Advanced Waste and Resource Recovery Technologies
Metropolitan Regional Business Case and Procurement Strategy
SEPTEMBER 2018
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Executive summary
The need for change

Melbourne’s growing population means we’re sending more and more rubbish to landfill every year.

By 2046, 7.5 million people will call Melbourne home.

With more people will come more waste – municipal residual waste (garbage collected from households) will grow by 65% and over half million extra tonnes will go to landfill each year.

This will have a significant impact if we don’t look for new ways to manage the waste we produce:

- we’ll need two more landfills
- the cost of landfill is likely to rise
- landfill will become more difficult to access for some councils
- the environmental and social impacts of landfill will grow, such as greenhouse gas emissions, odour and litter.

But if we recover more resources from waste, we won’t need to build new landfills and we can use our existing landfills to manage the waste that can’t be avoided or recycled.
A new solution to manage kerbside waste

When it comes to avoiding, reusing and recycling waste, communities and local government are leading the way.

Victorians have a great recycling track record. But everything we don’t recycle goes to landfill – currently there is no other way to deal with our household waste.

So we need a smarter solution that will do more with the resources that are being sent to landfill.

The Metropolitan Waste and Resource Recovery Group (MWRRG) has been funded by the Sustainability Fund to prepare a business case for infrastructure that can process Melbourne’s municipal waste instead of sending it straight to landfill.

With the waste hierarchy as a guiding principle, the Metropolitan Regional Business Case provides a detailed assessment of advanced waste processing. It evaluates the viability of these technologies to deal with Melbourne’s growing municipal waste, and outlines a proven pathway for councils to procure complex waste management infrastructure.

A solution that will do more with the valuable resources being sent to landfill

WHAT IS ADVANCED WASTE PROCESSING?

Advanced waste processing solutions are sophisticated technologies that recover more resources from waste compared to landfill or basic recycling sorting.

These technologies bridge the current gap between recycling and sending kerbside waste to landfill.

Other terms are Advanced Waste and Resource Recovery Technology (AWRRT), Alternative Waste Treatment (AWT) or Advanced Resource Recovery Technology (ARRT).

A number of different technologies have been used successfully overseas to recover recyclables and produce electricity, heat, gas, liquid fuel and solid fuel.
Business case objectives

The Metropolitan Waste and Resource Recovery Group 10 year Implementation Plan aims to boost resource recovery and reduce our reliance on landfill.

The Implementation Plan identifies the need to establish new infrastructure that can recover resources from residual municipal waste.

In line with the Implementation Plan, this business case aims to:

**Objective 1**
Assess if advanced waste processing and/or Food Organics and Garden Organics (FOGO) solutions can divert enough waste by 2026 to limit the amount of municipal waste sent to landfill to 2016 levels (940,000 tpa).

**Objective 2**
Evaluate the effectiveness of advanced waste processing to recover 25% or more of resources from municipal residual waste collected through collaborative procurement.

**Objective 3**
Assess if advanced waste processing can deliver better environmental and social outcomes compared to landfill.

**Objective 4**
Determine an effective and efficient method for councils to procure advanced waste infrastructure.

**Objective 5**
Build stakeholder knowledge of advanced waste processing as an alternative to landfill.
Findings

Advanced waste processing can reduce Melbourne’s reliance on landfill.

WHAT WE FOUND

• Advanced waste processing can limit the amount of household waste being sent to landfill and achieve the 25% recovery objective.
• Food and garden organics recycling is important, but on its own will not achieve objectives.
• Some form of energy recovery will be required to achieve the business case objectives.
• Advanced waste processing will deliver better environmental and social benefits compared to landfill.
• The private sector has shown strong interest in establishing new advanced waste processing infrastructure in Melbourne.
• Councils are keen to explore options to divert residual municipal waste from landfill.
• Councils want to understand the benefits of advanced waste processing as a potential alternative to managing municipal waste.
• Aggregation of waste by councils will be key to driving investment by the private sector.
• MWRRG’s current contract model is not suited to contracts that require substantial private sector investment in new infrastructure.
• Councils can drive investment and achieve greater control of service outcomes by adopting a new procurement and contract approach.
• Significant private investment in infrastructure could be attracted to Victoria if the right framework for investment is established.

WHAT WE LEARNED FROM INTERNATIONAL EXPERIENCE

Experience overseas has shown that advanced waste processing is an effective solution to recover the materials in waste. To establish advanced waste processing successfully requires a guaranteed, long-term supply of waste, substantial capital investment, acceptance by the community, an appropriate site and access to end markets.
Investigating options

Some form of energy recovery will be required to achieve objectives.

MWRRG has modelled a range of resource recovery options, with a focus on solutions to expand recycling and recover organics.

**Scenario 1:** councils implement kerbside FOGO recycling services only.

**Scenario 2:** combustion only, kerbside FOGO recycling services are not implemented.

**Scenario 3:** kerbside FOGO recycling services are implemented plus combustion for residual waste.

**Scenario 4:** mechanical biological treatment plus gasification for energy recovery, kerbside FOGO recycling services are not implemented.

**Scenario 5:** mechanical biological treatment only (no energy is recovered), kerbside FOGO recycling services are not implemented.

**OUTCOMES**

Councils will need to decide their preferred balance of financial, social and environmental outcomes, so it is not the intention of this business case to recommend an option.

Instead, the scenarios illustrate whether advanced waste processing can achieve objectives and deliver better environmental and community outcomes compared to landfill.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Limit waste to landfill (2016 levels)</th>
<th>25% recovery of residual waste</th>
<th>$ (over 25 years)*</th>
<th>CO₂e emissions reduced (tpa)</th>
<th>Power produced MW**</th>
<th>Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>✗</td>
<td>✗</td>
<td>$211m cost</td>
<td>122,700</td>
<td>0</td>
<td>55</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>✓</td>
<td>✓</td>
<td>$119m saving</td>
<td>170,300</td>
<td>17 37% renewable</td>
<td>300-445</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>✓</td>
<td>✓</td>
<td>$92m cost</td>
<td>287,770</td>
<td>18 35% renewable</td>
<td>400-500</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>✓</td>
<td>✓</td>
<td>$45m cost</td>
<td>173,970</td>
<td>17 37% renewable</td>
<td>455</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>✗</td>
<td>✗</td>
<td>$36m cost</td>
<td>92,806</td>
<td>0</td>
<td>455</td>
</tr>
</tbody>
</table>

Based on one facility to process around 300,000 tonnes of residual waste each year

*Additional costs or savings compared to Business As Usual (in today’s dollars)

**Power generation capacity
What benefits can advanced waste processing deliver?

Advanced waste processing can deliver significant benefits for Melbourne.

- Limit waste to landfill
- Recover more resources from household waste
- Attract $300-400 million infrastructure investment to Victoria
- Reduce greenhouse gases (up to 290,000 tonnes of CO$_2$e a year)
- Councils will have cost and service certainty
- Create 300-400 jobs during construction
- Better environmental outcomes compared to landfill
- Energy produced from waste can be sold
- Create 50-60 ongoing jobs

Based on one facility to process around 300,000 tonnes of municipal residual waste each year
Securing investment

New infrastructure will require substantial investment.

Currently there are no private advanced waste facilities in metropolitan Melbourne capable of processing substantial quantities of kerbside waste. To establish facilities with sufficient scale will require significant upfront investment.

From the private sector’s perspective, a financially viable facility will process a minimum of 150,000 tonnes of waste each year. As no single metropolitan council manages a sufficient quantity of residual municipal waste to attract investment for an exclusive solution, the aggregation of waste by councils will be the key to drive investment by the private sector.

Given the complexity and costs associated with new facilities, there will be limits on the type of procurement options available. Where substantial capital investment in new infrastructure is required before service delivery commences, the current contract arrangement used by councils is not well suited as it can limit access to private sector funding.

It is essential that councils develop agreements that facilitate:

- aggregation of residual waste
- the appointment of a contractor to construct and operate advanced waste processing facilities
- financing of the capital investment (land acquisition and construction) and the operation of the facilities.

Contract models

Over the last 20 years, out-sourcing of waste and recycling services has led to efficiencies in service delivery, but councils have had little control over performance.

The contract model adopted by councils will determine their level of control over costs, technology, location and performance (including environmental and social outcomes).

Contract models can range from a service delivery model (where the private sector builds, owns and operates a facility and councils provide waste under contract) to a Build, Own, Operate, Transfer model (where a private entity builds and operates a facility owned by councils).

Successful operations of advanced waste processing internationally demonstrate that suitable contract models and delivery pathways exist. The procurement strategy will provide the opportunity to select a preferred contract model.

Aggregation of waste by councils will be the key to drive investment by the private sector.
Procurement strategy

Procuring highly engineered infrastructure is complex, and dialogue between procuring councils and potential providers will be critical to success.

Collective procurement for advanced waste processing can only proceed if there is agreement between councils on what to achieve in terms of financial, environmental and social outcomes. MWRRG will work with groups of councils to develop cluster business cases that will define the problems that councils are seeking to address. The business cases will present the detailed evidence that supports going to market for a solution.

**A multi-phase procurement process**

A new multi-phase procurement strategy is recommended that has been designed to:

- clarify councils’ requirements
- build understanding and commitment
- engage effectively with industry to ensure that future contracts are fit for purpose
- provide the time to adequately engage with the community before decisions are made.

The proposed procurement strategy has four stages. Each stage refines specifications and the pool of suitable bidders is reduced progressively. Councils can confirm their participation at each stage and commitment to enter into a contract will be required prior to issuing the Final Tender. The stages are:

1. **Expression of interest** - an open approach to market to identify an initial pool of suitable bidders.
2. **Invitation to submit outline solution** - approach to a selected market to inform detailed specifications.
3. **Invitation to submit detailed solution** - approach to a selected market to inform the final tender specifications.
4. **Call for final tender** - approach to a selected market to identify the preferred bidder and solution. Final tender specifications will include a firm commitment by participating councils to enter into the term contract.

This phased approach will ensure competitive dialogue between councils and bidders that will inform the refinement of specifications and align bidders proposals with councils’ requirements.

**Risk analysis**

There are a number of risks associated with the procurement of advanced waste processing solutions, including:

- procurement process risks related to the process and partnering arrangements
- contracting risks related to security of waste supply, waste composition, planning and approvals and changes in law
- finance and commercial risk.

Managing risk is a vital aspect of delivering a procurement process. The multi-stage procurement process has been designed to minimise risks, and will adhere to a probity plan that promotes transparency and reduces risk during and after the procurement stage.
Recommendations

Advanced waste processing is a proven and necessary solution to better manage Melbourne’s municipal residual waste.

The Metropolitan Regional Business Case demonstrates the viability of advanced waste processing and validates further investigation of potential solutions.

Councils will need to work together to boost Melbourne’s resource recovery capability, limit the amount of municipal waste sent to landfill and secure significant private investment in new infrastructure.

The Metropolitan Regional Business Case recommends metropolitan councils partner with MWRRG to develop cluster business cases and realise the opportunities available through advanced waste processing.
Metropolitan Regional Business Case detailed findings
1 Introduction

The Metropolitan Regional Business Case provides a detailed assessment of advanced waste processing and whether these technologies are a viable approach to deal with Melbourne’s growing residual waste.

1.1 THE NEED FOR CHANGE

Melbourne’s growing population means we’re sending more and more rubbish to landfill every year.

Around 940,000 million tonnes of residual municipal solid waste (MSW) were sent to landfill in 2015-16 by Melbourne’s 31 councils (Local Government Performance Reporting Framework).

With population growth, the region is anticipated to generate around 1.55 million tonnes of residual MSW each year by 2046. The quantity of residual commercial and industrial (C&I) waste being sent to landfill will increase from around 1.5 million tonnes (2015-16) to around 3.9 million tonnes each year by 2046 (source: Waste Flow Model).

Currently, all municipal residual waste collected by metropolitan councils is sent to landfill. If we don’t make any changes to our infrastructure and systems, it is anticipated that around one million tonnes of extra waste from municipal, C&I, and construction and demolition (C&D) will need to be landfilled each year. That’s the equivalent of needing two more landfills over the coming decades.

This will have a significant impact if we don’t look for new ways to manage the waste we produce:

- the cost of landfill is likely to rise
- landfill will become more difficult to access for some councils due to the limited availability of nearby landfill
- the environmental and social impacts of landfill will grow, such as greenhouse gas emissions, odour and litter.

If we recover more resources from municipal waste we can reduce the need to build new landfills and rely on existing landfills to manage the waste that can’t be avoided or recycled.
1.2 A NEW SOLUTION TO MANAGE MUNICIPAL WASTE

When it comes to avoiding, reusing and recycling waste, communities and government are leading the way. Victorians have a great recycling track record. But everything we don’t recycle goes to landfill – there is no other way to deal with our household waste currently.

So we need a smarter solution that will do more with the resources that are being sent to landfill.

The Metropolitan Waste and Resource Recovery Group (MWRRG) has been funded by the Sustainability Fund to prepare this business case for infrastructure that can process Melbourne’s kerbside waste instead of sending it straight to landfill.

With the waste hierarchy as a guiding principle, the Metropolitan Regional Business Case provides a detailed assessment of advanced waste processing. It evaluates the viability of these technologies to deal with Melbourne’s growing residual waste, and outlines a proven pathway for councils to procure complex waste management infrastructure.

This business case will be refined throughout the procurement process as detailed information becomes available from bidders on their proposed service. An updated business case will be released following the last procurement stage and prior to confirming the preferred bidder.

Advanced waste solutions have great potential as part of a total approach to managing the waste produced. Adding Advanced Waste and Resource Recovery Technologies (AWRRT) into the mix of landfill and resource recovery infrastructure should make the system more resilient to natural market fluctuations and provide enhanced contingency options.

Experience overseas and to some extent in Australia has shown that efficient technologies can recover the valuable materials in garbage and use them to cost effectively and safely produce new goods, fuels or other sorts of energy.

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**WHAT ARE ADVANCED WASTE AND RESOURCE RECOVERY TECHNOLOGIES?**

The term Advanced Waste and Resource Recovery Technologies (AWRRT) covers a range of sophisticated and complex technology solutions that provide greater recovery of resources (materials and/or energy) from waste compared to traditional processes like landfill or basic recycling sorting.

These technologies bridge the current gap between recycling and sending kerbside waste to landfill.

Other terms can often be used to mean the same suite of advanced processing solutions including Alternative Waste Treatment (AWTs) or Advanced Resource Recovery Technology (ARRT). These terms are viewed as interchangeable.

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1.3 THE STRATEGIC CONTEXT

The Metropolitan Waste and Resource Recovery Implementation Plan 2016 (Metropolitan Implementation Plan) sets out how Melbourne’s waste and resource recovery infrastructure needs will be met over the next 10 years. It has four strategic objectives:

- reduce waste to landfill
- increase organic waste recovered
- deliver community, environmental and economic benefit
- plan for Melbourne’s growing population.

The Metropolitan Implementation Plan identifies 13 actions to limit waste to landfill by 2026. This includes establishing new infrastructure that can recover 25% more resources from residual municipal waste collected through collaborative procurement.

The plan specifically seeks to divert 300-400,000 tonnes of municipal waste from landfill each year via new, advanced technologies.

The Metropolitan Implementation Plan integrates with a range of other long term strategic plans, strategies, policies and decision making principles that articulate the waste and recycling aspirations of the Victorian Government. Eleven principles of environment protection are enshrined in the Environment Protection Act 1970 (EP Act) to guide decision making, including the waste hierarchy. The Victorian Government is working to build a waste and resource recovery system informed by the circular economy principle, where there is a circular
pathway from production, to consumption, to resource recovery.

The Metropolitan Implementation Plan is one part of the Victorian Waste and Resource Recovery Infrastructure Planning Framework, which is complemented by other waste and recycling initiatives including:

- specific strategies on waste education, market development for recovered resources, and organic waste recovery
- a new approach to managing e-waste
- consulting on the role of waste to energy technologies in the integrated network
- reducing the impact of plastic pollution on our environment, including banning single use plastic bags
- supporting local governments to maintain kerbside recycling collections.

MWRRG has worked closely with the Department of Environment, Land, Water and Planning (DELWP), the Environment Protection Authority (EPA) Victoria and Sustainability Victoria (SV), to align this Metropolitan Regional Business Case and Procurement Strategy with these initiatives.

1.4 BUSINESS CASE OBJECTIVES

In line with the Metropolitan Implementation Plan, this business case aims to:

Objective 1
Assess if advanced waste processing and/or Food Organics and Garden Organics (FOGO) solutions can divert enough waste by 2026 to limit the amount of municipal waste sent to landfill to 2016 levels (940,000 tpa).

Objective 2
Evaluate the effectiveness of advanced waste processing to recover 25% or more of resources from municipal residual waste collected through collaborative procurement.

Objective 3
Assess if advanced waste processing can deliver better environmental and social outcomes compared to landfill.

Objective 4
Determine an effective and efficient method for councils to procure advanced waste infrastructure.

Objective 5
Build stakeholder knowledge of advanced waste processing as an alternative to landfill.
2 Building the evidence base

The procurement of an AWRRT solution is a comprehensive process of collecting evidence about existing and future waste and resource recovery needs and making objective and informed decisions about possible options. The evidence base that MWRRG is developing includes:

- estimates of the annual quantities of residual MSW and C&I waste that is likely to be generated within each local government area (LGA) over the next three decades
- the composition of residual waste that is potentially available for resource recovery within individual LGAs
- the technical capabilities and commercial track record of different technologies
- the environmental impacts of AWRRT solutions
- capital and operating costs of AWRRT solutions
- existing infrastructure and potential sites for the deployment of technology solutions
- existing and future markets for process outputs (materials and/or energy)
- management options for process residues that are technically available and able to meet the relevant necessary regulations.

This evidence base is being developed and collated through a number of key documents that build and refine the evidence over time:

- an Advanced Waste and Resource Recovery Technologies Metropolitan Regional Business Case and Procurement Strategy (this document), September 2018
- up to three specific business cases to support procurements of Advance Waste and Resource Recovery Technologies by clusters of metropolitan councils (to be delivered 2019-20).

2.1 WASTE GENERATION

Solid waste is generated through the collective actions of communities. The primary influences on waste generation are:

- total population and consumption of goods
- population demographics, culture and levels of affluence
- industrial and commercial activity
- infrastructure development.

MWRRG has developed a waste flow model that attempts to forecast the future growth in residual waste from MSW and C&I waste streams from 2016-17 to 2050-51 by individual LGA. Municipal solid waste includes waste from household kerbside bins and hard waste, and C&I waste is generated from businesses.

The projected growth in residual MSW is based upon forecasts of population growth that have been published by the Victorian Government. The projected growth in residual C&I waste is based on an analysis of the distribution of different business types across the metropolitan region.
Table 1 presents an estimate of future residual waste generation in the south-east of the region, Table 2 presents estimates for the inner metropolitan region, and Table 3 presents estimates for the north-west of the region. Appendix 1 provides further information of forecasts of residual waste generation by LGA.

Table 1: Estimates of future residual waste generation within the south-east metropolitan region

<table>
<thead>
<tr>
<th>LGA</th>
<th>Total residual waste (tpa) from MSW and C&amp;I waste streams</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2016</td>
</tr>
<tr>
<td>Bayside</td>
<td>61,306</td>
</tr>
<tr>
<td>Boroondara</td>
<td>137,124</td>
</tr>
<tr>
<td>Cardinia</td>
<td>41,932</td>
</tr>
<tr>
<td>Casey</td>
<td>122,767</td>
</tr>
<tr>
<td>Frankston</td>
<td>67,625</td>
</tr>
<tr>
<td>Glen Eira</td>
<td>83,300</td>
</tr>
<tr>
<td>Greater Dandenong</td>
<td>107,371</td>
</tr>
<tr>
<td>Kingston</td>
<td>108,776</td>
</tr>
<tr>
<td>Knox</td>
<td>109,743</td>
</tr>
<tr>
<td>Manningham</td>
<td>82,491</td>
</tr>
<tr>
<td>Maroondah</td>
<td>71,427</td>
</tr>
<tr>
<td>Monash</td>
<td>135,279</td>
</tr>
<tr>
<td>Mornington Peninsula</td>
<td>81,103</td>
</tr>
<tr>
<td>Whitehorse</td>
<td>110,009</td>
</tr>
<tr>
<td>Yarra Ranges</td>
<td>97,604</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,417,857</td>
</tr>
</tbody>
</table>
### Table 2: Estimates of future residual waste generation within the inner metropolitan region

<table>
<thead>
<tr>
<th>LGA</th>
<th>Total residual waste (tpa) from MSW and C&amp;I waste streams</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2016</td>
</tr>
<tr>
<td>Melbourne</td>
<td>183,960</td>
</tr>
<tr>
<td>Stonnington</td>
<td>97,650</td>
</tr>
<tr>
<td>Maribyrnong</td>
<td>63,725</td>
</tr>
<tr>
<td>Port Phillip</td>
<td>111,327</td>
</tr>
<tr>
<td>Yarra</td>
<td>96,886</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>553,548</td>
</tr>
</tbody>
</table>

### Table 3: Estimates of future residual waste generation within the north-west metropolitan region

<table>
<thead>
<tr>
<th>LGA</th>
<th>Total residual waste (tpa) from MSW and C&amp;I waste streams</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2016</td>
</tr>
<tr>
<td>Banyule</td>
<td>59,416</td>
</tr>
<tr>
<td>Brimbank</td>
<td>104,891</td>
</tr>
<tr>
<td>Darebin</td>
<td>82,527</td>
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<tr>
<td>Hobsons Bay</td>
<td>49,931</td>
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<tr>
<td>Hume</td>
<td>106,950</td>
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<tr>
<td>Melton</td>
<td>53,048</td>
</tr>
<tr>
<td>Moonee Valley</td>
<td>68,072</td>
</tr>
<tr>
<td>Moreland</td>
<td>94,863</td>
</tr>
<tr>
<td>Nilumbik</td>
<td>27,319</td>
</tr>
<tr>
<td>Whittlesea</td>
<td>92,823</td>
</tr>
<tr>
<td>Wyndham</td>
<td>96,479</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>836,320</td>
</tr>
</tbody>
</table>
2.2 WASTE COMPOSITION

Information on the composition of MSW and C&I waste in the metropolitan region is limited. MWRRG commissioned a review of 67 waste composition audits that have been undertaken by metropolitan councils in recent years. The review found that none of the previous audits were specifically focused on assessing the composition of residual waste generated by households. Figure 1 is based on the findings of the review of previous audits and provides an indication of the composition of residual MSW across the region, but this information is not robust enough to inform a procurement process for residual waste treatment solutions.

To improve the quality of data and ensure a consistent approach to waste audits, MWRRG commissioned the development of an auditing methodology and tool. This tool will be used to conduct local government waste composition audits for each procurement. MWRRG has also secured funding to support audits for metropolitan councils that engage in future procurements so that we better understand spatial and seasonal variability in the composition of residual MSW.

C&I waste has the most variable composition of the three primary sources of waste. There is little reliable information on the composition of the C&I waste that is being generated and sent to landfill in the region. To help address this situation, Sustainability Victoria is undertaking further work to investigate the generation and composition of C&I waste.

2.3 FEEDSTOCK FOR FUTURE RESIDUAL WASTE TREATMENT SOLUTIONS

Overseas experiences shows that the deployment of an AWRRT solution is usually predicated on the supply of a specified quantity of MSW, with investors generally requiring at least 80% of the feedstock being secured through long-term contracts with councils. Industry feedback suggests that a procurement for AWRRT needs to offer a minimum of 100-150,000 tonnes of feedstock to be viable.

Often AWRRT facilities also receive third party C&I waste and MSW from other councils on short term contracts, for which higher gate fees are usually charged by the facility operator. In addition to providing a revenue stream that can subsidise the cost of treating MSW, third party waste can be used to fill spare capacity that is initially built into the facility to allow room for growth in the supply of MSW over time. As the supply of MSW increases, the third party C&I waste input is reduced.
2.4 TECHNICAL CAPABILITY AND COMMERCIAL TRACK RECORD OF AWRRT SOLUTIONS

The separation of materials at source is the most effective means of recovering recyclables. However, source separation systems can result in increased collection costs, are more difficult to implement in semi-rural areas, and may not be cost-effective for C&I and C&D collections.

Consequently, technology solutions have been developed that allow the recovery of value from recyclables and organics in municipal, C&I, and C&D waste collections. Other sources of mixed residual waste that can be processed through AWRRT include municipal hard waste and a large proportion of the waste that householders and businesses self-haul to transfer stations.

AWRRT can be broadly classified into three types:

- biological processes, where microbes breakdown the organic material
- advanced sorting solutions, where manual, mechanical or biological processes separate hard recyclables from organic waste
- thermal treatment (waste to energy) solutions, where energy (gas, steam, heat, electricity) is recovered from the high carbon elements in the waste.

2.4.1 Integrated technologies

While standalone examples of these technology types exist, the three approaches are often integrated into solutions that are designed to meet local or regional needs.

Table 4 provides a simple comparison between the different processes that can be used to recover value from mixed residual waste, with more information provided in Appendix 2. Further information is available from Sustainability Victoria’s Resource Recovery Technology Guide published in May 2018. This guide helps build understanding of current and emerging resource recovery technologies and their application to different material streams, as well as management of environmental and community impacts, managing risks, stimulating markets for recycled products, and outlining the different models of procurement and ownership.

KWINANA WASTE TO ENERGY PROJECT

Phoenix Energy is developing a waste to energy facility at Kwinana, Perth.

When complete, the facility will divert up to half of the residential (post-recycling) rubbish collected in the Perth metro area from landfill sites. By combusting this waste stream, the facility will generate enough electricity to power up to 65,000 households, divert hundreds of thousands of tonnes of kerbside rubbish from landfill, reduce the greenhouse gases associated with landfill and enable better use of valuable land.

Phoenix Energy has signed 20-year waste supply agreements with both the Rivers Regional Council, (representing seven LGAs, including the City of Canning), and with the City of Kwinana. Under these agreements all eight LGAs will supply residential (post-recycling) waste to the plant, which is designed to receive and process up to 400,000 tonnes of residual waste each year.

The Kwinana Waste to Energy Project has received development approval and final environmental approvals from Western Australian Government agencies in order to construct the plant within the Kwinana Industrial Zone. The project has received positive support from successive Western Australian Governments. The project has been progressing for seven years, with construction yet to commence.

Construction of the $400 million, 32MW plant is expected to create at least 800 jobs during the project’s three-year construction phase, with a range of subcontracting and supply opportunities available to local businesses. There will be approximately 60 operational and management jobs at the plant once the facility is completed.

Adapted from www.phoenixenergy.com.au
### Table 4: Comparing AWRRT solutions

<table>
<thead>
<tr>
<th>Technology genre</th>
<th>Technology</th>
<th>Waste type</th>
<th>Outputs</th>
<th>Track record</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced sorting</td>
<td>Dirty MRF</td>
<td>Mixed residual MSW, C&amp;I and C&amp;D waste</td>
<td>Dry recyclables (e.g. glass, wood, metals, hard plastics)</td>
<td>Strong track record for recovering materials from mixed C&amp;D, limited track record with respect to MSW and C&amp;I residual waste streams</td>
</tr>
<tr>
<td>Advanced sorting</td>
<td>Mechanical biological treatment (MBT)</td>
<td>Residual MSW and C&amp;I waste</td>
<td>Depending on the configuration: Dry recyclables A separated organic fraction Refuse Derived Fuel (RDF) Energy</td>
<td>Strong track record with examples in Australia (NSW and WA) and overseas</td>
</tr>
<tr>
<td>Advanced sorting</td>
<td>Mechanical heat treatment (MHT)/autoclaving</td>
<td>Residual MSW and C&amp;I waste</td>
<td>Dry recyclables A separated organic fraction (floc) RDF</td>
<td>Limited number of examples in Australia (Coffs Harbour) and overseas</td>
</tr>
<tr>
<td>Thermal treatment</td>
<td>Mass burn combustion</td>
<td>Residual MSW and C&amp;I and C&amp;D waste</td>
<td>Energy Metals Bottom ash (which may be recycled) Air pollution control residues</td>
<td>Very strong track record for treating residual waste with hundreds of examples worldwide</td>
</tr>
<tr>
<td>Thermal treatment</td>
<td>Advanced thermal treatment (ATT)</td>
<td>RDF (Residual MSW and C&amp;I and C&amp;D waste in the case of plasma gasification)</td>
<td>Energy (syngas) Char (pyrolysis) Oil (pyrolysis) Ash (gasification) Molten metals and slag (plasma gasification)</td>
<td>Very limited track record for treating mixed residual waste</td>
</tr>
<tr>
<td>Biological</td>
<td>Composting (in-vessel composting)</td>
<td>FOGO</td>
<td>Compost</td>
<td>Strong track record with examples at scale in Victoria Not well suited to treating residual waste</td>
</tr>
<tr>
<td>Biological</td>
<td>Anaerobic digestion</td>
<td>Source separated food and garden waste, or organic waste separated from residual waste through a sorting process</td>
<td>Biogas Energy Digestate (which may be processed into a soil improver)</td>
<td>Strong track record in treating separated organics from the MSW and C&amp;I waste streams, and other organics such as biosolids Not well suited to treating residual waste</td>
</tr>
</tbody>
</table>
Environmental Impacts of AWRRT Solutions

In common with any industrial activity, residual waste processing facilities have the potential to impact the environment. Potential impacts associated with AWRRT include the following:

- **Air emissions**, including:
  - bio-aerosols from the transport and processing of organic waste
  - acid gases, dioxins, furans, heavy metals and oxides of nitrogen from thermal treatment processes
  - dust from vehicle movements and processing operations odours.
- **Contamination** of surface and ground water due to site run-off and/or disposal of liquid effluent.
- **Traffic impacts** associated with the delivery of waste and the collection of process outputs (products and residues).
- **Noise** from delivery vehicles, vehicle movements on site, and the operation of plant and equipment.
- **Visual intrusion** from buildings and stockpiles of materials.
- **Vermin** (principally rodents and flies) in waste storage areas.

The main environmental impacts associated with different AWRRT solutions are presented in Table 15, Appendix 2.

Controlling Environmental Impacts

A range of environmental regulations exist to control emissions and will apply to the operation of AWRRT facilities in Victoria. Expectations for protecting the environment and human health in Victoria are described and enforced through a hierarchy of instruments (see Table 5), including:

- the *Environment Protection Act 1970*

The *Waste Management Policy (Siting, Design and Management of Landfills)* promotes best practice and continuous improvement in the way landfills are planned, sited, designed and managed in Victoria. The policy also promotes waste minimisation and resource recovery infrastructure that will in turn encourage market opportunities for recycling.

The policy recognises landfills are an important part of Victoria’s waste management infrastructure. While disposal of materials to landfill is the least preferred management option, they will continue to be required in the future to manage those wastes that cannot be practically removed from the waste stream.

For AWRRT, residual waste is typically processed in buildings that operate under strict environmental control regimes, which may include the use of fast-closing doors in waste reception areas and negative pressure air-control systems that limit the egress of odours and air pollutants from processing areas.

Thermal treatment solutions are required by law to monitor and control air emissions within statutory limits. Acid gases and heavy metals from combustion processes are usually controlled through the use of extensive flue gas treatment systems that often include bag filters, electrostatic precipitators and acid neutralisation stages (injection of lime water or bicarbonate). The production of dioxins and furans are usually avoided through strict combustion controls.
Table 5: Overview of controls for potential environmental impacts

<table>
<thead>
<tr>
<th>Environmental aspect</th>
<th>Potential impact</th>
<th>Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air (including greenhouse gases, odours and other pollutants)</td>
<td>AWRRT solutions can generate a variety of airborne pollutants, including gases, bio-aerosols, dusts and odours which require control through the design and operation of the facility.</td>
<td>Environment Protection Act 1970&lt;br&gt;State Environment Protection Policy (Ambient Air Quality)&lt;br&gt;State Environment Protection Policy (Air Quality Management)</td>
</tr>
<tr>
<td>Land and water contamination</td>
<td>Organic processing facilities, including composting plants, have the potential to generate a liquid leachate that may contaminate land, as well as surface and ground waters.</td>
<td>Environment Protection Act 1970&lt;br&gt;Planning and Environment Act 1987&lt;br&gt;State Environment Protection Policy (Prevention and Management of Contamination of Land)&lt;br&gt;State Environment Protection Policy (Waters of Victoria)&lt;br&gt;State Environment Protection Policy (Groundwaters of Victoria)&lt;br&gt;Land use planning permit requirements</td>
</tr>
<tr>
<td>Traffic</td>
<td>The movement of trucks to and from processing facilities has the potential to impact local traffic flow, road infrastructure and amenity. Land use planning decision makers need to consider potential local transport network impacts.</td>
<td>Planning and Environment Act 1987</td>
</tr>
<tr>
<td>Noise</td>
<td>Vehicles, processing equipment and site operations have the potential to generate noise.</td>
<td>Planning and Environment Act 1987&lt;br&gt;Environment Protection Act 1970&lt;br&gt;State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade)</td>
</tr>
</tbody>
</table>

2.5.2 Climate change impacts

Victoria’s Climate Change Framework describes the government’s long-term vision for climate change action. Driving emissions reductions is one element of this framework and in Victoria, four pillars underpin the transition to net zero emissions while maintaining economic prosperity:

- increase energy efficiency and productivity across the economy, including in our homes, offices, industry and transport
- move to a clean electricity supply by increasing renewable energy generation
- electrify our economy and switch to clean fuels by increasing the use of electricity to power our homes, cars and public transport and using biofuels and gas in freight, air travel and industry
- reduce non-energy emissions and increase carbon storage through industrial processes improvements and improving carbon storage in trees, plants and soil.

The first three pillars focus on reducing energy emissions, which account for over 80% of Victoria’s emissions, while the fourth pillar is about reducing non-energy emissions from activities such as landfilling waste and fertiliser use.

The Climate Change Framework recognises the role and contribution that resource recovery can make to realising a low emission climate-resilient built environment, by:


Climate change impacts are incorporated into the scenario cost benefit analysis (Section 3).
2.5.3 Land use planning

The Victorian land use planning system is designed to ensure land is used and developed to protect and conserve land in Victoria in the interests of all Victorians, in accordance with the Planning and Environment Act 1987.

Residual waste processing facilities must be located in appropriately zoned areas (industrial) and operate in accordance with planning permits.

A planning permit is necessary when the planning scheme specifies that it is required. In most cases the party responsible for processing and determination of planning permit applications is the local council.

The land use planning system also has a critical role to ensure waste management and recovery facilities are protected from encroachment by incompatible land uses. Land use planning can ensure there is adequate infrastructure to service our growing population while protecting the public health and amenity of residents and businesses in the vicinity.

Waste and resource recovery facilities, including a future AWRRT, should operate to best practice standards and in line with all regulatory requirements. Even when waste and resource recovery facilities operate to best practice standards, there will be occasions when impacts may be felt in neighbouring sites for example, odour impacting on neighbours during extremely windy conditions.

Establishing and protecting buffer distances over the life of the facility is critical for minimising potential adverse impacts on adjoining communities, and for preventing encroachment of incompatible adjacent uses (which can lead to the early closure of facilities).

The early closure of facilities could in turn have a negative impact on business confidence, investment processing capacity and local government waste and recovery costs and contracts.

MWRRG has developed and is deploying a suite of land use planning tools to define, protect and maintain buffers to waste and resource recovery facilities; and help protect communities from potential impacts of waste and resource recovery facilities. MWRRG will work in partnership with state and local governments to define, protect and maintain buffers for any future AWRRT.

2.5.4 Environmental permits

Within Victoria a statutory approval process applies to establishing and operating certain industrial activities that have potential to adversely affect human health and the environment. The approval controls include:

- works approval regulations
- state and local planning frameworks
- building controls.

Under the Environmental Protection Act 1970 occupiers of scheduled premises (i.e. premises that are considered to pose a significant threat to the environment) are required to hold an EPA licence and seek works approval from EPA before undertaking new and/or altered activities.

In addition, the Environment Protection (Scheduled Premises and Exemptions) Regulations 2017 require operators of organic facilities (aerobic and anaerobic) that process more than 100 tonnes or 200 cubic metres of waste per month to obtain a works approval.

For premises that recover energy from waste at a rated capacity of less than 3 MW thermal capacity or 1 MW electrical capacity it may be possible to apply for an exemption under section 19A of the regulations.

The EPA assesses the required separation distances for AWRRT (i.e. waste treatment facilities for the immobilisation, thermal degradation, chemical conversion, biological oxidation (aerobic or anaerobic), incineration, gasification or other treatment of solid waste) on a case by case basis.

A waste to energy facility will also need to comply with Schedule E (emission limits for new stationary sources in air quality control regions) of the State Environment Protection Policy (Air Quality Management).

Before applying for a works approval, a pathway form should be lodged, which informs an applicant of the need for an approval and allows EPA to provide the applicant with advice regarding the necessary technical assessment, investigations, supporting evidence and timeline for considering the application. The length of time that EPA will require to assess the application will largely depend on the following:

- the nature of the proposed technology
- the scale of the facility
- the feedstock being targeted
- level of stakeholder interest and the amount of public consultation that the applicant has undertaken
• impact on the local community and land use implications such as whether planning and other approvals are being sought
• the proponent’s track record operating a licensed facility
• the environmental assessment of the proposed technology and how it demonstrates compliance with all relevant legislation and policy, including best practice.

As a minimum, the works approval application process should involve:
• engaging with EPA
• understanding the requirements of EPA
• the submission of a draft application
• responding to comments on the draft application that have been made by EPA
• the lodgement of a final application and payment of a fee.

EPA will refer the application to other parties such as local councils, and any relevant authority, departments or agencies.

In response to public comments and interest, EPA may hold a public meeting known as a Section 20B Conference, so community views can be discussed and EPA can understand the views of the community regarding the application. A Section 20B Conference will be independently chaired and a report produced detailing key issues and possible solutions raised in written submissions and at the conference. This report will be used by EPA to inform its decision on the works approval application.

Where necessary throughout the assessment process, EPA may request further information from the proponent before making a final decision.

Once EPA has received all the required information it will undertake a final internal/external review of the application and sends any draft works approval to the proponent for review before making a final decision on the application.

For standard works approvals, EPA endeavours to arrive at decisions within three months from the date of submission of the application to EPA. However, the review of poorly prepared applications or applications involving novel technologies may take considerably longer to assess.

Should a planning permit also be required, the applicant is strongly encouraged to progress the two applications in parallel, to improve the level of community engagement and potentially reduce the associated costs.

Following the grant of the works approval and the construction and commissioning of the facility, an EPA licence will be required for the operation of the facility. If EPA is satisfied that the work has been completed in accordance with the works approval, a licence will be issued to the proponent.

2.6 CAPITAL AND OPERATING COSTS

2.6.1 Capital costs

Establishing residual waste processing solutions in metropolitan Melbourne represents a significant opportunity to secure substantial private sector investment in proven resource recovery solutions tailored to Melbourne’s needs.

The capital cost of deploying an AWRRT facility is determined by a number of factors, including:
• the scale of the proposed facility (in terms of the installed processing capacity)
• the targeted feedstock
• the complexity of the technology
• the investment required to manage emissions to the environment
• architectural treatment of the facility to address any concerns about its external appearance
• site specific factors, such as the cost of land and site preparation works
• exchange rates for equipment manufactured overseas
• construction, including materials and labour costs.

Realistic capital costs (capex) for AWRRT facilities can only be obtained through the receipt of tenders as part of a procurement, however Table 6 provides estimates of capital costs for different technologies based on a literature search and market research.

The capital works associated with infrastructure projects can be funded through loans made by financial institutions. Typically the award of the loan follows the lender’s review of the proponent’s proposed technology, capability to meet environmental compliance, operational competency and full business case for the project. This review may include a formal due diligence investigation of the project that is undertaken by the lender or their advisers (the cost of which is usually recovered as part of the loan).
The capital costs of a project may also be funded through the sale of shares (equity) in the venture either through a public release or through a private arrangement.

Local government has the opportunity to consider partnering with industry to share the capital costs of a facility. Such an investment may then influence the gate fee (see Section 2.6.3) and contract arrangements.

2.6.2 Operating costs

Operating costs usually include:
- labour costs
- maintenance and asset management costs
- utility costs (e.g. electricity, gas and water)
- consumables and reagents (e.g. chemicals required for the control of emissions)
- management of process residues (i.e. disposal of contamination, ash and air pollution control residues to landfill)
- annual monitoring and licensing costs
- insurance premiums.

As with capital costs, realistic operating costs for different types of AWRRT facilities can only be obtained through a tender process. Table 6 provides estimates of operating costs for different AWRRT solutions based on overseas experience.

Table 6: Estimates of capital and operating costs for different AWRRT solutions

<table>
<thead>
<tr>
<th>Technology</th>
<th>Capital cost per tonne of capacity</th>
<th>Operating cost per tonne of capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static pile composting</td>
<td>$100 - $220</td>
<td>$50 - $65</td>
</tr>
<tr>
<td>In-vessel composting</td>
<td>$200 - $350</td>
<td>$90 - $120</td>
</tr>
<tr>
<td>Anaerobic digestion</td>
<td>$350 - $800</td>
<td>$50 - $100</td>
</tr>
<tr>
<td>Dirty MRF</td>
<td>$55 - $80</td>
<td>$50 - $80</td>
</tr>
<tr>
<td>MBT</td>
<td>$220 - $875</td>
<td>$120 - $170</td>
</tr>
<tr>
<td>MHT / autoclaving</td>
<td>$280 - $550</td>
<td>$150 - $200</td>
</tr>
<tr>
<td>Combustion</td>
<td>$650 - $1,350</td>
<td>$75 - $120</td>
</tr>
<tr>
<td>Pyrolysis</td>
<td>$750 - $2,000</td>
<td>Not available</td>
</tr>
<tr>
<td>Gasification</td>
<td>$600 - $850</td>
<td>$85 - $150</td>
</tr>
<tr>
<td>Plasma gasification</td>
<td>$1,150 - $2,000</td>
<td>Not available</td>
</tr>
</tbody>
</table>

1 These cost estimates have been derived from a variety of published and unpublished sources and are provided for comparative discussion purposes only.
2.6.3 Gate fees and contract waste charges

To dispose of waste, metropolitan Melbourne councils currently pay a landfill gate fee charged by operators per tonne of material, to which the cost of the landfill levy is added. The average gate fee that metropolitan councils pay per tonne of waste that is managed through the four Metropolitan Landfill Contracts is approximately $110 per tonne, including the landfill levy.

The Metropolitan Landfill Contracts are due to ‘sunset’ in March 2021, after which it is anticipated that landfill gate fees in the region are likely to increase. The magnitude of the increase is difficult to assess (see Section 3.2.1 for further discussion about landfill gate fees).

Capital and operating costs for processing waste through AWRRT solutions are usually passed on to the councils that have procured the facility through a monthly service charge based on the quantity of ‘contract waste’ processed.

The operating costs that are presented are not necessarily directly comparable to landfill gate fees. In addition to operating costs, gate fees for AWRRT solutions are likely to include a capital and financing cost, together with the operator’s profit margin. Further discussion of gate fees is presented in Section 3.2.1.

The monthly ‘contract waste charge’ that is paid by councils will also be influenced by any revenue sharing that is agreed with the contractor associated with the sale of recovered materials and/or energy from the facility. Other factors influencing the waste charge will be the extent to which the council has a share in the ownership of the AWRRT infrastructure and/or the land upon which the facility is located.

The cost of transporting waste material to the AWRRT is generally not included in the gate fee. Rather it remains a part of the collection contract. Local governments have expressed a desire to exclude collection system arrangements from the potential procurement for processing solutions. Collection arrangements nevertheless influence the consideration of processing solutions and vice versa. A systems approach is therefore valuable and a successful bidder for an AWRRT solution is likely to want to understand the collection system arrangements in place.
2.7 EXISTING INFRASTRUCTURE AND POTENTIAL SITES FOR AWRRT

2.7.1 Existing infrastructure

A diverse mix of waste and resource recovery infrastructure is located in metropolitan Melbourne. An audit of the region’s infrastructure in 2015-16 identified over 150 facilities that collectively managed around 10.4 million tonnes of material per annum.

The Metropolitan Implementation Plan highlights the current status, future needs and opportunities for resource recovery infrastructure in metropolitan Melbourne. The Metropolitan Implementation Plan’s Future Resource Recovery Infrastructure Schedule details the boost in consolidation and resource recovery infrastructure required to keep pace with the projected growth in waste generation and the objective to boost resource recovery and reduce the reliance on landfills. Establishing municipal residual waste processing capacity in the order of 300-400,000 tpa and establishing total processing capacity for food and garden organics of 600,000 tpa by 2026 are key to achieving this outcome.

Table 7 presents a summary of resource recovery infrastructure across the metropolitan region taken from the 2015-16 survey. The data illustrates the throughput and capacity of infrastructure that is largely dedicated to the recovery of source separated waste and materials – little, if any residual waste from the MSW and C&I waste streams is recovered within the region. Data is not available for all the facilities operating within the metropolitan region, thus tonnages are indicative.

Table 7: Summary of consolidation and resource recovery infrastructure types in metropolitan Melbourne

<table>
<thead>
<tr>
<th>Infrastructure type</th>
<th>Tonnes managed</th>
<th>Installed capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource recovery drop off</td>
<td>178,000</td>
<td>213,000</td>
</tr>
<tr>
<td>Resource recovery centres and transfer stations</td>
<td>929,000</td>
<td>1,427,000</td>
</tr>
<tr>
<td>Material recovery facilities (MRFs)</td>
<td>751,000</td>
<td>1,079,000</td>
</tr>
<tr>
<td>Organics reprocessing</td>
<td>254,000</td>
<td>296,000</td>
</tr>
<tr>
<td>Paper/card reprocessing</td>
<td>724,000</td>
<td>794,000</td>
</tr>
<tr>
<td>Glass reprocessing</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Plastics reprocessing</td>
<td>19,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Tyres reprocessing</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Wood/timber reprocessing</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Metals reprocessing</td>
<td>1,219,000</td>
<td>1,596,000</td>
</tr>
<tr>
<td>Aggregates, masonry and soils reprocessing</td>
<td>3,416,000</td>
<td>5,282,000</td>
</tr>
<tr>
<td>Textiles reprocessing</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

*Data is withheld to protect commercially sensitive information

Source: Metropolitan Waste and Resource Recovery Infrastructure Capacity Assessment Project 2015-16

Table 7 notes that resource recovery centres and transfer stations manage close to 1 million tonnes of material. Resource recovery centres and transfer stations play a key role in the integrated waste and resource recovery network to sort and aggregate materials prior to their transfer to reprocessing facilities. This role is likely to continue with the potential introduction of AWRRT. Indeed there is an opportunity to realise upgrades to existing or investment in new Resource Recovery Centre/Transfer Stations (RRC/TS) as part of establishing residual waste processing solutions. The procurement process will provide the opportunity for industry to propose how they might use and improve existing or establish new aggregation and transfer capacity in the region.
2.7.2 Site availability and selection

While mobile AWRRT technologies are available (for example portable gasifiers and combustion units), they are typically small-scale and only suitable as short-term clean-up solutions in response to disasters (e.g. floods, bush fires, hurricanes). In contrast, most of the world’s AWRRT facilities are fixed assets that require permanent sites.

The locational requirements of AWRRT solutions include:

- an area of flat land that within an appropriately zoned district that is large enough to locate the facility and any required buffer distances
- proximity to transport networks (road, rail, or water) to enable the delivery of waste
- access to the electricity grid or a neighbouring off-taker for electricity, heating/cooling, or process steam (for waste to energy solutions).

To satisfy current land use planning requirements, AWRRT solutions in the metropolitan region will need to be located within an appropriately zoned area – either Industrial Zone 1 (IN1Z) or Industrial Zone 2 (IN2Z); or in a Special Use Zone.

The footprint of AWRRT facilities vary depending on the nature and scale of the operation (processing capacity) and the extent to which other waste and resource recovery operations are undertaken on the same site. Table 8 presents indicative land requirements for different types and scales of AWRRT solutions.

Land values within the region’s industrial areas vary widely with recent estimates ranging from $250 to more than $1,000 per m². Industrial land values are subject to temporal fluctuations and trends, and are influenced by the size of the land bank that is available for industrial development; competition between developers; and the strength of the local, state and national economies.

Table 8: Indicative land requirements for AWRRT solutions

<table>
<thead>
<tr>
<th>Technology type</th>
<th>Size/capacity (tpa)</th>
<th>Total land take (m²)</th>
<th>Total land take (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaerobic digestion</td>
<td>&lt;30,000</td>
<td>Around 15,000</td>
<td>Around 1.5</td>
</tr>
<tr>
<td></td>
<td>30,000 &lt; 50,000</td>
<td>15,000 &lt; 25,000</td>
<td>1.5 &lt; 2.5</td>
</tr>
<tr>
<td></td>
<td>50,000 &lt; 100,000</td>
<td>25,000 &lt; 40,000</td>
<td>2.5 &lt; 4.0</td>
</tr>
<tr>
<td>Mechanical biological treatment</td>
<td>&lt;100,000</td>
<td>Around 35,000</td>
<td>Around 3.5</td>
</tr>
<tr>
<td></td>
<td>100,000 &lt; 150,000</td>
<td>35,000 &lt; 55,000</td>
<td>3.5 &lt; 5.5</td>
</tr>
<tr>
<td></td>
<td>150,000 &lt; 250,000</td>
<td>55,000 &lt; 75,000</td>
<td>5.5 &lt; 7.5</td>
</tr>
<tr>
<td></td>
<td>250,000 &lt; 400,000</td>
<td>75,000 &lt; 120,000</td>
<td>7.5 &lt; 12</td>
</tr>
<tr>
<td></td>
<td>400,000 &lt; 650,000</td>
<td>120,000 &lt; 230,000</td>
<td>12 &lt; 23</td>
</tr>
<tr>
<td>Thermal treatment</td>
<td>&lt; 50,000</td>
<td>Around 25,000</td>
<td>Around 2.5</td>
</tr>
<tr>
<td></td>
<td>50,000 &lt; 100,000</td>
<td>25,000 &lt; 45,000</td>
<td>2.5 &lt; 4.5</td>
</tr>
<tr>
<td></td>
<td>100,000 &lt; 150,000</td>
<td>45,000 &lt; 60,000</td>
<td>4.5 &lt; 6.0</td>
</tr>
<tr>
<td></td>
<td>150,000 &lt; 250,000</td>
<td>60,000 &lt; 100,000</td>
<td>6.0 &lt; 10</td>
</tr>
<tr>
<td></td>
<td>250,000 &lt; 400,000</td>
<td>100,000 &lt; 120,000</td>
<td>10 &lt; 12</td>
</tr>
<tr>
<td></td>
<td>400,000 &lt; 650,000</td>
<td>120,000 &lt; 200,000</td>
<td>12 &lt; 20</td>
</tr>
</tbody>
</table>

In addition to these locational requirements, there is a need to establish and maintain community support for the siting of AWRRT solutions.
2.8 MANAGING PROCESS OUTPUTS

Alternative waste treatment solutions generate products and residues from the waste that they process. The viability of a particular type of technology is often predicated on the existence of a market for the products that are recovered by a processing solution.

Markets for materials are influenced by a number of factors including:

- the market price for similar virgin materials
- the quality of the recovered materials (i.e. the extent to which the recovered materials are contaminated)
- the bulk density of the recovered materials and the cost of transporting the materials to end users or reprocessors.

Where energy or fuel is produced from the waste, it is important to consider whether:

- the energy or fuel can compete in terms of price with existing energy sources or fuels with or without government subsidies
- access to distribution networks can be achieved at reasonable cost
- the fuel can meet the necessary quality standards required by energy distribution agencies, as well as engine and boiler manufacturers.

Residues from recovery processes have to be managed in accordance with statutory regulations. This may mean that some residues have to undergo further treatment before they are sent to landfill. The cost associated with the treatment and disposal of process residues forms part of the viability equation for alternative waste treatment solutions.
3 Options appraisal and cost-benefit analysis

3.1 EXPLORING AWRRT OPTIONS

A variety of opportunities exist to divert MSW and C&I waste from landfill. The waste hierarchy (Figure 2) illustrates the Victorian Government’s preference for managing waste. This decision making principle is enshrined in the Environment Protection Act 1970. Where waste cannot be avoided and reuse of materials is not practicable, generators and managers of waste are encouraged to explore recycling, which may include composting organic waste.

Metropolitan Melbourne councils divert hard recyclables through commingled recycling contracts, and most have arrangements for the collection and processing of garden waste. The councils that are part of MWRRG’s organic waste processing contracts have the option to introduce food organics collection and processing as part of existing arrangements for garden waste (FOGO arrangements).

For some councils, particularly those with many residents living in multi-unit developments, collecting kerbside organic waste is often impracticable or cost prohibitive. In addition, research has indicated that about only 50% of the food waste that is in householders’ residual bins can be effectively recovered through FOGO arrangements, with the remaining food waste being attached to containers or wrapping, or considered by residents to be too odorous to place in their garden waste bin.

Residual waste is essentially the waste that is left over when waste avoidance programs and higher order reuse and recycling options for source separated waste have been exhausted. The residual waste treatment solutions described in Section 3.3 have been developed to recover value from the remaining materials through advanced sorting and processing and waste to energy solutions (such as anaerobic digestion of organic waste or thermal treatment of combustible material).

Figure 2: The waste hierarchy

![Waste Hierarchy Diagram]
3.2 WASTE HIERARCHY INTERVENTION MODEL (WHIM)

MWRRG has created the waste hierarchy intervention model (WHIM) to explore future interactions between different resource recovery system approaches and landfill requirements within the region. WHIM is a model that enables MWRRG to test combinations of waste management and resource recovery technologies from different tiers of the waste hierarchy. The model enables year-by-year estimation of waste flows (up to year 2051) by LGA, by sub-region, and at the regional level.

WHIM is capable of estimating the net present value (NPV) of different waste hierarchy interventions (scenarios). This means that for each scenario, the model can show the projected costs or savings in today’s dollars.

WHIM incorporates current and forecast municipal waste generation and collection tonnage data for the metropolitan region, together with the following management options:

- collection and processing of source separated food organics (FO)
- collection and processing of source separated garden organics (GO)
- combined collection and processing of source separated food and garden organics (FOGO)
- collection and processing of commingled recyclables through material recovery facilities (MRFs)
- collection and treatment of residual waste through combinations of advanced waste resource recovery technology (AWRRT) solutions
- diversion of residual MSW through improved capture of organics and recyclables from the residual stream, including reducing contamination/increasing recovery within collected organics and recycling streams
- diversion through recovery of the hard waste residual stream (through a non AWRRT solution)
- collection and disposal of residual waste to landfill.

The ability to reduce the diversion/recovery rate of a particular scenario that may result from market failure (such as a collapse in the market for commingled recyclables or facility failures) has also been incorporated into WHIM.

While WHIM is a sophisticated model, there are numerous assumptions and simplifications in the current model that have been made in view of the available data. These will be refined in future iterations.

Refer to Appendix 3 for model assumptions, details of the key outputs and limitations of the model.

3.2.1 Estimating costs of waste hierarchy interventions

Gate fees charged by facility operators for the treatment or disposal of waste are the most significant cost component in the model and the parameter most likely to be affected by implementation of AWRRT and FOGO solutions. Where available, real gate fees charged to councils through MWRRG’s existing collaborative contracts for residual and organics kerbside disposal have been incorporated into WHIM.

The existing metropolitan landfill contracts sunset in March 2021. MWRRG expects landfill prices to rise above inflation into the future as a result of landfill closures, decreasing approved airspace, and increasing engineering/operations/compliance costs and profit margins. However the rate and quantum of that increase is uncertain.

In order to model the cost benefit of different interventions, WHIM has made assumptions about the future cost of landfill (see Appendix 3 for assumptions). The WHIM assumes:

- an increase in landfill costs every five years from 2021
- an additional increase of 15% every five years, which with annual CPI indexation at 2.5% per year equates to an effective increase of 30% in landfill gate fees every five years. This increase occurs regardless of the implementation of AWRRT and FOGO solutions.
A summary of the estimated range of gate-fees for each AWRRT technology option (accepting kerbside residual waste only) is provided in Table 9.

The medium values have been estimated from the cost build-up while the low and high range values are estimates based on industry knowledge. The modelling has been tested with low, medium and high gate fees, given the uncertainty in actual gate fee costs that may apply in individual circumstances.

Table 9: Summary of AWRRT gate fees 2017-18

<table>
<thead>
<tr>
<th>AWRRT</th>
<th>Low ($/t)</th>
<th>Med ($/t)</th>
<th>High ($/t)</th>
<th>Key assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass burn combustion</td>
<td>$125</td>
<td>$143</td>
<td>$180</td>
<td>Capacity: 300,00 tpa</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diversion performance: 85%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Key outputs: electricity to grid, residuals to landfill</td>
</tr>
<tr>
<td>MBT (to compost)</td>
<td>$170</td>
<td>$188</td>
<td>$220</td>
<td>Capacity: 250,00 tpa</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diversion performance: 63%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Key outputs: saleable recyclables, compost and residuals to landfill</td>
</tr>
<tr>
<td>MBT + gasification</td>
<td>$170</td>
<td>$193</td>
<td>$220</td>
<td>Capacity: 300,00 tpa MBT facility producing RDF to a 200,000 tpa gasification plant</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diversion performance: 86%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Key outputs: saleable recyclables, compost and residuals to landfill</td>
</tr>
</tbody>
</table>
3.3 SCENARIO COST-BENEFIT ANALYSIS

Aligned to the aims of Metropolitan Implementation Plan, WHIM has been used to model the possible impact of different waste hierarchy interventions and their ability to achieve the following targets:

- recover 25% of residual MSW collected through collaborative contracts by 2026
- limit the quantity of residual MSW sent to landfill in 2026 to 2016 levels (940,000 tpa).

The landfill diversion and financial impacts of five scenarios have been modelled compared to business as usual (all residual waste to landfill).

The scenarios seek to illustrate whether AWRRT can achieve the targets and deliver better environmental outcomes compared to landfill as a business as usual scenario. Councils will need to consider the outcomes they seek to achieve and the cost implications. Ultimately the procuring councils will need to determine their preferred balance of financial, social and environmental costs and benefits. At this stage the findings of the scenario modelling should be considered as an illustrative starting point for council’s consideration due to the uncertainty associated with some of the core data inputs to WHIM. Therefore this cost benefit analysis does not identify a preferred scenario.

Business as usual (BAU) scenario

No changes to the core waste management services, with landfill for all residual wastes.

Outcomes

- Overall MSW diversion will continue its current trajectory.
- Landfill costs will continue to increase (see assumptions in Section 3.2.1).
- The target to recover 25% residual MSW collected through collaborative contracts for residual waste by 2026 will not be achieved.
- The target to limit the quantity of residual MSW sent to landfill in 2026 at 2016 levels will not be achieved.
- Additional landfill capacity likely to be needed.

Scenario 1 - FOGO implementation by 24 councils

The 24 councils with access to the North-West, South-East and Eastern Metropolitan Organics Contracts implement FOGO services, but do not adopt advanced waste processing.

Outcomes

- Increases overall MSW diversion (compared to BAU) from 43% to 50%.
- Lowest diversion and does not achieve target to maintain the 2016 MSW landfill tonnage in 2026.
- Additional costs across the region of $211 million over 25 years (in today’s dollars). The additional cost to divert the material (through FOGO) is $60 per tonne (in today’s dollars), averaged over 25 years.

This scenario could be improved as better data becomes available on collection costs, capture rates and processing cost efficiencies.

Scenario 2 - combustion of residual waste only

Deploy a combustion facility to treat and recover energy from approximately 300,000 tonnes of residual MSW each year from councils in the south and east of the region. No implementation of FOGO services.

Outcomes

- Increases overall MSW diversion (compared to BAU) from 43% to 56%.
- Achieves targets to recover at least 25% of the residual MSW by 2026 and keeps the 2026 municipal waste landfill tonnage below the 2016 level.
- Savings across the region of $119 million over 25 years (in today’s dollars). The savings achieved for every additional tonne of waste diverted is $24 per tonne (in today’s dollars), averaged over the 25 years.
Scenario 3 - FOGO plus combustion of residual waste

FOGO implemented by 24 councils plus a combustion facility to treat and recover energy from approximately 300,000 tonnes of residual MSW each year in the south and east of the region.

Outcomes
- The highest overall MSW diversion rate of 63% (compared to BAU).
- Achieves targets to recover at least 25% of the residual MSW by 2026 and keeps the 2026 municipal waste landfill tonnage below the 2016 level.
- Additional costs across the region of $92 million (in today’s dollars) over 25 years. The additional cost to divert the material is $10.80 per tonne (in today’s dollars), averaged over the 25 years.

Scenario 4 - Mechanical Biological Treatment and gasification of residual waste

Mechanical biological treatment (MBT) with anaerobic digestion of the organics and gasification of the residual digestate for energy recovery. Able to accept 300,000 tonnes of residual MSW each year from councils in the south and east of the region. No implementation of FOGO services.

Outcomes
- Increases overall MSW diversion to 56% (compared to BAU).
- Achieves targets to recover at least 25% of the residual MSW by 2026 and keeps the 2026 municipal waste landfill tonnage below the 2016 level.
- Additional costs across the region of $45 million over 25 years (in today’s dollars). The additional cost to divert the material is $8.80 per tonne (in today’s dollars), averaged over the 25 years.

Scenario 5 - Mechanical Biological Treatment of residual waste only

Mechanical biological treatment (MBT) of 300,000 tonnes of residual MSW each year from councils in the south and east of the region. An advanced sorting solution that recovers metals, composts the garden organics via in-vessel-composting to produce a low grade compost-like material, and sends residual waste to landfill and provides no energy recovery and assumes no implementation of FOGO services.

Outcomes
- Increases overall MSW diversion to 52% (compared to BAU).
- Does not achieve targets to divert at least 25% of the residual MSW by 2026 and keep the 2026 municipal waste to landfill tonnage below the 2016 level.
- Additional costs across the region of $36 million over 25 years (in today’s dollars). The additional cost to divert the material is $10.46 per tonne (in today’s dollars), averaged over the 25 years.

The analysis of the six scenarios shows that establishing AWRRT is necessary in order to achieve the targets to divert at least 25% of the residual MSW by 2026 and to keep the 2026 MSW landfill tonnage below the 2016 level. The analysis further shows that introducing FOGO services alone will not achieve those targets.

A summary of the details and outcomes of scenario modelling are presented in Table 10 and the relevant time series curves are presented in Figure 3 to Figure 7. A complete description of the scenario modelling is presented in Appendix 3.

Councils participating in a procurement process will need to consider the different financial, social and environmental costs and benefits various waste processing solutions offer.

Section 3.4 considers the broader environmental, social and economic impacts of different waste hierarchy interventions.

A more refined cost benefit analysis will be developed through the cluster business case for councils participating in a procurement process. The multi-phase procurement strategy (Section 6) will further enable councils to inform their decision of their preferred solution, and the associated costs and benefits, with information from bidders that progressively becomes more detailed.
Table 10: Regional waste management and resource recovery scenarios

This modelling and analysis will be refined further and tailored to the participating cluster of councils through the development of the cluster specific business case. Subsequently the results are expected to vary from those presented below.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Residual tonnes to landfill in 2026</th>
<th>Diversion of residual MSW collected via MWRRG contracts in 2026</th>
<th>Difference NPV (compared to BAU in 2018 dollars)</th>
<th>Net NPV cost per additional tonne diverted (compared to BAU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAU</td>
<td>• No change to the core waste management services with landfill for all residual waste.</td>
<td>1,133,441</td>
<td>0%</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
| Scenario 1        | • No AWRRT solution is implemented, with landfill for all residual waste.  
• 24 councils (west, north, east and south) implement FOGO by 2019.                                                                                                                                       | 997,349                             | 14%                                                           | $211 million                                      | $59.69                                                   |
| Scenario 2        | • Southern councils commit set tonnes at 2023 and eastern councils commit set tonnes at 2030 (based on 2015-16 annual residual waste generation).  
• 300,000 tonnes of committed residual waste diverted through combustion by 2030 (assumes private sector investment of $300-$400 million). Includes energy recovery. | 881,706                             | 25%                                                           | -$119 million                                     | -$23.55                                                   |
| Scenario 3        | • Southern councils commit set tonnes at 2023 and eastern councils commit set tonnes at 2030 (based on 2015-16 annual residual waste generation).  
• Approx. 300,000 tonnes of residual waste diverted through a combustion facility(ies) by 2030 (assumes private sector investment of $300-$400 million). Includes energy recovery.  
• 24 councils (west, north, east and south) implement FOGO (regular service) by 2019 (changing existing GO system to FOGO), capture rate of FO of 40% by 2019. | 748,134                             | 38%                                                           | $92 million                                       | $10.75                                                   |
<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Residual tonnes to landfill in 2026</th>
<th>Diversion of residual MSW collected via MWRRG contracts in 2026</th>
<th>Difference NPV (compared to BAU in 2018 dollars)</th>
<th>Net NPV cost per additional tonne diverted (compared to BAU)</th>
</tr>
</thead>
</table>
| Scenario 4                | • Mechanical biological treatment with anaerobic digestion of the organics and gasification of the residual digestate for energy recovery.  
• Southern and eastern councils commit set tonnes (2015-16 annual residual waste generation) at 2023.  
• In total approximately 300,000 tonnes of committed residual tonnes diverted through an MBT facility(ies) by 2030 (assumes private sector investment of $300-$400 million).  
• No food and garden organics recovered. | 876,317 | 26% | $45 million | $8.79 |
| Scenario 5                | • A relatively simple advance sorting solution that recovers metals, composes the garden organics via in-vessel-composting to produce a low grade compost like material. Residual waste to landfill.  
• Approx. 300,000 tonnes of residual waste diverted through an MBT facility(ies) by 2030 (assumes private sector investment of $300-$400 million).  
• No energy recovery.  
• No food and garden organics recovered. | 963,517 | 17% | $36 million | $10.46 |

See Appendix 3 for assumptions.
Figure 3: Business as usual scenario

Figure 4: Scenario 1 - FOGO only
Figure 5: Scenario 2 - Combustion only

Figure 6: Scenario 3 - FOGO plus combustion
Figure 7: Scenario 4 - Mechanical biological treatment (MBT) plus gasification

Figure 8: Scenario 5 - Mechanical biological treatment (MBT) only
3.4 EMISSIONS ABATEMENT AND ENERGY PRODUCTION

The non-financial impacts that have been considered in the regional business case are:

- **Renewable energy production (for energy-from-waste AWRRT solutions):** an estimation of the production of renewable energy, noting that energy recovered in thermal systems is only partly renewable.
- **Carbon impacts:** a high-level carbon impact analysis based on waste flows that estimates:
  - avoided landfill emissions for organic waste diverted from landfill based on the National Greenhouse and Energy Reporting (NGER) landfill emissions methodology and making assumptions around BAU landfill gas capture performance
  - carbon impacts of replacing existing grid electricity (mostly fossil fuel derived) with partly-renewable energy, based on published generic rates of grid carbon intensity (NGERs)
  - carbon impacts of recovered recyclable materials (e.g. metals, compost) based on published unit rates for carbon savings through recycling
  - transport carbon impacts based on transport distances estimated in the model and published unit rates for carbon intensity of heavy vehicle transport.

Table 11: Energy production and abatement of carbon emissions

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Carbon emissions abatement (averaged over 25 yrs)</th>
<th>Power production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1 FOGO only</td>
<td>122,702 tonnes CO₂-equivalent per year.</td>
<td>No energy production in this scenario.</td>
</tr>
<tr>
<td></td>
<td>The lowest of all scenarios.</td>
<td></td>
</tr>
<tr>
<td>Scenario 2 combustion only</td>
<td>170,322 tonnes CO₂-e per year.</td>
<td>17 MW (conservatively low).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>37% of which would be renewable energy.</td>
</tr>
<tr>
<td>Scenario 3 FOGO plus combustion</td>
<td>287,767 tonnes CO₂-e per year.</td>
<td>Approximately 18 MW of power.</td>
</tr>
<tr>
<td></td>
<td>The highest of all scenarios.</td>
<td>35% would be renewable.</td>
</tr>
<tr>
<td>Scenario 4 MBT plus gasification</td>
<td>173,968 tonnes CO₂-e per year.</td>
<td>Approximately 17 MW of power.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>37% would be renewable.</td>
</tr>
<tr>
<td>Scenario 5 MBT only</td>
<td>92,806 tonnes CO₂-e per year.</td>
<td>No energy production in this scenario.</td>
</tr>
</tbody>
</table>

See Appendix 3 for details regarding how emissions have been calculated.
3.4.1 Job creation

It is likely that the increased recovery of waste under the scenarios will lead to the creation of new jobs in and around Melbourne, including:

- direct permanent jobs in operations and maintenance of new or expanded facilities (AWRRT, organics processing)
- direct permanent jobs (mostly drivers) to service the increased number of waste collections under FOGO implementation
- temporary jobs for design and construction of new facilities, which for a large AWRRT plant could extend over three years
- indirect jobs in service and support industries (maintenance contractors, suppliers, service firms) and downstream secondary industries such as compost utilisation, metals recycling or civil construction (using bottom ash aggregates).

Table 12: Employment impacts for modelled scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Jobs outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1 FOGO only</td>
<td>Additional jobs expected to be created through greater FOGO implementation, will be in additional collection services, estimated to be around 50 new roles.</td>
</tr>
<tr>
<td></td>
<td>Approximately five to six new jobs can be expected in organics processing.</td>
</tr>
<tr>
<td></td>
<td>No significant change in landfill jobs is expected due to the relatively minor impact on landfill inputs.</td>
</tr>
<tr>
<td>Scenario 2 Combustion only</td>
<td>Significant additional direct jobs are expected to be created through the development of a mass burn combustion facility. For a 300,000 tpa facility, data from similar facilities overseas suggest that 50 direct jobs may be created in site operations and maintenance.</td>
</tr>
<tr>
<td></td>
<td>Direct job losses in the landfill sector as a result of the drop in throughput is expected to be minimal, with up to three potential job losses.</td>
</tr>
<tr>
<td></td>
<td>A net direct job creation of around 47 jobs is expected. In the order of 300-400 jobs will be created over the three year construction period.</td>
</tr>
<tr>
<td>Scenario 3 FOGO plus combustion</td>
<td>Job creation is likely to be a combination of the outcomes expected in scenarios 1 and 2.</td>
</tr>
<tr>
<td></td>
<td>A net direct job creation of around 102 jobs is expected. In the order of 300-400 jobs will be created over the three year construction period of the AWRRT, with around three jobs at landfills being lost.</td>
</tr>
<tr>
<td>Scenario 4 MBT plus gasification</td>
<td>The MBT facility incorporates some manual sorting processes and a high maintenance requirement resulting in more jobs than some other processes. The staff required to run the gasification plant will be similar to other thermal plants, despite it being smaller capacity that the plant in scenarios 2 and 3.</td>
</tr>
<tr>
<td></td>
<td>Around 60 new jobs for operations and maintenance could be created.</td>
</tr>
<tr>
<td></td>
<td>In the order of 400 jobs will be expected over the approximate three year construction period, with around three jobs at landfills being lost.</td>
</tr>
<tr>
<td>Scenario 5 MBT only</td>
<td>The MBT facility incorporates some manual sorting processes and a high maintenance requirement resulting in more jobs than some other processes.</td>
</tr>
<tr>
<td></td>
<td>Around 55 new jobs for operations and maintenance could be created.</td>
</tr>
<tr>
<td></td>
<td>In the order of 400 jobs will be expected over the approximate three year construction period, with around two jobs at landfills being lost.</td>
</tr>
</tbody>
</table>
3.4.2 Other impacts

There are other social and environmental costs and benefits which are difficult to quantitatively evaluate but are nonetheless important. These include:

- reduced need for future landfills and associated avoided (or delayed) amenity and environmental impacts of additional landfill sites
- social/economic development impacts including:
  - support for secondary industries utilising recovered products (e.g. bottom ash in brick making or civil construction applications)
  - support for industry by potentially providing low cost, additional baseload renewable power/heat
- air quality/emission impacts
- benefits of attracting significant private sector investment to establish and operate long term facilities in the local resource recovery sector
- growing and enhancing the expertise of the local professionals required to support the design, construction and operations of AWRRT
- supply of secondary materials, offsetting the need for virgin materials (e.g. aggregates/road-base recovered from incinerator bottom ash)
- providing long term certainty to councils (and communities) on the environmental, social and economic outcomes from managing residual waste.

MWRRG will undertake further work on the financial, social and environmental impacts of different AWRRT solutions during the development of the cluster business cases.

The details of the non-financial impacts are presented in a separate report in Appendix 2.
4 Managing risks

Managing risks effectively is essential to the successful delivery of AWRRT solutions.

The risks associated with the selection, delivery and operation of a resource recovery solution can be broadly considered under the following three headings:

- procurement risks
- contracting risks
- finance and commercial risks.

The sections below provide a high level discussion of these risks.

4.1 PROCUREMENT RISKS

The procurement of AWRRT solutions requires extensive investment in time and resources by state and local government, and by industry. The procurement process will seek responses from industry to deliver councils’ residual waste processing requirements resulting in the creation and sharing of extensive documentation, accompanied by dialogue between the parties, much of which will be confidential. The procuring authority (MWRRG and councils) will need to implement and maintain processes that are fair and transparent, whilst protecting any confidential information that is shared by bidders.

A legal challenge from an unsuccessful bidder or any another party, disputing the selection process that has been followed, may introduce major delays and have significant cost implications for the project. Therefore, the procurement process will adhere to a project specific probity plan that promotes transparency and reduces the risk that the selection process will be challenged during or after the procurement stage.

The main risks associated with the procurement stage are associated with:

- partnering arrangements
- procurement process.

These are discussed below.

4.1.1 Partnering arrangements

The number of partners in the procurement has the potential to influence the complexity and clarity of what is required from the procurement as a whole, and is also likely to influence the market appetite for the procurement in question. Clear and binding agreements are the best solution for inter-council partnering arrangements as they demonstrate commitment from each party to award the contract being procured on the basis of a common set of objectives. However, it is important that individual councils recognise that they may not get their ultimate preferred solution, but that partnering delivers economies of scale and risk sharing benefits that may not otherwise be achieved by a council undertaking a procurement on its own.

4.1.2 Procurement process

Residual waste treatment procurements are complex and it is often not possible to define the detailed requirements of the contract at the outset of a procurement. To help address this, MWRRG advocates that councils adopt a multi-stage procurement process and an Outline Specification that sets out councils’ broad objectives. The Outline Specification will be refined through competitive dialogue procurement process with short-listed bidders at each short-listing stage during the procurement. A competitive dialogue procurement process enables the councils’ requirements to be discussed, refined and responded to by bidders through a probity-proof dialogue process.

Other documentation at the start of procurement will include the proposed project agreement and payment mechanism, and a proposed performance mechanism for monitoring of the contractor’s performance against specified criteria. The number and nature of shortlisting stages will be made clear from the outset to allow bidders to gauge the level of resource likely to be required to participate in the process.

The evaluation criteria and associated weightings that will be used during the procurement process will be agreed by MWRRG and participating councils and published with the procurement documentation. Criteria and their weightings can be different at different stages of the procurement (e.g. weighted towards technical responses at the early stages and more weighted to financial/cost elements at the latter stages) but this must be agreed and published at the commencement of the procurement process to minimise the risk of challenge from unsuccessful bidders or third parties.

It is also important to design and test the evaluation criteria to minimise the risk that the procurement ends up awarding a contract to a bidder that is unlikely to meet the outcomes that were specified at the start of the procurement, or having to abandon a procurement because the councils do not wish to award a contract to a ‘winning’ bid that does not conform with their aspirations.
Evaluation of tenders and shortlisting of bidders have to be undertaken in full accordance with the published details, fully documented and auditable, and with clear and robust recommendations as to which bidders are to be shortlisted. Feedback will be provided to successful and unsuccessful bidders.

Section 6 discusses the procurement process in more detail.

4.2 CONTRACTING RISKS

The guiding principle of risk management and transfer in contracts is that risk should be held by the party(ies) best placed to control/manage that risk. Contracts that transfer risks to an inappropriate party are almost always poor value for money as risks are priced and paid for, whether they arise or not.

The main contracting risks are associated with:

- security of waste supply
- waste composition
- planning and approvals
- changes in law.

These are discussed below.

4.2.1 Security of waste supply

The amount of residual waste that is to be managed through the contract is the major factor in defining the project and contract requirements. The risk that waste will not be available at the contracted levels needed to be managed through clear contractual provisions. This is critical for the contractor as the flow of waste (and hence income) from the councils is the basis on which the contractor and its lenders decide to invest in the project. This commitment is usually dealt with by setting a guaranteed minimum tonnage (GMT) provision and/or exclusive waste provisions.

In contracts containing a GMT, councils would be obliged for the full contracted amount of waste, irrespective of whether councils actually deliver all of the waste to the contractor for processing. As such, GMT is often referred to as a ‘Take or Pay’ commitment.

In contracts where exclusivity is provided instead of, or in addition to, GMT, the councils commit to provide contract waste (that is clearly defined in terms of specific waste streams such as kerbside collected residual waste) on an exclusive basis up to a maximum tonnage per annum for the term of the contract. This means that councils surrender any opportunity to find alternative (potentially lower cost) sources for contract waste that may become available during the contract term.

4.2.2 Waste composition

The risk that the composition of the contracted waste will change during term of the contract is usually characterised in terms of ‘revolutionary’ and ‘evolutionary’ change. Revolutionary change is where the composition of contract waste changes due to changes in collection methodologies that are introduced by councils over time. Evolutionary change relates to changes in the material composition of waste as a result of gradual changes due to socio-economic or other general factors (for example changes in household consumption and/or behaviour or changes to packaging) not directly under the control of the contracting councils.

Contractors are generally prepared (if reluctant) to accept the evolutionary change element but they are not normally prepared to take revolutionary change risk on the basis that councils will be in control of (or able to influence) collection arrangements, but have no direct control over evolutionary change.

The contractor is best able to manage evolutionary change by providing a robust, flexible, and adaptable treatment service and technology that is capable of dealing with the relatively slow pace and magnitude of evolutionary change.

4.2.3 Planning and approvals

Residual waste treatment plants are controversial propositions and will attract varying levels of support and opposition from stakeholders. In addition to securing a site for the AWRRT facility, proponents will need to obtain planning permission and a works approval prior to construction. On completion of the construction and commissioning phases, the contractor will need to obtain a licence from EPA to operate the facility.

If the procuring councils are in a position to secure a site it may be possible to secure planning permission before, or during, the procurement which would reduce the complexity of the contract by removing the planning provisions from the contract. However, this approach would require councils to make a decision on the technology before completing the procurement process.

If planning consent has not been secured before achieving financial closure in the contract negotiations, the first phase of the project after closure will be dedicated to securing planning permission. The contractor will be responsible for using reasonable endeavours to secure satisfactory planning permission. If this is not secured, the councils could be liable for contract breakage costs which could run to many tens of millions of dollars.
The contractor will be responsible for undertaking the consultation exercises required as part of the planning application. However councils who wish to participate in procuring AWRRT, are well placed to lead coordinated and consistent communications with their communities on the vision for waste and recycling in their area and the role AWRRT will play in that. Section 7.3 provides further discussion on community engagement.

The issue of an EPA works approval will only occur when sufficient evidence demonstrates compliance with all relevant legislation and policy. An increase in the burden of evidence is generally associated with the selected technology and targeted feedstock. EPA works approval decisions are also subject to third-party review at the Victorian Civil and Administrative Tribunal. The process can result in a determination which supports, amends or overturns the approval. To be issued an operational licence, evidence will be required that demonstrates full compliance with the works approval conditions and application.

4.2.4 Changes in law
During the life of a long term waste treatment contract there are likely to be changes in waste specific legislation or binding guidance which affect the works and/or services to be provided by the contractor. Changes in law are often difficult to price, even when foreseeable at the date of the contract. This means that if all the risks associated with future changes in law are placed on the contractor, the contractor would artificially increase the price of the contract to cover all potential cost risks relating to foreseeable changes in law whether they occur or not.

To inform the management of risks associated with future changes in law, MWRRG will develop a ‘Waste Law List’ that will identify specific changes in law that are foreseeable at the date of the contract that contractors cannot be expected to price with sufficient certainty.

The financial consequences associated with any of the foreseeable specific changes in law on the Waste Law List coming into force are generally at councils’ risk; whereas the financial consequences associated with any changes of law that are not on the Waste Law List are likely to be at the contractor’s risk.

4.3 FINANCE AND COMMERCIAL RISKS
Unlike traditional collection and disposal contracts, residual waste processing solutions require a significant upfront investment in fixed assets that require maintenance and periodic upgrade over the contract period.

Investors need to be certain that their investment is protected from policy changes that may result from changes in government at the local, state and federal level. This uncertainty is reduced where local government is a major stakeholder in the project, for example, by becoming a party to a joint venture arrangement. Similarly, the availability of grant funding from the state government which offsets some of the initial capital spend can help to build confidence within the private sector.

AWRRT solutions are also reliant upon strong and sustainable markets for the products (materials and/or energy/heat) that are obtained from processing residual waste. While much of this commercial risk will be carried by the contractor or joint venture, MWRRG in association with Sustainability Victoria will work with local government to progress the development of local and regional markets for recovered materials in line with the Victorian Organic Resource Recovery Strategy and the Victorian Market Development Strategy for Recovered Resources.
5 Contracts for joint procurement of AWRRT

This section explores the limitations of the existing contract arrangements that have been used by metropolitan councils for waste and recycling services, and discusses alternative arrangements that councils could adopt to achieve the delivery of new infrastructure to treat residual MSW.

The challenges that MWRRG and metropolitan councils face to procure residual waste treatment solutions include:

- no single metropolitan council currently manages a sufficient quantity of residual MSW to attract investment by the private sector in an exclusive solution
- solution providers are looking to councils to aggregate and supply at least 150,000 tonnes of residual MSW per annum
- there are no privately owned and operated AWRRT facilities within the region capable of processing substantial quantities of residual MSW
- there is a lack of expertise within local government to oversee the design, construction, commissioning and long-term operation of complex AWRRT solutions
- local government is generally reluctant to raise the capital investment required for the construction of residual waste treatment infrastructure
- metropolitan councils prefer to transfer appropriate risks to experienced and competent private sector solution providers.

Given the above, it is essential that MWRRG and councils develop contract arrangements that facilitate the:

- appointment of an entity (or entities) to construct and operate AWRRT solutions
- financing of capital investment (land acquisition and construction) and the operation of the facilities
- identification and acquisition of the land upon which the facilities will be located.

A range of contract arrangements exist that councils could adopt to address these challenges.

5.1 LOCAL GOVERNMENT WASTE AND RESOURCE RECOVERY CONTRACTS

5.1.1 Traditional council contracts

Historically, metropolitan councils managed residents’ waste through council-owned and operated facilities and services. But the adoption of compulsory competitive tendering over the last 20 years has meant that most metropolitan councils now engage contractors to undertake services.

Out-sourcing waste and recycling services has led to efficiencies in service delivery. However, as the quantity of waste through any one council contract has been insufficient to support investment in new resource recovery technology, councils have had little option but to take what the local market has been willing to provide using existing infrastructure. This has resulted in councils having little control over the available solutions or the outcomes.

5.1.2 MWRRG-led collective procurements

Section 49H(1) of the EP Act, enables MWRRG to facilitate the joint procurement of waste and resource recovery facilities and services on behalf of metropolitan councils. Under the EP Act, metropolitan councils that participate in an MWRRG facilitated procurement are exempt from section 193 of the Local Government Act 1989, which otherwise requires councils to obtain Ministerial approval to enter into joint contracts for services.

MWRRG is well-placed to lead the procurement of waste and resource recovery solutions on behalf of metropolitan councils, but it is important to acknowledge that under the EP Act, MWRRG cannot:

- own or operate a waste management facility
- apply for or hold a planning permit
- enter into contracts for the procurement of waste and resource recovery facilities or services, unless the contract is jointly entered into with one or more of the region’s councils.

In the last decade MWRRG has worked with clusters of metropolitan councils to aggregate quantities of residual MSW, garden and food organics, and commingled recycling to achieve economies of scale for contracting purposes. Most metropolitan councils are now parties to one or more of MWRRG’s collective contracts and have benefitted from the ‘buying power’ that collective landfill, composting and recycling procurements have achieved through the aggregation of councils’ waste.
MWRRG has developed a tripartite contract (see Figure 9) that enables MWRRG to be principal to a collective contract, so long as one or more of the partnering councils are co-signatories to the deed with the contractor.

The tripartite contract has generally worked well for collective procurements for solutions based on existing infrastructure. However, MWRRG, partnering councils and potential contractors have experienced major procurement challenges where the tripartite contract has been used for the delivery of new infrastructure.

**MWRRG TRIPARTITE CONTRACT**

MWRRG has the ability to aggregate waste and recyclable tonnage via collective procurements facilitated on behalf of local governments.

Access to long term, secure and large quantities of waste and recyclable material is critical to enable industry investment in modern, efficient and cost effective infrastructure.

Following completion of the joint procurement process, MWRRG manages the subsequent contracts in its role as facilitating contract principal. MWRRG manages annual contracts with a value of more than $100 million:

- landfill contracts with 26 participating councils (840,345 tonnes processed under contract in 2017-18)
- a recycling processing contract with four participating councils (60,054 tonnes processed under contract in 2017-18)
- organics processing contracts with 19 participating councils (259,345 tonnes processed under contract in 2017-18).

MWRRG’s tripartite contract was designed to facilitate a service delivery model predicated on the use of existing infrastructure that is owned and operated by the service provider. This model has worked effectively in such circumstances.

The tripartite contract is not well suited to contracts that require substantial capital investment in new infrastructure by the private sector before commencement of service delivery, as will be needed to establish residual waste processing solutions.

MWRRG has sought legal advice on effective contract model(s) to inform the expectations of procuring councils. The multi-phase procurement process will provide the opportunity for local government to develop a preferred contract model informed by industry experience and expectations.

Figure 9: MWRRG traditional contract model
5.2 CONTRACT ARRANGEMENTS THAT SUPPORT THE DELIVERY OF NEW INFRASTRUCTURE

5.2.1 Self-procure and individually negotiate a contract

At its simplest, individual councils could contract a service provider to deliver new resource recovery infrastructure. While such a contract will give councils a high degree of control over where their waste goes to be treated, individual metropolitan councils are unlikely to be able to supply sufficient residual waste to be attractive to the market. A contractor would have to agree to separate contracts with a number of councils to secure a critical mass of waste, which is likely to take a number of years (as evidenced by recent experience in Western Australia). Each council would be severally liable under its own contract. It is also likely that the contractor, rather than the councils, would benefit from any economies of scale associated with the solution.

5.2.2 Collectively procure and negotiate a contract

As evidenced by the Metropolitan South-East Organics Contract, it is possible for a group of councils to negotiate a contract with a private company to deliver new infrastructure, using the MWRRG tripartite contract. However, the Metropolitan South-East Organics Contract has shown that the complexities associated with the multiple contract arrangements that sit behind the tripartite contract, may lead to financing challenges for the contractor. Decision-making during the procurement and contract phases is likely to be protracted as councils will need time to reach consensus.

Collective negotiation of a contract with a solution provider (if achievable) could bring economies of scale to the councils, but individual councils will likely forego some control over whether the contract expressly meets their requirements. Each council would be jointly and severally liable under the contract.

5.2.3 Adopt a special purpose vehicle (SPV)

Using their entrepreneurial powers under section 193 of the Local Government Act 1989, a group of councils could work together to establish a company through share ownership – a special purpose vehicle (SPV) – to negotiate and enter into a contract with a private entity for the delivery and operation of an AWRRT solution. The SPV would be a separate legal entity and any liabilities associated with the contract would be ring-fenced, thereby greatly limiting councils’ liabilities under any contract that the SPV manages. In its simplest form each council that is a party to the contract would hold shares in the SPV.

The SPV would have the powers necessary to carry out the project, which includes the ability to:

- acquire and dispose of any land necessary for the contract
- apply for planning permission for an AWRRT facility on land that it owns or otherwise acquires
- grant a concession to the contractor to use the land for the purposes of the contract
- engage an agent to manage the contract.

The SPV would have its own board, and if necessary its own officers. The appointment of board members could be done in a number of ways:

- each council could appoint its own representative
- councils could each be given a vote to determine suitably qualified candidates
- there could be a combination of the above options.

The SPV can nominate an agent that can manage the contract on a day-to-day basis. MWRRG can play this role in the same way it does for current contract arrangements. The creation of the SPV as a corporation is a relatively simple process. As a private corporation (even though its shareholders are public authorities), the SPV would be subject to regulatory reporting requirements under the Corporations Act 2001.

An SPV would bring economies of scale to the contract and be attractive to the market as a contracting entity.

There are examples of where Victorian councils have collectively procured complex infrastructure and services using a SPV (see Establishing Regional Kitchen and Community Chef next page).
ESTABLISHING REGIONAL KITCHEN AND COMMUNITY CHEF

Community Chef is an innovative local government-owned social enterprise that provides quality meals at affordable prices for people who are nutritionally at risk.

Community Chef is the result of concerns expressed by Victorian local governments about long-term food security and nutritional wellbeing of older people and people with a disability.

Failure of the private market to provide suitable choice and quality, and the significant level of financial investment required by individual councils to meet food safety standards and upgrade existing kitchens, meant a new and long-term solution was critically needed.

In response, 13 Victorian councils came together to drive the development and construction of a state-of-the-art food production facility - Regional Kitchen Pty Ltd.

Regional Kitchen was a Special Purpose Vehicle (SPV) incorporated by the 13 councils using the entrepreneurial powers under the Local Government Act 1989. Regional Kitchen leased the facility to Community Chef (RFK Pty Ltd), which was another SPV formed by a number of councils, including those who established Regional Kitchen.

Regional Kitchen Pty Ltd, owned the land, building and the plant. It leased the facilities to Community Chef (RFK Pty Ltd), which employed the staff and produced the meals. Both companies are owned by local government, and only local governments can be shareholders.

By registering the service as a company, Councils could ensure that risks and liabilities associated with the project could be quarantined in the company vehicle. A Shareholder Agreement and Constitution define the operation of both companies, and a separate agreement specifies meal supply arrangements. Each shareholder Council nominates representatives to vote on key decisions concerning the two companies. Similarly, a separate board governs each company.

The kitchen opened in December 2010 and now prepares and delivers more than 1.2 million meals a year to its 20 local government customer-shareholders as well as hospitals and residential aged care. Community Chef was later bought out by and merged with Regional Kitchen.

The value of the Regional Kitchen project was approximately $30 million, with $17 million funded by Federal and State Government grants and the balance from capital contributions from the 13 contributing councils.
5.3 CONTRACT MODELS

The term contract model refers to the arrangements through which the contractor delivers the contract. Contract models can take a variety of forms, but the discussion below explores two extremes:

- the service delivery model – where the contractor takes full control over the delivery of the contract using its own, or subcontracted resources.
- the build, own, operate, transfer (BOOT) contract model involves a partnership between the procuring entity (councils) and the contractor, where ultimately the councils involved in the contract take possession of the assets that are created through the contract.

5.3.1 Service delivery contract model

The service delivery model is where private companies use their own infrastructure and assets to deliver services for councils. MWRRG’s existing collective contracts for landfill disposal services, organics processing, and commingled recycling processing are all based on a service delivery model. The councils that are parties to these contracts have little or no say in the operation or ownership of the infrastructure that is used by the contractors to deliver the contracts. Councils generally pay for the services on a monthly basis until the contract terminates. Consequently, the contracting councils have little opportunity to influence the environmental performance or social impacts associated with services that are used to deliver these services.

The infrastructure that is used to deliver the service may have been market driven. Instances where this has occurred include infrastructure that has been re-purposed – for example voids created through quarrying activities that are re-engineered as landfills. Less commonly, private companies may build waste and resource recovery infrastructure on speculation that they will be able to secure contracts for the supply of waste from councils and/or the commercial sector. It is unlikely (though not impossible) that the private sector will invest the hundreds of millions of dollars required for AWRRT solutions in Melbourne without first securing long-term council contracts for residual MSW with metropolitan councils.

5.3.2 Build, own, operate, transfer (BOOT) contract model

BOOT contracts are the opposite of service delivery contracts. BOOT contracts are predicated on the selection and appointment of a contractor to create new infrastructure that is purpose-designed to meet councils’ requirements. In addition, the ownership of the asset and the land upon which it has been constructed is transferred to the contracting council(s) at the end of the contract period.

Typically, the contracting councils do not pay for the capital investment in the infrastructure upfront. Instead, councils make monthly service payments to the contractor that cover:

- repayments on the capital investment and associated financing costs
- a service charge based on the quantity of waste processed by the contractor during the payment period.

In this situation, the councils have strong control over:

- what the infrastructure is (in terms of the technology solution)
- where the facility is located
- how the facility performs (in terms of environmental performance and social impacts).

5.3.3 Build, own, operate (BOO) contract model

A BOO contract can be viewed as a hybrid between the service delivery and the BOOT models. In BOO contracts, councils specify the requirements of the contract and the facility is designed and constructed to meet councils’ requirements. The councils pay for the cost of constructing and operating the facility through monthly payments made over the contract period. At the end of the contract period the asset and the land upon which it sits are retained by the contractor.

It is often argued that BOO contracts are cheaper than BOOT contracts, but in reality there is usually little difference in the costs paid by councils through either contract model, as the contractor will look to recover the full construction costs of the facility from the councils and will leave little residual value in the asset.
6 Procurement strategy

6.1 OVERVIEW
The collective procurement of AWRRT solutions is a complex and lengthy process. This procurement strategy sets out how councils can work with MWRRG to establish:

- the outcomes that they are seeking from the procurement and the subsequent contract
- how they will work together to aggregate their waste
- the contract model that will form the basis of the agreement with the solution provider
- the procurement process
- the process to seek approval from the Australian Competition and Consumer Commission (ACCC) for the collective procurement
- how risks will be identified and managed during the procurement and contracting phases.

The approach that is described below is consistent with the Victorian Government Purchasing Board (VGPB) guidelines and the Victorian Local Government Best Practice Procurement Guidelines 2013.

6.2 ESTABLISHING COUNCILS’ REQUIREMENTS
A collective procurement for an AWRRT solution can only proceed if there is agreement between councils on what they want to achieve. MWRRG will continue to engage with metropolitan councils to:

- define the problem(s) that they are seeking to address through a collective procurement
- develop the evidence base that substantiates councils’ needs
- establish councils’ preferences in terms of financial, environmental and social outcomes from the contract.

6.2.1 Problem definition and establishing the evidence base
MWRRG has engaged (and will continue to engage) with geographic clusters of metropolitan councils to understand their drivers for diverting residual MSW from landfill through AWRRT solutions. Membership of a geographic cluster of councils is on a self-nomination basis, and it is possible for councils to be part of more than one cluster.

As a precursor to a collective procurement for an AWRRT solution, MWRRG will work with groups of councils to develop a ‘cluster’ business case. The cluster business case will define the problem(s) that councils are collectively seeking to address through the procurement of an AWRRT solution. The cluster business case will also present the detailed evidence that supports the need to go to market for a solution.

6.2.2 Establishing councils’ preferences for financial, environmental and social outcomes
For each cluster, councils’ preferences for financial, environmental and social outcomes will be established through:

- a multi-criteria assessment that identifies councils’ outcome preferences and how these should be weighted
- an appraisal of potential solution options that may satisfy councils’ requirements
- the development of a reference project that is based on one of the agreed options, against which solutions that are proposed by industry can be assessed
- the development of a financial model that considers the costs and benefits associated with the reference project and solutions proposed by bidders.

To help inform the potential solutions appraisal and outline specification development, MWRRG will conduct a market sounding process. It will also notify industry about the intention of metropolitan councils to procure residual waste processing solutions. The market sounding will also inform industry that MWRRG will lead collective procurements on behalf of metropolitan councils for:

- the processing of commingled recycling
- the processing of garden organics received by transfer stations
- the disposal of residual MSW to landfill when the existing four MWRRG collective landfill contracts terminate on 31 March 2021.

MWRRG will seek information from the market on its interest in providing residual waste treatment solutions, and the extent to which industry can offer solutions that can deliver desired services.

6.2.3 Developing the outline specification
MWRRG strongly recommends that metropolitan councils focus their efforts on identifying the outcomes that they wish to achieve, rather than specifying the means (technology and service...
arrangements) that a contractor uses to recover value from residual MSW. Such an approach significantly reduces the risk that councils make the wrong choice of technology or service delivery method, and allows industry to offer solutions that can be tailored to meet councils’ needs.

To support this approach, MWRRG will work with councils through the cluster business case process to develop an outline specification as the starting point for the procurement. The outline specification will document councils’ service requirements and the financial, environmental and social outcomes that they are seeking to achieve through the contract.

The outline specification will be refined through competitive dialogue with shortlisted bidders at each stage of the procurement process (see Section 6.4.4). The specification will be finalised prior to the call for final tenders.

6.3 PROJECT GOVERNANCE AND AGREEMENT BETWEEN COUNCILS

The preparation of a cluster business case, the procurement of a solution, and the management of a contract, will require MWRRG and councils to adopt governance arrangements that comply with:

- relevant legislation and government policies
- relevant MWRRG policies
- approved project documentation and plans.

In its work with councils in the south-east and inner parts of the region, MWRRG has requested these councils sign a memorandum of understanding (MOU) and a confidentiality agreement.

To continue this work, MWRRG recommends that the participating councils agree and sign a management agreement that will cover the procurement phase.

6.3.1 Management agreement and procurement governance structure

The management agreement will provide each party with:

- a clear timeline for the procurement
- confidence that it will be able to make the best decisions for itself and its stakeholders
- confidence that the other parties will not slow the process down unnecessarily.

The management agreement will consider all the decisions that need to be made by the parties in the course of conducting the tender. It will establish:

- decisions that can be delegated to the procurement manager (in this case MWRRG)
- decisions that can be delegated by the council to its CEO
- decisions that can be delegated by the council to its representative on a working group
- decisions that need to be made by the council itself.

The proposed management agreement aligns with the suite of standard Victorian Government procurement templates and has been developed specifically for collaborative procurements facilitated by Victoria’s waste and resource recovery groups (WRRGs).

In addition to the management agreement, MWRRG will work with the procuring councils to develop an appropriate governance structure for the procurement phase. An example of a suitable governance structure is presented in Figure 10.

The working group will be made up of officers from MWRRG and representatives from the councils that are involved in the procuring cluster. The working group will take responsibility for progressing the procurement and developing the necessary tender documentation. MWRRG involvement will be managed by senior staff with experience in complex procurements and a strong understanding of the selection and deployment of AWRRT solutions.

Where necessary MWRRG will engage specialist advisers to undertake research and provide advice on discrete aspects of the procurement, including probity, compliance with legal requirements, as well as financial and technical aspects.
Figure 10: Example governance structure

<table>
<thead>
<tr>
<th>Councils</th>
<th>Procurement Manager (MWRGG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approve:</td>
<td>Appointed by the Working Group to be responsible for the day-to-day activities of the procurement.</td>
</tr>
<tr>
<td>• Business Case (includes governance)</td>
<td></td>
</tr>
<tr>
<td>• Management Agreement</td>
<td></td>
</tr>
<tr>
<td>• Evaluation Report.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Council CEO or delegate</th>
<th>Evaluation/Negotiation team</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approves:</td>
<td>• Undertakes the evaluation and/or negotiation as required</td>
</tr>
<tr>
<td>• Procurement Plan and timeline</td>
<td>• May be different members to the Working Group.</td>
</tr>
<tr>
<td>• Probit Plan</td>
<td></td>
</tr>
<tr>
<td>• RFT (including specifications &amp; draft contract).</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Working Group</th>
<th>Assurance</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Manages the procurement process from end to end</td>
<td>• Legal</td>
</tr>
<tr>
<td>• Working Group Chair makes decisions on day-to-day activities as referred by the Procurement Manager (i.e. management of Conflict of Interest).</td>
<td>• Probit</td>
</tr>
<tr>
<td></td>
<td>• Technical specialist.</td>
</tr>
</tbody>
</table>

Note: RFT (Request for tender)

### 6.3.2 Formal agreement between councils on how they will aggregate and supply their waste

Section 5.2 discusses the types of formal arrangement that councils could adopt to aggregate and supply their waste. The arrangement that appears to have greatest merit is the creation of a special purpose vehicle (SPV). An SPV also has the potential to act as the contracting entity that negotiates and manages the contract on behalf of councils.

MWRGG will continue to work with its advisers and councils to determine the arrangement that is best suited to councils’ needs. When agreement has been reached between MWRGG and councils, MWRGG will expedite the work (with support from councils) to put the arrangement in place.

### 6.3.3 Developing the contract model

Section 5.3 provides a discussion of the different ways that councils may enter into a contract with a provider for the delivery and operation of an AWRRT solution. MWRGG will continue to work with its advisers and councils within each cluster to identify the most appropriate contract model.

It is highly likely that discussions around the contract model will continue during the procurement phase with the objective of achieving consensus within the cluster councils prior to the call for final tenders.
6.4 DESIGNING THE PROCUREMENT PROCESS

6.4.1 Procurement plans and documents

As illustrated in Figure 10, a number of plans and documents are required to execute the procurement of an AWRRT solution. These include:

- a procurement plan including the objectives, resources, decision making points and processes
- the specifications and documents that will be released to the market at each stage of the procurement process
- an evaluation plan including the evaluation criteria, and roles and responsibilities of the evaluation panel members
- evaluation reports summarising the process, outcomes and lessons learnt at each procurement gateway
- a risk management plan
- a probity plan
- a stakeholder engagement plan.

The procurement plan, specification and documents, evaluation plan and risk management plan will be developed by MWRRG in partnership with the procuring councils prior to commencing the procurement. A probity plan and stakeholder engagement plan have already been developed by MWRRG and are described below.

6.4.2 Probity plan

MWRRG has developed a probity plan for the pre-procurement and procurement phases in collaboration with specialist advisers. The probity plan will ensure that the procurement process:

- is conducted in a transparent manner
- is effectively managed
- meets relevant probity and governance requirements.

The desired outcomes flowing from the probity plan will include:

- less chance of problems, conflicts or disputes with prospective suppliers
- avoidance of suspicion of corrupt practices
- better outcomes against stated objectives, including achieving value for money
- positive public perception of the integrity of the procurement process
- reassurance to those proposing to do business with MWRRG that a fair, consistent and competitive process will be conducted

- reassurance that no supplier (or group of suppliers) is provided with an unfair advantage over the rest of the market
- protection against arbitrary decision-making
- less potential for complaints and/or litigation.

6.4.3 Stakeholder engagement plan

MWRRG will develop a stakeholder engagement plan for the procurement phase. It will be supported by collateral and engagement activities that MWRRG will develop in conjunction with the cluster councils. The procurement’s stakeholders will include:

- Victorian Government departments and agencies
- the cluster councils
- communities that may be affected by the technology solutions
- environment and community groups
- prospective technology and service providers (including investors).

6.4.4 The multi-stage procurement process

MWRRG proposes that councils adopt a multi-stage procurement process involving four gateways. At each stage competitive dialogue will be used to inform the refinement of the specification. The four gateway stages are:

- Expression of interest: an open approach to market that will identify an initial pool of potentially suitable bidders
- Invitation to submit outline solution: an approach to bidders short-listed at the EOI stage that seeks their responses to the outline specification
- Invitation to submit detailed solution: an approach to bidders that have been short listed at the completion of the invitation to submit outline solution stage that seeks their responses to the detailed specification
- Call for final tender: an approach to bidders that have been short listed at the completion of the ISDS stage that seeks their response to the final specification.

The specification for the final tender will include a firm commitment by participating councils to enter into the contract.

An evaluation report will be developed for each stage of the procurement. The final evaluation report will include an assessment against the agreed evaluation process, a discussion of the deliberation and outcomes of each stage, and the evaluation panel’s recommendation for the appointment of a preferred tenderer. An independent probity report will also be developed.
The evaluation report will be considered by the participating councils in accordance with the agreed governance arrangements. Once all necessary parties have endorsed the recommendations, MWRRG and participating councils will enter into contract negotiations.

An overview of this proposed process is presented in Figure 11. Through the cluster business cases, councils and MWRRG will further developed this process including the timeframes and governance arrangements prior to councils endorsing it.

6.4.5 Competitive dialogue and refining the specification

As is described above, MWRRG recommends that councils’ focus attention on the outcomes that they want to achieve through the procurement and contract, and that these outcomes are tested through the bidding process. This allows the private sector the opportunity to inform the development of the specification, so that by the end of the procurement phase the remaining bidders’ proposals align closely with the councils’ final specification of requirements.

The adoption of a competitive dialogue process provides the opportunity for parallel but separate dialogue sessions between bidders and procuring councils in which solutions and supporting enablers (e.g. access to suitable sites) can be discussed and co-developed. It is suited to situations where:

- requirements may not be fully defined at the outset
- requirements may be outcome or output based
- the solutions may be complex or innovative within the local/national market.

The aims of competitive dialogue are to increase value by encouraging innovation, and to maintain competitive pressure in bidding for complex contracts. Competitive dialogue has been used extensively in Europe for complex infrastructure and strategic partnering contracts for AWRRT, and in Australia for large, strategic procurements including within the health sector, and information and communication technology industry.

6.5 AUSTRALIAN COMPETITION AND CONSUMER COMMISSION AUTHORIZATION

For the purposes of the Competition and Consumer Act 2010 (CCA), councils are considered to be competitors for the acquisition of waste and resource recovery services. In this sense, councils participating in the collective procurement of an AWRRT solution may be considered to be restricting competition. In the absence of a relevant exception, defence or authorisation the CCA strictly prohibits competitors from agreeing the:

- price at which they acquire goods or services
- persons from whom they will or will not acquire goods or services
- terms on which they will acquire goods or services that would diminish competition
- any contract, arrangement or understanding that has the purpose or likely effect of substantially lessening competition.

Contravention of these prohibitions has significant potential financial and other consequences for those involved in the contravention.

The cluster councils and MWRRG must seek authorisation from the Australian Competition and Consumer Commission (ACCC) before entering into any contracts, arrangements or understandings that may contravene the CCA. In general this will mean that authorisation from the ACCC will be required prior to councils reaching a decision to appoint a contractor. Thus ACCC authorisation is likely to be required before tenders are issued.

The ACCC may authorise councils to undertake a collective procurement if it is satisfied that the public benefit from the arrangement would outweigh any public detriment. Public benefits from the procurement of an AWRRT solution and associated services may include:

- environmental and public health benefits
- transaction cost savings for participating councils and the contractor(s)
- improved purchasing power, leading to lower costs for participating councils (and their respective residents)
- reduced operational risks for contractors, thereby underwriting investment in waste processing facilities.

MWRRG, on behalf of the cluster councils will seek legal advice and progress the authorisation with the ACCC. The ACCC will seek submissions from interested parties and must decide whether or not to grant authorisation within six months of the application being lodged (although this time period may be extended in certain cases).
Figure 11: Proposed procurement process

EOI
Open approach to market for private entities to nominate to be part of procurement bidding process. Evaluation of legal and financial standing, current/historical past performance and experience, legal records (incl. Occupational Health & Safety), social licence to operate.

Invitation to submit outline solution
Approach to selected market. Initial solution development and short-listing to identify viable bidders and solutions. Bidders respond to the outline solution specifications issued at EOI stage. Technical, financial, social and legal evaluation used to short list for next stage.

Invitation to submit detailed solution
Bidders respond to more detailed solution specifications. Informs development of final specifications. Technical, financial, social and legal evaluation used to short list for next stage.

Call for final tender
Final tender development and short-listing stage – reduces pool to a preferred/successful bidder. Bidders to provide a response to the final specification. Final tender specifications will include a firm commitment of participating councils to the long term contract.
7 Stakeholder interest in AWRRT solutions

7.1 COUNCIL INTEREST IN AWRRT SOLUTIONS

MWRRG has been working with councils across metropolitan Melbourne to understand their interest in establishing residual waste processing solutions as part of an integrated mix of waste and resource recovery infrastructure.

Engagement with councils has taken place through a variety of forums, including:

- meetings with councils in geographical clusters – particularly in the south-east and inner parts of the region
- workshops designed to help council officers understand:
  - what the technologies can and can’t achieve
  - procurement and contract approaches
  - planning for engagement and communications to support the delivery of AWRRT solutions.

Through these activities councils have been clarifying their expectations and aspirations for future residual waste processing solutions. Common to all councils is the need for solutions that are tailored, proven, effective, safe, reliable, cost effective and an expectation that solution providers gain and maintain a strong social licence to operate. Councils are also keen to focus on the outcomes they are seeking rather than selecting a preferred technology type.

There are also sub-regional drivers for change, some of which are described below.

7.1.1 Sub-regional drivers for change

In the south-east of the region, landfills that have served Melbourne for many years are closing as the available void space is filled. A number of councils in the south and east of the region are actively considering offering FOGO collections and processing to further advance resource recovery. In addition to this, MWRRG has received advice from a number of south-east councils that their residents expect them to explore alternatives to landfill that have the potential to boost local employment, and are based on proven technologies.

In the inner metropolitan area, councils are responding to an increase in the number of multi-unit developments, together with expectations from communities for opportunities to reduce waste-related climate change impacts. Within inner Melbourne, food organics are generally disposed of via the garbage bin as there is limited space for a third organics bin, however some councils are exploring their options for offering food waste collections.

The City of Port Phillip and the City of Melbourne are exploring the prospect of establishing a sustainability hub as part of the Fishermans Bend precinct that could potentially act as a centralised and focused location for future resource recovery activities that could include an AWRRT solution.

Councils in the north and west of the region have long-term access to local landfills for putrescible waste. However, a number of councils and communities in the north and west are expressing a strong desire to reduce the amount of waste going to landfill, including organic waste. Some councils in the north and west of the region are exploring introducing FOGO services (particularly through the Metropolitan North-West Organics Contract) and opportunities to address climate change.

In 2017, the Victorian Government established the Western Metropolitan Partnership which has been engaging with communities on regional priorities. Subsequently MWRRG has received funding to work with the Partnership to explore opportunities to create a Waste and Recycling Centre of Excellence in the west.

7.2 INDUSTRY APPETITE FOR PROVIDING RESIDUAL WASTE PROCESSING SOLUTIONS

In accordance with a project probity plan, MWRRG has engaged with the private sector (including technical and legal advisers, reprocessors, technology providers, water authorities, transfer station operators and landfill operators) to understand their interest in investing in residual waste processing solutions within the region.

As part of this, MWRRG initiated a series of activities with industry in November 2017. Over 42 organisations have already attended forums that have been designed to:

- inform industry about the ‘who, what, when’ of the process for procuring AWRRT solutions
- explore what will maximise industry input to and participation in the process
- allow collaboration between industry players in responding to the opportunity.
Feedback on what MWRRG can do to maximise industry participation has included:

- working with the Victorian Government to remove grey policy areas and barriers – e.g. levies, transport, feed in tariffs, contribution from state
- run a smooth procurement – set realistic timeframes, maintain and meet timeframes, provide clear commitments and advice
- secure the waste supply from councils via memoranda of understanding
- clarify the ownership of risk – industry expects government to share the risk of establishing AWRRT solutions
- share accurate and current waste tonnages and composition data
- work with the EPA and other regulators to help ensure that they are able to respond to approval applications in a timely manner
- continue to engage, communicate and be transparent with industry, including financiers, governments, and communities.

Through these forums and other engagement with the private sector, it is clear that there is considerable interest from industry to work with local government to establish residual waste processing solutions.

MWRRG will seek further information from industry through a formal market sounding process, to understand industry’s interest, capability and capacity to deliver AWRRT solutions.

7.3 COMMUNICATIONS AND ENGAGEMENT

Waste and resource recovery facilities represent some of the most contentious land uses that operate within today’s society. While very common in other parts of the world, residual waste processing solutions for municipal waste are a new prospect for metropolitan Melbourne. Communities will need support to understand why these facilities are being sought, what they do (and don’t do), how they operate, the controls for preventing and managing environmental and amenity impacts, where they will be located, and when they will become operational. Best practice community engagement and communication needs to occur throughout and beyond the process of establishing processing solutions: from procurement to the operation of facilities.

The Victorian Government has provided funding to MWRRG to undertake social research that will inform our communications and engagement approach. Working with local government will be critical to build understanding and support for establishing residual waste processing solutions. Industry also has a strong role to play and contractors will be expected to build and maintain the social licence for future AWRRT facilities.

7.4 ENGAGEMENT WITH STATE GOVERNMENT PARTNERS

MWRRG’s government partners within the Environment Portfolio (EPA, SV, DELWP, and other Waste and Resource Recovery Groups) have been keen to understand MWRRG’s approach to facilitating council interest in AWRRT solutions; the proposed process, and timeframes. In response, MWRRG has regularly engaged with EPA, SV, DELWP and the Minister for Energy, Environment and Climate Change through a variety of forums. MWRRG will continue to work with our portfolio partners and others across government to secure their support and cooperation in establishing AWRRT solutions.

Table 17 summarises the interest that Victorian Government departments and agencies have in the waste and resource recovery infrastructure mix within the metropolitan region.

7.4.1 Possible intervention options for the Victorian Government

While the Victorian Government has no direct responsibility for, or current ability to direct municipal waste processing, it can incentivise and/or facilitate particular outcomes.

The regional business case and the ongoing engagement with councils and industry provides valuable evidence and information to state government on potential opportunities to support investment in AWRRT. Any potential opportunities will be guided by government objectives such as the development of a whole-of-government circular economy policy by 2020 and the newly released Recycling Industry Strategic Plan, and may include activities presented in Table 13.
### Table 13: Opportunities for state government to provide further support to establishing AWRRT

<table>
<thead>
<tr>
<th>Opportunity and description</th>
<th>Support for procurement and contracting</th>
</tr>
</thead>
</table>
| Victorian Government interest in supporting and strengthening the regional collective procurement model. | • Level of investment into collective procurement through regional model  
• Organisational capacity, capability and shared services |

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<thead>
<tr>
<th>Locating and siting an AWRRT</th>
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</table>
| Level of Victorian Government intervention in the selection, designation, planning approval and/or acquisition of prospective AWRRT sites. | • Development and application of AWRRT siting protocol  
• Nominated site designated and prioritised as state or regionally significant  
• Government purchase of site/mandatory acquisition  
• Government management of planning approvals process |

<table>
<thead>
<tr>
<th>Communicating and engaging community about AWRRT and waste to energy</th>
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</thead>
</table>
| Level of Victorian Government involvement and activity in providing communication and engagement messaging around waste hierarchy intervention options (FOGO, recycling, etc) and importance of AWRRT/waste to energy (WtE) in the infrastructure mix. | • Development of messaging around integrated nature of waste hierarchy related interventions – positioning AWRRT contribution  
• Develop and deliver consistent communication messaging around AWRRT and WtE  
• Support ongoing engagement activity around importance of AWRRT (including WtE) as critical infrastructure |

<table>
<thead>
<tr>
<th>Influencing feedstock supply via relative attractiveness and pricing of landfill</th>
<th></th>
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</thead>
</table>
| Level of Victorian Government involvement in controlling current and future landfill airspace – supply of airspace. | • Landfill scheduling  
• Landfill policy and guidelines informing works approval and licensing |
| Victorian Government preferences around forward application of levy or tax to inflate relative price of landfill as a residual waste treatment option. | • Landfill by weight (levy applied $’s per tonne)  
• Differential levies (by material type) |
| Victorian Government preferences around imposing restrictions, bans or similar on the type of materials that can go directly into landfill. | • Landfill bans (particular materials)  
• Require pre-treatment of residual prior to landfilling |

<table>
<thead>
<tr>
<th>Clarifying preferences (and any restrictions) for outputs and applications</th>
<th></th>
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</thead>
</table>
| Victorian Government interest and role in clarifying potential returns and/or costs associated with outputs of AWRRT. | • Specific market development support programs  
• Government procurement and use of products from AWRRT  
• Specific categorisation and/or controls around applications for and/or disposal of AWRRT outputs and residuals  
• Clarity around energy from waste (electricity and heat products) from mixed residual waste streams. Categorisation as renewable source or otherwise |

<table>
<thead>
<tr>
<th>Ownership models and influencing cost of finance (capex)</th>
<th></th>
</tr>
</thead>
</table>
| Victorian Government preference in providing direct capital injection into AWRRT plant. | • Capital grants to lower capital costs (and/or cost of finance)  
• Access to green bonds/CEFC and/or local government finance vehicle (MAV)  
• Ownership stake in plant |
### Opportunity and description

<table>
<thead>
<tr>
<th>Processing and output subsidies (opex)</th>
<th>Victorian Government appetite for subsidising AWRRT performance.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Provision of a processing subsidy (reducing cost and/or gate fee)</td>
</tr>
<tr>
<td></td>
<td>• Application of subsidies for particular outputs i.e. heat. This could follow categorisation of renewable heat from particular WtE processes/ feedstocks.</td>
</tr>
<tr>
<td></td>
<td>• Feed in tariffs (given renewable electricity categorisation)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Industrial precincts and hubs of complementary activity</th>
<th>Victorian Government appetite for brokering complementary place-based activity.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Supporting complementary activities within existing industrial precincts</td>
</tr>
<tr>
<td></td>
<td>• Promoting and incentivising ‘Resource Recovery Parks’ or similar to ensure improved domestic reprocessing of recyclate to new products and/or utilisation of waste derived energy</td>
</tr>
</tbody>
</table>
8 Conclusion

Metropolitan Melbourne will have sufficient landfill until 2026 if the current significant landfills operate according to the Metropolitan Implementation Plan. However, the future availability of scheduled landfill is subject to change in response to public acceptance, as may be expressed through appeals to grants of planning permission and works approvals.

By 2046, around 1.6 million tonnes of residual MSW will be generated each year within the metropolitan region. Over the same time period, the quantity of residual C&I waste being sent to landfill will increase to around 3.9 million tonnes each year, and the amount of residual waste managed through transfer stations could increase to around 660,000 tonnes per year. If nothing changes in the way that we manage our waste, by 2046 more than 6 million tonnes of waste will be sent to landfill each year.

The Metropolitan Implementation Plan aims to deliver new infrastructure and resource recovery activity to ensure that the amount of waste going to landfill in 2026 will be no more than the amount of waste that was sent to landfill in 2016. The plan proposes that this is achieved through greater diversion of organic waste from landfill (particularly through increased collection and processing of FOGO), and the recovery of around 300,000 tonnes each year of residual MSW that is managed through collective council contracts.

8.1 THE ROLE OF AWRRT TO REDUCE RELIANCE ON LANDFILL

MWRRG has taken a waste hierarchy approach to explore a range of potential interventions that could achieve the diversion of significant amounts of residual MSW from landfill. The resource recovery scenarios that are described in Section 3 indicate that the adoption of FOGO services across the region can make a sizeable contribution to resource recovery and diversion of municipal waste from landfill. However, it is only through the introduction of AWRRT solutions that the region can restrict the amount of municipal residual waste that is sent to landfill to 2016 levels.

The review of AWRRT solutions indicates that although a range of advanced waste and resource recovery technologies exist, the technologies that have the strongest technical and commercial track records to recover value from residual MSW are:

- mass burn combustion with energy recovery
- mechanical biological treatment, coupled with some form of energy recovery (either combustion or gasification).

Key findings

AWRRT is necessary to limit municipal solid waste to landfill by 2026 and achieve the 25% recovery target.

Food and garden organics recycling is important, but on its own will not achieve targets. Some form of energy recovery will be required.
8.2 DELIVERING ENVIRONMENTAL AND SOCIAL BENEFITS

The non-financial impacts that have been considered in the regional business case are:

- Carbon abatement: the five modelled scenarios all provide some degree of carbon abatement. The highest abatement is achieved through Scenario 3 (FOGO plus combustion of residual waste) – approximately 287,000 tpa CO₂e.

- Energy production: Scenarios 2, 3 and 4 produce similar amounts of energy as an output of the process. Up to 37% of the energy can be considered renewable.

- Jobs: establishing an AWRRT facility will lead to the creation of new jobs in and around Melbourne, including permanent jobs in operation and maintenance of facilities, as well as temporary jobs for design and construction.

**Key findings**

AWRRT will deliver better environmental and social benefits compared to landfill.

8.3 COUNCIL INTEREST

The development of the regional business case has provided the opportunity for MWRRG to engage with councils to understand their interest to explore how their individual and collective needs could be met through AWRRT solutions (see Section 7.1).

To date, 14 of 16 councils in the south-east and five of seven councils in inner Melbourne have formally committed to work together to develop cluster specific business cases. Preliminary engagement with councils in the north and west of the region is in progress.

**Key findings**

Councils want to understand the benefits of advanced waste processing as a potential alternative to manage residual waste.

8.4 INDUSTRY’S INTEREST

MWRRG has engaged with the private sector to understand its interest to work with local and state government to develop residual waste processing solutions within metropolitan Melbourne.

Industry’s feedback on what MWRRG can do to maximise the private sector’s participation has included:

- working with the Victorian Government to remove grey policy areas and barriers – e.g. levies, transport, feed in tariffs for renewable energy, and possible investment contributions
- run a smooth procurement process – set realistic timeframes, provide clear commitments and advice
- work with councils to aggregate and secure long-term supplies of residual MSW
- clarify the ownership of risk – industry expects government to share the risk of establishing AWRRT facilities
- share accurate and current waste tonnages and composition data
• work with Environment Protection Authority Victoria and other regulators to help ensure that they are able to respond to approval applications in a timely manner
• continue to engage, communicate and be transparent with stakeholders including prospective solution providers, financiers, governments, and communities.

Key findings

The private sector has shown strong interest in establishing new advanced waste processing infrastructure in Melbourne.

Industry has advised the need for a procurement process that clearly outlines the scope, process and timeline.

Significant private investment in infrastructure can be attracted to Victoria.

8.5 EFFECTIVE CONTRACTING ARRANGEMENTS

At present there is a lack of residual waste recovery infrastructure within Melbourne and most metropolitan councils are unwilling to directly fund the development of AWRRT solutions. While it is possible that some councils may be able to supply residual MSW to AWRRT solutions that are being developed by the private sector, it is unlikely that such ventures will deliver the capacity needed to treat around 300,000 tonnes of residual MSW each year by 2026. It is also unlikely that individual metropolitan councils will have sufficient residual MSW to be a viable proposition for industry to provide solutions tailored to their needs.

As is discussed in Section 5, councils that want to procure AWRRT solutions will need to enter into collective agreements with other like-minded councils to aggregate their residual waste.

It is unlikely that MWRRG’s existing tripartite contract will provide an effective means for the collective procurement of AWRRT solutions. A better alternative would be for the procuring councils to develop a special purpose vehicle (SPV). The SPV would be a company that is wholly owned by the participating councils through the issue of shares. The SPV shareholder agreement would then form the basis of the contract arrangement between the participating councils. The SPV itself would be the party that contracts with the AWRRT solution provider.

The contract for an AWRRT solution will be the means through which the risks associated with the design, construction, commissioning, operation and maintenance of a facility are allocated between councils and the contractor. An SPV can be used to limit the risk that councils take on through the contract.

Key findings

MWRRG’s existing tripartite contract is not suitable as a means of aggregating councils’ waste, or to contract with the private sector for the financing, construction and operation of new infrastructure.

Aggregation of waste by councils will be key to driving investment by the private sector for the delivery and operation of residual waste processing solutions.

Councils can drive investment and achieve greater control of service outcomes by adopting a new procurement and contract approach.

The creation of an SPV will provide councils with an effective means of aggregating their waste and contracting with AWRRT solution providers.

The procurement strategy will provide the opportunity to select a preferred contract model.
8.6 PREPARING FOR PROCUREMENT

The regional business case can only go so far in identifying potential AWRRT solutions. The specification for any future solution that will take residual MSW as its primary feedstock will need to reflect the needs of the councils that are party to the procurement and future contract.

Section 7 has outlined the engagement activities that MWRRG has undertaken with local government and Section 6 explains the process that MWRRG will follow to formally recruit clusters of councils to a procurement process.

For each cluster, MWRRG in conjunction with councils, will prepare a cluster-specific outline business case and outline specification that will be supported by:

- collection and analysis of additional data on waste generation and composition to better understand the feedstock that is potentially available from the MSW stream
- an options assessment that will consider possible arrangements for organics processing, residual waste processing and disposal of residual waste to landfill
- investigation of existing assets that have potential to act as aggregation sites for residual waste
- interfaces with existing collection contracts
- investigation of councils’ appetites for risk
- local investigation of potential sites for AWRRT solutions
- engagement (where relevant) with local planning departments
- identification of resources needed to support the procurement
- the development and implementation of effective stakeholder engagement programs
- governance, contracting and decision-making arrangements
- the development of a timetable for the procurement.

As part of the cluster-specific business case MWRRG will work with local government to develop a detailed financial model. The cluster-specific business case will also continue to build on the regional exploration of environmental and social considerations and impacts.

**Key findings**

Further analysis and detail is required (through a cluster business case) to support procurements that reflect sub-regional needs.

8.7 IMPROVING OUR UNDERSTANDING OF THE COMPOSITION OF RESIDUAL WASTE

As outlined in Section 3.2, existing information on the composition of MSW in the metropolitan region is limited. An MWRRG commissioned review of 67 waste composition audits undertaken by metropolitan councils in recent years found that none of these audits were specifically focused on assessing the composition of residual waste generated by households.

To improve understanding of the composition of residual MSW across the region, MWRRG has developed a waste composition data tool. MWRRG has secured funding from the Victorian Government to support councils that participate in collective procurements for residual waste solutions to undertake waste composition audits.

**Key findings**

Understanding of the composition of residual MSW within the region needs to be improved through comprehensive and consistent waste audits.
8.8 RESOURCING AND SUPPORTING FUTURE PROCUREMENTS

MWRRG is well positioned to facilitate joint procurement of waste and resource recovery services. However, the procurement of AWRRT solutions will require specialist technical and advisory services, and additional resourcing for MWRRG. The Victorian Government is providing increased funding to MWRRG to support the resources required for the procurement process.

To help build knowledge and understanding of AWRRT solutions within the metropolitan region, MWRRG is keen to involve council officers and personnel from other Victorian Government agencies in the procurement process.

The Victorian Government has no direct responsibility for, or current ability to direct how municipal waste is managed, but through its support of the development of business cases and grant funding to small-scale projects, it is already providing a level of intervention assistance to proponents of AWRRT solutions.

This regional business case and the ongoing engagement with councils and industry, provides valuable evidence and information to state government on potential further opportunities to support future investment in AWRRT solutions.

**Key findings**

MWRRG needs to take on additional resources to lead the procurement of AWRRT solutions and is keen to involve personnel from local and state government in this process.

Government can play a more active role in creating greater certainty for councils and industry in pursuing AWRRT solutions.
9 Recommendations

Advanced waste processing is a proven and necessary solution to better manage Melbourne’s municipal residual waste.

The Metropolitan Regional Business Case demonstrates the viability of advanced waste processing and validates further investigation of potential solutions.

Councils will need to work together to boost Melbourne’s resource recovery capability, limit the amount of municipal waste sent to landfill and secure significant private investment in new infrastructure.

The recommendations of the regional business case for AWRRT solutions are:

1. Metropolitan councils consider the opportunities presented in this business case and partner with MWRRG to develop cluster business cases and realise the opportunities available through advanced waste processing.
2. MWRRG complete the South-East cluster specific business case given the demand and interest expressed by sub-regional councils.
3. MWRRG undertake a market sounding process to understand industry’s capability and interest in providing residual waste processing solutions for the metropolitan region.
4. DELWP continues to support MWRRG to deliver future procurements for residual waste processing solutions, and to build the capability and understanding within local government.
5. DELWP considers feedback from industry and local governments to clarify policy setting(s) and levers in relation to AWRRT solutions.
6. DELWP explores how the Planning and Environment Act 1987 will be used to establish residual waste processing solutions. This could include consideration of:
   – development and application of an AWRRT siting protocol, or similar
   – operating international reference case studies in a Victorian context.
7. EPA continues to build its internal capacity to assess and regulate new residual waste processing solutions under the Environment Protection Act 1970.
8. EPA confirms, and if necessary, clarifies the regulatory expectations for managing the inputs, processes and outputs from residual waste processing solutions.
9. Sustainability Victoria continues to encourage market development for the use of outputs from residual waste processing solutions.
10. DELWP supports MWRRG’s engagement with Department of Treasury and Finance and Local Government Victoria on the collective procurement process and contract model development for AWRRT solutions.
Appendix 1 – Estimates of residual MSW and C&I waste

Table 14: Estimates of residual MSW and C&I waste

<table>
<thead>
<tr>
<th>Subregion/LGA</th>
<th>Estimated residual MSW generation (tpa)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>2016</td>
</tr>
<tr>
<td>Central</td>
<td>24,204</td>
</tr>
<tr>
<td>Melbourne</td>
<td>22,154</td>
</tr>
<tr>
<td>Stonnington</td>
<td>18,992</td>
</tr>
<tr>
<td>Maribyrnong</td>
<td>34,755</td>
</tr>
<tr>
<td>Port Phillip</td>
<td>18,723</td>
</tr>
<tr>
<td>Sub total</td>
<td>118,829</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subregion/LGA</th>
<th>Estimated C&amp;I waste to landfill (tpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2016</td>
</tr>
<tr>
<td>Central</td>
<td>130,743</td>
</tr>
<tr>
<td>Melbourne</td>
<td>51,852</td>
</tr>
<tr>
<td>Stonnington</td>
<td>26,462</td>
</tr>
<tr>
<td>Maribyrnong</td>
<td>53,249</td>
</tr>
<tr>
<td>Port Phillip</td>
<td>58,366</td>
</tr>
<tr>
<td>Sub total</td>
<td>320,674</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subregion/LGA</th>
<th>Transfer station waste to landfill (tpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2016</td>
</tr>
<tr>
<td>Central</td>
<td>29,012</td>
</tr>
<tr>
<td>Melbourne</td>
<td>23,644</td>
</tr>
<tr>
<td>Stonnington</td>
<td>18,270</td>
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<tr>
<td>Maribyrnong</td>
<td>23,322</td>
</tr>
<tr>
<td>Port Phillip</td>
<td>19,797</td>
</tr>
<tr>
<td>Sub total</td>
<td>114,045</td>
</tr>
</tbody>
</table>
### Subregion/LGA Estimated residual MSW generation (tpa)

<table>
<thead>
<tr>
<th>Subregion/LGA</th>
<th>2016</th>
<th>2021</th>
<th>2026</th>
<th>2031</th>
<th>2036</th>
<th>2041</th>
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<td>82,272</td>
<td>96,773</td>
<td>113,830</td>
<td>133,893</td>
<td>157,492</td>
<td>185,251</td>
<td>217,902</td>
</tr>
<tr>
<td>Mornington Peninsula</td>
<td>46,446</td>
<td>54,633</td>
<td>64,262</td>
<td>75,588</td>
<td>88,911</td>
<td>104,582</td>
<td>123,015</td>
<td>144,698</td>
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<tr>
<td><strong>Sub total</strong></td>
<td>371,563</td>
<td>437,053</td>
<td>514,086</td>
<td>604,696</td>
<td>711,277</td>
<td>836,643</td>
<td>984,106</td>
<td>1,157,560</td>
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### Transfer station waste to landfill (tpa)

<table>
<thead>
<tr>
<th>Subregion/LGA</th>
<th>2016</th>
<th>2021</th>
<th>2026</th>
<th>2031</th>
<th>2036</th>
<th>2041</th>
<th>2046</th>
<th>2051</th>
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<tbody>
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<td>Southern</td>
<td>2016</td>
<td>2021</td>
<td>2026</td>
<td>2031</td>
<td>2036</td>
<td>2041</td>
<td>2046</td>
<td>2051</td>
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<td>4,429</td>
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<td>5,467</td>
<td>5,854</td>
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<td>7,046</td>
<td>7,567</td>
<td>8,103</td>
<td>8,654</td>
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<td>15,659</td>
<td>17,301</td>
<td>19,057</td>
<td>20,466</td>
<td>21,916</td>
<td>23,407</td>
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<td>5,865</td>
<td>6,138</td>
<td>6,761</td>
<td>7,261</td>
<td>7,775</td>
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<td>Glen Eira</td>
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<td>6,439</td>
<td>6,740</td>
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<td>7,973</td>
<td>8,537</td>
<td>9,118</td>
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<td>7,960</td>
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<td>9,777</td>
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<td>6,825</td>
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<td>8,507</td>
<td>9,110</td>
<td>9,729</td>
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<td><strong>Sub total</strong></td>
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<td>54,271</td>
<td>58,833</td>
<td>63,271</td>
<td>69,692</td>
<td>74,846</td>
<td>80,147</td>
<td>85,599</td>
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<td>Estimated residual MSW generation (tpa)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Western</td>
<td>2016  2021  2026  2031  2036  2041  2046  2051</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Hobsons Bay</td>
<td>20,362  21,451  22,795  23,814  26,231  28,170  30,166  32,218</td>
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<tr>
<td>Melton</td>
<td>26,752  33,111  41,727  51,499  56,726  60,920  65,235  69,673</td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>Moonee Valley</td>
<td>27,669  29,496  31,385  33,255  36,631  39,339  42,126  44,991</td>
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<tr>
<td>Wyndham</td>
<td>47,563  57,678  67,752  77,965  85,878  92,228  98,761 105,479</td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Sub total</strong></td>
<td><strong>169,414</strong>  <strong>191,022</strong>  <strong>214,752</strong>  <strong>239,704</strong>  <strong>264,032</strong>  <strong>283,556</strong>  <strong>303,640</strong>  <strong>324,296</strong></td>
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<tr>
<th>Subregion/LGA</th>
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<td>2016  2021  2026  2031  2036  2041  2046  2051</td>
<td></td>
</tr>
<tr>
<td>Brimbank</td>
<td>47,671  56,073  65,956  77,581  91,255 107,339 126,258 148,512</td>
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<tr>
<td>Hobsons Bay</td>
<td>24,853  29,234  34,386  40,447  47,576  55,961  65,825  77,427</td>
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</tr>
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<td>Melton</td>
<td>19,332  22,739  26,747  31,462  37,007  43,529  51,202  60,226</td>
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<tr>
<td>Moonee Valley</td>
<td>34,262  40,301  47,404  55,759  65,587  77,147  90,745 106,739</td>
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</tr>
<tr>
<td>Wyndham</td>
<td>37,804  44,467  52,305  61,524  72,368  85,123 100,126 117,774</td>
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<td><strong>Sub total</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Subregion/LGA</th>
<th>Transfer station waste to landfill (tpa)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Western</td>
<td>2016  2021  2026  2031  2036  2041  2046  2051</td>
<td></td>
</tr>
<tr>
<td>Brimbank</td>
<td>10,152  10,631  11,021  11,468  12,632  13,567  14,527  15,516</td>
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</tr>
<tr>
<td>Hobsons Bay</td>
<td>4,716  4,969  5,280  5,516  6,076  6,525  6,987  7,463</td>
<td></td>
</tr>
<tr>
<td>Melton</td>
<td>6,965  8,620  10,863  13,407  14,768  15,860  16,983  18,139</td>
<td></td>
</tr>
<tr>
<td>Moonee Valley</td>
<td>6,141  6,547  6,966  7,381  8,130  8,731  9,350  9,986</td>
<td></td>
</tr>
<tr>
<td>Wyndham</td>
<td>11,112  13,475  15,829  18,215  20,063  21,547  23,073  24,643</td>
<td></td>
</tr>
<tr>
<td><strong>Sub total</strong></td>
<td><strong>39,086</strong>  <strong>44,241</strong>  <strong>49,958</strong>  <strong>55,987</strong>  <strong>61,670</strong>  <strong>66,230</strong>  <strong>70,921</strong>  <strong>75,745</strong></td>
<td></td>
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</tbody>
</table>
Appendix 2 – Review of advanced waste and resource recovery technologies

Advanced waste and resource recovery technologies (AWRRT) can be broadly classified into three types:

- biological processes
- advanced sorting solutions
- thermal treatment (waste to energy) solutions.

While standalone examples of these technology types exist, the three approaches are often integrated into solutions that are designed to meet local or regional needs.

BIOLOGICAL PROCESSES

There are two generic biological waste treatment processes that can be used to treat source separated organic waste or an organic fraction that has been separated from mixed residual waste:

- composting solutions
- anaerobic digestion solutions.

Composting solutions

Composting involves the decomposition of organic material (plant and animal matter) by microbes in the presence of oxygen. Composting operations can vary significantly in scale and their level of sophistication. At its simplest, composting can take the form of a garden compost heap or bin where green waste is left to decompose naturally over time. At the other extreme, some commercial composting operations process in excess of 250,000 tonnes of garden and food waste per year to produce a high-quality compost product that is sold as a growing medium to gardeners and horticulturalists.

At a commercial level, the principal types of composting operations are:

- windrow
- static pile
- in-vessel.

Windrow is generally suitable for the processing of garden waste, where the waste is spread into extended piles in the open air and turned on a regular basis to ensure an even breakdown of the material. Static piles are similar to windrows, but instead of the waste being turned regularly, air is piped into the material to ensure that the decomposition process remains aerobic.

In-vessel composting solutions involve the processing of food and/or garden waste in an enclosed container (which may be a box or tunnel made out of steel, concrete, or a breathable reinforced weather-proof fabric). Air is supplied through a network of pipes or channels that are either incorporated into the vessel structure, or into the waste material. Excess moisture is removed either through porous pipes or drains at the base of the vessel.

The principal output from composting solutions is compost. Depending on the feedstock and the type of processing that is used, the quality of the compost that is produced can vary from low-grade material that is suited to agricultural operations, to high quality material for horticultural uses.

Anaerobic digestion

Energy can be recovered from the organic fraction (plant and animal matter) present in MSW and C&I waste through anaerobic digestion (AD). The process takes place in a sealed container where microbes breakdown the organic material to produce a methane-rich biogas. Energy is usually recovered by burning the biogas in an internal combustion engine coupled with a generator to produce electricity. Alternatively, the biogas can be cleaned and injected into the gas grid, used as a transport fuel, or burnt in a furnace.

AD processes were originally developed to recover energy from wet organic streams such as sewage sludge and are widely deployed for this purpose throughout the world. Over the last 30 years or so the technology has been modified to process drier organic wastes such as food and garden waste.

In addition to the generation of biogas, a semi-solid digestate is left over from the AD process which can be converted into compost through further processing.

AD processes are well suited to recover energy from source separated food and garden waste and can also be used to process the organic fraction that is separated from mixed residual waste through MBT and mechanical heat treatment (MHT) solutions. Unlike mass combustion and advanced thermal treatment (ATT) processes, AD processes do not recover the energy content from plastics that may be present in the waste.
ADVANCED SORTING SOLUTIONS

Sorting solutions range in their scale and degree of sophistication and have been proven internationally to recover resources from MSW residual waste. Recovery of hard recyclables (metals, hard plastics, timber, glass and inert material) from kerbside collections of residual MSW, hard waste collections, and mixed MSW, C&I and C&D wastes received at transfer facilities, can be achieved in several ways, including:

- dirty material recovery facilities (dirty MRFs)
- mechanical biological treatment (MBT)
- mechanical heat treatment (MHT).

Dirty MRFs

A dirty MRF is a relatively simple sorting and recovery operation where hard recyclables are removed from a mixed waste stream either mechanically and/or by a picking crew. This may or may not be supplemented by automated size reduction and sorting equipment, such as ball mills, hammer mills, magnets, eddy current and ballistic separators, and air classifiers.

Dirty MRF solutions are widely used to recover materials from C&D waste and there are examples of these types of processes in Victoria. Dirty MRFs are less commonly used to recover materials from mixed residual MSW and C&I waste due to health concerns associated with manually handling such wastes. Also, the hard recyclables that are recovered via dirty MRF processes are generally highly contaminated and of lower value than recyclables recovered through clean MRFs processing commingled recycling. Nevertheless, there is potential for dirty MRFs to be deployed at landfills to recover higher value materials such as ferrous and non-ferrous metals, and hard plastics.

Mechanical biological treatment (MBT)

Refinements to the basic dirty MRF design allow the creation of sophisticated mechanical treatment solutions that separate out an organic fraction that is processed separately within the facility. Such processes are often referred to as mechanical biological treatment (MBT) solutions.

MBT facilities are designed to process mixed waste streams to recover not only the hard recyclables but also to process the organic fraction (plant and animal matter) that is present in residual waste from municipal and C&I collections. MBT processes are typically large-scale facilities that employ a range of sorting and size reduction technologies that separate out individual material streams together with a fine organic fraction that is subjected to one or more biological processes to reduce the biodegradability of the waste (i.e. reduce the active carbon component) and manufacture either a soil improver, landfill cover, biogas, or a refuse derived fuel (RDF) which is used for energy generation. Over 300 MBT are operating in Europe and there are examples of MBT facilities in NSW and WA.

MBT processes can be broadly classified into two main types:

- Pre-sort technologies where hard recyclables are separated from the organic fraction. The organic fraction is then treated through a separate biological process which can include the recovery of the energy content of the material through anaerobic digestion. Alternatively, the organic fraction can be processed through a composting plant.
- Post-sort ‘biodrying’ technologies where the whole mass of waste is placed in a drying hall and microbes begin to break down the organic material. The heat generated by the biological process reduces the biodegradability of the waste and helps to dry the material. After several weeks, the dried waste is sorted and the hard recyclables are removed and the organic fraction is usually incorporated into a RDF that is sent for energy recovery in a dedicated facility. Alternatively, the organic fraction can be sent to landfill.

Mechanical heat treatment (MHT)/autoclaving

MHT is a variant of the MBT process in which mixed waste is subjected to heat and/or steam under pressure in an enclosed vessel. Once the heating process has been completed, the waste is sorted to recover the hard recyclables. The organic fraction is reduced to a sanitised ‘floc’ by the heating process and it can be treated biologically or incorporated into an RDF and used for energy recovery. Only a small number of MHT facilities processing mixed municipal waste are operating worldwide.
THERMAL TREATMENT (WASTE TO ENERGY) SOLUTIONS

Waste to energy technologies have potential to recover energy from the high carbon elements present in the waste (e.g. paper, cardboard, wood, textiles, food waste, green waste, plastics, and rubber) of MSW, C&I and C&D waste.

Waste to energy solutions can be broadly classified into two types:

- Incineration technologies that recover energy from untreated waste (e.g. mass burn combustion) or from a prepared fuel (e.g. an RDF).
- Advanced thermal treatment, including pyrolysis, gasification and plasma gasification.

Energy can be recovered from waste as:

- electricity
- sensible heat for the heating and/or cooling of spaces (the latter application using absorption chillers)
- high or low pressure steam for industrial processes
- chemical energy (as a gaseous, liquid or solid fuel)
- a combination of these forms.

Incineration technologies

Incineration involves the controlled burning of mixed residual waste or an RDF in an excess supply of air in a purpose-designed facility. Energy from the combustion process is recovered using a water tube boiler and heat exchangers to generate steam (in a similar way to that used in a coal-fired power station). The steam is then fed into a steam turbine to generate electricity; and/or supplied to a district heating/cooling network; or used in an industrial process.

Modern incineration plants have extensive gas clean up processes that remove the acid gases, particulates and heavy metals from the flue gases before they are discharged to the atmosphere. The generation of dioxins and furans is avoided through careful control of combustion conditions. Modern combustion plants are required to expose the gases generated from the incineration of waste to a temperature of 850°C for two seconds (dependent on the feedstocks chemical composition). Facilities avoid the emission of dioxins and furans through a combination of: the destruction of precursor molecules during the combustion process at temperatures >850°C for two seconds, rapid reduction of temperature, and filter systems.

Combustion plants incorporate extensive monitoring systems throughout the combustion, energy recovery and gas clean-up stages that allow almost instantaneous adjustment of the process to ensure efficient operation of the plant and compliance with emission requirements.

Advanced thermal treatment

Advanced thermal treatment (ATT) is a generic term that has been applied to processes that are used to manufacture energy-rich fuels from waste.

Three principal types of ATT process exist:

- Pyrolysis - the thermal decomposition of an RDF in the absence of oxygen or air to produce a solid char, pyrolysis oil and a gaseous fuel (syngas).
- Gasification - the thermal decomposition of an RDF in a limited supply of oxygen or air to produce syngas and ash.
- Plasma gasification - high temperature decomposition of mixed residual waste or an RDF to recover syngas, molten metal, and an inert slag.

These technologies have been developed from established industrial processes. Pyrolysis is the fundamental process by which charcoal is manufactured. Gasification was the traditional means of manufacturing ‘town gas’ from coal. Plasma gasification was originally developed as a means of smelting metals from mineral ores.

Syngas is combustible and is comprised of varying amounts of hydrogen, methane and carbon monoxide.

Energy can be recovered from the fuels produced by ATT processes by:

- combusting the gaseous, liquid or solid fuel products in a furnace and then recovering the energy in the ways described above for mass burn processes
- combusting the syngas and liquid fuels in an internal combustion engine coupled to a generator to produce electricity; or to produce mechanical energy to provide motive power (e.g. for transport purposes).

Of the three types of ATT technology, only gasification has achieved a satisfactory technical and commercial track record to be considered at a significant municipal scale. The City of Manningham operates a small pyrolysis unit processing less than 5,000 tonnes of garden waste per year, producing biochar but without energy recovery.
INTEGRATED SOLUTIONS

The advanced sorting processes described above are only partial solutions and are designed to generate products – for example a separated organic fraction, floc, or an RDF which require further treatment to recover additional value from the material. Consequently, advanced sorting processes are often combined with energy recovery technologies (combustion, advanced thermal treatment or anaerobic digestion) to complete the recovery process. The energy recovery component may be co-located with the sorting plant; or the organic fraction/floc/RDF may be transported to a separate energy recovery facility. The choice between the co-location of the two processes or the use of separate facilities is influenced by the size of site available at a particular location, as well as access to an energy user (for example an industrial complex or residential area), or proximity to a suitable grid connection.

A high-level technology assessment matrix for different AWRRT solutions is presented in Table 15.
<table>
<thead>
<tr>
<th>Technology</th>
<th>Principal waste types</th>
<th>Scale (tonnes pa)</th>
<th>Potential to be part of an integrated solution</th>
<th>Track record</th>
<th>Capital cost per tonne of capacity*</th>
<th>Operating costs per tonne of waste*</th>
<th>Local employment (FTE during operational phase)</th>
<th>Products and residues</th>
<th>Bankability (investor risk and interest)</th>
<th>Emissions to air, water and land</th>
<th>Other environmental impacts</th>
<th>Land-use planning zones and buffer distances</th>
<th>Deliverability in the Victorian context</th>
<th>Timelines to deployment</th>
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<td>Static pile</td>
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<td>$50 - $65</td>
<td>2 - 5</td>
<td>Residues to landfill</td>
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<td>Odour Bioaerosols Dust Runoff</td>
<td>Noise Traffic Vermin (rodents, flies) Birds</td>
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<td>In-vessel</td>
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<td>2 - 5</td>
<td>Residues to landfill</td>
<td>Medium risk, medium interest</td>
<td>Odour Bioaerosols Dust</td>
<td>Noise Traffic Visual intrusion</td>
<td>&gt; 300 M to &gt; 1400 M</td>
<td>High</td>
<td>13 - 24 months</td>
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<tr>
<td>Anaerobic digestion</td>
<td>Green waste</td>
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<td>$50 - $100</td>
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<td>CLO</td>
<td>Medium risk, high interest</td>
<td>Odour Bioaerosols Dust</td>
<td>Traffic Visual intrusion</td>
<td>Site Specific - EPA referral</td>
<td>Medium</td>
<td>13 - 24 months</td>
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<td>Sorting of mixed waste</td>
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<td>Commercial plants in Victoria</td>
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<td>$50 - $80</td>
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<td>Metals Plastics Paper/card Inert Glass Residues to landfill</td>
<td>High risk, medium interest</td>
<td>Odour Dust</td>
<td>Noise Traffic Visual intrusion</td>
<td>Site Specific - EPA referral</td>
<td>Medium</td>
<td>13 - 24 months</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Technology</th>
<th>Principal waste types</th>
<th>Scale (tonnes pa)</th>
<th>Potential to be part of an integrated solution</th>
<th>Track record</th>
<th>Capital cost per tonne of capacity*</th>
<th>Operating costs per tonne of waste*</th>
<th>Local employment (FTE during operational phase)</th>
<th>Products and residues</th>
<th>Bankability (investor risk and interest)</th>
<th>Emissions to air, water and land</th>
<th>Other environmental impacts</th>
<th>Land-use planning zones and buffer distances</th>
<th>Deliverability in the Victorian context</th>
<th>Timelines to deployment</th>
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<td>Mechanical biological treatment (MBT)</td>
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<tr>
<td>Pre-sort</td>
<td>Residual MSW C&amp;I Green waste Food waste</td>
<td>50,000 – 500,000</td>
<td>Yes</td>
<td>Commercial plants in Australia</td>
<td>$220 - $875</td>
<td>$120 - $170</td>
<td>21 - 35</td>
<td>CLO Metals Plastics Paper/card Glass Inert Residues to landfill</td>
<td>Medium risk, medium interest</td>
<td>Odour Bioaerosols Dust Noise Traffic Visual intrusion</td>
<td>Site Specific - EPA referral</td>
<td>Medium</td>
<td>25 - 36 months</td>
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<td>Bio-drying</td>
<td>Residual MSW C&amp;I Green waste Food waste</td>
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<td>Yes</td>
<td>Commercial plants overseas</td>
<td>$220 - $875</td>
<td>$120 - $170</td>
<td>21 - 35</td>
<td>CLO Metals Plastics Paper/card Glass Inert Residues to landfill</td>
<td>Medium risk, medium interest</td>
<td>Odour Bioaerosols Dust Noise Traffic Visual intrusion</td>
<td>Site Specific - EPA referral</td>
<td>Medium</td>
<td>25 - 36 months</td>
<td></td>
</tr>
<tr>
<td>Mechanical heat treatment (MHT)</td>
<td>Residual MSW C&amp;I Green waste Food waste</td>
<td>50,000 – 250,000</td>
<td>Yes</td>
<td>Commercial plants overseas</td>
<td>$280 - $550</td>
<td>$150 - $200</td>
<td>21 - 35</td>
<td>Organic floc Metals Plastics Glass Inert Residues to landfill</td>
<td>High risk, medium interest</td>
<td>Odour Bioaerosols Dust Noise Traffic Visual intrusion</td>
<td>Site Specific - EPA referral</td>
<td>Low</td>
<td>25 - 36 months</td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td>Principal waste types</td>
<td>Scale (tonnes pa)</td>
<td>Potential to be part of an integrated solution</td>
<td>Track record</td>
<td>Capital cost per tonne of capacity*</td>
<td>Operating costs per tonne of waste*</td>
<td>Local employment (FTE during operational phase)</td>
<td>Products and residues</td>
<td>Bankability (investor risk and interest)</td>
<td>Emissions to air, water and land</td>
<td>Other environmental impacts</td>
<td>Land-use planning zones and buffer distances</td>
<td>Deliverability in the Victorian context</td>
<td>Timelines to deployment</td>
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<tr>
<td>Pyrolysis</td>
<td>Residual MSW C&amp;I C&amp;D Green waste Food waste</td>
<td>10,000 – 100,000</td>
<td>Yes</td>
<td>Commercial plants overseas</td>
<td>$750 - $2,000</td>
<td>NA</td>
<td>11 - 20</td>
<td>Syngas Heat Electricity Char Air pollution control residue</td>
<td>High risk, medium interest</td>
<td>Odour Bioaerosols Dust</td>
<td>Traffic Visual intrusion</td>
<td>Site Specific - EPA referral</td>
<td>Low</td>
<td>25 - 36 months</td>
</tr>
<tr>
<td>Gasification</td>
<td>Residual MSW C&amp;I C&amp;D C&amp;D Green waste Food waste</td>
<td>10,000 – 250,000</td>
<td>Yes</td>
<td>Commercial plants overseas</td>
<td>$600 - $850</td>
<td>$85 - $150</td>
<td>11 - 20</td>
<td>Syngas Heat Electricity Bottom ash Air pollution control residue</td>
<td>Medium risk, medium interest</td>
<td>Odour Bioaerosols Dust</td>
<td>Traffic Visual intrusion</td>
<td>Site Specific - EPA referral</td>
<td>Medium</td>
<td>25 - 36 months</td>
</tr>
<tr>
<td>Plasma gasification</td>
<td>Residual MSW C&amp;I</td>
<td>5,000 – 20,000</td>
<td>No</td>
<td>Commercial plants overseas</td>
<td>$1,150</td>
<td>NA</td>
<td>11 - 20</td>
<td>Syngas Heat Electricity Metals Inert Air pollution control residue</td>
<td>High risk, low interest</td>
<td>Odour Bioaerosols Dust</td>
<td>Traffic Visual intrusion</td>
<td>Site Specific - EPA referral</td>
<td>Low</td>
<td>37 - 48 months</td>
</tr>
<tr>
<td>Technology</td>
<td>Waste types</td>
<td>Scale (tonnes pa)</td>
<td>Potential to be part of an integrated solution</td>
<td>Track record</td>
<td>Capital cost per tonne of capacity*</td>
<td>Operating costs per tonne of waste*</td>
<td>Local employment (FTE during operational phase)</td>
<td>Products and residues</td>
<td>Bankability (investor risk and interest)</td>
<td>Emissions to air, water and land</td>
<td>Other environmental impacts</td>
<td>Land-use planning zones and buffer distances</td>
<td>Deliverability in the Victorian context</td>
<td>Timelines to deployment</td>
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<td>Mass burn incineration with energy recovery</td>
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<tr>
<td>Moving grate</td>
<td>Residual MSW C&amp;I C&amp;D Green waste Food waste</td>
<td>20,000 – 1.5 million</td>
<td>No</td>
<td>Commercial plants overseas</td>
<td>$650 - $1,350</td>
<td>$50 - $75</td>
<td>21 - 35</td>
<td>Heat Electricity Inert Metals Bottom ash Air pollution control residue</td>
<td>Medium risk, high interest</td>
<td>Odour Dust</td>
<td>Traffic Visual intrusion</td>
<td>Site Specific - EPA referral</td>
<td>Medium</td>
<td>37 - 48 months</td>
</tr>
<tr>
<td>Rotary kiln</td>
<td>Residual MSW C&amp;I C&amp;D Green waste Food waste</td>
<td>20,000 – 300,000</td>
<td>No</td>
<td>Commercial plants overseas</td>
<td>$500 - $800</td>
<td>$50 - $75</td>
<td>21 - 35</td>
<td>Heat Electricity Inert Metals Bottom ash Air pollution control residue</td>
<td>Medium risk, high interest</td>
<td>Odour Dust</td>
<td>Traffic Visual intrusion</td>
<td>Site Specific - EPA referral</td>
<td>Medium</td>
<td>37 - 48 months</td>
</tr>
<tr>
<td>Fluidised bed</td>
<td>Residual MSW C&amp;I C&amp;D Green waste Food waste</td>
<td>20,000 – 300,000</td>
<td>Yes</td>
<td>Commercial plants overseas</td>
<td>$600 - $800</td>
<td>$50 - $75</td>
<td>21 - 35</td>
<td>Heat Electricity Inert Metals Bottom ash Air pollution control residue</td>
<td>Medium risk, medium interest</td>
<td>Odour Dust</td>
<td>Traffic Visual intrusion</td>
<td>Site Specific - EPA referral</td>
<td>Medium</td>
<td>37 - 48 months</td>
</tr>
<tr>
<td>Technology</td>
<td>Principal waste types</td>
<td>Scale (tonnes pa)</td>
<td>Potential to be part of an integrated solution</td>
<td>Track record</td>
<td>Capital cost per tonne of capacity*</td>
<td>Operating costs per tonne of waste*</td>
<td>Local employment (FTE during operational phase)</td>
<td>Products and residues</td>
<td>Bankability (investor risk and interest)</td>
<td>Emissions to air, water and land</td>
<td>Other environmental impacts</td>
<td>Land-use planning zones and buffer distances</td>
<td>Deliverability in the Victorian context</td>
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<td><strong>Landfill</strong></td>
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<tr>
<td>Residual MSW</td>
<td></td>
<td>2,000 – 1.5 million</td>
<td>Yes</td>
<td>NA</td>
<td>Commercial plants in Victoria</td>
<td>NA</td>
<td>6 - 10</td>
<td>Landfill gas Leachate</td>
<td>Medium risk, low interest</td>
<td>Noise Traffic Visual intrusion Visual intrusion Birds</td>
<td>Odour Bioaerosols Dust Landfill gas Runoff Leachate Litter</td>
<td>100m from surface waters 500m from buildings / structures 1500m from aerodrome (piston-engine propeller-driven aircraft) 3000m from aerodrome (jet aircraft)</td>
<td>Medium</td>
<td>25 - 36 months</td>
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<tr>
<td>C&amp;I</td>
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<td>With gas capture and energy recovery</td>
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<tr>
<td>Residual MSW</td>
<td></td>
<td>60,000 – 1.5 million</td>
<td>Yes</td>
<td>NA</td>
<td>Commercial plants in Victoria</td>
<td>NA</td>
<td>6 - 10</td>
<td>Leachate Heat Electricity</td>
<td>Medium risk, medium interest</td>
<td>Odour Bioaerosols Dust Runoff Leachate Litter</td>
<td>Noise Traffic Visual intrusion Vermin (rodents, flies) Birds</td>
<td>100m from surface waters 500m from buildings / structures 1500m from aerodrome (piston-engine propeller-driven aircraft) 3000m from aerodrome (jet aircraft)</td>
<td>Medium</td>
<td>25 - 36 months</td>
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<td>C&amp;I</td>
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</tbody>
</table>

*Indicative only
Appendix 3 – Waste hierarchy intervention model (WHIM)

WHIM OUTPUTS

The key outputs of WHIM are:

- time series curves that illustrate the impact that different waste hierarchy intervention scenarios have on resource recovery and the diversion of waste from landfill
- indicative incremental net cost/savings relative to business-as-usual (BAU) for each scenario after considering the various changes in collection, disposal and transportation costs. A negative net cost profile indicates that the scenario is cheaper than BAU
- difference in Net Present Value (NPV) compared to BAU for each scenario across a 25-year period (2018 to 2043)
- carbon emissions abatement.

WHIM will be further refined as better data becomes available, including waste supply and cost data sourced through targeted consultation with councils and third parties.

ASSUMPTIONS

Inflation

The model assumes that all baseline/current cost rates will increase annually by inflation (CPI) assumed to be 2.5% per annum, with flexibility to incorporate additional uplift factors to rates beyond inflation, as required.

Net Present Value (NPV)

To calculate Net Present Value, a nominal discount rate of 6.5% per annum has been assumed based on estimated cost of capital for local government.

COST BENEFIT ANALYSIS

The estimated gate fees (unit charge per tonne of kerbside residual waste processed) for a range of AWRRT solutions are based on a cost build-up of capital and operating costs and revenues. The estimated gate fees have then been compared against interstate and international references. For each technology option, the gate fee estimate takes into consideration the following components:

- capacity of the facility (to reflect a large-scale facility as expected from this procurement exercise) which has a significant impact on unit costs
- diversion performance of the technology (based on typical performance but also matched to the diversion capability of residual waste stream determined from its average composition)
- likely capital expenditure and repayment terms and costs
- estimated operating and maintenance costs
- landfill gate fees for residuals (based on current Melbourne rates, but including an uplift where part of the residual stream is likely to be classified as hazardous – e.g. fly ash from thermal plants)
- revenue from saleable outputs (energy, heat/cooling, process steam, bottom ash, recyclables, compost)
- contractor profit margin/mark-up.

For the purposes of this regional cost-benefit analysis it has assumed that AWRRT gate fees will be fixed over a long-term contract, only increasing with CPI. The AWRRT gate fees are all-inclusive and account for the landfill disposal of residuals from the process, to avoid double-counting of this in the modelling.

The estimate for gasification (in this case linked with MBT) is particularly uncertain as there are few reference plants of this type internationally and limited public information on costs. For thermal technologies, there is an assumption of partial recovery of bottom ash as road-base (or similar) within the diversion rates and gate fees.

WHIM also includes high-level costs associated with providing residual and organics kerbside collection services. Council specific data in relation to bin lift rates in existing collection contracts were not available at this stage of model development so the following assumptions and data inputs have been incorporated into WHIM:

- $1.00 per bin lift for organics and residual kerbside bin collection for all councils
- frequency of bin lifts for organics and residual kerbside collection based on data collected by SV in the Victorian Local Government Association Survey
- known collection contract end dates for each council
• number of households serviced for residual kerbside collection assumed to be 100% of total households
• number of households serviced for organics kerbside collection dependant on the nature of the service. Where council specific data was not available, the proportion of households serviced has been estimated based on historical data.

The costs do not reflect potential implications of processing third party waste or streams other than kerbside residual (i.e. C&I, hard waste, MRF residuals).

LIMITATIONS OF THE MODEL

Whilst WHIM is a sophisticated model, there are numerous assumptions and simplifications in the current model that have been made in view of the available data that will be refined in future iterations.

Although WHIM has the capability to model interactions between different management scenarios for waste from a wide range of sources, the current version of WHIM is focused on kerbside MSW only and does not address the following:

• C&I waste, due to insufficient accurate and robust data for this waste stream
• transfer station/drop-off waste, due to gaps in the available data
• full details of existing waste management infrastructure and facility capacity within the region
• impact of policy interventions on managing e-waste and single use plastic bags.

Other categories of waste that may be considered to be part of the municipal stream, such as street sweepings, public place waste, event waste, have not been incorporated into WHIM as insufficient data is currently available for these waste streams.

The indicative residual MSW composition that is presented in Figure 1 (Section 2.2) is not suitable for modelling purposes due to the large proportion of material that is classified as ‘other’. Instead the modelling analysis has based on compositional data that has been provided by the City of Maribyrnong. The composition of Maribyrnong’s residual waste is illustrated in Figure 12.
**Table 16: Breakdown of residual and recyclable streams by category**

<table>
<thead>
<tr>
<th>Residual stream categories</th>
<th>Recycling stream categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper and cardboard</td>
<td>Recyclable paper</td>
</tr>
<tr>
<td>Glass</td>
<td>Recyclable glass</td>
</tr>
<tr>
<td>Plastics</td>
<td>Recyclable plastic</td>
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<tr>
<td>Ferrous</td>
<td>Recyclable ferrous</td>
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<tr>
<td>Non-ferrous</td>
<td>Recyclable non-ferrous</td>
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<tr>
<td>Other inert</td>
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<tr>
<td>Food</td>
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<tr>
<td>Garden</td>
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<tr>
<td>Soil and other organic</td>
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<tr>
<td>Hazardous and fines</td>
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<tr>
<td>E-waste</td>
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<tr>
<td>Miscellaneous combustibles</td>
<td></td>
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<tr>
<td>Miscellaneous non-combustibles</td>
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</tr>
</tbody>
</table>

In its current form WHIM can only be used to forecast the impact of the deployment of FOGO services and/or an AWRRT solution based on an initial commitment of contracted supply of waste by councils and cannot model supplies of waste that may subsequently become available from other councils seeking to join an established cluster.
Appendix 4 – Calculating emissions

CALCULATING CARBON EMISSIONS ABATEMENT

The WHIM model has been used to calculate the net carbon emissions abated under the four scenarios described in Section 3.4 compared to BAU, where positive net abatement is the total abated or avoided emissions, and negative abatement represents an increase in carbon emissions relative to BAU.

The following potential emissions sources have been identified and modelled:

- Partly renewable electricity generation – net emissions abated by replacing grid electricity (mostly fossil based) with partially renewable power from the project. For the purpose of this assessment, it has been assumed that AWRRT solutions involving energy recovery produce electricity for export to the grid, as is the most common approach for such projects globally. It is possible that heat/steam or other energy products could be directly exported from a facility to an industrial user (offsetting natural gas or other fuel use), but this option has not been tested at this stage.

- Avoided landfill - emissions abated by diverting organic waste from landfill, either through an AWRRT solution or increased source segregation and recovery of kerbside organics, thereby reducing emission of methane in landfill gas.

- Recycling and carbon sequestration – net emissions abated from recycling of key materials (namely metals through AWRRT and composted organics through FOGO systems) relative to production from virgin materials. In the case of compost, the abatement is relative to the use of alternative products (e.g. chemical fertilisers in agriculture) and also considers carbon sequestration in soil.

- Transportation of waste – net changes in emissions generated from the additional/reduced transportation of organics and residual waste to assumed facility locations, relative to BAU landfills.

Emissions from changes to material flows in the kerbside recycling stream (i.e. increased/decreased MRF throughput) have not been modelled in these scenarios. This is consistent with the approach taken for the CBA, and while it is recognised that there may be efforts by councils to improve recyclables recovery and/or implications of recycling market constraints, which could see fluctuations in diversion and capture rates, these implications are not part of the current modelled scenarios. In future, the current model may be expanded to estimate the emissions impact of changes to the recycling sector.

Net emissions were calculated in tonnes CO₂-equivalent largely using published factors and methods from the Australian Government National Greenhouse Accounts Factors – July 2017 (NGA Factors) or from other reputable literature sources as noted below. Assumptions were made regarding fuel use, consumption, waste transport and waste decomposition, as discussed below.

CALCULATING ENERGY EMISSIONS

AWRRT solutions that involve energy recovery are assumed to produce electricity that would then be exported to the national grid and replace predominantly fossil fuel generated power. The net abatement due to export of partly renewable electricity from an AWRRT solution to the grid is calculated from two components:

- Emissions avoided by replacing existing grid power - 1.08 kg CO₂-e per kilowatt-hour of electricity output in Victoria (NGA Factors). This figure is updated annually depending on the source mix of power supplied in Victoria. The modelling assumes this figure remains constant, although in reality it can be expected to decline over time as more renewable energy sources are added to the grid.

- Emissions produced from combustion of non-renewable waste – a generic rate of 0.09 tonnes CO₂-e per GJ of non-renewable energy produced (NGA Factors, 2017). This a generic rate, not specific to the mix of non-renewable waste (mostly plastic).

No energy recovery is assumed from any organics treatment (i.e. tonnes diverted through FOGO implementation), as it is assumed that FOGO will be processed through existing facilities and procurement contracts, which are mainly in-vessel composting solutions.
AVOIDED LANDFILLING OF ORGANIC WASTE

Emissions abatement from the diversion of organic waste from landfill (either within the residual stream or separated) is typically the most significant contributor to the net carbon impact of waste recovery solutions. When organic waste decomposes in landfill under anaerobic conditions, it produces methane which is a greenhouse gas 25 times more potent than carbon dioxide. Most modern landfills, including those that service Melbourne, have landfill gas capture systems in place to capture the majority of this but a significant volume of methane is still released to the atmosphere.

Specific landfill emissions factors for the streams that would be diverted from landfill under a number of scenarios have been calculated by using a customised First Order Decay (FOD) model to comply with NGER guidelines:

- For the diversion of source segregated organics (GO and FO), the emissions factor per tonne of garden organics and food organics have been modelled.
- For the diversion of residual MSW, emissions factors for four separate cases have been modelled using different collection system options based on a representative composition set for each collection system. Based on organics capture rate assumptions the likely residual waste composition has been modelled. This resulted in an emissions factor (per tonne) for each residual MSW stream when landfilled being determined.
- It is assumed that existing landfills servicing Melbourne have gas capture systems in place which capture on average 70% of landfill gas generated. There is no public data on the capture rate of Melbourne landfills but this is considered a reasonable industry average for large-scale modern landfills.

RECYCLABLES

Assessing the abated emissions due to the recovery of recyclables and compost is complex and requires a detailed life-cycle analysis which is beyond the scope of this study but there are several previous studies that can be referenced in literature that consider the likely use of the recovered materials and likely alternatives (e.g., manufacturing from virgin materials). In the modelling, abated emissions from the two main recovered materials were assessed:

- the abated emissions from the production and use of compost from organics, and
- the abated emissions from the recycling of metals from residual waste (ferrous and non-ferrous) through an AWRRT solution. For thermal energy recovery options, metals would be recovered in the bottom ash. For MBT, some metals would be expected to be recovered during front-end processing.

There may be small volumes of rigid plastics or paper/cardboard recovered from residual waste through an MBT process but their impact is likely to be minor and insignificant in the broader context and has not been assessed in the carbon modelling.

There are a number of limitations in this calculation, including the boundaries and definitions adopted in the source life-cycle analyses. Overall, recovery of recyclables has a relatively small impact on abated emissions in comparison to other emission sources.

The quantity of metals in the diverted residual stream was determined by using the compositional data (discussed above) and the tonnes diverted to AWRRT, which takes into consideration the diversion performance of each technology type in recovering each component in the residual stream.

The emissions factor for recycled metals was sourced from the study, LCA of Kerbside Recycling in Victoria (RMIT, 2015)\(^2\), and has the following assumptions in the derivation of the emissions factors:

- ferrous metals: 1.7t CO\(_2\)-e abated per tonne of ferrous metals recovered.
- non-ferrous metals: 17t CO\(_2\)-e abated per tonne of nonferrous metals recovered.

\(^2\) Sustainability Victoria
For compost produced from recovered organics, the emission factors have been sourced from the NSW Office of Environment and Heritage report *Benefits of using compost for mitigating climate change* (2011) and are:

- organics: 118.7kg CO$_2$-e abated per tonne of garden organics compost when used in agriculture applications to substitute for mineral fertilisers and providing long-term carbon sequestration.

It is assumed this figure can also be applied to compost made from mixed garden and food organics. This figure does not include emissions abatement from diverting the organics from landfill which is estimated separately as above. It is noted that a significant proportion of compost could be used in urban amenity/landscaping applications which would have a different emissions impact. Minor methane and nitrous oxide emissions may be released during the composting processing, although these are likely to be insignificant in comparison, and have not been included in this figure.
Appendix 5 – Project stakeholders

Establishing Victoria’s first municipal residual waste processing solutions involves a large number of stakeholders with various roles, interests and contributions. Table 17 provides a short description of the project’s stakeholders and their interest.

Table 17: Project stakeholders

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Interest in the project</th>
</tr>
</thead>
<tbody>
<tr>
<td>MWRRG</td>
<td>Delivering the project in partnership with local government to achieve the objectives of the Metropolitan Implementation Plan. Facilitates collaborative procurements on behalf of local government. Supports local government with a range of services, including programs, incentives, research, and advice to boost recycling and reduce waste.</td>
</tr>
<tr>
<td>Metropolitan councils</td>
<td>Responsible for provision of municipal waste and resource recovery services for their community in line with their corporate strategy. Need to perform waste management functions consistent with the Metropolitan Implementation Plan (Section 50BH Environment Protection Act). Utilise regional business case process to inform and confirm level of commitment to participate in group procurement process facilitated by MWRRG.</td>
</tr>
<tr>
<td>Department of Environment, Land, Water, and Planning (DELWP)</td>
<td>Responsible for articulating policy directions, including on waste and resource recovery, energy and climate change. Manage state planning framework, including potential pathways for regional and state significant infrastructure projects. Advise ministers on developing and implementing policy and on progress towards achieving policy outcomes. Use project outputs to inform coordination of environment portfolio prioritisation and submissions for government support. Interest in portfolio budgetary impacts.</td>
</tr>
<tr>
<td>Environment Protection Authority Victoria (EPA)</td>
<td>Regulates industry’s impact upon the environment and will consider applications made by proponents for future AWRRT solutions. Will assess any applications deemed a scheduled activity and will regulate the operations in line with the Environment Protection Act 1970. Project informs relative prioritisation of internal capacity to respond to needs.</td>
</tr>
<tr>
<td>Department of Treasury and Finance</td>
<td>Interest in the procurement model that is adopted, risk allocation, and the financial outcomes that can be achieved. Interest in state budgetary impacts.</td>
</tr>
<tr>
<td>Regional Waste and Resource Recovery Groups</td>
<td>Gippsland Waste and Resource Recovery Group is exploring opportunities with local government to establish municipal residual waste processing solutions to service the Gippsland region. Other Waste and Resource Recovery Groups and regional councils may in time seek to partner with metropolitan authorities to take advantage of economies of scale.</td>
</tr>
<tr>
<td>Water authorities</td>
<td>Interest as waste generator - water authorities manage and process significant quantities of organic waste from sewage. Inform consideration of opportunities to locate residual waste processing solutions with existing sewage treatment infrastructure and utilisation of heat and/or power outputs in the sewage treatment processes.</td>
</tr>
<tr>
<td>Organisation</td>
<td>Interest in the project</td>
</tr>
<tr>
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</tr>
<tr>
<td>Potential solution providers</td>
<td>Interest in investing, constructing and operating waste and resource recovery solutions within the metropolitan region.</td>
</tr>
<tr>
<td>Communities</td>
<td>Users of waste and resource recovery system. Interest in the location of future AWRRT solutions and their environmental, social and economic impacts.</td>
</tr>
</tbody>
</table>
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCC</td>
<td>Australian Competition and Consumer Commission.</td>
</tr>
<tr>
<td>AWRRT</td>
<td>Advanced waste resource recovery technology.</td>
</tr>
<tr>
<td>Advanced thermal treatment (ATT)</td>
<td>A class of thermal treatment technologies including pyrolysis, gasification and plasma gasification that can be used to recover energy from the carbon matter (plant and animal material and plastics) present in residual waste or a fuel prepared from waste material.</td>
</tr>
<tr>
<td>Air pollution control residues (APC)</td>
<td>Materials that are produced as a consequence of treating noxious chemicals that arise from the thermal treatment or combustion of waste materials. Air pollution control residues are typically classified as hazardous waste. (See also flue gas treatment)</td>
</tr>
<tr>
<td>Anaerobic digestion (AD)</td>
<td>The biological decomposition of organic matter (plant and animal material) by microbes in the absence of air or oxygen.</td>
</tr>
<tr>
<td>Ash/bottom ash</td>
<td>The residual material (largely inert matter) that is left following the thermal treatment or combustion of waste.</td>
</tr>
<tr>
<td>Bankability</td>
<td>The extent to which a technology solution can attract the necessary investment funding and is a function of the risks inherent in the technology and/or proposed solution.</td>
</tr>
<tr>
<td>Biogas</td>
<td>A methane rich gas that is generated from organic waste via anaerobic digestion.</td>
</tr>
<tr>
<td>Biosolids</td>
<td>Solid and semi-solid organic and inorganic matter produced as a result of the treatment of waste water.</td>
</tr>
<tr>
<td>BOOT contract</td>
<td>An infrastructure development contract where the contractor designs, builds, owns and operates the facility on behalf of a client (e.g. a council or group of councils) and transfers ownership and operation of the facility to the client after an agreed period of time.</td>
</tr>
<tr>
<td>Capex</td>
<td>The capital expenditure associated with the design, construction and commissioning of a facility.</td>
</tr>
<tr>
<td>CCA</td>
<td><em>Competition and Consumer Act 2010</em> (Commonwealth).</td>
</tr>
<tr>
<td>Char</td>
<td>A carbon rich material that may be left over following the pyrolysis of a waste or fuel.</td>
</tr>
<tr>
<td>Collaborative procurement</td>
<td>A procurement where two or more councils work together to procure waste and resource recovery services and/or infrastructure by consolidating waste materials or products to maximise environmental, social and economic outcomes.</td>
</tr>
<tr>
<td>Commercial and industrial waste (C&amp;I)</td>
<td>Solid waste generated from trade, commercial and industrial activities including the government sector. It includes waste from offices, manufacturing, factories, schools, universities, and state and government operations and small to medium enterprises.</td>
</tr>
<tr>
<td>Commingled recycling</td>
<td>Materials combined generally for the purposes of collection, mainly through municipal collection services. Includes plastic bottles, other plastics, paper, glass and metal containers. Commingled recyclable materials require sorting after collection before they can be recycled. Can also be called commingled materials.</td>
</tr>
<tr>
<td>Composting</td>
<td>The biological processing of organic matter in the presence of oxygen, yielding carbon dioxide, heat and stabilised organic residues that may be used as a soil additive. Composting can be undertaken using an open windrow or in-vessel system.</td>
</tr>
<tr>
<td>Construction and demolition waste (C&amp;D)</td>
<td>Solid waste generated from residential and commercial construction and demolition activities e.g. bricks and concrete.</td>
</tr>
<tr>
<td>CPI</td>
<td>Consumer price index (CPI) - measures changes in the price level of consumer goods and services purchased by households.</td>
</tr>
<tr>
<td>D&amp;B contract</td>
<td>An infrastructure development contract where the contractor designs and builds a facility for a client.</td>
</tr>
<tr>
<td>DBO contract</td>
<td>An infrastructure development contract where the contractor designs, builds and operates a facility on behalf of a client.</td>
</tr>
<tr>
<td>DBOF contract</td>
<td>An infrastructure development contract where the contractor designs, builds, operates and finances a facility on behalf of a client.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>Energy from waste (EfW)</td>
<td>The recovery of energy in some usable form (e.g. sensible heat, electricity or process steam) from waste materials.</td>
</tr>
<tr>
<td>Energy-from-waste facility</td>
<td>A facility that converts waste into heat and/or electricity for which there is an economically viable end use. Technologies can include, but are not limited to: anaerobic digestion, combustion, pyrolysis, gasification, and plasma gasification.</td>
</tr>
<tr>
<td>EPA</td>
<td>Environment Protection Authority Victoria</td>
</tr>
<tr>
<td>Flue gas treatment</td>
<td>The removal of acid gases, particulates, heavy metals and volatile organic compounds (VOCs) from flue gases through the use of chemical or physical agents. (See air pollution control residues).</td>
</tr>
<tr>
<td>Fly ash</td>
<td>Small particulate materials carried over from the combustion chamber that becomes entrained in the flue gases.</td>
</tr>
<tr>
<td>FOGO</td>
<td>Combined collection and processing of food and garden organics.</td>
</tr>
<tr>
<td>Food organics</td>
<td>Food waste from households or industry, including food processing waste, out-of-date specification food, meat, fruit and vegetable scraps. Excludes liquid wastes.</td>
</tr>
<tr>
<td>FTE</td>
<td>Full-time equivalent - a unit that indicates the workload of an employee in a way that makes workloads or class loads comparable across different contexts.</td>
</tr>
<tr>
<td>Garden organics</td>
<td>Organics derived from garden sources, e.g. grass clippings, tree prunings. Also known as green organics.</td>
</tr>
<tr>
<td>Gasification</td>
<td>Thermal technology that converts material into combustible gases by partial oxidation under the application of heat, leaving a solid ash or slag residue.</td>
</tr>
<tr>
<td>Gate fee</td>
<td>A charge made by a facility operator for the receipt of a quantity of waste or recyclable material.</td>
</tr>
<tr>
<td>Implementation Plan/s</td>
<td>Regional Waste and Resource Recovery Implementation Plans</td>
</tr>
<tr>
<td>Incineration</td>
<td>The combustion of waste materials in a controlled manner, with or without energy recovery.</td>
</tr>
<tr>
<td>Land use planning</td>
<td>A statutory system of infrastructure development control administered by local and state government.</td>
</tr>
<tr>
<td>Landfill gas (LFG)</td>
<td>A methane rich gas produced by the anaerobic decomposition of animal and plant matter within a landfill.</td>
</tr>
<tr>
<td>Landfill levy</td>
<td>A tax imposed by the Victorian Government on the disposal of waste materials to landfill.</td>
</tr>
<tr>
<td>Leachate</td>
<td>A noxious liquid that is generated from waste as a result of biological decomposition and/or rainfall and/or wash-down water passing through the waste material.</td>
</tr>
<tr>
<td>Mass combustion</td>
<td>The combustion of residual material without sorting of the waste before the thermal treatment phase. Recyclable materials may be recovered from the bottom ash.</td>
</tr>
<tr>
<td>Materials recycling facility (MRF)</td>
<td>A centre for the receipt, sorting and transfer of materials recovered from the waste stream. At a MRF, materials are also sorted by type and treatment, which may include cleaning and compression.</td>
</tr>
<tr>
<td>Mechanical biological treatment (MBT)</td>
<td>A facility that processes mixed waste (MSW, C&amp;I, C&amp;D) to separate recyclables and an organic fraction from the residual waste. The recyclables are sent to reprocessors. The organic fraction is processed on site anaerobically and/or aerobically to recover energy and/or produce a soil improver. Residual waste is sent to landfill or for energy recovery.</td>
</tr>
<tr>
<td>Mechanical heat treatment (MHT)</td>
<td>A facility that processes mixed waste (MSW, C&amp;I, C&amp;D) to separate recyclables and produce an organic-rich fraction (floc). The recyclables are sent to reprocessors. The floc may be further processed on site anaerobically and/or aerobically to recover energy and/or produce a soil improver. Alternatively the floc may be incorporated into a refuse derived fuel. Residual waste is sent to landfill or for energy recovery.</td>
</tr>
<tr>
<td>Municipal solid waste (MSW)</td>
<td>Solid waste generated from municipal and residential activities, and including waste collected by, or on behalf of, a municipal council.</td>
</tr>
<tr>
<td>MWRRG</td>
<td>Metropolitan Waste and Resource Recovery Group</td>
</tr>
<tr>
<td>Opex</td>
<td>Operating expenditure, including labour costs, consumables, utility costs, insurance, etc..</td>
</tr>
<tr>
<td>Options assessment</td>
<td>A structure process by which different technology solutions are evaluated in respect of their ability to meet the desired outcomes of the procurement.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>Plasma gasification</td>
<td>The use of ionised gases at high temperatures within a closed vessel to thermally decompose the organic content (animal and plant matter, and plastics) that is present in waste.</td>
</tr>
<tr>
<td>Pyrolysis</td>
<td>The thermal decomposition of organic material (plant and animal matter, and plastics) in the absence of air or oxygen.</td>
</tr>
<tr>
<td>Reference project</td>
<td>A fully worked example of a representative technology solution that meets the requirements of the procurement.</td>
</tr>
<tr>
<td>Refuse derived fuel (RDF)</td>
<td>A fuel that is manufactured from the carbon rich matter that is present in residual waste through a sorting and separation process.</td>
</tr>
<tr>
<td>Residual waste</td>
<td>Waste that remains after materials have been recovered for reuse and recycling. Recyclable materials may still be present in residual waste but their recovery for recycling may not be achievable without further treatment or processing.</td>
</tr>
<tr>
<td>Social licence to operate</td>
<td>The level of acceptance or approval continually granted to an organisation’s operations or project by the local community and other stakeholders.</td>
</tr>
<tr>
<td>State Infrastructure Plan</td>
<td>The Victorian Government’s Statewide Waste and Resource Recovery Infrastructure Plan</td>
</tr>
<tr>
<td>Syngas</td>
<td>A synthetic gas, rich in hydrogen, methane and carbon monoxide that is a manufactured from a fuel or waste through the use of pyrolysis, gasification or plasma gasification.</td>
</tr>
<tr>
<td>Waste to energy (WtE)</td>
<td>The recovery of energy in some usable form (e.g. sensible heat, electricity or process steam) from waste materials.</td>
</tr>
<tr>
<td>Waste Hierarchy Intervention Model (WHIM)</td>
<td>A MWRRG model to explore future interactions between different resource recovery system approaches and landfill requirements within the region.</td>
</tr>
</tbody>
</table>