SOUTH AUSTRALIA'S WASTE AND RESOURCE RECOVERY INFRASTRUCTURE PLAN

Companion Report: Modelling Assumptions

Government of South Australia
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Contents

1. Assumptions for Waste Flow Projection Modelling

South Australia's Waste and Resource Recovery Infrastructure Plan Companion Report: Modelling Assumptions (Companion Report) provides an overview of key data and assumptions underpinning the model and shows the output tables.

1.1 Baseline waste volumes estimates

Waste volumes for the baseline period (2015-16) were estimated based on the best available data.

The baseline resource recovery waste volumes (including breakdown by metro/regional, source sector, and materials) were sourced from *South Australia's Recycling Activity Survey 2015-16*. Hazardous waste volumes were based on a study undertaken by the Australian Government (Australian Government Department of the Environment, 2015). This information was then broken down by the South Australian Government Regions on a population basis using population data (Australian Bureau of Statistics, 2016). Adjustments to Commercial and Industrial (C&I) waste volumes were made for select regions where it was known that volumes of particular materials were generated in the region (e.g. fly ash from mid-north, timber from the South East, foundry sands from Yorke and Mid North, organics from Murray Mallee and Barossa, Light and Lower North, etc.).

The baseline landfill waste volumes were sourced from a combination of:

- The 2015-16 South Australian recycling activity data for totals by metro/regional and source sector (Green Industries SA, 2017)
- The 2007 South Australian landfill audit estimating material composition of C&I, Construction and Demolition (C&D) landfill streams (Zero Waste SA, 2008)
- Councils' kerbside audit data for materials composition of Municipal Solid Waste (MSW) landfill stream (various audits, unpublished), with information then broken down into the South Australian Government Regions on a population basis using population data (Australian Bureau of Statistics, 2016)

1.2 Waste generation projection

Waste volumes were projected for future periods using demographic and economic data.

Volumes of MSW and medical waste were projected using the most recent data on South Australian population projections (medium series) from the South Australian Department of Planning, Transport and Infrastructure (South Australian Department of Planning, Transport and Infrastructure, 2016) using the more conservative estimates for waste generation (adopting over the 10-year period projections from 2016 to 2026). See **Table 1** for growth rates. Material compositions of future MSW stream are based on baseline compositions.

Table 1 **Annual growth rates for waste generation adopted for MSW**

Geographical region	Annual growth rate for MSW
Eastern Adelaide	0.92%
Northern Adelaide	0.99%
Southern Adelaide	0.69%
Western Adelaide	1.02%
Adelaide Hills	1.03%
Barossa, Light and Lower North	1.69%
Fleurieu Kangaroo Island	1.68%
Eyre Western	0.28%
Far North	0.36%
Limestone Coast	0.16%
Murray Mallee	0.21%
Yorke Mid North	0.33%

Volumes of C&I and C&D waste were projected using Gross State Product growth forecasts published in the 2016-17 Mid-Year Budget Review Paper (Government of South Australia, 2016). See **Table 2** for growth rates.

Table 2 **Annual growth rates for waste generation adopted for C&I and C&D waste**

Source sector	Annual growth rate
C&I	2.25%
C&D	2.25%

Volumes of hazardous waste were adopted from previous projections provided in a study for the Australian Government (Australian Government Department of the Environment, 2015).

Material compositions of MSW, C&I and C&D streams were based on baseline compositions with an adjustment made for periods 2018 onwards because the planned closure of the Port Augusta Power Station will remove volumes of fly ash.

Future volumes of waste sent for resource recovery as opposed to landfill for MSW, C&I and C&D streams were estimated based on different resource recovery scenarios (see Section 1.3).

Future recovery of e-waste volumes was based on targets set under the Australian National Television and Computer Recycling (Australian Government Department of the Environment, 2015), and estimates of photovoltaic panel waste (International Renewable Energy Agency, 2016).

1.3 Landfill diversion scenarios

The landfill diversion rates in **Table 3** were adopted for the Business-as-Usual (BAU), Moderate Additional Diversion and High Additional Diversion scenarios.

The BAU is modelled to provide a baseline for economic and infrastructure needs to be compared against the 10 year Moderate Additional Diversion Scenario and the 30 year High Additional Diversion scenario. The BAU considers the current diversion as at 2015-16 continuing for the 10 and 30 year time periods, with the additional tonnes due to population and economic growth assumptions.

Table 3 **Diversion rates for landfill diversion scenario adopted in the Waste Flow Projection Modelling**

MSW diversion rate	SA	metro	regional
Business-as-usual (baseline)	54%	58%	39%
Moderate additional	70%	70%	70%
High additional	98%	100%	90%
C&I diversion rate	**SA**	**metro**	**regional**
Business-as-usual (baseline)	86%	82%	93%
Moderate additional	89%	85%	94%
High additional	98%	100%	95%
C&D diversion rate	**SA**	**metro**	**regional**
Business-as-usual (baseline)	88%	89%	65%
Moderate additional	94%	95%	70%
High additional	99.7%	100%	95%

2. Assumptions for Infrastructure Needs Assessment

This Companion Report provides an overview of key data and assumptions underpinning the assessment of infrastructure needs. It should be noted that the infrastructure assessment was limited to certain infrastructure types as nominated in the main report. It does not include estimates of investment needs for a range of potential infrastructure, including replacement of existing infrastructure assets, litter bins and additional specific needs to service remote South Australian communities.

2.1 Application of technology/infrastructure to manage additional waste volumes

Outputs from the Waste Flow Projection Model were used to estimate additional volumes of waste that would need to be managed by new/upgraded infrastructure under each diversion scenario for the 10 and 30 year timeframes.

The following sections describe the set of assumptions used to allocate additional waste volumes to types of infrastructure, so that an assessment could be made regarding infrastructure needs. Where known, excess capacity in existing infrastructure was taken into account. Data on existing capacities was sourced from a previous review of South Australia's waste and resource recovery infrastructure (Zero Waste SA, 2014) and other industry intelligence. Only the net volume of additional waste (taking into account this excess capacity) was applied to estimate infrastructure needs.

2.1.1 Business-as-Usual, 10 year

The following assumptions were made to estimate the volume of additional waste going to each infrastructure type under the Business-as-Usual 10-year timespan.

Metropolitan – MSW

The following has been assumed:

- 70% of additional waste volumes to kerbside source-separation system infrastructure (balance is hard-waste, dropped off by residents or collected by street sweeper)
- 80% of additional waste generated to collection vehicle infrastructure (the rest dropped off by residents)
- Nominal allowance of 5,000 tonnes to vacuum system infrastructure
- 80% of additional waste generated to transfer station infrastructure
- 80% of additional waste generated to transfer vehicle infrastructure
- 100% of additional recovered dry recyclable volumes (cardboard/paper, plastics, glass and metals) to Material Recovery Facility (MRF) infrastructure
- 50% of the additional recovered container deposit legislation (CDL) volumes to a CDL facility
- 100% of the additional materials recovered to product stewardship scheme drop-off facilities
- 10% of additional recovered organics to anaerobic digestion infrastructure (then to composting infrastructure for secondary processing)
- 60% of additional recovered organics to open windrow composting infrastructure, with balance (40%) to covered tunnel composting infrastructure
- 75% of additional recovered dry recyclables to be processed in SA (balance exported interstate or overseas) and to reprocessing infrastructure (medium tech)

Regional – MSW

Assumptions are the same as for metropolitan MSW with the following differences:

- No allowance for waste to vacuum system
- 80% of additional waste volumes to kerbside source-separation system infrastructure (balance is hard-waste, dropped off by residents or collected by street sweeper)
- 90% of additional waste generated to collection vehicle infrastructure (the remainder is dropped off by residents)
- None of the additional recovered organics would go to anaerobic digestion infrastructure
- 100% of recovered organics to open windrow composting infrastructure

Metropolitan – C&I

The following has been assumed:

- 100% of additional waste volumes to skip bin infrastructure
- 100% of additional waste generated to collection vehicle infrastructure
- 70% of additional waste generated to transfer station infrastructure
- 50% of additional waste generated to transfer vehicle infrastructure
- 30% of additional recovered dry recyclable volumes (cardboard/paper, plastics, glass and metals) to MRF infrastructure
- 50% of the additional recovered CDL volumes to a CDL facility
- 20% of additional recovered organics to anaerobic digestion infrastructure (then to composting infrastructure for secondary processing)
- 60% of additional recovered organics to open windrow composting infrastructure, with balance (40%) to covered tunnel composting infrastructure
- 75% of additional recovered dry recyclables to processing in SA (balance exported interstate or overseas) and 100% of additional meat rendering volumes and 100% of additional refuse-derived-fuel to reprocessing infrastructure (medium tech)

Regional – C&I

Assumptions are the same as for metropolitan C&I with the following differences:

- 20% of additional waste generated to transfer station infrastructure, acknowledging that many of the large C&I volumes from regional areas such as meat rendering would go directly to reprocessors; except for Eyre West and Far North, where it was assumed 80% of additional waste to transfer station infrastructure
- 20% of additional waste generated to transfer vehicle infrastructure; except for Eyre West and Far North, where it was assumed 80% of additional waste to transfer vehicle infrastructure

- Nominal allowance for anaerobic digestion infrastructure of 10,000 tonnes in the Limestone Coast, Adelaide Hills and Barossa regions, and 5,000 tonnes in the Fleurieu/Kangaroo Island region
- 100% of additional recovered organics to open windrow composting infrastructure (none to covered tunnel)
- Extra waste streams to medium tech reprocessing infrastructure, including 100% of additional volumes of waste from Tarac plus additional volumes of meat rendering

Metropolitan – C&D

The following has been assumed:

- 25% of additional waste generated to skip bin infrastructure (the remainder is collected straight into trucks)
- 100% of additional waste generated to collection vehicle infrastructure
- 25% of additional waste generated to transfer vehicle infrastructure
- 20% of additional recovered waste (would be mixed building bins) to MRF infrastructure
- 100% of additional recovered waste to C&D processing facilities
- 50% of additional recovered soil to waste soil storage and remediation facilities

Regional – C&D

Assumptions are the same as for metropolitan C&D with the following differences:

- None of the additional recovered material to MRF infrastructure
- No regional infrastructure for waste soil storage and remediation

Other waste streams

The following has been assumed:

- 100% of additional waste to landfill (across MSW, C&I and C&D) to landfill infrastructure
- 100% of additional hazardous waste to hazardous waste facilities infrastructure
- 100% of additional recovered e-waste to emerging waste stream facility infrastructure
- 100% of additional medical waste to medical waste disposal infrastructure

2.1.2 Moderate Additional Diversion, 10 year

This scenario makes the same assumptions as for 'Business-as-Usual 10 year' scenario in terms of application of technologies to process additional waste and resource recovery volumes.

As an example, assume 100% of additional recovered dry recyclables go to MRF infrastructure, noting that the volume of recovered dry recyclables is larger than under the Business-as-Usual scenario due to higher diversion rates. Hence the volumes through this recovery infrastructure are higher.

2.1.3 Business-as-Usual, 30 year

This scenario makes the same assumptions as for 'Business-as-Usual scenario 10 year' in terms of application of technologies to process additional waste and resource recovery volumes, with the following exceptions:

- Nominal allowance of 50,000 tonnes of metropolitan MSW to vacuum system technology
- 100% of additional recovered organics from metropolitan MSW and C&I sources to covered tunnel composting (no additional tonnes to open windrow composting)
- 20% of additional recovered organics from metropolitan MSW sources to anaerobic digestion infrastructure (then to composting infrastructure for secondary processing)
- Nominal allowance for anaerobic digestion infrastructure of 50,000 tonnes for Limestone Coast, 20,000 tonnes each for the Adelaide Hills and Barossa regions, and 10,000 tonnes for Fleurieu/Kangaroo Island

2.1.4 High Additional Diversion, 30 year

Metropolitan and Regional – MSW

This scenario includes adoption of mechanical biological treatment (MBT) and energy-from-waste thermal treatment technologies to achieve High Additional Diversion scenario. It assumes the same tonnage of waste as under the 'Business-as-Usual 30 year' scenario go to MRF, composting and anaerobic digestion technologies, with the rest of volumes (material from the general waste bins) going to MBT to achieve High Additional Diversion (100% diversion for metro, and 90% diversion for regional SA).

The scenario assumes that 25% of material from MBT (the residual) goes to energy-from-waste thermal treatment infrastructure. Additional waste volumes would need to be transported in bulk from regional areas to MBT facilities.

The scenario also assumes an increase to 90% of regional MSW goes via transfer vehicle.

Metropolitan – C&I

As above, this involves adoption of MBT technology to achieve High Additional Diversion scenario of 100% for metropolitan Adelaide. The scenario assumes that 25% of material from MBT (the residual) goes to energy-from waste thermal treatment infrastructure.

All other streams

Other streams involve the same assumptions regarding application of technology as in 'Business-as-Usual 30 year' scenario.

2.2 Assumptions on capital expenditure, operating expenditure and revenue per tonne processed

The following sections provide tables that summarise infrastructure data assumptions on:

- Average processing capacity
- Capital expenditure per tonne (CAPEX)
- Operating expenditure per tonne (OPEX)
- Revenue per tonne

These assumptions were applied on a pro-rata basis to estimate the number of new/upgraded infrastructure units needed to manage additional waste volumes, and the associated total capital expenditures, annual operating expenditures and revenues.

Assumptions on average processing capacity and capital expenditure, where available, were adopted from a report by the Australian Government on waste and resource recovery infrastructure needs for Australia (Australian Government Department of the Environment, 2014). In absence of published data, estimates were based on industry intelligence.

2.2.1 Collection infrastructure

Table 4 summarises assumptions regarding processing capacity (tonnes per annum), CAPEX (per tonne), OPEX (per tonne) and revenue (per tonne) for collection infrastructure in South Australia. Fuel costs are included in OPEX. Any difference in these values for Metropolitan Adelaide [M] versus Regional Adelaide [R] are also shown.

Table 4 **Collection infrastructure assumptions for processing capacity, CAPEX per tonne, OPEX per tonne and revenue per tonne.**

	Kerbside source separation bin systems	Skip bin	Collection vehicles	Vacuum system
Nominated average processing capacity per unit (tonnes pa)				
MSW	1		10,400	10,000
C&I		37	10,400	10,000
C&D		499	32,500	
Estimated infrastructure CAPEX for nominated infrastructure size				
MSW	$150 [M] $195 [R]		$350,000	$10,000,000
C&I		$1,000 [M] $1,300 [R]	$350,000	$10,000,000
C&D		$2,000 [M] $2,600 [R]	$300,000	
Estimated infrastructure CAPEX per tonne				
MSW	$150.00 [M] $195.00 [R]		$30.00	$1,000.00
C&I		$26.71 [M] $34.72 [R]	$30.00	$1,000.00
C&D		$4.01 [M] $5.21 [R]	$10.00	
Estimated OPEX per tonne				
MSW	$6.00		$19.00	$300
C&I		$1.34 [M] $1.74 [R]	$19.00	$300
C&D		$0.20 [M] $0.26 [R]	$6.08	
Estimated revenue per tonne				
MSW	$7.80		$24.70	$390.00
C&I		$1.74 [M] $2.26 [R]	$24.70	$390.00
C&D		$0.26 [M] $0.34 [R]	$7.90	

2.2.2 Recovery infrastructure

Table 5 summarises assumptions regarding processing capacity (tonnes per annum), CAPEX (per tonne), OPEX (per tonne) and revenue (per tonne) for resource recovery infrastructure.

The transfer station category includes compaction equipment, such as balers and shredders, to reduce the volume of material prior to transportation.

Table 5 **Resource recovery infrastructure assumptions for processing capacity, CAPEX per tonne, OPEX per tonne and revenue per tonne**

	Transfer stations (inc. compaction equipment)	Transfer vehicles	Material recovery facility	CDL facilities	Drop off facilities
Nominated average processing capacity per unit (tonnes pa)					
MSW	100,000 (M) 10,000 (R)	19,500	50,000 (M) 5,000 (R)	250	250
C&I	100,000 (M) 10,000 (R)	19,500	50,000 (M) 5,000 (R)	250	250
C&D	100,000 (M) 10,000 (R)	19,500			
Estimated infrastructure CAPEX for nominated infrastructure size					
MSW	$6,000,000 (M) $4,000,000 (R)	$400,000	$10,000,000 (M) $2,000,000 (R)	$100,000	$100,000
C&I	$6,000,000 (M) $4,000,000 (R)	$400,000	$10,000,000 (M) $2,000,000 (R)	$100,000	$100,000
C&D	$6,000,000 (M) $4,000,000 (R)	$400,000			
Estimated infrastructure CAPEX per tonne					
MSW	$60.00 (M) $400.00 (R)	$20.00	$200.00 (M) $400.00 (R)	$400.00	$400.00
C&I	$60.00 (M) $400.00 (R)	$20.00	$200.00 (M) $400.00 (R)	$400.00	$400.00
C&D	$60.00 (M) $400.00 (R)	$20.00			
Estimated OPEX per tonne					
MSW	$20.00 (M) $100.00 (R)	$12.16	$30.00 (M) $60.00 (R)	$1,000.00	$1,000.00
C&I	$20.00 (M) $100.00 (R)	$12.16	$30.00 (M) $60.00 (R)	$1,000.00	$1,000.00
C&D	$20.00 (M) $100.00 (R)	$12.16			
Estimated revenue per tonne					
MSW	$26.00 (M) $130.00 (R)	$15.81	$39.00 (M) $78.00 (R)	$1,300.00	$1,300.00
C&I	$26.00 (M) $130.00 (R)	$15.81	$39.00 (M) $78.00 (R)	$1,300.00	$1,300.00
C&D	$26.00 (M) $130.00 (R)	$15.81			

2.2.3 Reprocessing infrastructure

Table 6 summarises assumptions regarding processing capacity (tonnes per annum), CAPEX (per tonne), OPEX (per tonne) and revenue (per tonne) for reprocessing infrastructure.

	Composting facilities (open windrow)	Composting facilities (covered tunnel)	Energy-from-waste facilities - thermal treatment	Energy-from-waste facilities - anaerobic digestion
Nominated average processing capacity per unit (tonnes pa)				
MSW	50,000 (M) 10,000 (R)	50,000 (M) 10,000 (R)	100,000	10,000
C&I	50,000 (M) 10,000 (R)	50,000 (M) 10,000 (R)	100,000	10,000
C&D			100,000	
Estimated infrastructure CAPEX for nominated infrastructure size				
MSW	$3,000,000 (M) $2,000,000 (R)	$10,000,000 (M) $5,000,000 (R)	$100,000,000	$5,000,000
C&I	$3,000,000 (M) $2,000,000 (R)	$10,000,000 (M) $5,000,000 (R)	$100,000,000	$5,000,000
C&D			$100,000,000	
Estimated infrastructure CAPEX per tonne				
MSW	$60.00 (M) $200.00 (R)	$200.00 (M) $500.00 (R)	$1,000.00	$500.00
C&I	$60.00 (M) $200.00 (R)	$200.00 (M) $500.00 (R)	$1,000.00	$500.00
C&D			$1,000.00	
Estimated OPEX per tonne				
MSW	$25.00 (M) $60.00 (R)	$60.00 (M) $70.00 (R)	$200.00	$70.00
C&I	$25.00 (M) $60.00 (R)	$60.00 (M) $70.00 (R)	$200.00	$70.00
C&D			$200.00	
Estimated revenue per tonne				
MSW	$32.50 (M) $78.00 (R)	$78.00 (M) $91.00 (R)	$260.00	$91.00
C&I	$32.50 (M) $78.00 (R)	$78.00 (M) $91.00 (R)	$260.00	$91.00
C&D			$260.00	

Table 6 **Reprocessing infrastructure assumptions for processing capacity, CAPEX per tonne, OPEX per tonne and revenue per tonne**

Mechanical biological treatment	C&D processing facilities	Other reprocessing facilities (medium tech)	Other reprocessing facilities (high tech)
100,000		20,000 (M) 10,000 (R)	5,000
100,000		20,000 (M) 10,000 (R)	5,000
	200,000 (M) 50,000 (R)		
$30,000,000		$1,200,000 (M) $1,000,000 (R)	$5,000,000
$30,000,000		$1,200,000 (M) $1,000,000 (R)	$5,000,000
	$8,000,000 (M) $2,000,000 (R)		
$300.00		$60.00 (M) $100.00 (R)	$1,000.00
$300.00		$60.00 (M) $100.00 (R)	$1,000.00
	$40.00		
$200.00		$50.00	$500.00
$200.00		$50.00	$500.00
	$25.00		
$260.00		$65.00	$650.00
$260.00		$65.00	$650.00
	$32.50		

2.2.4 Hazardous and emerging waste management and disposal infrastructure

Emerging waste stream facilities include those for processing e-waste, PV panels and other emerging waste streams.

Table 7 summarises assumptions regarding processing capacity (tonnes per annum), CAPEX (per tonne), OPEX (per tonne) and revenue (per tonne) for hazardous and emerging waste management and disposal infrastructure in South Australia.

Table 7 **Hazardous and emerging waste management and disposal infrastructure assumptions for processing capacity, capital expenditure per tonne, operating expenditure per tonne and revenue per tonne**

	Hazardous waste facilities	Waste soil storage and remediation facilities	Emerging waste streams facilities	Medical waste disposal
Nominated average processing capacity per unit (tonnes pa)				
MSW	5,000		2,000	
C&I	5,000		2,000	4,000
C&D		100,000	2,000	
Estimated infrastructure CAPEX for nominated infrastructure size				
MSW	$5,000,000		$2,000,000	
C&I	$5,000,000		$2,000,000	$10,000,000
C&D		$4,000,000	$2,000,000	
Estimated infrastructure CAPEX per tonne				
MSW	$1,000.00		$1,000.00	
C&I	$1,000.00		$1,000.00	$2,500.00
C&D		$40.00	$1,000.00	
Estimated OPEX per tonne				
MSW	$500.00		$500.00	
C&I	$500.00		$500.00	$650.00
C&D		$50.00	$500.00	
Estimated revenue per tonne				
MSW	$650.00		$650.00	
C&I	$650.00		$650.00	$845.00
C&D		$65.00	$650.00	

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