent to 58 per cent. Based on current, planned and approved infrastructure in 2020, the Great Southern requires the following additional capacities to meet the waste strategy targets in 2030: • 16,500 tonnes of recovery capacity is needed for C&D waste, which will require consolidation and transfer from the region as it is not sufficient to allow for an additional recovery facility. A mobile C&D recovery facility may be considered. • 7,000 tonnes of additional consolidation capacity is needed for scrap metal. • 5,000 tonnes of additional consolidation is needed for an MRF. • While not identified though *Infrastructure Needs Analysis* modelling, stakeholders have reported local demand for access to FOGO processing capacity. Further investigation of this need at a regional level is required.
Mid West	Modelling to achieve all waste strategy targets in 2030 found the Mid West region would generate (83,000 tonnes) lower quantities while transferring out of the region (21,000 tonnes) higher quantities compared with 2020. This change will result in a 22 per cent net decrease in the total waste treated in the Mid West region. These changes, supported by new infrastructure, will increase the Mid West resource recovery rate from 14 per cent to 56 per cent. Based on current, planned and approved infrastructure in 2020, the Mid West requires the following additional capacities to meet the waste strategy targets in 2030: • 13,000 tonnes of additional capacity is needed in MRFs, which may be sufficient to allow for an additional recovery facility if augmented with material received from the Gascoyne region (1,000 tonnes). • 7,000 tonnes of additional consolidation capacity is needed for scrap metal recovery.

Region	Waste generation, inter-regional flows and treatment summaries for 2030
Gascoyne	Modelling to achieve all waste strategy targets in 2030 found the Gascoyne region would generate (83,000 tonnes) lower quantities while transferring out of the region (21,000 tonnes) similar quantities compared with 2020. This change will result in a decrease in the total waste treated in the Gascoyne region. New infrastructure will aim to change treatment methods to increase the Gascoyne resource recovery rate from 14 per cent to 56 per cent. Based on current, planned and approved infrastructure in 2020, the Gascoyne requires the following additional capacities to meet the waste strategy targets in 2030: • 500 tonnes of additional recovery capacity is needed for C&D waste, which will require consolidation as it is not sufficient to allow for a new facility. • 1,000 tonnes of additional consolidation capacity is needed for MRFs. • 6,000 tonnes of additional recovery capacity is needed for organics, which is sufficient volume to allow for the development of a new organics recovery facility but not enough for a FOGO recovery facility. A high percentage (68 per cent) of the organics feedstock is estimated to consist of MSW, indicating that there may also be a need for a FOGO recovery in the region. This may be achieved through the extension, or expansion of existing organics facilities to be able to accept FOGO. • 500 tonnes of scrap metal recovery capacity is needed, which will require consolidation, although is not sufficient to allow for a new facility.
Wheatbelt	Modelling to achieve all waste strategy targets in 2030 found the Wheatbelt region would generate (125,000 tonnes) and transfer out of the region (22,000 tonnes) similar quantities compared with 2020. Changing waste received from Perth will significantly decrease the total quantity of waste treated in the Wheatbelt, resulting in a net decrease of 84 per cent compared with 2020. These changes and improvements to local recovery capacity will increase the Wheatbelt resource recovery rate from 18 per cent to 29 per cent. Based on current, planned and approved infrastructure in 2020, the Wheatbelt requires the following additional capacities to meet the waste strategy targets in 2030: • 17,000 tonnes of additional consolidation capacity is needed for MRF. • 5,000 tonnes of additional consolidation capacity is needed for scrap metal recovery.

Region	Waste generation, inter-regional flows and treatment summaries for 2030
Goldfields-Esperance	Modelling to achieve all waste strategy targets in 2030 found the Goldfields-Esperance region would generate (124,000 tonnes) less material while transferring out of the region (48,000 tonnes) significantly more compared with 2020. Greater amounts of waste transfer out of the region for recovery will decrease total waste treated in the region by 37 per cent. Additional infrastructure planning and waste strategy initiatives will increase the Goldfields-Esperance resource recovery rate from 37 per cent to 59 per cent. Based on current, planned and approved infrastructure in 2020, the Goldfields-Esperance region requires the following additional capacities to meet the waste strategy targets in 2030: • 13,500 tonnes of additional capacity is needed for MRFs, which will require consolidation, although is not sufficient to allow for a new facility. • 4,000 tonnes of additional recovery capacity is needed for organics, which is not sufficient volume to allow for the development of an organics recovery facility or a FOGO recovery facility. Half of the organics feedstock (50 per cent) is estimated to consist of MSW, indicating that there may also be a need for a FOGO recovery in the region. This may be achieved through the extension, or expansion of existing organics facilities to be able to accept FOGO. • 5,000 tonnes of additional capacity is needed for scrap metal recovery, which will require consolidation, although it is not sufficient to allow for a new facility.

Infrastructure capacity needs in 2030

Recovery and consolidation infrastructure capacity needs in 2030

The estimated capacity for recovery and consolidation infrastructure needed to process the waste projected for 2030, and meet waste strategy targets, is presented in Table 12 and Figure 16. The method applied for determining capacity constraints is provided in the Estimating infrastructure capacity constraints section.

Western Australia's most significant infrastructure needs include the:

- development of 291,000 tonnes of cardboard and paper recovery capacity with a recovery facility in the Perth region
- development of 100,000 tonnes of food and garden organics recovery capacity (from municipal and commercial sources), to address the state's capacity needs.

The latter may include upgrading existing organics recovery facilities to accept this waste or determining whether spare capacity is available in existing 67A facilities to alleviate FOGO capacity need.

Table 12 Recovery and consolidation infrastructure capacity needed by infrastructure type to achieve the waste strategy 2030 targets

Infrastructure types	Recovery facility	Consolidation facility	Potential to increase capacity through changes to existing facilities	Priority
Cardboard and paper	291,000 tonnes/year			High
FOGO	100,000 tonnes/year		✓	High
MRF	29,000 tonnes/year	124,500 tonnes/year	✓	Medium
C&D	107,500 tonnes/year		✓	Medium
Scrap metal		99,500 tonnes/year		Low
Rubber/tyre		8,000 tonnes/year		Low
Waste-to-energy	164,500 tonnes/year			Low

The Regional summaries section provides further discussion on the facility development options in each respective region.

The infrastructure plan determined that there was sufficient plastic recovery capacity in Western Australia. Another publication (Envisage Works 2021) reports different quantities of plastic generation and reprocessing within the state. It is expected that this analysis relied on different data sources compared to the infrastructure plan, leading to the variation. To maintain a consistent method for all material and facility types, data reported in the other source was not considered as part of the infrastructure plan.

Analysis of licensed capacity to alleviate capacity need

The *State Waste Infrastructure Needs Analysis* (Talis unpublished) determined that there was need for an additional 254,000 tonnes of FOGO recovery capacity in Perth by 2030.

Outside of the Perth and Peel regions, *State Waste Infrastructure Needs Analysis* (Talis unpublished) modelling classified all facilities under licence categories 67A or a combination of 67A, 61 and 61A as organics recovery facilities. This was regardless of whether the facility was processing FOGO, only garden organics (green waste, other non-food organic waste) or a combination. This presents an opportunity to further explore licensed capacity of 67A facilities.

Adjoining regions to Perth may have capacity to receive FOGO to alleviate capacity need. This is also explored in this preliminary analysis of FOGO capacity within Category 67A facilities. The Peel, South West and Wheatbelt regions are considered adjoining regions for the purpose of this analysis.

A preliminary analysis of Perth and adjoining regions has identified the potential FOGO capacity in each region by looking at facilities which are licensed to accept FOGO, but which have not been categorised as processing FOGO in the *State Waste Infrastructure Needs Analysis* (Talis unpublished) modelling.

Under the *State Waste Infrastructure Needs Analysis* (Talis unpublished) modelling, 543,000 tonnes of FOGO waste will be generated in Perth in 2030. Perth will have 330,000 tonnes of FOGO recovery capacity in 2030. Perth will also have 553,000 tonnes of organics capacity. Under licensing, 190,500 tonnes of this capacity is available to accept FOGO. Combined, Perth has the capacity to treat 520,500 tonnes of FOGO material, leaving a 22,500-tonne capacity need to potentially be treated in adjoining regions.

In Peel 31,000 tonnes of FOGO will be generated in 2030. Peel will have 100,000 tonnes of FOGO recovery capacity in 2030. This means Peel has the capacity to accept up to 69,000 of FOGO from Perth or the South West after receiving material generated within the region.

In the South West, 93,000 tonnes of organic material will be generated in 2030. With 48 per cent of this from MSW, the resulting estimate for FOGO waste generation is 45,000 tonnes. The South West will have 210,000 tonnes of organics recovery facility capacity. Under licensing, 5,000 tonnes of this capacity is available to accept FOGO. This means the South West will have a 40,000 FOGO capacity need to be treated in adjoining regions or that will require new capacity to be developed within the region.

In the Wheatbelt, 18,000 tonnes of organic material will be generated in 2030. With 57 per cent of this from MSW, the resulting estimate for FOGO waste generation is 10,500 tonnes. The Wheatbelt will have 370,000 tonnes of organics recovery facility capacity. Under licensing, 222,000 tonnes of this capacity is available to accept FOGO. This means the Wheatbelt has the capacity to accept up to 211,500 tonnes of FOGO from Perth or the South West after receiving material generated within the region.

Combined, the four regions will produce 629,500 tonnes of FOGO material, with capacity to treat 847,500 tonnes of FOGO material. This indicates a surplus of 218,000 across all adjoining regions in the analysis.

This surplus could alleviate the 100,000-tonne capacity need across Western Australia, which is raised by relatively low quantities of organic material generated in more remote regions like the Kimberley, Pilbara, Gascoyne and Goldfields-Esperance regions. The transport of organics from all sources from these regions to the Wheatbelt, Perth, Peel or South West regions, although technically possible, may not be feasible. Instead, these regions may have an opportunity to establish composting and/or bioenergy facilities close to regional centres or towns to supply energy and treat organics.

This preliminary analysis aims to provide decision-makers with insight into the possible capacity available within adjoining regions. There is a limitation with this approach, however, with updated surveying of facilities required to determine, with confidence, the capacity available as facilities change over time. The spare capacity calculated based on facility licensing is a snapshot from 2020, with the actual capacity for FOGO likely to have reduced as these facilities receive more material over time. The avoidance of C&D waste in 2030 is important for meeting waste strategy avoidance targets for the state; however, there is ample processing capacity available.

The additional resource recovery infrastructure capacity needs and priorities, by region, are outlined in the infrastructure priorities and guidance section. A detailed discussion is provided for each region in the Regional summaries section

CURRENT RECOVERY INFRASTRUCTURE PIPELINE

STATE OVERVIEW

This overview includes a comparison of projected generation and capacities to determine the infrastructure need in 2030. It includes planned and approved facilities, as well as closures between 2020 and 2030.

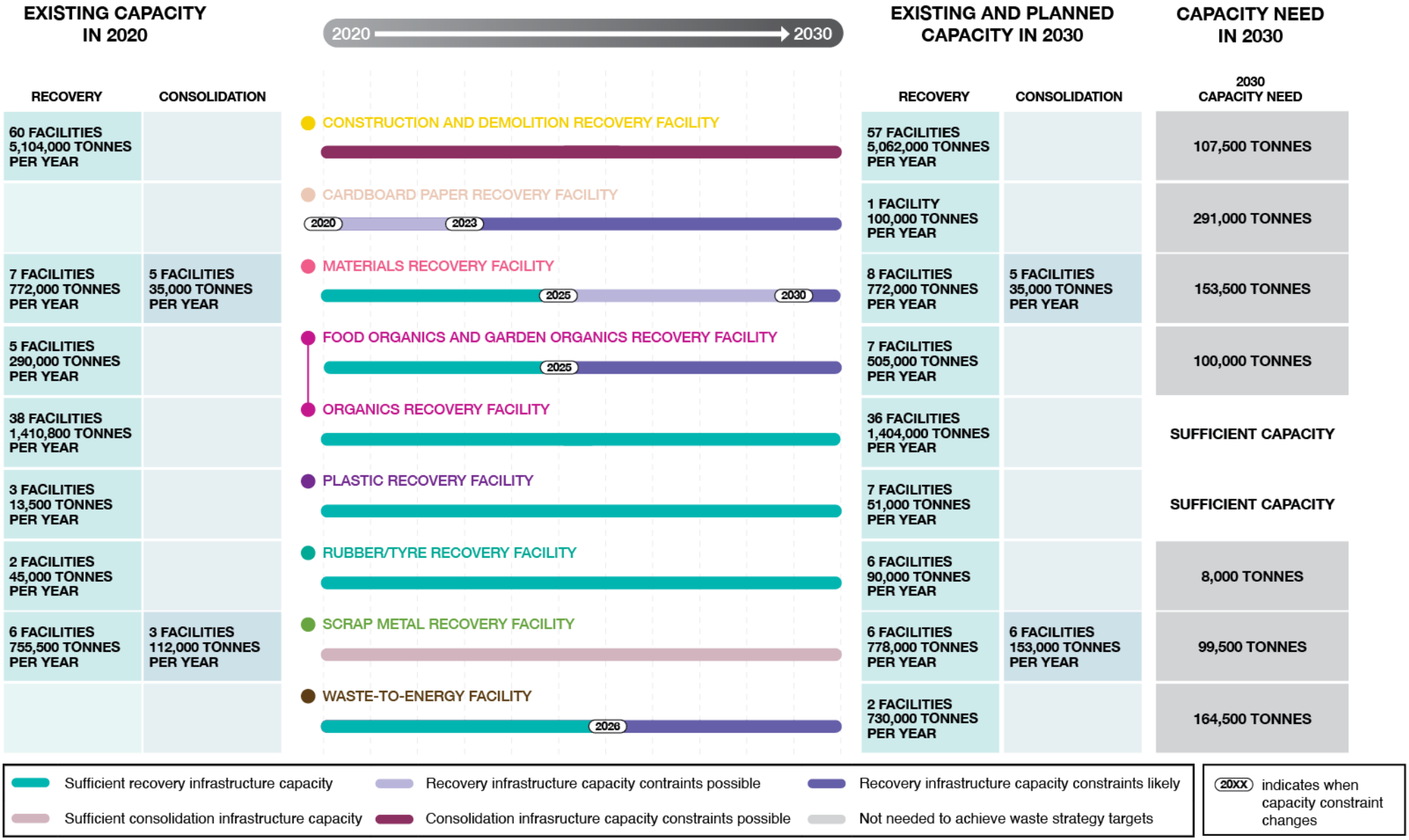


Figure 16 Western Australia infrastructure capacity constraints between 2020 and 2030

Local resource recovery

Western Australia's expansive landscape, where some communities are widely dispersed, increases the significance of localised resource recovery solutions. Treating waste near its point of generation becomes a key consideration for effective and sustainable waste management, in line with Principle 2. While the scope of this plan does consider regional processing options, it does not extend to local (intra-regional) processing and the development of local manufacturing. As an example, development of a manufacturing business that could take shredded plastic to make safety barriers for use in regional roads could prompt local plastic waste sorting and shredding. It is crucial to recognise the importance of fostering local resource recovery solutions. This infrastructure plan, serving as a statewide framework, lays the foundation for guiding regional solutions. As reflected in principle 1, waste as an essential service relies on integrating local solutions where viable.

Local resource recovery strengthens regional communities and economies and contributes to positive environmental outcomes:

- Efficiency: Localised resource recovery reduces transportation distances, lowering associated costs and emissions.
- Tailored solutions: Solutions designed for local needs are more effective in addressing specific waste compositions and management challenges.
- Community engagement: Local resource recovery facilities encourage community involvement and awareness, fostering responsible waste practices.
- Environmental impact: Reducing transport reduces carbon footprint and environmental strain caused by long-distance waste movement.
- Job creation: Local facilities generate employment opportunities, contributing to regional economic development.
- Resilience: Local solutions enhance waste management resilience and self-sufficiency, ensuring continued service availability even in challenging circumstances such as export bans, and reducing reliance on external waste markets.

Landfill facilities

Putrescible landfills are well distributed across urban and regional centres. Inert landfills are concentrated near major C&D generation sources at major urban centres. In areas without inert landfill, inert waste is generally disposed of to putrescible landfill, so increased recovery of inert waste (in particular C&D waste) can both increase recovery rates and extend the lifespan of putrescible landfills. REMS facilities are also distributed across regional areas to service Aboriginal communities.

Landfill capacity lifetime assessment to 2030 and 2050

Landfills will continue to play a role in the provision of waste services in the state. Landfills also provide opportunity for landfill gas capture in which biogas may be used as a renewable energy source.

Using high-level capacity assumptions from the *Western Australia Waste Infrastructure Audit Report* (ASK Waste Management unpublished), a high-level analysis projected remaining landfill capacity by region and the rates of generation for different types of waste disposed of to landfills. The lifetime capacity modelling applies waste generation projection aligned with the waste strategy targets against the remaining capacity of facilities in 2020.

Figure 17 shows the projected year that current landfills will exhaust their capacity. Planning should start before that projected capacity exhaustion, allowing five years for planning for expansion or closure and transporting the material to another existing landfill facility and seven or more years for establishment of a new landfill.

Key assumptions used to establish future landfill capacity use include:

- all facilities will remain in operation and continue to receive waste as identified in the *Western Australia Waste Infrastructure Audit Report* (ASK Waste Management unpublished)
- that waste disposal projections are in accordance with the waste strategy material recovery and avoidance targets
- that waste will be continue to be disposed of in the regions where they originate and/or are modelled to flow
- projecting to 30 years from now, no new processes are introduced to treat material disposed of to landfill other than the two waste-to-energy facilities already planned in Perth.

Figure 17 illustrates that in the short term the Kimberley region will exhaust its current capacity and several other regions need to commence planning to expand capacity or consider alternatives. Further individual site analysis and assessment of remaining landfill capacity is required to provide specific capacity projections for landfills across the state.

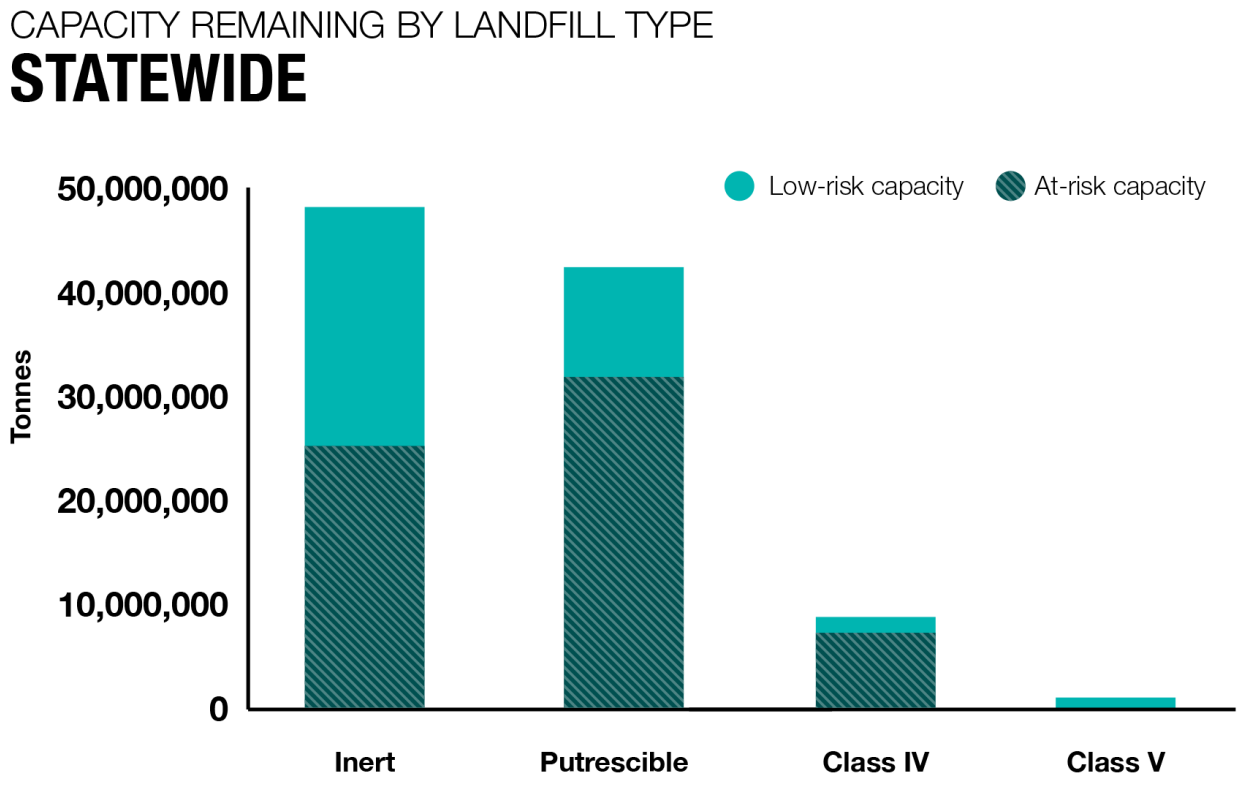
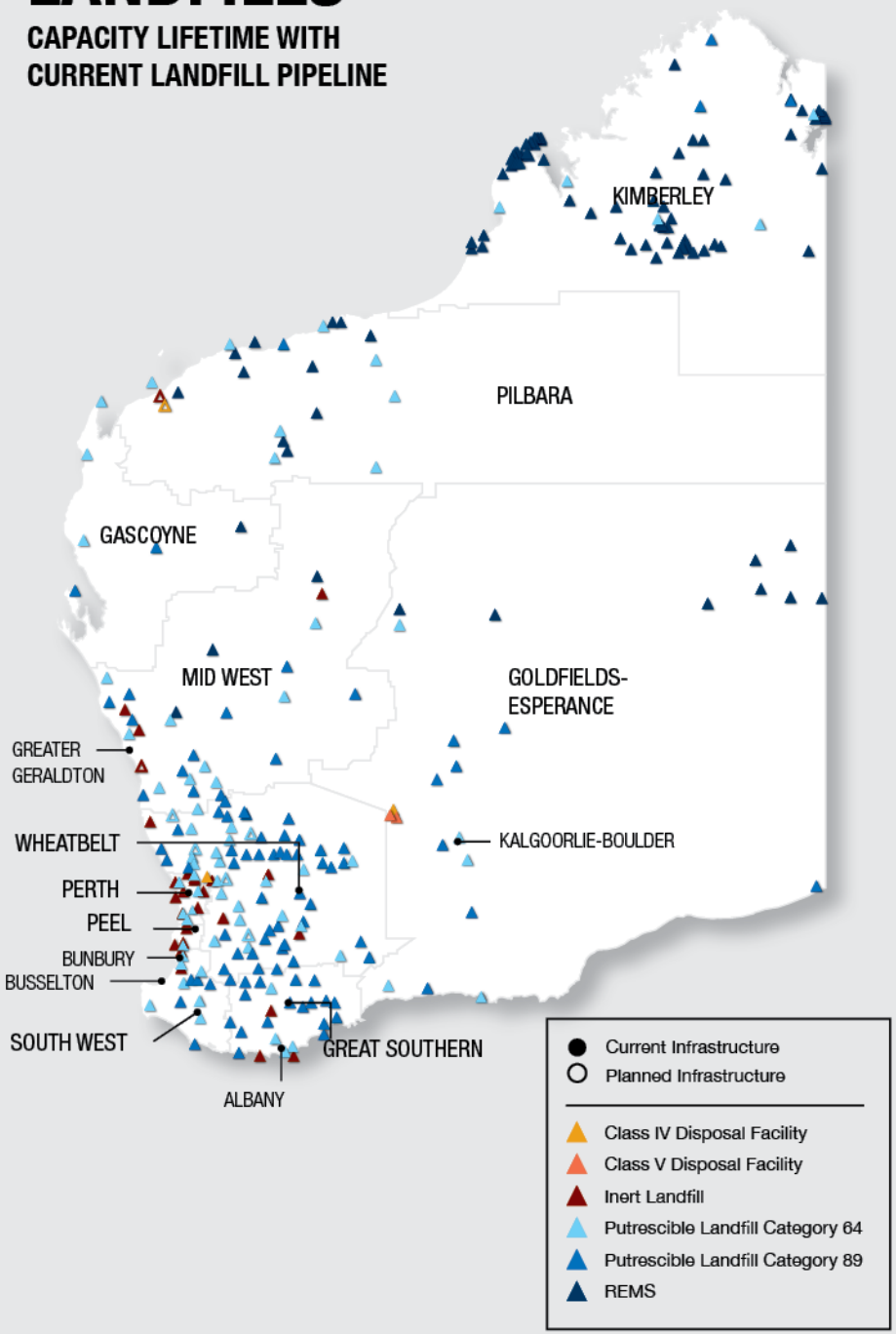


Figure 17 Capacity remaining by landfill type, showing capacity considered low risk and at risk

CURRENT AND PLANNED INFRASTRUCTRE

LANDFILLS

CAPACITY LIFETIME WITH CURRENT LANDFILL PIPELINE



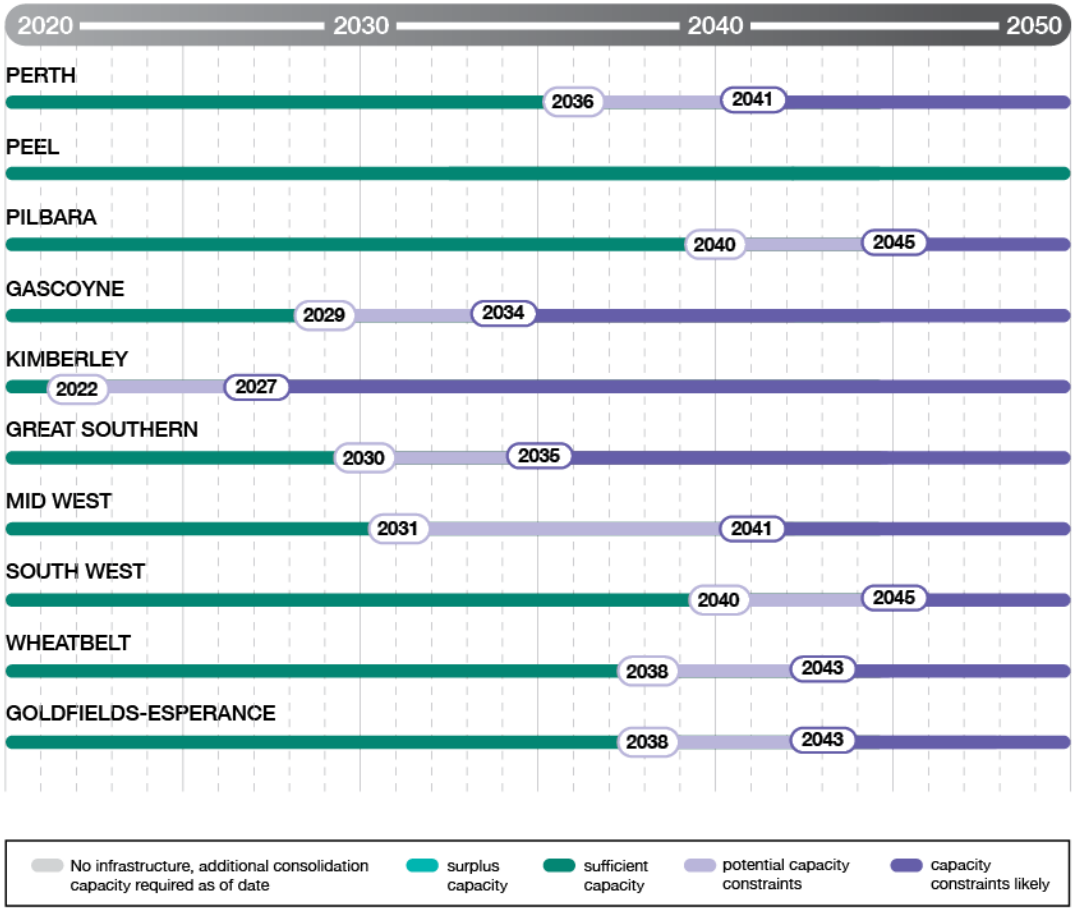


Figure 18 REMS, class IV, class V, putrescible and inert landfill locations and lifetime capacities

The department commissioned ASK Waste Management to conduct a geographic information system (GIS) siting analysis of landfills in Western Australia to provide a high-level indication of the siting of landfills relative to sensitive receptors. The basis for the GIS siting analysis was the list of datasets provided in Appendix 1 of the *Guideline: Environmental siting*.

Several additional datasets were included in the analysis, including local planning zones. The geoprocessing tools in ESRI ArcMap were used to identify where the 1 km buffer around a point locating each landfill identified in the waste infrastructure register intersected with each of the GIS datasets.

Most landfills in Western Australia have few or no identified siting issues based on the scope of this analysis. Of the 326 landfills included in the analysis, 135 had no identified siting issues, and another 82 had only one identified siting issue. However, there are several landfills that are sited close to sensitive areas, either an environment protection area or a residential/urban planning zone.

A key limitation to the landfill lifetime projection is the uncertainty about the ability of existing sites to continue to receive the projected volumes in line with their assumed capacity. By removing landfill facilities and capacity with uncertainty, a low-risk approach to landfill capacity lifetimes can be considered.

Emissions from landfills can pollute land and water (surface and ground water) and contribute to global warming. Factors that increase the risk to the viability and future availability of a landfill site include proximity to groundwater and sensitive land use as well as financial capacity to generate revenue to support the cost associated with landfill better practice design, construction and operations (for example, the State's focus on achieving net zero emissions by 2050 may increase pressure on landfills to operate landfill gas abatement measures and divert organics from landfills). Financial capacity may be particularly restricted for small and unlicensed sites, where gate fees are not applied.

The infrastructure plan considered the size of a landfill as well as previously identified environmental and planning issues as indicators to suggest the potential risk of a landfill site and future availability of its capacity.

Environmental Protection Authority Victoria established a national benchmark with the release of its publication, *Better practice environmental management: Siting, design, operation and rehabilitation of landfills*. In 2017, it released further guidelines for operators on the siting, design, operation, rehabilitation and aftercare of landfills exempt from licensing. This latter guideline addressed the unacceptable environmental and public health risk that unlicensed facilities could present and updated the exemption criteria for municipal landfill facilities occupied by a municipal council and serving less than 500 people. Compliance with higher standard engineering construction requirements and increased operating costs impacted the viability of many regional and rural landfills.

For the infrastructure plan, the following two criteria were used to identify and exclude landfill sites and capacity deemed at risk:

1. The *Western Australia Landfill Siting GIS Analysis* (ASK Waste Management unpublished) report identifies the landfill as being at risk. The potential environmental and social risk as it is situated within 1 km of sensitive land use planning and environmental considerations and/or poses a heightened environmental or public health risk (e.g. limited depth to ground water).
2. The facility was a Category 89 registered landfill or a REMS landfill.

The capacity of facilities that met these two criteria were removed from the assessment for the low-risk approach to landfill capacity. The alternative low-risk or conservative projection of landfill capacity, whereby this uncertainty is taken into consideration, is presented in Figure 19. This is not intended to be a detailed risk assessment of landfills in Western Australia, but an indication of regions where the longevity of landfill capacity may be at higher risk.

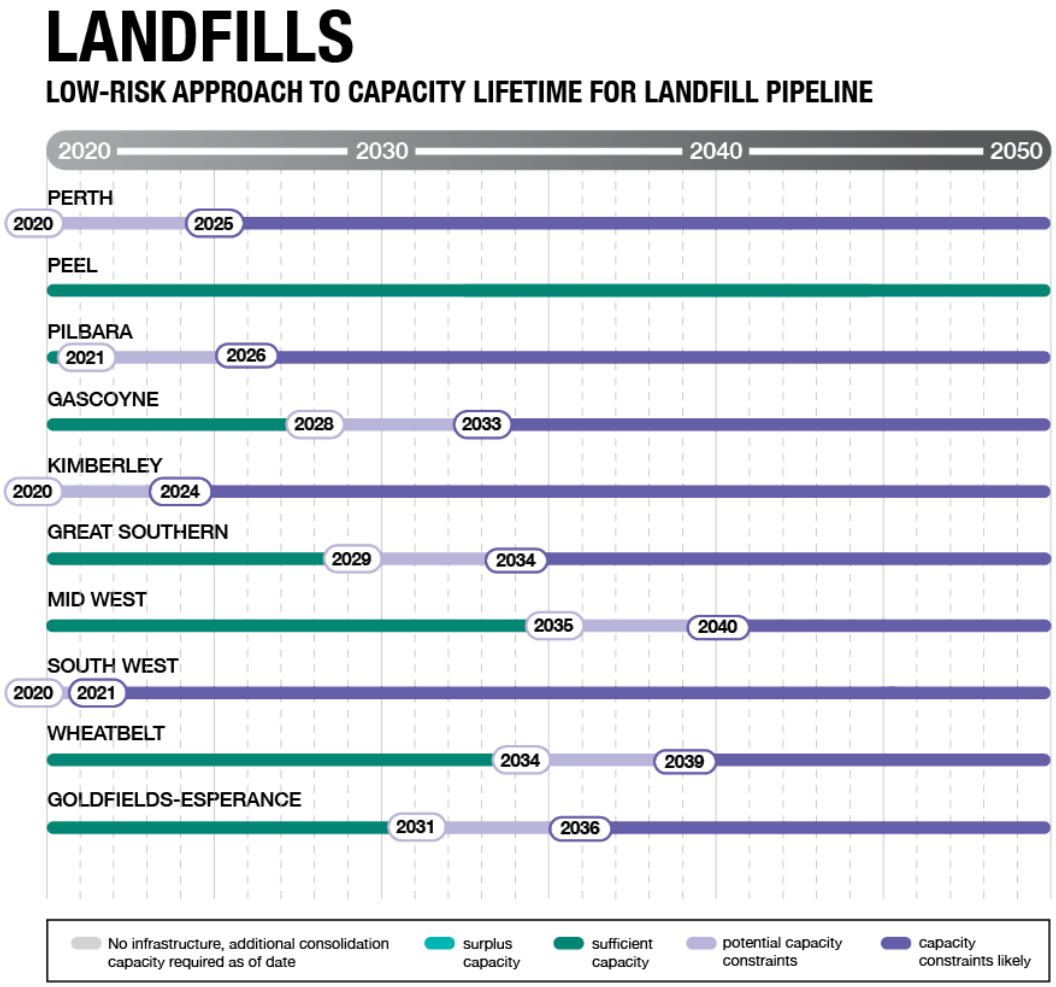


Figure 19 Low-risk approach to capacity lifetime for landfill pipeline in Western Australia

The low-risk approach aims to mitigate the risks of the standard landfill lifetime projection by removing sites identified as likely to be affected by the limitations above. This means more regions are likely to face capacity constraints by 2030, with a total of 37,457,000 tonnes across 144 landfill sites identified as at risk. About 70 per cent (107) of the at-risk sites are putrescible landfill.

In particular, the low-risk approach identifies potential capacity constraints in Perth and the South West. In the short term the surplus capacity forecast for the Peel region may be able to provide contingency capacity for these regions. Similarly, landfill capacity in the Kimberley is identified as being constrained in the short term, and contingency arrangements may be required while planning for additional landfill capacity in the Shire of Broome, near the region's major source of waste generation, and considering local constraints. Further detail is provided in the Regional summaries section.

Projections for 2050

Western Australia is predicted to almost double in population, from 2.7 million in 2020, to 4.2 million in 2050. The rise in population suggests a significant rise in waste generation, even if waste avoidance targets are met. In 2050, it is projected that Western Australia will generate 7.89 million tonnes of waste if the waste strategy targets are achieved in 2030, and these rates of generation and recovery are continued to 2050 (Figure 20 and Figure 21).

As shown in Figure 20, to treat 7.89 million tonnes of waste, infrastructure will be required to landfill just over 1 million tonnes, apply energy recovery to 942,200 tonnes, and recover the remaining 5.918 million tonnes of material.

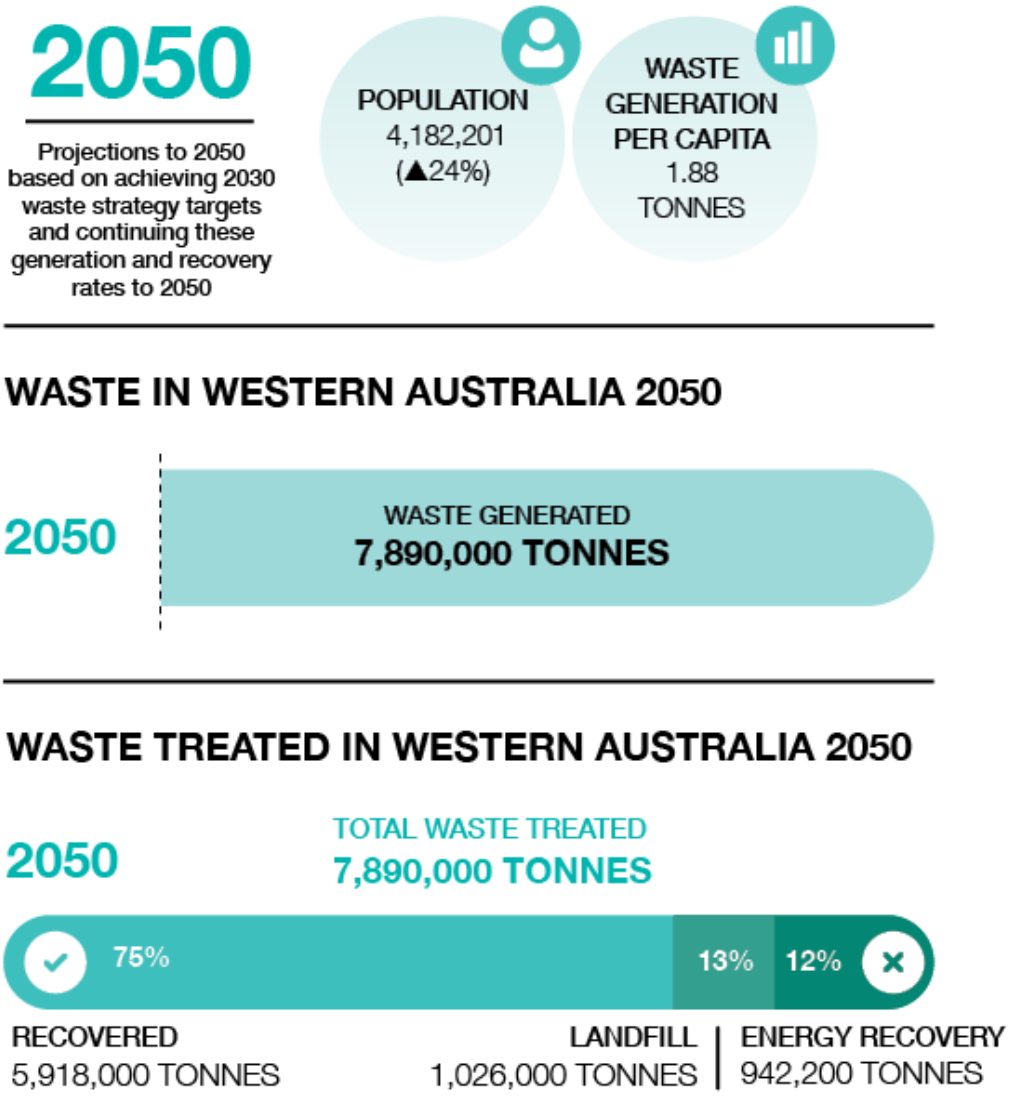


Figure 20 Western Australia project waste generation, recovery and landfill in 2050

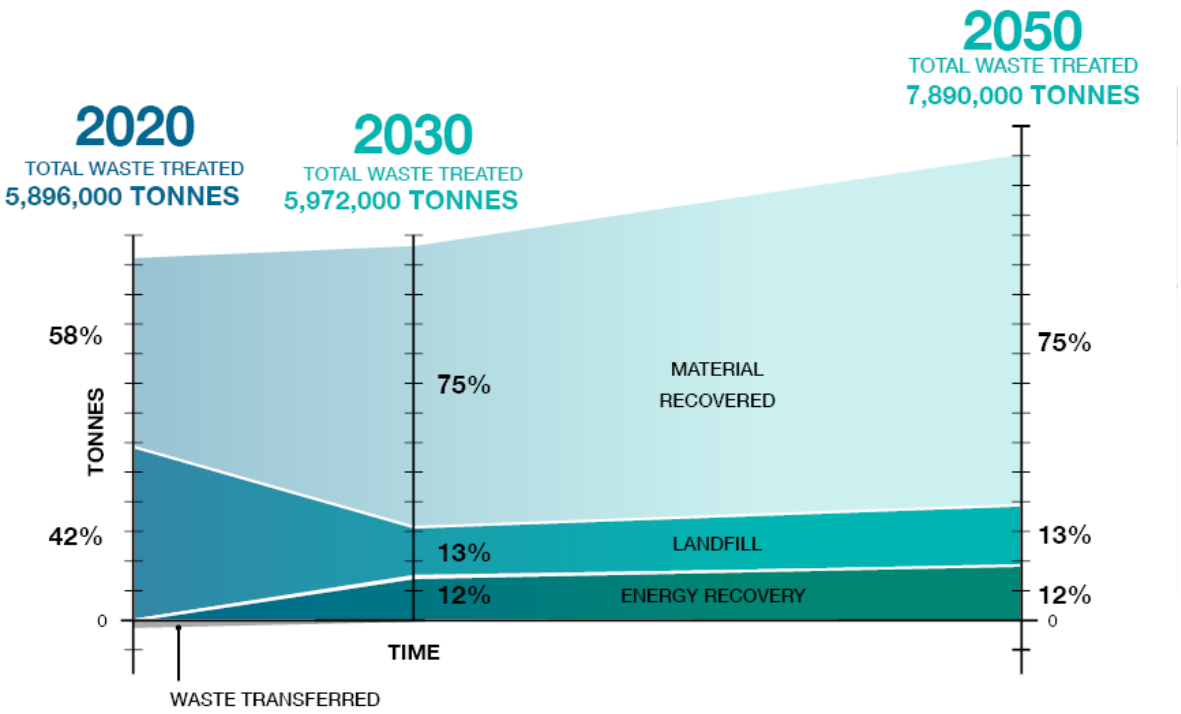


Figure 21 Waste treatment for Western Australia in 2020, 2030 and 2050

Macro trends

Between now and 2050 there may be major shifts affecting waste infrastructure requirements. Anticipated macro trends and how they could affect the economy, society, environmental performance, and the climate in Western Australia with respect to waste management infrastructure, are outlined in Table 13.

Table 13 Macro trends expected to impact waste generation and treatment options in the future

Macro trend	Sub-trend	Effect on waste and resource recovery
Urbanisation	• Significant changes in the way communities live and operate – new major metropolitan centres and urban infill • Shrinking household size	• Increased waste concentration in urban centres • Collection and waste management systems need to be designed for larger urban populations • Need to plan for multi-unit dwelling collection and increased density of generation • Siting of processing facilities need to consider urban needs and constraints • Brown field development and contaminated soils
Changes to energy model	• Electric vehicles • Household and commercial solar and battery storage • Commercial solar and battery storage • Increased generation from renewables • Waste-to-energy • Development of State Bioeconomy Strategy – growth of bioenergy and bio-product industries including biofuels manufactured from waste	• Repurposing of end-of-life electric vehicle batteries e.g. as household battery storage • End-of-life processing of batteries from electrical vehicles, household and commercial installations • End-of-life processing of: – renewable energy infrastructure and equipment; for example, solar panels from household and commercial installations, retired windfarm turbines, etc. – non-renewable energy infrastructure and equipment; for example, demolition of coal fired power stations, decommissioning of oil and gas platforms • Economic incentives to generate power from waste • Increased use of waste as feedstock in energy generation and fuel production • New technologies reducing economies of scale for waste-to-energy and biofuel facilities (e.g. pyrolysis for biofuel production)
Changes in consumer behaviour and social changes	• Increased environmental awareness and consumer pressure to reuse/repurpose • Small businesses growth • Changing material consumption patterns,	• Consumer shift from reliance on convenient and challenging materials (e.g. mixed soft plastics) • Adoption of new stewardship schemes • Increased use of CDS drop-off points • Opportunities for businesses to promote the circular economy

Macro trend	Sub-trend	Effect on waste and resource recovery
	including transitions to new technologies	• High number of smaller businesses spread across the regions may result in dispersion of small generators • Increase in uptake of product stewardship, better product design, etc. by companies that are expected to contribute to the circular economy by reducing waste generation and increasing recycling
Changes in technology	• Robotics/autonomous vehicles • Increase in biopolymers	• High volume of e-waste/batteries and new materials • Biodegradable materials need to be considered for processing • Presence of biopolymers may affect reprocessing
Water	• Scarcity • Recycling	• Water recycling becomes critical • Reduced reliance on fresh water sources and increased need for resource recovery facilities to recycle and reuse their wastewater • Controlled liquid waste and sewage treatment included in further iterations of the infrastructure plan
Western Australia economic activity	• Circular economy • Mining waste • New and different classes of infrastructure • Western Australia growth of primary industries • Growth in healthcare • Investors seeking low-emission projects or requiring strong Environmental Social Governance as part of their decision-making	• Western Australia developing its minerals industry to meet battery materials demand • Increase in primary industry provides more offtake arrangements for compost arising from the treatment of FOGO, which may increase competition for traditional chemical fertilisers • Increase in healthcare activities increases clinical waste volumes in all regions • Mining waste generation increases as new projects are developed requiring management consistent with waste strategy principles
Climate change	• Climate impacts e.g. extreme weather events	• Climate change will increase the frequency of extreme weather events and their severity, resulting in: – an increased amount of waste arising from natural disasters – impacted access to waste infrastructure

Macro trend	Sub-trend	Effect on waste and resource recovery
		– damage to waste infrastructure, resulting in costly repairs and disruption of service • Increased infrastructure development costs, including the cost of building and maintaining waste and resource recovery infrastructure because of increased energy and material needs, more frequent repairs, and increased maintenance requirements • Changing composition of waste and need for separated materials based on the carbon emissions footprint (e.g. organics and textiles), which could require new types of waste and resource recovery infrastructure • Increased need for contingency planning and management of waste generated by events such as floods and fire
Environmental changes	• Positive uptake of the waste strategy by communities, businesses and industries	• Less organic material in landfills reduces the generation of greenhouse gas emissions • Reduced reliance on virgin materials
Regional communities	• Change in communities, • Aggregation of regional townships	• Changes in waste generation patterns • Changes will require consolidation of regional services
Legislative/ regulatory changes	• Foreseeable legislative changes (problematic waste materials) • Product stewardship schemes • Carbon pricing mechanisms • Changing landfill practices • Changes to social licence	• Carbon pricing mechanisms results in businesses and individuals investing in more efficient waste management infrastructure by increasing the cost of carbon-intensive activities; this leads to development of more efficient and sustainable waste management infrastructure • Encouragement of investment in resource recovery technologies, such as composting, anaerobic digestion, and waste-to-energy systems; this could lead to improved resource recovery rates and reduced greenhouse gas emissions • Incentivise reduced waste generation by encouraging businesses and individuals to reduce their carbon footprint

Macro trend	Sub-trend	Effect on waste and resource recovery
		• Increased participation of and regulation on businesses producing waste materials under product stewardship schemes • Development of disassembly industry • Significant reduction of landfill volume may require closure/caretaking/ development of other options
Macroeconomic trends	• Lending abilities • Financial markets	• Risk profile of waste projects may change depending on market conditions requiring the development/implementation of instruments where the market is not responsive

Emergence of new waste streams

As described in the macro trends in the previous section, certain trends will introduce new materials that will require novel treatment processes for which factors – such as the technology used, processing costs, markets for recovered materials, safety and regulatory framework – may be less mature. Emerging waste streams include e-waste, electric vehicles, solar panels and other new technologies.

E-waste is one of the fastest-growing waste streams in Australia. Its growing volume represents huge resource recovery opportunities for Australia.

Western Australia's proposed ban on e-waste disposal to landfill is being delivered by the State Government and seeks to divert materials and unwanted/damaged products away from landfill where they pose a fire risk and loss of resources. The ban is also expected to create local jobs, attract local investment and drive circular economy objectives. Proposed laws see the ban starting on 1 July 2024.

A broad range of items covered under product stewardship schemes or with waste management pathways alternative to landfill are included in the initial bans. Examples are televisions, screens, mobile phones, medical equipment, computers, lighting and lamps. Future phases of the ban are expected to capture small household items and photovoltaic systems.

Business and e-waste service providers will have obligations to manage e-waste responsibly under the proposed laws. The obligations focus on source separation, storage time limits, care with transport and treatment as well as prohibition from sending or leaving e-waste at landfill for disposal. Recordkeeping and reporting provisions are in place and will help to measure and evaluate effectiveness. Infrastructure grants will help industry by offsetting some costs to collect and process e-waste in the state.

Households in the community are not obligated under the ban; however, Western Australians will be encouraged to participate through stakeholder partnerships, communications and community education campaigns.

Western Australian households are rapidly taking up the use of photovoltaic cells and battery systems, with the number of photovoltaic cells in operation increasing by about 17 per cent each year, and the total number of photovoltaic cells having increased more than 12 times

since 2016. Additionally, batteries in operation to support these systems have increased by 92 per cent each year, with more than eight times the number of batteries than in 2016 currently operational (Clean Energy Regulator 2022). Photovoltaic cells and supporting battery systems are an emerging waste trend for Western Australia, with a lifetime of about 10–15 years. As such, the need for capacity for the recovery of this waste stream will increase.

Table 14 provides preliminary estimates of capacity needs in 2030, 2040 and 2050.

The state has developed a battery strategy that considers the recycling of the material (See Future Battery Industry Strategy Western Australia issued by the Department of Jobs, Tourism, Science and Innovation WA).

Table 14 Waste streams and projected volumes

Waste stream	Origin	Assumptions	Projected volume 2030	Projected volume 2040	Projected volume 2050
Batteries	Electric vehicles	Battery lifespan of 10 years, based on projected number of electric vehicles for Western Australia (based on population)	36,000 tonnes	128,000 tonnes	1,314,000 tonnes
Photovoltaic waste	Solar panels	Solar panels lifespan of 15 years, based on projected rooftop solar panels energy production in Western Australia	149,000 tonnes	188,000 tonnes	331,000 tonnes

More than 250 major renewable energy generation projects are expected to be operating in Western Australia by 2050 for a total of renewable energy generation capacity that will exceed 126,000 megawatts (Australian Energy Market Operator 2022).

The construction of these projects and the demolition of retired facilities and technologies such as batteries, wind turbines or solar panels reaching end of life, will generate a range of different waste types that will need to be managed. Further infrastructure and capacity needs analyses would be considered as areas of future investigation.

Pillars supporting the infrastructure plan

Six pillars support the infrastructure plan, enabling and influencing the prioritisation, focus and delivery of initiatives related to this plan. The pillars are interconnected and impact each other.

Strategies, policies and legislation

The State and Australian governments develop strategies, policies and legislation to tackle waste and resource recovery challenges.

Land use planning

Although recognised as an essential service, waste and resource recovery infrastructure requires additional focus and long-term considerations.

Product stewardship

Product stewardship programs are in place for several difficult to manage waste. Currently there are 99 active schemes.

Government procurement

GOVERNMENT OF WESTERN AUSTRALIA

State and local governments are major procurers of services and products. State and local government procurement plays an important role in setting standards, rewarding good operators, driving demand and creating market certainty.

Waste levy and bans

Waste levies send an important signal to the market which drives landfill diversion and creates revenue/funding for future investments and programs. Landfill bans serve to tackle problematic wastes/ materials that may be better managed through other channels.

Climate and carbon

The *Western Australian Climate Policy* sets out the State Government's plan for a climate-resilient community and a prosperous low-carbon future. Reducing waste to landfill and increasing resource recovery supports the objectives of this plan.

Strategies, policies and legislation

The State Government's suite of policy, legislation and guidance drives landfill diversion and resource recovery. These directions support and link to the infrastructure plan which in turn supports the objectives of the waste strategy.

The infrastructure plan also recognises and considers Australian Government policies, legislation and priorities. Table 15 identifies relevant policies and programs at state and national level that link to or support the infrastructure plan.

Table 15 Policy and legislation supporting the infrastructure plan

Waste and environmental policy and legislation	Planning policy and legislation	Infrastructure and legislation	National policy and legislation
Considerations for the infrastructure plan*:*			
Western Australia has a comprehensive suite of policy, legislation and guidance to support landfill diversion and resource recovery.	The relevant agencies' policies and programs promote and acknowledge the opportunities for industry ecology and the factors influencing the establishment of facilities.	*Foundations for a Stronger Tomorrow State Infrastructure Strategy* aligns with the waste strategy, including the acknowledgement of waste infrastructure. Essential infrastructure and major project development is a major producer and consumer of waste and secondary resources (e.g. through the use of recycled products instead of virgin excavated materials).	In recent years, the Australian Government has increased policy, legislation and regulation related to waste. There are now various commitments related to waste, recycling and circular economy.
Key strategy, policy, legislation and guides:			
• *Environmental Protection Act 1987* and Environmental Protection Regulations 1987 • *Waste Avoidance and Resource Recovery Act 2007* and Waste	• *State Planning Strategy 2050* • *Planning and Development Act 2005* • Planning and Development (Local Planning Schemes) Regulations 2015	• *Foundations for a Stronger Tomorrow State Infrastructure Strategy*	• *National Waste Policy* • *National Waste Policy Action Plan* • Recycling Modernisation Fund • National Partnership on

Waste and environmental policy and legislation	Planning policy and legislation	Infrastructure and legislation	National policy and legislation
Avoidance and Resource Recovery Regulations 2008 • *Waste Avoidance and Resource Recovery Levy Act 2007* and Waste Avoidance and Resource Recovery Levy Regulations 2008 • Waste Avoidance and Resource Recovery Regulations (Container Deposit Scheme) 2019 • *Western Australian Climate Policy* • *Waste Avoidance and Resource Recovery Strategy 2030* • *Waste Authority business and action plan 2023-24* • *Better practice FOGO kerbside collection guidelines* • *Guidelines for local government vergeside and drop-off services: Better practice principles* • *Source Separation of*	• *State Planning Policy 4.1 Industrial Interface* • *State Planning Policy 2.5 Rural Planning*		recycling infrastructure • Modern Manufacturing Initiative • Waste Export Bans • Product stewardship • National waste reports • *National Food waste strategy* • Food Waste for Healthy Soils • *Opportunities to increase organic waste recovery* • *Review of Regulations and Standards for Recycled Organics in Australia* • Clean Energy Finance Corporation

Waste and environmental policy and legislation	Planning policy and legislation	Infrastructure and legislation	National policy and legislation
Waste – Position Statement • *Position statement on waste to energy* • *Plan for Plastics – Fast Tracked* • *Better practice FOGO kerbside collection guidelines* • *Guideline: Better practice organics recycling*			

Since 2017, the department has been progressing legislative reform projects to improve waste management in Western Australia, including:

- *Closing the loop: Waste reforms for a circular economy*
- Waste not, want not: Valuing waste as a resource – proposed legislative framework for waste-derived materials
- review of the waste levy
- statutory review of the *Waste Avoidance and Resource Recovery Act 2007*.

These projects have led to the development of a suite of legislative amendments to strengthen the waste legislative framework. The legislative reforms will support the implementation of key targets in the waste strategy and Western Australia's transition towards a sustainable, low-waste circular economy.

In 2022, the department commenced the development of a proposed legislative framework known as the Recovered Materials Framework. The proposed regulatory framework would facilitate the use of materials derived from waste in various applications through the issuing of a recovered materials approval.

Setting standards for recovered materials is expected to provide industry and consumers confidence in the quality and safety of recovered materials. It will also provide assurance and direction for industry to stimulate innovation and research into materials, development of markets, and investment in processing infrastructure.

Work on the legislative framework, standards, system and applications is being progressed, and the project aims to have a Recovered Materials Bill and early-stage guidance for use of the framework by mid-2025. Extensive stakeholder consultation with government, industry and other groups will occur during development to ensure the most practical and effective framework is produced while ensuring the environment is protected.

Land use planning

Headline strategy 6 of the *Waste Authority business and action plan 2023–24* acknowledges the crucial role of land use planning in meeting reuse targets and delivering the infrastructure for a circular economy.

The waste strategy supports meeting better practice standards while exploring options to improve state planning for infrastructure, including the development of planning instruments and guidelines, and investigation of a needs-based approach in consultation with the Department of Planning, Lands and Heritage.

The consultation on the infrastructure plan has shown a desire for better industry assistance in securing approvals for waste-related infrastructure, especially when new technologies are being proposed.

The specific state frameworks and/or plans considered by the infrastructure plan include the:

- *State Planning Strategy 2050* (WAPC 2014)
- *Planning and Development Act 2005* and Planning and Development (Local Planning Schemes) Regulations 2015
- *State Planning Policy 4.1 Industrial Interface*

The *State Planning Strategy 2050* proposes an integrated approach to waste management, favouring the co-location of waste producers and reprocessors, and includes strategic considerations, as listed in Table 16, which have been adopted to inform the land use planning priorities in the infrastructure plan.

Infrastructure Australia is Australia's independent infrastructure adviser. A recent analysis of systemic, sectoral and project risks for infrastructure delivery with detailed consideration of 12 critical risks to upcoming infrastructure projects.

Table 16 Strategic considerations for waste infrastructure planning, State Planning Strategy 2050

Strategic site considerations
Access to feedstock and end markets (including transport linkages roads, rail, airports and ports)
Growth in scale to service a growing population
Accommodation of new processes and changes in technologies
Co-location of complementary waste and reprocessing facilities
Social licence to operate – locations with adequate buffers that can be maintained over time impeding, encroachment by other activities, being residential development or other
Avoiding environmentally and culturally sensitive areas

In the *Infrastructure Market Capacity* report (Infrastructure Australia 2022) risks for all infrastructure projects were analysed. The report included a section focused on waste infrastructure, identifying four main risks:

- inadequate infrastructure development coordination
- community concerns delaying planning approvals
- security and scale of supply for waste-to-energy projects
- low levels of market and regulatory readiness.

The report recognises, as a positive development, that the two largest waste projects (waste-to-energy) in Australia are being developed in Western Australia but also identifies common risks impacting infrastructure project timelines, approvals and community acceptance.

> "Unclear planning and regulations, alongside a lack of community support is creating uncertainty within the waste sector which is driving risks" – Infrastructure Australia

The need for community involvement and cooperation around waste and resource recovery services and infrastructure is still being understood in Australia. Communities in Australia can influence how an industrial sector is regulated, including how planning and other approvals are managed by relevant agencies.

Given the possible community sensitivities posed by the development of some waste infrastructure, developers and operators need to better understand their roles in community engagement, including through the education of the critical role the waste sector plays in communities and in the economy.

Research by CSIRO (McCrea et at. 2016) identifies key drivers that impact (build or erode) public trust and acceptance for waste and resource recovery facilities. Appropriate consideration of the key drivers that impact community acceptance can support proponents of existing or new facilities. Failure to appropriately consider relevant stakeholders will impact project timeframes and, in some cases, project viability.

Most of the state's resource recovery infrastructure is currently concentrated in Perth, as the region is the largest waste generator, and its resource recovery facilities can benefit from economies of scale and support outer lying regions. The infrastructure plan considers that the trend of waste and material consolidation and transport to Perth (or other larger regional centres) will continue, in response to major urban and commercial growth centres, and adopts a concept of critical mass for the viability predicating the establishment of new facilities within a region.

Although consolidation of waste volumes, proximity to developed markets, and synergies with existing waste infrastructure are enablers of infrastructure development, this makes development in regional areas less advantageous and affects waste management costs in smaller communities. Future additional capacity could potentially be managed by a larger number of smaller distributed facilities or by fewer major facilities – both options have pros and cons, and different arrangements will suit different locations. Consideration of these options is provided in more detail in the Regional summaries section.

Small-scale landfills (which fall below the minimum capacity required for licensing) are currently spread across many regions. This can impede implementation of better practice or

improved economic, cultural, environmental and public health outcomes. This is because of the relatively high cost per tonne for management and often a reduced ability to structure gate fees to cover all management costs. The infrastructure plan considers existing site planning constraints, viability and risk associated with smaller landfills. Opportunities to consolidate these landfills to realise more viable regional and cross-regional solutions are discussed further in the Landfill capacity lifetime assessment to 2030 and 2050 section and the Regional summaries section.

Another key consideration, beyond individual facility size and distribution, is the development of waste processing in designated strategic industrial areas. These strategic industrial areas are designed for heavy or strategic industrial activities and include industries which generate significant investment, employment and value for the state. They are found in the Perth, Pilbara, Mid West, South West, Goldfields-Esperance and Great Southern regions. As these areas are selected based on proximity to large resource projects and require infrastructure such as roads or ports, waste management should also be a consideration. As an example, the two waste-to-energy facilities under development in Perth are both in the Kwinana Strategic Industrial Area in southern Perth (there are no strategic industrial areas in northern Perth, which potentially inhibits the development of these kinds of facilities in this area).

Another important planning option to facilitate waste infrastructure development is the creation of waste precincts. These are areas designed for the co-location of waste facilities and offer several economic, social and innovation opportunities (Australian Government 2019). Many existing precincts have emerged organically because of market economics associated with concentration of lower cost industrial land close to waste generators and/or offtake markets. Precincts may also be planned and designed to comprise a concentration of multiple waste and reprocessing activities and could offer significant benefits:

- cross-synergies between processors, where one’s output becomes another’s input, including power generation from waste used in other processes, wastewater recycled for process water, etc.
- optimisation of logistics by consolidating waste materials for collection, transportation and storage
- specialisation of the labour force by developing a skilled workforce in the area
- driving innovation and local partnerships
- bringing together shared values and shared benefits to the local communities that house them
- generation of auxiliary or secondary industries such as mechanical and electrical contractors, transportation, maintenance, etc.
- centralisation of common services such as wastewater treatment and power.

An example of a waste precinct in Western Australia is the Dardanup Waste Precinct, which includes several facilities including liquid waste treatment, composting and landfill. Northern Perth lacks a strategic industrial area, so may benefit from the designation of a waste precinct to support further development of waste infrastructure in this area.

Where a need for additional waste facilities has been identified within the infrastructure plan, planning is needed to ensure availability of suitably zoned land and other supporting infrastructure including power, wastewater and road.

The infrastructure plan considers the availability of appropriate land arising from analysis undertaken in the *State Waste Infrastructure Needs Analysis* (Talis unpublished) and identifies where this challenge needs to be addressed as a priority within each regional assessment.

Product stewardship

Product stewardship, and similar approaches such as extended producer responsibility, aim to manage materials and products at their end-of-life to maximise recovery and minimise impacts from those wastes. These approaches seek to give effect to the principles of shared responsibility and 'polluter pays' by ensuring the responsibility for collection, transportation and management of end-of-life products (post-use) shifts away from communities and governments towards manufacturers, distributors and consumers of products.

Product stewardship acknowledges those involved in designing, manufacturing, selling and consuming products have a responsibility to ensure those products or materials are managed in a way that reduces their environmental and human health impacts, throughout the life cycle (or whole of life) and across the supply chain.

Through a life-cycle approach, product stewardship aims to reduce waste generation through the better design and manufacture of products, including the use of materials that are easier to recover, reuse and recycle, along with – in many cases – the use of targeted systems for the collection of those products. Major product stewardship schemes in Australia include:

- Battery Stewardship Council's **B-Cycle (Battery Stewardship Scheme)**
- Australian Mobile Telecommunications Association's **Mobile Muster**
- Australian Packaging Covenant Organisation's **National Environment Protection Measures**
- Tyre Stewardship Australia's **Tyre Product Stewardship Scheme**

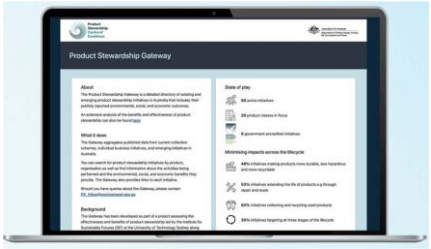
Work is also underway on the development of a national e-stewardship scheme that includes solar panels.

Many product stewardship programs require collection points and a distributed network that maximises collection in a cost-effective way. There are many opportunities for co-location with existing and new infrastructure. Important considerations include ensuring access for remote communities, opportunities for employment and compliance with scheme requirements.

Product Stewardship Centre of Excellence

The Product Stewardship Centre of Excellence

The Product Stewardship Centre of Excellence was established in December 2020 by a consortium of UTS Institute for Sustainable Futures, the Australian Industry Group, and Cox Inall dentsu in partnership with the Australian Government through the Department of Climate Change, Energy, the Environment and Water. It was established with the assistance of a grant through the National Product Stewardship Investment Fund.



Product Stewardship Gateway

The Product Stewardship Gateway is a detailed directory of existing and emerging product stewardship initiatives in Australia that includes their publicly reported environmental, social and economic outcomes.

The Gateway aggregates published data from current collective schemes, individual business initiatives and emerging initiatives in Australia.

The Gateway has been developed as part of a project assessing the effectiveness and benefits of product stewardship.

Approaches in other jurisdictions includes subsidies and cost benefit opportunities for existing facilities that may house drop-off points. Although some schemes will have awareness of product flows through each state, further work may need to be carried out to understand the opportunities for Western Australia. It is likely larger urban and industrial centres would have appropriate volumes for collection/drop-off for some schemes.

These programs are important contributors to the development of a circular economy and must be considered when planning for infrastructure as they can be the most effective driver of waste consolidation and reduction in illegal dumping and landfill disposal of recyclable items.

Government procurement

State and local governments can actively promote a circular economy and related infrastructure development through procurement. The significant expenditure by these levels of government can have a substantial impact on the market when used to achieve specific goals.

This support can take various forms, including spending on products and services that promote a circular economy, making direct investments in resource recovery infrastructure, or offering incentives such as tax credits or subsidies to companies that invest in the desired infrastructure. Such financial support can stimulate the expansion of the circular economy and encourage investment in the essential supporting infrastructure.

The legislative and policy frameworks for these two levels of government are distinct, which means that different approaches may be required to effectively utilise local government and State Government spending to support better infrastructure and circular economy outcomes.

The *Waste Authority Business and Action Plan 2023–24* set outs a range of procurement practices and actions under headline strategy 3: “Implement sustainable government procurement practices that encourage greater use of recycled products and support local market development.”

A priority action of the action plan, and an example of the State Government facilitating the use of recycled C&D products, is the Roads to Reuse program which encourages State Government organisations, local governments, regional councils and the private sector to use recycled C&D products in civil applications, such as road construction.

Waste levy and bans

The *Waste Avoidance and Resource Recovery Levy Act 2007* and the Waste Avoidance and Resource Recovery Levy Regulations 2008 provide for a levy (waste levy) to be paid in respect to waste received at licensed landfills in the metropolitan region and waste collected within the Perth metropolitan region that is received at licensed landfills outside of the metropolitan region.

The waste levy plays a key role in achieving the objectives of the waste strategy by providing a disincentive to dispose of waste to landfill and by generating revenue to fund programs which support the waste strategy.

The waste levy increases the gate fee price of landfill disposal, and thus increases the economic viability of resource recovery facilities. Similarly, increased standards for landfill facilities, such as applying better practice, also increase the costs associated with operating a landfill and supporting the economic viability of resource recovery.

The recent waste levy increases in the state have been found to have a greater impact on the recovery of materials sourced from the C&D sector (DCCEWW 2022) compared with

putrescible waste. This is most likely in part because of the dense nature of the C&D materials, the lower cost to separate and recover, and more readily available markets for major components within the C&D stream. The same effect from the inert waste levy has not yet been observed with putrescible wastes, particularly in those generated by the municipal waste sector. There are significant additional economic hurdles to overcome with respect to the cost of source separated collection, more complex and costly recovery processes to implement and greater barriers with respect to accessing markets for end products.

In other jurisdictions there has been a trend to apply higher levy rates to further incentivise resource recovery, as well as differentiated waste levy rates for metropolitan versus regional waste and disposal facilities.

In addition to economic incentives, additional steps may also be taken by governments to manage risks or issues posed by hazardous, problematic and, in some cases, valuable materials and products. Landfill bans may relate to:

- environmental considerations
- safety or fire risk (including worker safety)
- community concerns
- market regulation.

E-waste is one of the fastest-growing waste streams in Australia. Its growing volume represents huge resource recovery opportunities for Australia and Western Australia's recent consultation on a its proposed ban on e-waste disposal to landfill. This proposed ban seeks to divert materials and unwanted/damaged products away from landfill where they pose a fire risk and loss of resources. This is expected to create local jobs, attract local investment and drive circular economy objectives. On 9 August 2019, at the Council of Australian Governments' meeting, state and territory leaders agreed to establish a timetable to ban the export of waste plastic, paper, glass and tyres, to support increased recycling capacity in Australia and a transition to a national circular economy. The implementation of these bans has created a need for additional infrastructure to process the materials at locations and at a scale where it is economically viable to do so.

On 8 September 2021, the State Government announced that logging in native forests would be banned from January 2024, conserving an estimated 2 million hectares of native forest. The ban's implementation is expected to impact both the volume and composition of feedstock at organics recovery facilities, particularly in the South West and Great Southern regions. Organics recovery facilities may seek alternative sourcing options or re-examine current operations.

Net zero emissions by 2050

The *Western Australian Climate Policy* sets out the State Government's plan for a climate-resilient community and a prosperous low-carbon future. The policy underscores the commitment to adapting to climate change and working with all sectors of the economy to achieve net zero greenhouse gas emissions by 2050. The policy also creates a unique opportunity to develop low-carbon jobs and new industries.

The State Government is developing sectoral emissions reduction strategies which will:

- provide robust and credible emissions reduction pathways for Western Australia with tangible actions for reducing emissions consistent with the State Government's target of net zero emissions by 2050

- recognise the importance of significant action this decade to reduce emissions, transition emissions-intensive industries and protect Western Australia's economy from carbon transition risks.

The structure and content of the sectoral emissions reduction strategies will be informed by modelling and analysis and have regard to opportunities for emissions reduction across WA's economic sectors. These include electricity, industry (including resources and manufacturing), transport, buildings, agriculture, waste, and land use.

In 2020 Western Australia reported direct emissions of 1,927 kilotonnes of carbon dioxide equivalent (CO_2-e) from solid waste management activities, which is equivalent to 2 per cent of the state's total greenhouse gas emissions (DCCEWW 2020). Of this, solid waste disposal to landfill contributes 1,666 kt CO_2-e – or 86 per cent – of waste emissions.

Reform in the waste sector has been underway in Western Australia for more than a decade. These reform measures, alongside the recent programs delivered under the waste strategy, have supported emissions reductions in the waste sector and reduced environmental degradation associated with waste generation and disposal. Most emissions reductions in the waste sector can be achieved through the existing pace and extent of waste reforms, particularly for organic solid waste management. Through achieving the waste strategy material recovery and waste reduction targets, there is likely to be a reduction in emissions of 800 kilotonnes of CO_2-e in 2030 from landfill activity and 500 kilotonnes of CO_2-e in 2050 from landfill activity.

Landfill facilities are the most significant source of greenhouse gas emissions within the waste sector. This is the result of the methane emitted from the landfill before the installation of and/or in the absence of landfill gas capture.

Many large landfills capture methane through landfill gas capture systems to either flare the gas or use generators to produce electricity. Landfill gas capture can be as high as 85 per cent in closed and engineered landfills (bioreactors) or as low as 10 per cent in older, small and poorly managed facilities. The Carbon Credits (Carbon Farming Initiative—Source Separated Organic Waste) Methodology Determination 2016 sets out that an average methane emissions capture rate for a landfill in Western Australia is 30 per cent when undertaking calculations relating to the baseline emissions for landfills.

Opportunities to achieving net zero emissions from the waste sector through directly addressing the impact of landfill emissions include:

- reducing the disposal to landfill of waste materials with degradable organic carbon; for example by separating and diverting organics from landfill to organics recovery facilities (avoiding emissions from avoided landfilling)
- utilising waste-to-energy as the preferred alternative to landfill for the treatment of residual waste
- implementing better practice landfill design to achieve a highly efficient gas capture systems (improving landfill gas flaring and recovery).

Opportunities for consideration across the broader waste and resource recovery infrastructure include:

- the use of energy sources, such as landfill gas, solar, wind and waste-to-energy facilities to reduce the carbon footprint of waste and resource recovery processes
- investment in energy-efficient technologies and equipment to help reduce the amount of energy used in waste and resource recovery processes (DCCEWW 2022).

Infrastructure priorities

The waste and resource recovery infrastructure needs to support the waste strategy targets have been identified for each region in the Regional summaries section. Statewide waste and resource recovery infrastructure capacity needs are drawn from this regional analysis. The prioritised infrastructure capacity needs by region are provided in Table 17 below. The statewide summary is given in the Infrastructure capacity needs in 2030 section.

Table 17 Statewide waste and resource recovery infrastructure capacity needs and priorities

Infrastructure types	Additional capacity need (tonnes)	Recovery facility	Consolidation facility	Change to existing facility	Priority
Perth					
Cardboard and paper	291,000	✓			High
FOGO	254,000	✓		✓	High
Material recovery	33,0000	✓			Low
Waste-to-energy	73,000		✓		Low
Peel					
C&D	51,500	✓			Medium
Pilbara					
C&D	38,000	✓		✓	High
Organics	26,000	✓			High
Material recovery	7,000		✓		Medium
Kimberley					
Organics	13,500			✓	High
Scrap metal	3,000		✓		High
C&D	1,000		✓	✓	Medium
South West					
Material recovery	64,000	✓			High
Scrap metal	72,000	✓			High
Rubber/tyre	8,000	✓	✓		Medium
Waste-to-energy	91,500	✓*	✓		Medium
Great Southern					
C&D	16,500		✓		Medium
Scrap metal	7,000		✓		Medium

Infrastructure types	Additional capacity need (tonnes)	Recovery facility	Consolidation facility	Change to existing facility	Priority
Material recovery	5,000		✓		Medium
Mid West					
Material recovery	13,000	✓	✓		High
Scrap metal	7,000		✓		Medium
Gascoyne					
Organics	6,000		✓		Medium
C&D	500		✓		Low
Material recovery	1,000		✓		Low
Scrap metal	500		✓		Low
Wheatbelt					
Material recovery	17,000		✓		Medium
Scrap metal	5,000		✓		Medium
Goldfields-Esperance					
Material recovery	13,500			✓	High
Organics	4,000		✓		Medium
Scrap metal	5,000		✓		Low

Landfill will continue to play a fundamental role in waste and resource recovery activities in Western Australia, with management of residual, specialised or hazardous waste that remains unrecoverable presenting an ongoing need for landfill. Under a low-risk approach to landfill capacity lifetimes, the additional landfill capacities by region are priorities and guidance on options to address the need is provided in Table 18.

Table 18 The year in which additional landfill capacity is needed under a low-risk approach to landfill capacity lifetime and options to address the capacity need

Region	Year additional landfill capacity needed	Develop capacity within region	Develop contingency with adjoining regions	Provide contingency	Priority
Perth	2025		✓		High
Peel	-			✓	High
Pilbara	2026	✓			High
Kimberley	2024	✓			High
South West	2021	✓	✓		High
Great Southern	2034			✓	Low
Mid West	2040			✓	Low
Gascoyne	2033		✓		Medium
Wheatbelt	2039			✓	Low
Goldfields-Esperance	2036	✓			Low

Additional considerations to improve decision-making and support infrastructure development include:

- monitoring critical programs delivering infrastructure capacity such as the Recycling Modernisation Fund and Food Waste for Healthy Soil programs
- improving the quality and access to data that enables business and investment decisions to be made
- development of guidance:
  - with particular focus on industry practices and waste facility siting, design and operation standards
  - community engagement
  - social licence to operate considerations
- targeted waste reduction and recovery interventions, as industries have specific challenges and opportunities that would benefit from a targeted investigation involving relevant industry sector partners
- improving accuracy of data on waste generation, infrastructure and needs in remote Aboriginal communities

Issues, opportunities and priorities to support infrastructure capacity need

In addition to the infrastructure priorities outlined in Table 17, this section outlines other priority activities or considerations of future work to support the development of infrastructure capacity need identified for 2030. A more detailed discussion of these priorities and the principles applied is provided for each region in the Regional summaries section.

The opportunities with highest identified priorities to support the infrastructure capacity need include to:

- investigate contingency planning arrangements for cardboard and paper in Perth
- investigate waste precinct(s) in northern Perth and/or waste precincts throughout the Perth region to facilitate additional facilities
- investigate and facilitate the upgrade of existing organics 67A licensed facilities to accept FOGO in the Peel, Wheatbelt, South West, and Kimberley regions to alleviate neighbouring regions' FOGO recovery capacity need
- investigate the opportunity for 67A licensed facilities to accept FOGO to alleviate capacity need
- investigate transfer opportunities between Perth and adjoining regions to support capacity needs for FOGO
- facilitate appropriate guidelines and a regulatory framework and specification for the recovery and treatment of bottom ash
- assess the opportunity for treatment of residual waste generated in the South West through a waste-to-energy facility
- investigate alternative landfill facility contingency arrangements between the Perth and Peel regions
- assess waste generation and infrastructure needs in Aboriginal communities to ensure adequate access to services
- investigate a rural landfill risk of unlicensed landfill and REMS landfills.

A summary of these additional opportunities to support the infrastructure capacity need, as identified through the Regional summaries section, are listed below in Table 19.

Table 19 Opportunities to consider and support the infrastructure capacity needs

Area	Opportunities to consider and support infrastructure capacity needs	Priority
All facility types	Develop better practice guidelines for waste facility siting, design and operation standards to provide clear guidance on expectations to industry and other relevant stakeholders.	High
	Update site development and environmental approvals process to include whole-of-life risk assessments, compliance with better practice guidelines, and a needs-based approach to minimise the potential risk of environmental, human health and amenity impacts.	High
	Options for more efficient inter-regional waste transfer infrastructure and systems could create opportunities for an improved consolidation network and inter-regional capacity sharing.	High
	Expand the infrastructure plan to be used as a guiding document from which action plans can be developed, such as region-specific plans.	High
	Investigate future iterations of the infrastructure plan to verify the diversion of material from MRFs and update assumed treatment pathways for more accurate modelling of state waste infrastructure capacity and needs. For example, the CDS' impact on MRFs.	Medium
MRFs	Options for precincts in Perth (33,000 tonnes), Bunbury-Busselton (56,000), Geraldton (13,000 tonnes), and Carnarvon (500 tonnes) could facilitate low-risk development of MRFs.	High
	Investigate lifetime and capacity expansions of existing MRFs in the Kimberley, Great Southern and Goldfields-Esperance regions to decrease the risk, capital costs and timeframes required to meet capacity needs.	High
	Better understand inter-regional needs to support the development of new infrastructure to address capacity need for the Pilbara (7,000 tonnes) and Gascoyne (1,000 tonnes) regions.	Medium

Area	Opportunities to consider and support infrastructure capacity needs	Priority
	Better understand sub-regional gaps for material recovery consolidation near transportation networks to improve infrastructure coverage in the Wheatbelt region.	Medium
Cardboard and paper	Improve contingency planning in Perth (291,000 tonnes) to reduce the risk of capacity needs not being met.	High
FOGO	Implementing the *Guideline: Better practice organics recycling* will improve waste strategy Protect target outcomes.	High
	Options for waste precinct(s), particularly in northern Perth to facilitate low-risk development of organics recovery facilities.	High
	Investigate upgrading existing organics facilities in the Perth, Peel and Wheatbelt regions to accept FOGO to decrease the risk, capital costs and timeframes required to meet capacity needs.	High
	Options for more efficient inter-regional waste transfer infrastructure and contingency arrangements could create opportunities to share capacity or feedstocks between the Perth, Peel and South West regions.	High
Organics	Expand on lifetime and capacity of existing organics recovery facilities in the Kimberley and Goldfields-Esperance regions to decrease the risk, capital costs and timeframes required to meet capacity needs.	High
	Options for a waste precinct in Carnarvon could facilitate low-risk development of co-located consolidation or recovery facilities (including 4,000 tonnes of organics recovery).	Medium
	Leverage the mining rehabilitation markets to create opportunities for recovered organic products offtake in the Pilbara, Kimberley, and Goldfields-Esperance regions.	Low
	Investigate further to confirm actual FOGO processing capacity in regional areas. Comparison of actual capacity versus licensed capacity.	High

Area	Opportunities to consider and support infrastructure capacity needs	Priority
C&D	Expand lifetime and capacity of existing C&D facilities in the Peel, Pilbara and Kimberley regions to decrease the risk, capital costs and timeframes required to meet capacity needs.	High
	Better understand sub-regional gaps for C&D recovery near major regional generators to improve infrastructure outcomes for Albany and Karratha.	Medium
	Options for a waste precinct in Carnarvon could facilitate low-risk development of co-located consolidation or recovery facilities (including 200 tonnes of C&D recovery).	Medium
Scrap metal	Options for waste precinct(s) in Bunbury-Busselton (66,000 tonnes), Geraldton (7,000 tonnes), Esperance (6,000 tonnes) and Carnarvon (400 tonnes) to facilitate low-risk development of scrap metal consolidation facilities.	High
	Better understand sub-regional gaps for scrap metal consolidation near transportation networks required to improve infrastructure coverage in the Kimberley, Great Southern and Wheatbelt regions.	Medium
Rubber/ tyre	Better understand inter-regional opportunities to support the development of new infrastructure to address capacity need for rubber/tyre recovery in the South West (8,000 tonnes). Options include a waste precinct in the Bunbury-Busselton area that could facilitate low-risk development of additional consolidation or recovery infrastructure.	Medium
Waste-to-energy	Investigate increasing waste-to-energy capacity in the South West region through the development of additional infrastructure, to improve the region's progress towards waste strategy Recover and Protect targets, while providing additional contingency to facilities in Perth.	High
	Investigate consolidation infrastructure in northern Perth and Bunbury to facilitate efficient transfers to waste-to-energy infrastructure in southern Perth to decrease reliance on local landfill capacity.	High
Bottom ash	Develop capacity for Peel to supply contingency waste-to-energy bottom ash recovery or disposal to improve outcomes for waste strategy Recover and Protect targets.	High

Area	Opportunities to consider and support infrastructure capacity needs	Priority
	Facilitate appropriate guidelines and regulatory framework and specification for the recovery and treatment of bottom ash. This is a high priority as waste-to-energy facilities are expected to be operation in 2025, necessitating fast-tracked development of bottom ash recovery framework and guidelines.	High
Landfill	Options for more efficient inter-regional waste transfer infrastructure and contingency arrangement could alleviate short-term capacity constraints between the Perth/Peel regions, Kimberley/Pilbara regions and South West/Great Southern/Wheatbelt regions.	High
	Update rural landfill risk assessment methodology of unlicensed landfill and REMS landfills can be used to effectively assess the potential risk of environmental, human health and amenity impacts.	High
	Conduct a more robust landfill risk assessment, particularly for Category 64 and REMs landfills, where accurate capacity and lifetime remaining is a risk of the current *State Waste Infrastructure Needs Analysis* modelling.	High
	Investigate potential synergies between the waste generation and infrastructure needs of mining operations and nearby MSW, C&I and C&D waste generators, to potentially decrease the scope of infrastructure planning and facilitate complementary activities that support local communities.	Medium
	Evaluate waste generation and infrastructure needs in remote Aboriginal communities to improve access to adequate services in remote areas.	High
	Develop better practice guidelines for landfill types, including consultation with stakeholders to carefully understand the implications of better practice guidelines on the lifetime capacity of landfills across Western Australia.	High
Emerging waste	Investigate emerging or unexpected waste material flows to provide a more robust understanding of infrastructure capacity needs scenarios in future iterations of the infrastructure plan. Areas such as batteries from e-vehicles, e-waste and disaster waste will need more research and study. Special focus on remote locations and waste management options in those areas may be a consideration.	Low

Area	Opportunities to consider and support infrastructure capacity needs	Priority
CDS	Incorporate into future reviews of the infrastructure plan the impact and infrastructure of the CDS.	Medium
Waste collection	Develop a detailed assessment on waste collection systems, the role of different stakeholders, and the delivery of waste management services in regional areas to understand the volumes that feed waste infrastructure.	Medium
Planning and financing of infrastructure	Consider instruments that can be used to level the playing field between more developed, larger markets, compared to regional smaller markets, and a more detailed identification of the gaps.	High
Consolidation facilities	Investigate regional consolidation facilities and all other types of transfer stations, bulking facilities and community recycling centres/container deposit return locations. This infrastructure plan focuses on 'final destination' infrastructure for the waste collected through consolidation facilities; therefore, this network of facilities has been excluded from modelling as it would require separate analysis. Their role, requirements, and development and implementation of better practices can be considered for future work.	Low
Controlled waste and clinical waste	Investigate generation, expected trends and available infrastructure to form future scope of the infrastructure plan.	High
Regional collection and disposal	Investigate opportunities for collaboration, partnership or sharing of transport or infrastructure resources with the mining industry.	Medium
	Investigate infrastructure needs in larger regional centres outside the major regional centres as defined by the waste strategy (e.g. Karratha, Broome).	Low

Risk considerations

There are several risks relating to infrastructure capacity which may prevent Western Australia from meeting the waste strategy targets. They will require ongoing monitoring and management over the life of the infrastructure plan. These risks include but are not limited to:

- not achieving waste avoidance targets
- loss of infrastructure capacity from the system (closure of facilities)
- failure to develop and operate planned infrastructure
- market failures
- regulatory reform at national or jurisdictional levels
- management of specialised or problematic waste streams
- inadequate contingency planning
- market demand for recycled materials is insufficient to generate adequate returns on investment for projects.

These risks are explored below. Further investigation of their potential impact, and mitigation strategies, will be considered in future reviews of the infrastructure plan.

Not achieving waste avoidance targets

In this plan infrastructure need has been analysed assuming that the 2030 waste strategy Avoid targets are met. It is acknowledged, however, that there is a risk that interventions will not achieve the waste strategy targets, resulting in waste generation rates exceeding 1.88 tonnes per capita in 2030. Direct interventions to achieve the waste strategy Avoid targets are outside the scope of the infrastructure plan.

Failure to achieve the waste strategy avoidance target, and continuation of waste generation at the 2020 rate of 2.2 tonnes per capita, would result in 7,465,000 tonnes of waste generated in Western Australia in 2030, compared with 5,972,000 tonnes if 2030 targets are met. This additional 1,493,000 tonnes of waste would increase the state's waste infrastructure capacity needs. Failure to achieve the target may vary across waste streams, so projecting which streams will fail to achieve the target would result in multiple scenarios, depending on assumptions.

If the state's waste generation rate is higher than the projected target, it would have a significant impact on the types and capacities of infrastructure needed. This is especially critical for MSW infrastructure capacity which already faces capacity constraints in certain regions.

The waste strategy targets require the C&D sector (the largest waste generation source) to achieve the largest gross tonne waste reduction by 2030. The projected C&D treatment capacity is about 2 per cent less than the projected capacity need. It is important to monitor whether the waste strategy targets will be met for the C&D sector to confirm the state's infrastructure needs.

The infrastructure plan also acknowledges the risk in consumers' resistance to embracing behaviour change, especially regarding the reduction of reliance on convenient yet environmentally damaging packaging. Meeting waste strategy targets and the required capacities outlined in the infrastructure plan necessitates a substantial reduction in the consumption of such materials. A failure to do so poses a significant risk, potentially

overwhelming waste management infrastructure with excess non-recyclable or difficult-to-recycle materials. The success of these waste reduction initiatives hinges on persuading consumers to adopt more sustainable habits, reducing waste at the source, and aligning with broader waste management goals. Resistance to such behavioural shifts could hinder progress and strain waste systems.

Future iterations of the infrastructure plan will be required to review tracking towards waste avoidance targets and update capacity needs if targets are not met.

Loss of expected infrastructure capacity from the system

There is a risk that current infrastructure will close prior to their expected end-of-life because of:

- decreasing feedstocks, or an inability to access feedstocks, impacting operational viability
- planned closures occurring earlier than initially reported
- failure to launch expected capacity (such as that anticipated through programs like the Food Waste for Healthy Soils and the Recycling Modernisation Fund)
- closures of facilities because of community opposition or environmental impacts
- application of better practice which may result in additional operating costs and the need for re-training and/or attracting skilled personnel, with certain facilities potentially unable to implement these or electing to cease operations.

Table 20 summarises the facilities currently scheduled for closure, which have the highest risk of impacting the ability to achieve all waste strategy targets.

Table 20 Identified risk of facilities with planned closure dates

Region	Facilities closing between 2020 and 2030	Capacity at risk
Perth	2 C&D facilities	100,000
	1 FOGO facility	110,000
South West	1 organics facility	20,000
Kimberley	1 C&D facility	6,000
	2 organics facilities	6,800

Priority planning has identified the need to review options to extend the lifetime of the existing C&D facility and organics facilities in the Kimberley region. Additional mechanisms should be investigated to support existing infrastructure and facilitate improvements to better practice standards.

A low-risk approach to landfill capacity lifetimes assumes some capacity will be at risk the under implementation of better practice guidelines for the siting and operation of landfills. Landfill capacity at risk is discussed in the Landfill capacity lifetime assessment to 2030 and 2050 section.

Failure to develop and operate planned infrastructure

Planned facilities are at risk of not being developed within the expected scope (timeframe and capacity) or not overcoming barriers that may prevent their development. Achieving waste strategy targets relies on the capacity provided by future planned infrastructure summarised in Table 21. This includes anticipated facilities funded through the Food Waste for Healthy Soils and Recycling Modernisation Fund programs.

Table 21 Summary of infrastructure in current planning and approval phase

Infrastructure type	Anticipated/ planned	Approved
Organics	7	0
C&D material recover	6	0
FOGO	8	2
Scrap metal recovery	1	1
Cardboard and paper recovery	1	0
Tyre/rubber recovery	1	1
Plastics recovery facility	0	0
Waste-to-energy facility	2	2
Bottom ash recovery facility	2	0

Successful operation of new recovery infrastructure, its viability and its implementation of better practice will also require viable market conditions, a sustainable market outputs, and access to technology and a skilled workforce. These factors are more critical in remote areas.

Certain projects may need long-term contracts to ensure financial viability, and this may be a significant risk.

Market failures

Secondary resources operate in a commodity market and are susceptible to pricing sensitivities. Contractual obligations should consider pricing sensitives, ensuring risks are appropriately managed by the relevant parties. Recent examples of market failures, illustrated through impacts of China National Sword and challenges to MRF operators, have impacted local government contracts and recyclables. This impact could extend into other waste services.

An important consideration is contamination of certain waste streams and its impact on yield of recovered materials, financial viability, technological challenges, and the way contamination levels may affect process and business viability because of removal costs, price decreases of recovered materials and operational costs.

Contingency planning may also be a consideration, and this is explored in more detail below.

Regulatory reform at national or jurisdictional levels

Environmental and market regulation may impact material pathways and treatment options for materials. Regulatory changes may impact economies of scale, facility types, pricing and transport routes. Examples of regulatory changes include landfill bans, additional licensing requirements or requirements on storage and handling, and regulatory restrictions on the end use of materials.

In relation to Principle 5: Waste facilities strive for better practice, instilling better practice policies in waste infrastructure can present challenges. One potential challenge being the financial investment required to implement new technologies, processes or infrastructure to meet higher standards. Transitioning to better practice may lead to disruptions in operations or require adjustments in workforce skills, potentially affecting efficiency in the short term.

Stricter policies could also introduce compliance challenges, requiring facilities to navigate complex regulatory landscapes. Moreover, resistance to change from stakeholders, including employees or management, could hinder the successful adoption of these practices. Funding or resource limitation can exacerbate this and may require additional governmental support to meet better practice standards.

New regulations may also increase volumes of waste or create new waste streams which will need to be considered in future revisions of the plan. Landfill bans of certain materials may change waste composition and volumes, whilst changes to other materials such as requirements for compostable materials in certain areas may increase or shift volumes. An example would be a ban on e-waste disposal to landfills which may divert materials into the hazardous waste streams, requiring facilities handling hazardous waste to accommodate and manage much larger quantities of such materials.

Social and economic factors affecting recycling and waste diversion

Consumer and business behaviours will affect the volume, quality and destination of waste and recyclables. Behavioural change will be a key element in addressing certain areas such as food waste avoidance, unnecessary consumption of single-use items and littering.

Specialised or problematic waste streams

Controlled waste and clinical waste are excluded from this infrastructure plan. These streams will pose challenges including:

- gathering data and information specific to these waste types and treatment pathways
- the geographical dispersion of generators
- ensuring application of better practice to mitigate risk of contamination or incidents
- the scale required to develop adequate infrastructure that deploys best available technologies may be challenged by low volumes of material, such as in the recycling of solvents or processing of materials with mercury.

Suitable data on controlled waste and clinical waste was not available to explore them in detail in this infrastructure plan, so further investigation into these waste streams could form part of future work in this area.

Contingency planning

The process of planning, approving, developing and operating waste infrastructure needs to consider contingency planning. Examples include disaster waste, climatic events, short-term population changes, facility shutdowns, government stimulus programs and the introduction of the CDS in October 2020.

Example contingency and mitigation measures are explored in Table 22.

Table 22 Example contingency and mitigation measures

Contingency	Possible mitigation measures to be considered during planning and design
Facility disruption because of extreme weather, incidents, market failure, legal action, industrial action or equipment/process failures	Consider alternative facilities that provide a similar service. Consider redundancies in equipment. Consider extreme weather events during planning and engineering.
Additional waste arising from extreme events including from natural disasters or accidents. Note that future pandemics may have significant impacts on waste and should be included in emergency waste management planning.	Landfills typically provide ample capacity that can be used but may not be suitable for all waste streams. Inert landfills can play a fundamental role in managing short-term increases in waste arising from extreme events (excluding hazardous waste this would need to be treated in specialised facilities). Consider storage capacities to allow gradual uptake, for planning and design. Consider temporary expansion of storage areas at existing facilities. Consider source separation of waste during the clean-up phase following a disaster, to facilitate resource recovery.
New waste streams	Consider events such as biosecurity outbreaks and the types of waste infrastructure and contingency plans needed to manage waste streams derived from such events.

Maintaining priority of the waste hierarchy

Waste-to-energy and bioenergy technologies offer valuable alternatives to landfill disposal, helping divert waste from landfills and promoting a circular economy, provided that waste management adheres to the waste hierarchy by prioritising reduction, reuse and recycling before energy recovery. A continued focus on the waste hierarchy, and the use of energy recovery for the management of only genuinely residual waste, will be needed to balance emerging market dynamics with circular economy objectives.

Monitoring and evaluation of the infrastructure plan

Process for monitoring, evaluating and reporting

The department will coordinate and monitor the state's progress towards developing the infrastructure needed to meet all waste strategy targets. A monitoring and evaluation plan will need to be developed to track the progress of development of waste infrastructure to support the objectives of the waste strategy.

Proposed indicators for tracking the progress of the development of waste infrastructure towards the objectives of the waste strategy, the related infrastructure plan objectives and principles include:

- improvement in the capacity need of priority infrastructure types in each region
- funds invested (and/or jobs created) by governments and industry in new or upgraded infrastructure
- improvement in the overall material recovery rate (tonnes material recovered over total waste generation) for all wastes in alignment with the waste strategy targets
- improvement in environmental, public health and/or amenity performance of waste management and resource recovery facilities, in alignment with better practice guidance and standards
- consideration of the infrastructure plan within government departments and agencies, including the development and implementation of their own specific waste and resource recovery plans where relevant.