Final V3

Shared organics facility feasibility study

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PREPARED FOR

Glenelg Shire Council and Southern Grampians Shire Council

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Abbreviations & glossary

ACCU	Australian Carbon Credit Units
AD	anaerobic digestion
ARENA	Australian Renewable Energy Agency
C&D	construction and demolition
C&I	commercial and industrial
CHP	Combined heat and power. This refers to thermal or biogas energy systems that recover usable heat and power
EfW	energy from waste
EoI	expression of interest
EPA	Environment Protection Authority
ERF	Emissions Reduction Fund
FOGO	food organics and garden organics. Refers to kerbside collection systems
GO	garden or green organics
GSC	Glenelg Shire Council
kt	kilotonnes (thousands of tonnes)
kW	kilowatt
kWh	kilowatt hours
MJ	megajoule
ML	megalitre
MW	megawatt
MWh	megawatt hour
MWRRG	Metropolitan Waste and Resource Recovery Group
PIW	prescribed industrial waste
RDF	refuse derived fuel
RD&D approval	research, development and demonstration approval. These can be granted from EPA to applications to trial and develop new environmental management systems, and could be sought to trial systems before seeking works approval and licensing to remove uncertainty about systems' performance and levels of environmental controls required.
SGSC	Southern Grampians Shire Council
SIW	solid industrial waste (in this report this refers to organic wastes)
WRG	Waste Reduction Group (South West Waste Management Group)

Summary

Organic food and garden wastes contribute about half of all landfilled household garbage. Organic waste in landfill creates pollution risks, and there is opportunity to recover this resource to make compost or energy. Landfill costs are increasing due to higher gate fees and longer transport distances, so the costs of recovering organics can be off-set by avoided landfill costs. Glenelg Shire Council (GSC) and Southern Grampians Shire Council (SGSC) are considering the introduction of new or expanded food organic and garden organic (FOGO) kerbside collection services.

Previous assessments of organics recovery options and resource recovery infrastructure have identified a lack of appropriate reprocessing infrastructure to serve GSC and SGSC. Consideration needs to be given to the scale, technology, location of future organics processing facilities and whether there is potential for a shared facility.

This report summarises work undertaken by Blue Environment on behalf of GSC and SGSC to investigate options for the future management of organic waste and other biomass within the region. The work focused on options that can process organics from a proposed FOGO service as well as garden organics from municipal resource recovery centres and other operations. Consideration has also been given to organic wastes from commercial and industrial (C&I) sources.

The study has reviewed appropriately-scaled processing technologies and considered the best options for the location of such a shared facility or separate facilities serving each municipality.

Key findings of the study are:

1. There is need for either a shared facility with capacity to process up to 10,000 tonnes of municipal and C&I organics per year, or two individual facilities with capacity to each process around 5,000 tonnes per year of municipal organics.
2. An additional 6,500 tonnes per year of paunch (stomach contents) and manures, and 60-70 megalitres (ML) of wastewater with organic content could be available if a proposed meat works is developed at Hamilton by Australian Meat Farmers (AMF). If this facility proceeds there is opportunity for SGSC, and potentially GSC, to work with AMF to develop a shared organics processing facility.
3. Different organics processing technologies were identified and reviewed. The most viable processing technologies identified for processing FOGO and other C&I organics are:
   - Small-scale anaerobic digestion (AD) e.g. Smartferm modular AD technology or similar. This could be viable if local users of heat and/power can be secured.
   - Covered aerated composting.
   - Uncovered windrow composting (aerated or turned) processing up to 5,000 tonnes per year.
   - Covered aerated bays.
   - Wet-dry ‘hybrid’ AD system (e.g. AnaeCo/DiCom system) if the AMF facility is developed.
   - Small-scale thermal gasification/pyrolysis (e.g. BigChar).
4. The estimated capital costs of different technology types have been estimated. Capital costs for a shared appropriately-scaled composting or AD facility capable of processing 10,000 tonnes of organics per year are expected to be around $1.7 to $2.0 million. Annual operating costs, including capital depreciation, are expected to be in the range of $29 to $68 per tonne of FOGO waste received. Net costs can be reduced by selling compost or energy, or securing revenue for receiving organics from industrial or other municipal sources. The lower end estimate represents a ‘best case’ scenario.

5. Potential sites where an organics processing facility could be located were identified and reviewed. The most suitable sites are:
   - Land adjacent to the current Hamilton landfill. This site is favoured for either a shared organics facility or an individual SGSC site.
   - If the proposed AMF meatworks is developed at Hamilton, an anaerobic digestion facility could be located at this site.
   - The Heywood transfer station could potentially be developed as a small-scale controlled composting site processing up to 5,000 tonnes per year. However, the proximity of a farm house may restrict the potential to develop the site.
6. The estimated costs of introducing a new or expanded FOGO service compared to 'business as usual' landfilling show the following:
   - Although landfilling costs are higher per tonne than organics processing, the introduction of a FOGO service would increase the total waste, recycling and organics recovery costs. This is because households provided with a FOGO service can be expected to dispose of more garden and food waste through the service than they are currently disposing as kerbside garbage. The cost savings achieved by diverting organics from landfill are less than the costs of collecting and processing such 'additional' FOGO materials.
   - For Glenelg:
     - Heywood would be cheaper to use as an organics processing site. However, the site is likely to be limited to less than 5,000 tonnes of material and controlled composting such as aerated covered windrows or bays may be needed to process FOGO materials.
     - An optional FOGO service with fortnightly collection could be introduced for $63-$72 per household using the service per year. This could be charged on a user-pays basis. This option would reduce waste to landfill by only around 12% by weight.
     - A compulsory FOGO service collected weekly with fortnightly garbage collection could be introduced for a net cost of $57-$68 per household per year in serviced areas. This would reduce waste to landfill by an estimated 41% by weight.
   - For Southern Grampians:
     - The Hamilton location is clearly cheaper than using Heywood.
     - Expansion of the current optional FOGO fortnightly collection service to achieve 40% household participation could be introduced for an additional net cost of as little as $37 per additional household using the organics service per year. Around 1,000 households already use the service. This assumes material would be processed at Hamilton. It would reduce waste to landfill by less than 13%.
     - A compulsory FOGO service with weekly collection could be introduced for a net cost of little as $15 per additional household using the service in the serviced areas per year. This achieves the greatest diversion from landfill (over 40%). The net costs are low because of the low organics processing and transport costs relative to landfill.
7. It is recommended that:
   - Councils consider introducing either:
     - A compulsory FOGO service collected weekly and fortnightly collection of garbage and recycling.
     - A well-promoted optional FOGO service collected weekly or fortnightly and fortnightly collection of garbage and recycling (the cost of this service will depend on household participation and organics recovery rates, but costs can be recovered on a fee-for-service basis). A target participation rate of at least 40% of households in serviced areas using the optional service is suggested. This would require SGSC to increase household participation rates in the existing service. This service is thought

by SGSC to already be well-promoted, but participation rates are only around 18%. Most other Councils with optional services achieve higher rates of participation although this can take several years.

- GSC and SGSC call for expressions of interest from suppliers of:
    - aerated (covered and uncovered) composting systems, including covered windrow and bay systems
    - small-scale AD system (such as Smartferm – see Appendix B)
    - small-scale pyrolysis/gasification systems (such as BigChar – see Appendix B).
- Councils seek to identify commercial users of heat or combined heat and power from energy recovery systems. Councils could discuss with AMF the option of a shared AD facility to process municipal FOGO and other organics as well as AMF's wastes, if the plant is established.

1 Introduction

Food and garden organics make up about half of landfilled household garbage. There is opportunity to recover these materials for compost or energy. As the costs of landfill rise, the net cost of providing an organics recovery service falls.

Glenelg Shire Council (GSC) is considering providing an organics recovery service and Southern Grampians Shire Council (SGSC) is considering expanding its current optional organics service.

A previous statewide review of waste and resource recovery infrastructure conducted by Sustainability Victoria (SV, 2015) identified a 'gap' in organics waste and biomass processing infrastructure in the south west region of Victoria. A report commissioned by the former Waste Reduction Group (South West Waste Management Group) identified options for the diversion of organics from landfill within the region (WRG, 2013). A further, more detailed feasibility study was required to determine the viability of a facility to be shared by GSC and SGSC.

This report details work undertaken by Blue Environment to assess the feasibility of sharing an organics processing facility between the two Councils.

This work involved:

- a review of potential technical processing options
- quantification of potential wastes and other biomass that could be recovered by a future processing facility or facilities
- a review of site requirements and potential site options
- a financial cost benefit analysis
- consideration of social and environmental impacts of the options.

The primary focus of this study is to assess the viability and optimal location of a shared organics processing facility capable of processing 5,000 tonnes and/or up to 10,000 tonnes of source-separated municipal organics. The report considers the potential to improve the commercial viability of a future facility by receiving organics from other sources.

The work has focused on the recovery of household organics through kerbside food organics and garden organics (FOGO) services, as well as garden organics received at Councils' resource recovery facilities. Opportunities for a shared facility to secure industrial organics and organics from other municipalities have also been considered.

This assessment did not consider 'mixed-waste' (garbage) processing technologies because the annual tonnages of landfilled waste from the two Councils is less than 10,000 tonnes. Typically, mixed waste technologies require at least 50,000-80,000 tonnes per year to be viable. Even if surrounding Councils were to commit waste to a facility, there would not be sufficient tonnes to make mixed waste facilities viable.

2 Review of technology options

This section considers possible organics processing technologies, as well as specific systems and potential suppliers of technologies at the appropriate scale for the amounts of organics being considered. The expected capital and operating costs were also assessed.

Three main modes of processing organic material have been considered:

- aerobic biological/composting
- anaerobic biological/anaerobic digestion (AD)
- thermal technologies.

Detailed reviews of technology types and specific appropriately scaled technologies are provided in Appendices A and B.

Table 1 compares the estimated capital and net costs per tonne of different organics processing systems considered. Net costs include capital depreciation and the operating costs, less any expected revenue from gate fees for receiving industrial or other organics, as well as sales of compost, biochar or energy. The table shows 'best case' (lower costs and including revenue from gate fees and product sales) and 'worst case' (higher costs and lower or no revenue) estimates. The capital costs and 'best' and 'worst' case ranges are shown in Figures 1 and 2.

Table 1: Estimated capital costs and 'best case' and 'worst case' net costs (i.e. capital and operating costs minus revenue from products sales and gate fees for C&I organics received)

Technology	Capital costs	Net costs ($ per tonne)		Ranking		Comment
		Best case	Worst case	Best case	Worst case	
Aerobic open windrow composting (<5,000 tonnes per year)	$535,000	$47	$58	-	-	Lower cost options but only for <5,000 tonnes. EPA might not allow for FOGO. Cannot accept high odour risk C&I organics.
Aerated uncovered windrow composting (<5,000 tonnes per year)	$750,000	$46	$57	-	-	May be allowable for <5,000 tonne per year for a facility receiving FOGO with a 500-1,000m separation distance, but will most probably require an EPA RD&D approval to demonstrate this.
Aerated covered windrows (e.g. GORE)	$1,680,000	$52	$63	4	2	Lower cost and proven technology. Likely minimum requirement for FOGO facility is >5,000 tonnes per year. Becomes cost-competitive if industrial organics can also be processed. Most viable if energy recovery technologies cannot be partnered with a user of heat or power. An EPA RD&D approval may be required to demonstrate FOGO can be processed without off-site odour.

Technology	Capital costs	Net costs ($ per tonne)		Ranking		Comment
		Best case	Worst case	Best case	Worst case	
Small-scale AD (e.g. Smartferm)	$1,710,000	$29	$60	1	1	Needs a partner with heat or combined heat and power needs. Pricing relies on supplier information on capital costs, as well as local sale of heat or heat and power. Odour risks and EPA separation distances may limit the potential to locate units with users of heat and power.
Aerated covered bays (e.g. Spartel)	$1,910,000	$48	$68	3	4	This technology is similar to covered windrows but has higher capital costs. It can accept industrial organics and generate revenue from this. EPA may consider covered bays as a superior odour management technology compared to covered windrows.
Gasification for biochar (e.g. BigChar)	$2,928,000	$37	$66	2	3	This technology needs a partner with energy needs. Pricing is based on assumed users for energy and sales of biochar. Better suited to woodier inputs, because storage of FOGO before being fed into units may cause odour issues.
In-vessel-Hotrot	$3,110,000	$57	$73	5	5	High capital cost, and is less competitive than aerated covered windrows or bays.
In-vessel-VCU*	$3,706,700	$78	$94	7	6	Unlikely to be viable at this scale.
Invessel-WCT*/ NRS* type system	$3,930,000	$76	$95	6	7	Unlikely to be viable at this scale.

* VCU – Vertical Composting Unit; WCT – Western Composting Technology; NRS – Natural Recovery System

This analysis suggests that:

- On a 'best-case' costing, small-scale AD (e.g. Smartferm) may be the most economically viable. This would need to be located with a user of energy, as well as sales of compost products produced by the unit. The ability to locate a facility with an energy user might be limited by odour risk and EPA requirements for separation distances. The estimated net cost range is $29-$60 per tonne of input. No potential partners to host a facility were identified.
- On a 'best case' costing, one small-scale thermal technology, BigChar, might be cost-competitive with composting technologies. The facility would need to be located with a user of energy and have ongoing markets for 500-1,000 tonnes of biochar per year. The technology can process FOGO materials, but is better suited to woodier biomass. There may be odour risks associated with processing and storing FOGO material before feeding it into the unit. The estimated net cost range is $37-$66 per tonne.
- Several aerobic composting technologies are cost-competitive. The lowest cost options may be two smaller (<5,000 tonnes per year) facilities using open windrow or uncovered aerated

composting. However, EPA might restrict such facilities from processing FOGO materials due to odour concerns. Such facilities are unlikely to be permitted to process industrial organics. The estimated cost range is $46-$58 per tonne.

- Covered aerated windrows or bays technologies could be used by either a 5,000 tonne per year or 10,000 tonnes per year facility, within an estimated net cost range of $48-$68 per tonne. The lower rate assumes revenue from receiving industrial organics and sales of compost products. These are more proven technologies than the AD or thermal systems and are considered to have less technical and commercial risk.
- Other composting units have high capital costs and are unlikely to be cost-competitive at the proposed scales of operation.

Figure 1: Estimated capital costs of organics processing facilities (for 10,000 tonnes per year facilities unless specified as <5,000 tonnes per year)

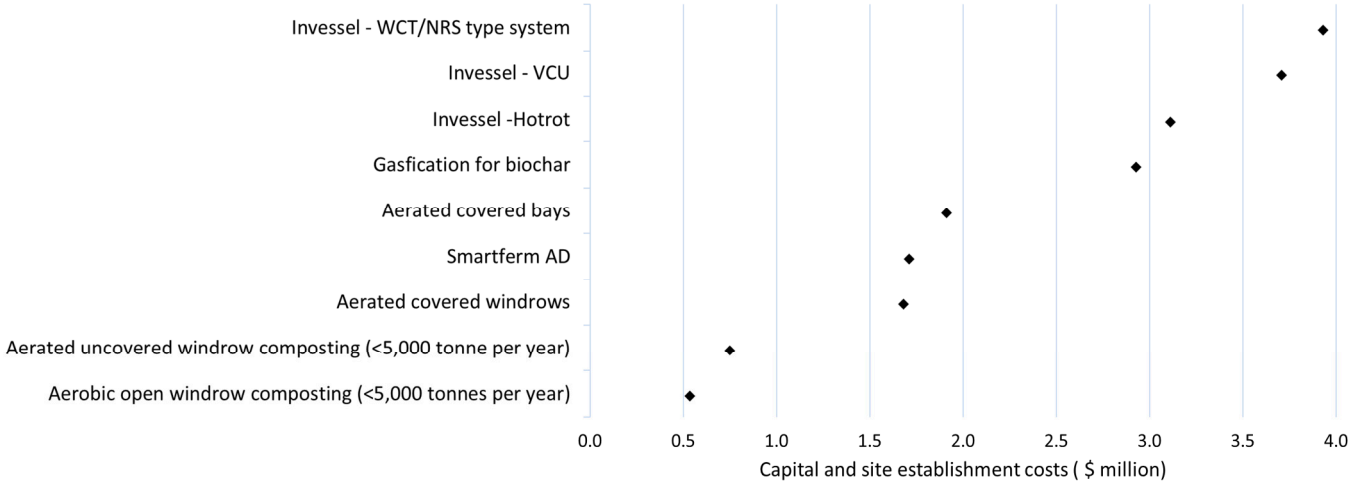
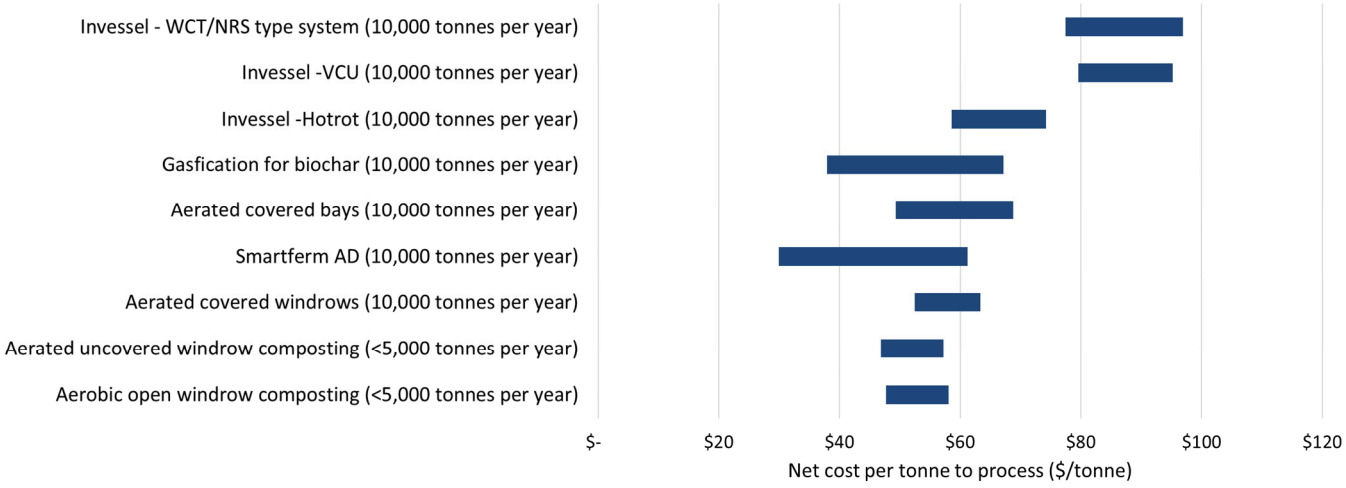


Figure 2: Estimated net costs of organics processing facilities



2.1 Specific opportunities

The review suggests some energy recovery technologies such as Smartferm AD, BigChar pyrolysis or similar technologies could be viable if they can be located where they can supply heat or combined heat and power to a commercial or community user. Some specific local distributed energy projects have been identified that could provide the basis for a shared organics processing facility. These are reviewed in Appendix C.

The proposed Australian Meat Farmers (AMF) meat works near the current Hamilton landfill will generate about 6,500 tonnes per year of paunch (stomach and intestine contents) and manures, as well as over 60-70ML of wastewater each year. There is opportunity to establish an on-site AD facility that can process both GSG/SGSC FOGO materials and AMF's wastes. An aqueous or hybrid wet-dry composting facility is suggested because the AMF facility will have excess wastewater requiring treatment. AMF have planning approvals for the development of the meat processing works and are currently working to secure investment in the facility. If this proceeds, it is recommended GSC and SGSC work with them to develop opportunities for a combined AMF-municipal FOGO waste AD facility, with solid residues being aerobically composted using windrow composting with shredded drop-off organics at the AMF or Hamilton landfill site.

The Portland District Heating project located at Henty Park in Portland needs upgrading and could potentially use woodier biomass as a source of energy using thermal combustion, gasification or pyrolysis technology. Such a facility would not be able to handle FOGO materials at the Henty Park site due to odour risks.

The Hamilton Aquatic Centre could also potentially use woodier biomass in a thermal system but is not suitable for processing FOGO materials due to odour risk.

Other opportunities for co-locating a small-scale AD or gasification/pyrolysis unit with an industrial user of heat and power could be identified through an expression of interest process, where potential users are invited to offer suitable sites for a facility. However, there is greater technical and commercial risk associated with this approach. Lower risk options are: an aerobic composting facility on Council land and operated by Council or a contractor; or an energy recover facility on Council land that meets community energy needs.

Location of an organics processing facility on Council land reduces risks associated with using external processing contractors. Arrangements such as SGSC's current delivery of material to a composting site in Corangamite have risks associated with increased transport costs, and future gate fee price increases by contractors. There is also risk of the contractor ceasing to operate.

A facility on Council land will reduce transport costs and ensure GSG and SGSC have access to a facility. The operation of such a facility or facilities could be contracted out, Councils would continue to have access to a processing site even if the contractor ceases to operate. If a contractor ceases to operate, a new operator can be tendered for and the Councils could potentially take over operation of the facility in the interim.

3 Quantification of available organics

A review of organic wastes and other biomass that could be available to a shared organics facility was undertaken and is detailed in Appendix D. This considered:

- municipal organics from GSC and SGSC
- municipal organics from other Councils
- commercial sources of suitable organics
- prescribed industrial waste (PIW) organics
- forestry and agricultural biomass.

Consideration was given to the types and quantities of organics/biomass, the likelihood of a facility operator being able to secure the wastes for the long term, and the 'balance' of organics needed for different processing options.

3.1 Municipal organics

Municipal organics recovered through kerbside services and drop-off facilities are the main focus of this study.

SGSC has an optional FOGO service. If viable and supported by the community both the SGSC and GSC are interested in introducing compulsory food organics and garden organics (FOGO) kerbside recovery services.

A previous study (MRA, 2013) estimated that, if a compulsory FOGO was introduced by both Councils, 3,000-5,000 tonnes of organics could be recovered. Blue Environment reviewed these estimates with the results shown in Table 2.

Our estimates suggest a maximum amount of 5,740-8,980 tonnes per year of organics could be recovered through municipal FOGO and drop-off services. The reason our estimate is higher than the previous study's estimate is because of assumed higher rates of food and garden diversion, and higher levels of 'additional' garden waste (i.e. waste not currently disposed via the household garbage bin).

Any organics processing facility needs to be designed to handle peak throughput. The generation of garden organics is seasonal, with peaks in spring and early summer and a lesser peak in autumn. In the south west, it is expected that although there will be seasonal peaks, there will be significant amounts of garden organics generated throughout the year. Blue Environment suggests a design capacity of facilities to process 230-350 tonnes per week during peak periods. This represents double the annual weekly average, which has implications for the costs of several of the in-vessel and covered composting systems, with higher capital costs per tonne due to the required processing capacity.

The populations for the municipalities are relatively stable and the quantities of municipal organics are unlikely to change significantly over the next 10-15 years.

The required scale, and therefore cost of such technologies, could be reduced by keeping the FOGO and other higher odour risk materials separate from drop-off organics. This would allow higher odour risk material to be processed through more controlled systems and lower odour risk drop-off organics to be managed through open windrow processing. Provided processing sites have the appropriate separation distances, after the higher odour risk material was processed using more controlled technologies it could be blended with shredded drop-off organics and managed though open windrow composting during the secondary and maturation stages. If this was undertaken, the controlled systems for treatment of FOGO and stockyard wastes would require capacity for up to

120-250 tonnes per week. These assumptions have been used in the scaling and costing of the systems.

Table 2: Summary of municipal organics from Glenelg Shire Council and Southern Grampians Shire Council available to the project

Council	Source of organics	Estimated tonnes per year	Peak capacity (tonnes per week)[1]	Comments
Glenelg	Kerbside FOGO	1,350-3,170	52-122	Low-end estimates are for an optional fortnightly service. High-end estimates are for a compulsory weekly service using kitchen tidies with a fortnightly garbage service and extensive community engagement.
	Resource recovery centre drop-off	1,350	52	This assumes provision of a kerbside service will not significantly reduce the amount of pruning and tree-felling organics and other timber dropped off at Portland.
Sub-total		*2,700-4,520*	*104-174*	
Southern Grampians	Kerbside FOGO	1,040-2,460	40-95	Low-end estimates are for an optional fortnightly service. High-end estimates are for a compulsory weekly service using kitchen tidies with a fortnightly garbage service and extensive community engagement.
	Waste facility drop-off	1,500	60	This assumes provision of kerbside service will not significantly reduce the amount of woody garden organics and other timber dropped off at Hamilton.
	Stockyard wastes	500	30	Quantities vary according to the number of stock at yardings, with peak volumes at times of peak sales[2].
Sub-total		*3,040-4,460*	*130-185*	
TOTAL - FOGO		**2,390-5,630**	**92-217**	
TOTAL - DROP-OFF GARDEN		**2,850**	**112**	
TOTAL - ALL ORGANICS		**5,740-8,980**	**234-359**	

1. *Peak municipal organics have been estimated as double the annual average to reflect typical seasonal fluctuations. Facilities need to be designed to manage peaks as well as average throughput.*

2. *Peak stockyard wastes reflect the largest herd numbers yarded and not the annual average.*

The options are:

A. Two individual smaller facilities to serve GSC and SGSC each with capacity of around 4,500-5,000 tonnes per year.
B. A shared facility near either Portland or Hamilton with capacity to process up to 9,000-10,000 tonnes per year, allowing for seasonal peak and the receival of industrial organics.
C. A shared facility located more centrally, or 'equidistant', to Portland and Hamilton.

For option A, it would make sense for all kerbside collected and drop-off organics to be processed at the facilities. Due to odour risks at this scale of operation, FOGO material cannot be stockpiled for more than 24-48 hours, and the costs of having a shredder on-site to process FOGO at the time of

receival will reduce the economic viability of the operation. Maintaining a stockpile of shredded garden organics and mixing unshredded FOGO with this on receival reduces odour risk. Larger particles from unshredded FOGO can be screened out after the initial 'hot' composting process reduces the odour potential of FOGO materials and stockpiled for shredding.

For options B and C, it may be more efficient to keep drop-off materials at one of the major centres separate from the shared facility. Currently green waste dropped off at the Hamilton and Portland transfer stations is stockpiled and managed on-site through shredding and piling for costs of less than $35 per tonne. If the materials can be managed without odour or other issues, continuing this will almost certainly be cheaper than transporting and processing materials at a shared facility. This would mean maintaining current drop-off garage organics recovery operations at the site (Portland or Hamilton) that does not host the shared FOGO processing facility. The quantities of shredded drop-off organics from either Hamilton or Portland would be enough to 'bulk up' FOGO materials collected from both Shires. This would reduce the design capacity required to process FOGO material at a shared facility.

3.2 Commercial and industrial (C&I) and construction and demolition (C&D) waste

Controlled composting systems required by EPA Victoria for the management of FOGO materials can have high capital costs. The viability of such facilities could be improved by attracting external sources of organics and charging a gate fee. Provided this gate fee was less than the costs of landfill disposal or other alternatives, a future shared facility could attract such material.

Most material from commercial and industrial (C&I) sources is privately managed by contractors. However, some of this waste may be available as a feedstock as it is often sent to landfill for disposal. Table 3 shows potential sources of additional C&I organics identified during consultation with some waste contractors and generators (including fisheries).

Table 3: Some potential sources of recoverable commercial and industrial organics within Glenelg Shire and Southern Grampians Shire municipal boundaries

Source	Types of waste	Estimated quantity	Security of supply	Current management
Cleanaway (Portland)	Grease trap waste	30,000-40,000L/month (estimated as 360-480 tonnes per year)	Moderate to high	Camperdown Compost
	Triple interceptor waste	60-80m^3/year (60-80 tonnes per year)		
Cleanaway (Mt Gambier)	Grease trap	10,000L/month (120 tonnes per year)	Moderate to high	Portland and Camperdown Compost
Southseas Abalone (Portland/ Narrawong)	Abalone waste (with shells)	~10 tonnes per year	High	Landfill
Wannon Water (various locations)	Biosolids from water treatment ponds	Unknown tonnages every 2-4 years when ponds are de-sludged.	Low	Wannon Water have treatment options
Total estimated		**~ 550-690 tonnes per year**		

Note: This table identifies existing sources of organics within the area. Potential sources such as Australian Meat Farmers are not included because it is uncertain whether these sources of materials will become available.

The waste contractors consulted indicated that grease trap sludge and triple interceptor waste could be diverted to a more local organics processing facility if established. Abalone waste (including shells) could also be recovered and used in composting, but would need to be shredded or crushed to produce shell grit in compost products.

Food and other compostable waste are produced by smaller commercial sites but there is insufficient data to accurately predict the amounts that may be available. Observations can be made based on employment and the known generation rates from different sectors. Major individual sources are likely to include:

- food retailing businesses
- accommodation, food services and hospitality venues
- food manufacturing businesses
- Portland Aluminium staff and food areas
- health services and aged care facilities.

About 3,000-3,500 tonnes per year of solid industrial waste (SIW) are landfilled at Hamilton. Of this up to 840 tonnes of C&I garden and food organics is potentially available. If 30% of this were to be recovered through source separated services a further 250 tonnes of compostable organics could be directed to a future organics processing facility.

Data suggest between 1,500-3,000 tonnes per year of SIW are disposed of at Portland. This could include up to 720 tonnes compostable garden and food organics. A 30 % recovery rate would contribute 110-220 tonnes of material to a future organics processing facility.

The cost of disposing of industrial waste is likely to increase when landfills close and wastes need to be transported greater distances. This may create an incentive for businesses to separate recyclables, including food and garden waste for recovery. However, it is unlikely that industrial organics from more dispersed sources will provide much in the way of additional compostable organics to a future processing facility. At most, around 360-470 tonnes per year could be expected to be recovered if 30% of available materials are diverted. Operators of a future organics facility would have better chances of recovering organics from a few large sources than many smaller sources.

Major food retailers and health care facilities in the area were also contacted. It was found that these organisations believed they did not generate much food waste and several had low cost management systems, such as supermarkets giving away vegetable wastes to home poultry owners and farmers, and health sector sites using ‘in-sink’ disposal units to grind and dispose food to sewer.

This suggests the best option for securing source-separated commercial organics may be to work with waste management firms to source organics from large individual sources or include commercial organics collection services as part of the FOGO services. This would only be practical if a weekly FOGO service was offered with commercial organics being collected at least two to three times per week. In some jurisdictions, government regulations require businesses producing more than a stated threshold of landfilled food waste (e.g. more than one tonne per week) to have a separate organics collection service. This could be considered in the future once FOGO services are established, but the research did not identify many sources that might exceed such a threshold.

3.3 Other sources of biomass

Blue Environment identified and directly contacted other potential sources of biomass including:

- other municipalities in surrounding areas
- Port of Portland

- forestry industries
- food manufacturers.

The proponents of a proposed meatworks at Hamilton, Australian Meat Farmers, were also consulted. This facility would be a significant source of paunch and manure wastes as well as wastewater with an organic load that will need treatment and disposal.

Desktop estimates of primary industry organic residues that occur within the study area were also conducted. This work is detailed in Appendix D.

3.4 Estimated available biomass

Table 4 provides a summary of identified and estimated available biomass. The table shows that the most immediate opportunity is for a 5,000-10,000 tonnes per year processing facility. This facility could process FOGO, transfer station drop-off organics and some C&I organics. If the AMF meat processing facility was established, a facility with an additional capacity for 6,500 tonnes of wet paunch and manures could be considered.

Table 4: Summary of all recoverable organics and other biomass within Glenelg Shire and Southern Grampians Shire municipal boundaries

Source and type of organics	Estimated tonnes per year	Details
MUNICIPAL ORGANICS		
- GSC	2,700-4,520	Includes around 1,200-1,500 tonnes per year of organics dropped off at the transfer stations at Hamilton and Portland. Lower range estimates are for optional garden only (GO) only services. Higher range estimates are for FOGO systems with high recovery rates. Estimate also includes 500 tonnes per year of stockyard waste from SGSC.
- SGSC	3,040-4,460	
Sub-total	*5,740-8,980*	
SIW & PIW Organics		
- major sources	450-570	Some major sources of industrial organics have been identified and are interested in a more local recycling option if it is cost-competitive.
- other sources	250	This assumes 30% recovery from an estimated 840 tonnes of C&I organics.
TOTAL READILY AVAILABLE TO A SHARED ORGANICS FACILITY	**6,440-9,800**	
OTHER SOURCES		
Municipal organics		
- Moyne	1,300-1,500	From existing FOGO service.
- Warrnambool	1,900-5,200	If a GO or FOGO service is introduced.
- other Councils	Uncertain	Neighbouring Councils to the north are unlikely to introduce FOGO services within the next few years.
Sub-total	***3,100-6,700***	
Port of Portland		

Source and type of organics	Estimated tonnes per year	Details
- grain and seed bunker waste	Up to 30,000[1]	Currently disposed to farms.
- forestry waste	~10,000	Currently stockpiled, sent to farms, burnt or purchased by Biogrow.
Other biomass within the study area		
- forestry biomass	Uncertain. Quantities vary from year to year	It may not be economically possible to secure these by-products unless suppliers are paid for them. Forestry residues are mainly managed on-site, burnt or sold as a mulch by-product. Stubbles are left standing or harvested for straw. There will be a cost to suppliers in getting the materials to a processing facility.
- grain and seed bunker waste	930-1,860 [1]	
- stubbles	50,000-210,000	
- spoilt fodder	2,000-15,000	
Sub-total of other biomass	*> 92,900-226,900*	*The potential to secure this biomass is uncertain.*
TOTAL	**>96,000-273,600**	This represents a theoretical 'maximum' of biomass available. Most of this biomass may not be readily available for a shared facility unless a major bioenergy facility was established, with payment to suppliers of woody biomass.

1. Grain and seed bunker waste is shown for: Port of Portland, which handles grain from growing areas outside of the study area; and within the study area based on cropped areas, average yields and typical grain and seed bunker losses.

Note: This table considers currently available sources of biomass. A potential future source of biomass is the Australian Meat Farmers' meat processing works to be located at Hamilton that could make a further 6,500 tonnes of wet paunch and manures available to a shared facility and over 60-70mL of waste water with organic load.

Opportunities to attract other biomass, such as woody biomass from forestry industries and the Port of Portland, may be limited unless there was a low gate fee or a willingness to pay for it by the facility operator. This would depend on markets for compost products, biochar or renewable energy.

4 Site requirements and potential sites

The site requirements for the different technologies and some potential sites identified by GSC and SGSC have been assessed. This is detailed in Appendix E. This section summarises this assessment.

4.1 Site requirements

The site requirements for different scales of operation and technologies are outlined in Table 5. Separation distances are based on EPA or Victorian Planning Provision (VPP) requirements.

Organics processing facilities with capacity to process more than 100 tonnes per month require EPA approvals and licensing. Resource recovery facilities, commercial composting or energy recovery facilities will always need planning permits regardless of location and are prohibited in all zones other than: Farming Zone; Industrial Zones; Special Use Zones that permit waste and resource recovery; Port Zone; and potentially Business 3 and 4 Zones. An organics processing facility located at a transfer station could theoretically be approved within a Township Zone but in most instances this would be difficult.

Table 5: Site requirements for different technology types

Technology type/system	Scale	Minimum separation distances[1]	Comments/other site requirements (odour management, power, gas, exportable grid connection, etc.) and opportunities (e.g. users of heat, power, products)
Aerobic composting			
On farm composting	<1,200 tonnes per year	200-600m	No requirement for an EPA licence but a separation distance is recommended.
Small-scale municipal open composting	1,200-5,000 tonnes per year	600-1,000m	An RD&D approval would be needed to demonstrate FOGO could be managed without off-site odour.
Small-medium scale open composting	5,000-10,000 tonnes per year	1,000m	EPA is likely to require some form of air management and may not allow open composting of FOGO materials.
Small-scale controlled composting	1,200-5,000 tonnes per year	500m	Controlled composting involves measures to contain air emissions. An EPA RD&D approval could be used to demonstrate FOGO could be processed with a reduced separation distance.
Small to medium scale controlled composting	5,000-10,000 tonnes per year	500m	
AD systems			
Aqueous/'liquid' AD	>20,000-50,000 tonnes per year for grid-connected. As low as 5,000 tonnes per year if it supplies local (non-grid) CHP needs	500m	Requires sewer connection or use for treated wastewater. Most systems cannot process the woodier component of FOGO. May need gas connection for heating chambers initially.
'Solid'/dry AD	>20,000-30,000 tonnes per year for grid	500m	Requires source of liquid (water or wastewater with organic load). Likely to require enclosed receival and unloading areas. Suited to FOGO,

Technology type/system	Scale	Minimum separation distances[1]	Comments/other site requirements (odour management, power, gas, exportable grid connection, etc.) and opportunities (e.g. users of heat, power, products)
	connection. Less for local CHP project		drop-off organics, SIW organics, PIW and up to 1,000L wastewater per tonne of garden organics. Solids from chambers will need to be processed aerobically and may have high odour risk when removed from vessels.
'Hybrid' wet/dry system	>20,000-30,000 tonnes per year for grid connection. Less for local CHP project	500m	Requires wastewater with organic load. System can be operated as an aqueous 'tank farm' with chambers for loading solid FOGO and other material. Solid outputs will need to be aerobically managed and may have high odour potential when first removed from vessels.
Thermal systems			
Single combustion chamber 'gasifier' /boiler	200kW-10MW	EPA: case-by-case VPP: 300m (wood only)	Requires connection to the gas grid. Likely to require controls for air emissions and the management of bottom ash.
Gasification/pyrolysis	100kW-20MW	EPA: case-by-case 300-500m likely	Requires electricity, water sewer and gas connection. Likely to require emission controls for bottom and fly ash.
Refuse Derived Fuel	No direct energy yield	200-300m Likely for woody garden organics	Requires a works approval or a RD&D approval if emissions are likely to be altered.

1. *The separation distances here are suggested based on EPA guidelines but the VPP and EPA do not specify separation distances. A case can be made for lesser separation distances and may be supported by a trial of a processing system at a site under an EPA RD&D approval. RD&D approval allow short term trials to demonstrate the ability of a proposed technology to comply with EPA requirements.*

4.2 Assessment of potential sites

The following eight locations were nominated by GSC and SGSC as potential sites for establishing an organics processing facility:

- Hamilton landfill precinct
- Australian Meat Farmers, Hamilton (proposed)
- Wannon Water, Hamilton
- Hamilton Aerodrome
- Heywood transfer station
- Branxholme former landfill
- Portland transfer station
- Portland district heating (Henty Park).

The suitability of each site was assessed based on land zoning, overlays and separation distances from sensitive receptors. The main planning overlays considered include designated bushfire prone areas, heritage, land subject to inundation and vegetation protection. Note other overlays have been discussed where relevant to the permitted use of the land. This assessment is detailed in Appendix F.

A review of the potential sites is summarised in Table 6. This assessment found the preferred sites to be:

- Hamilton landfill for SGSC or as a shared facility.
- Heywood transfer station for GSC processing less than 5,000 tonnes per year.
- If the proposed AMF meatworks is established at Hamilton an AD facility on that site could be considered.

Other sites may also be located and developed. If energy recovery options (e.g. AMF AD, Smartferm AD, BigChar pyrolysis) are developed they will need to be co-located with a user of heat and power.

A central 'equidistant' site for a shared facility was recommended by a previous study, but this is likely to incur higher costs to procure or lease and establish a site and higher operating costs associated with more remote staffing and the inability to share other waste and resource recovery resources. Heywood transfer station and Hamilton landfill resource recovery centre have the advantage that staff and equipment at the existing facilities could be shared with an organics processing facility.

Table 6: Summary of assessment of possible organics processing sites

Proposed site	Advantages	Limitations	Recommendation
Hamilton landfill (Council owned)	• Existing waste and resource recovery resources. • Compatible zoning and licensing. • Reasonable separation distances. • Well-located for Hamilton. • Good access to road, power, water, wastewater and gas systems.	• Separation distances are adequate but not large. • Other odour sources (landfill, Wannon Water treatment plant, and potentially AMF meat works) may require greater odour control. • Limited options for use of thermal or biogas energy.	• This is a preferred site for an individual SGSC or shared facility.
Heywood transfer station (Council owned)	• Existing waste and resource recovery resources. • Compatible zoning. • Large separation distances. • Access to power.	• Site is narrow and uneven, and may have higher site development costs. • There is a farm house within 500m of the site. • There is no access to gas or water. • No obvious thermal or biogas energy users.	• This is a potential site for an individual GSC aerobic composting site processing less than 5,000 tonnes per year. The proximity of a farmhouse may limit the potential or require controlled composting such as aerated covers. • An EPA RD&D approval may be needed to prove FOGO could be processed without off-site odour risks to the farmhouse.
Hamilton Aerodrome (Council owned)	• Large even site, with good separation	• Higher transport costs. • Separation distance to	• Not recommended unless other options are not

Proposed site	Advantages	Limitations	Recommendation
	distances off-site. • Compatible zoning. • Access to water and power.	aerodrome buildings is small. • May limit other potential developments at the site.	viable.
Wannon Water, Hamilton	• Well located from a transport perspective. • Good access to road, power, water, wastewater and gas. • Large separation distances. • Potential for wastewater and other organic wastes from proposed AMF meats works to be piped under the road. • Potential to export heat and power to AMF.	• Other odour sources in the areas (landfill, wastewater treatment facility and potentially AMF meat works) may require greater odour control. • Moving wastes and power across public land (the road between sites) may restrict the opportunity to 'co-locate' facility with AMF meat works.	• Site could be considered if preferred sites are not viable and AMF meat works seeks an 'off-site' facility to manage wastes.
AMF, Hamilton	• Potential for shared infrastructure and a co-located AD facility. • Good separation distances. • Well located from a transport perspective. • Good access to roads, water, power, gas and wastewater treatment.	• Uncertainty regarding the development of AMF, and potential cost-sharing arrangements.	• Availability and viability will depend on AMF. If the meat works proceeds this would be an excellent site for an AD facility. • Needs further investigation if AMF meat works is confirmed to proceed.
Portland landfill resource recovery centre (Council owned)	• Existing resource recovery infrastructure and staffing. • Zoning and historic association with waste and resource recovery.	• Inadequate separation distances for aerobic composting systems. • Habitat for bandicoots restricts potential for tree clearing on areas more distant from sensitive receptors.	• Not recommended for aerobic composting systems. Could potentially support bioenergy facilities, but storage of FOGO material poses odour risk.
Branxholme landfill (Council owned)	• Large separation distances. • More central to Portland and Hamilton.	• Site is small, uneven and has poor road access. It is not suited to development.	• Not recommended.
'Equidistant' site	• No specific site identified. • Would result in similar transport costs for both Councils.	• A site would need to be procured. • Operating costs are likely to be higher due to the inability to share resources from existing waste and resource recovery operations.	• Not recommended unless other sites prove to be unsuitable.

5 Logistics cost assessment

Blue Environment has modelled the net costs of different organics recovery options for Glenelg and Southern Grampians, considering:

- current and future landfill disposal costs
- transfer and transport costs
- expected gate fees for different processing options based on a high-level costing of each option
- different levels of organics recovery.

The purpose of the assessment is to compare the likely relative costs of using differently located facilities.

The following organics collection scenarios have been considered:

1. The 'base-case' – current practice.
    - GSC – weekly garbage collection service and no kerbside organics service.
    - SGSC – weekly garbage collection service and an optional FOGO service with low participation rates (about 1,000 households and rising slowly).
2. Optional garden organics collection in both GSC and SGSC with an increase in participation rate in SGSC.
3. Compulsory garden organics collection in both GSC and SGSC.
4. Optional FOGO service with a fortnightly organics collection and weekly garbage collection.
5. Compulsory FOGO service with a fortnightly organics collection and weekly garbage collection.
6. Compulsory weekly FOGO service and fortnightly garbage collection.

5.1 Performance and cost assumptions

Blue Environment has undertaken cost modelling based on waste data and assumptions about the performance and cost of different recovery options. These are given in Table 7 and show expected rates of household participation, the levels of garden and food organics diverted from garbage and recovery of 'additional' organics. The modelling also shows expected material transport and disposal or reprocessing costs, based on likely costs for these services.

The analysis of the comparative net costs of organics recovery options considers avoided landfill disposal costs. The assumptions about landfill costs are shown in Table 8.

These assumptions have been used to estimate the net costs of providing a kerbside organics service.

Table 7: Performance and cost assumptions used in modelling

		Base case	GO Only		FOGO		
			Optional	Compulsory	Optional	Compulsory	Compulsory – weekly organics, fortnightly garbage
Scenario definition		1	2	3	4	5	6
Kitchen caddy & biobags		No	No	No	Yes	Yes	Yes
Collection frequency	Organics	Fortnightly					Weekly
	Garbage	Weekly					Fortnightly
Regular participation rate in organics service		Current levels	40%	80%	40%	80%	90%
Organics diversion rate per participating household	Garden	80%	90%	80%	90%	80%	90%
	Food	0%	0%	0%	60%	50%	70%
'Additional' organics collected per additional participating household (kg/household/year)	Garden	0	250	200	250	200	250
	Food	0	0	0	10	10	15
Cost assumptions							
Bin lift costs ($ per lift) (at an average of 90 bins/hr at $120/hr)		$1.33	$1.33	$1.33	$1.33	$1.33	$1.33
Garbage bin depreciation costs (@$71.50 for 180L) per year		$9.26	$9.26	$9.26	$9.26	$9.26	$6.89[1]
Organics bin depreciation costs (@ $82.50 for 240L; $71.50 for 180L or 120L)		$10.68	$10.68	$10.68	$10.68	$10.68	$9.26[2]
Total garbage lift costs (lift and bin depreciation)		$1.51	$1.51	$1.51	$1.51	$1.51	$1.60
Total organics bin lift costs (lift and bin depreciation)		$1.74	$1.74	$1.74	$1.74	$1.74	$1.51
Cost of kitchen caddies per additional participating household ($/household/year)		$ 0	$ 0	$ 0	$2	$2	$2
Cost of biobags per year ($/household/year		$ 0	$ 0	$ 0	$6	$6	$6
Organics processing costs ($/tonne)		$35	$47	$47	$65	$65	$65
Cost of transport Hamilton-Heywood ($/tonne)		$35	$35	$35	$35	$35	$35
Cost of transport Portland-Heywood ($/tonne)		$14	$14	$14	$14	$14	$14
Cost of transport Portland-Hamilton ($/tonne)		$39	$39	$39	$39	$39	$39
Landfill costs Stawell (including levy and GST) ($/tonee)		$135	$135	$135	$135	$135	$135
Transfer and transport costs from Hamilton to Stawell landfill ($/tonne)		$45	$45	$45	$45	$45	$45
Transfer and transport costs from Portland to Stawell landfill ($/tonne)		$58	$58	$58	$58	$58	$58

1. *The depreciation costs for the fortnightly garbage service is lower because it is assumed the bin will last on average 15 years rather than 10 years for the weekly collected bin.*

2. *The depreciation cost of the weekly FOGO service is lower than for the fortnightly service because it is assumed a cheaper and smaller (120 or 180L) bin will be provided for the weekly service rather than a 240L bin for the fortnightly service.*

Table 8: Assumed avoided landfill costs

Costs	Portland to Stawell	Hamilton to Hamilton	Hamilton to Stawell
Transport ($/tonne)	$58	$2	$45
Disposal to landfill (including EPA levy) ($/tonne)	$135	$170-$180	$135
Total ($/tonne)	**$193**	**$172-$182**	**$180**

The modelling has considered the relative cost of the different management options to each of the Councils for either two individual sites or a single shared site. The assumed locations of future facilities are: the Heywood transfer station site; the Hamilton landfill precinct; and a hypothetical equidistant site for a shared facility. The equidistant site would be somewhere near Myamyn and would require purchase or lease and development of a greenfield site. The advantages and disadvantages of the site are considered in the costing and discussion of options.

5.2 Comparative cost analysis

The cost modelling has considered two issues:

- What will be the impacts of different kerbside organics recovery systems on costs and diversion of waste from landfill?
- How will the location of organics processing facilities impact on overall costs and costs to individual Councils?

Based on the analysis of site requirements and available sites, the modelled options for the location of organics facilities are:

- Option 1: Individual/separate Council facilities at the Heywood transfer station resource recovery centre and at or near Hamilton landfill.
- Option 2: Shared facility at Heywood transfer station (assuming an aerated covered compost could operate at the site to process up to 10,000 tonnes per year).
- Option 3: Shared facility at or near Hamilton landfill.
- Option 4: Shared facility at an equidistantly located site between Hamilton and Portland.

The results of this analysis are provided in Appendix G. Summaries of costings are shown in Tables 9 and 10.

This analysis shows that although organics recycling is cheaper than landfill on a cost per tonne basis, introduction or expansion of FOGO services will result in a net increase in waste and recycling services costs. The reason for this increase is that, although FOGO systems can significantly reduce the amount of waste sent to landfill, providing a kerbside service is likely to increase the amounts of garden and some food organics being collected at kerb. In other words, if a service is provided people will use it to dispose of garden organics that they do not currently dispose of to kerbside garbage. This increases the overall amount of material collected and the organics reprocessing costs. It is important to communicate the benefits and value of the organics service so the community recognises it as an expanded service rather than just another cost impost.

Table 9: Estimated comparative costs for GSC to introduce FOGO services and process materials at either Hamilton or Heywood

Scenario	GSC to Heywood				GSC to Hamilton		
	Business as usual	Optional FOGO (fortnightly)	Compulsory FOGO (fortnightly)	Compulsory FOGO (weekly)	Optional FOGO (fortnightly)	Compulsory FOGO (fortnightly)	Compulsory FOGO (weekly)
Kerbside garbage (tonnes per year)	2,900	2,540	2,280	1,720	2,540	2,280	1,720
Kerbside organics (tonnes per year)	-	1,350	2,220	3,170	1,350	2,220	3,170
Total kerbside tonnes (per year)	2,900	3,890	4,500	4,890	3,890	4,500	4,890
Cost of garbage disposal (collection, transport and disposal)	$1,311,100	$1,241,500	$1,192,000	$728,800	$1,241,500	$1,192,000	$728,800
Cost of organics service (collection, transport and processing)	$0	$310,700	$583,000	$994,700	$344,200	$638,000	$1,073,200
Total cost of services	$1,311,100	$1,552,200	$1,775,000	$1,723,500	$1,585,700	$1,830,000	$1,802,000
Net cost increase from business as usual	$0	$241,100	$464,000	$412,400	$274,600	$518,900	$490,900
Increase in cost per household using the service	$0	$63	$61	$48	$72	$68	$57
Increase in cost per all households in the service area	$0	$25	$49	$43	$29	$54	$51
Net cost increase per tonne of recovered organics	$0	$178	$209	$130	$203	$234	$155

Table 10: Estimated comparative costs for SGSC to expand FOGO services and process materials at either Hamilton or Heywood

Scenario	SGSC to Hamilton				SGSC to Heywood		
	Business as usual	Expanded optional FOGO (fortnightly)	Compulsory FOGO (fortnightly)	Compulsory FOGO (weekly)	Expanded optional FOGO (fortnightly)	Compulsory FOGO (fortnightly)	Compulsory FOGO (weekly)
Kerbside garbage (tonnes per year)	3,500	3,039	2,711	2,007	3,039	2,711	2,007
Kerbside organics (tonnes per year)	323	1,034	1,715	2,457	1,034	1,715	2,457
Total kerbside tonnes (per year)	3,823	4,073	4,426	4,464	4,073	4,426	4,464
Cost of garbage disposal (collection, transport and disposal)[1]	$1,063,047	$980,010	$921,042	$590,182	$980,010	$921,042	$590,182
Cost of organics service (collection, transport and processing)	$56,649	$184,818	$346,619	$589,145	$220,697	$406,094	$674,386
Total cost of services	$1,119,696	$1,164,828	$1,267,661	$1,179,327	$1,200,708	$1,327,136	$1,264,568
Net cost increase from business as usual	$0	$45,133	$147,965	$59,631	$81,012	$207,440	$144,872
Increase in net costs per additional household using the service	$0	$37	$43	$15	$67	$61	$37
Net cost increase per additional tonne of recovered organics	$0	$63	$106	$28	$114	$149	$68

[1] *Note that the estimated costs of landfilling is $180 per tonne whether waste is landfilled in Hamilton or Stawell. This is because the total costs of transport and disposal at Stawell are expected to about the same, and potentially cheaper, than the costs of continued landfilling at Hamilton.*

This analysis suggests:

- For GSC (see Table 9):
  - Using a facility at Heywood would be cheaper than using one at Hamilton, with a difference of about $23 per tonne of organics recovered due to transport costs.
  - The introduction of an optional FOGO service is expected to increase annual waste and resource recovery collection services costs by around $241,000-$275,000 per year. Garbage to landfill will only be reduced by 400 tonnes per year (14%) and the cost to participating households would be between $63-$72 per year. This could be charged on a 'user-pays' basis. Across all households in the service area the net cost increases would be between $25-$29 per household per year. The estimated net cost is expected to be $178-$203 per tonne of recovered organics.

- The introduction of a fortnightly compulsory FOGO service will increase waste and resource recovery costs by an estimated $464,000-$518,900 per year making this the most expensive option. This is because of the large amounts of 'additional' garden and food organics that would be expected to result from introducing the service. This would result in organics needing processing without a matching reduction in waste to landfill, which would only be reduced by 600 tonnes per year (21%). The cost increase across all households is estimated at $49-$54 per year depending on whether the organics were processed at Heywood or Hamilton respectively. The estimated net cost is expected to be $209-$234 per tonne of recovered organics.
- The most cost-effective option is the introduction of a weekly FOGO service with a fortnightly garbage service. This is expected to reduce waste to landfill by 1,200 tonnes per year (41%) due to higher diversion of food and increased other recycling. The net cost increase is estimated as $412,400-$490,900 per year. The cost across all households in serviced areas is expected to be $43-$51 per year, and the net costs are expected to be $130-$155 per tonne of organics recovered.

- For SGSC (see Table 10):
  - Using a facility at Hamilton would be cheaper than using one at Heywood with a difference of about $25 per tonne of organics recovered due to transport costs.
  - SGSC already provides an optional FOGO collection service which is used by about 1,000 households (about 18% of serviced households). Recovered organics are transported to Camperdown Compost. To receive the service residents must purchase and collect a bin for $85 for a 240L bin and pay $83 per year for a fortnightly service (based on current service costs). Council does not believe this participation rate can be improved unless the cost of the optional service is reduced or the service is made compulsory.
    Increasing household participation in the optional FOGO service to 40% participation would increase annual waste and resource recovery collection service costs by around $45,100 per year if the facility is located at Hamilton and $81,000 if it is at Heywood. Garbage to landfill will only be reduced by 460 tonnes per year (a 13% reduction) and the net cost to each additional participating household would be between $37-$67 per year depending on the location of the organics facility. This could be charged on a 'user-pays' basis.
    The estimated cost per tonne of additional organics recovered is expected to be $63-$114 per tonne.
    This analysis suggests the cost of the organics service could be reduced if it is charged on a net cost basis and organics are processed at or near Hamilton. Delivery of bins to households may also make the service more attractive to potential users. Most councils providing a well-promoted optional organics service achieve participation rates of around 40% with some achieving even higher rates.
  - The introduction of a fortnightly compulsory FOGO service will increase waste and resource recovery costs by an estimated $148,000-$207,400 per year making this the most expensive option. This is because of the expected large amounts of 'additional' garden and food organics to be disposed through the service without a matching reduction in waste to landfill, which would be reduced by about 790 tonnes per year (a 23% reduction). Costs per additional participating household would be between $43-$61 per year. The estimated costs per additional tonne of recovered organics is expected to be $106-$149 per tonne.
  - The most cost-effective option is the introduction of a weekly FOGO service with a fortnightly garbage service. This is expected to reduce waste to landfill by around 1,500

tonnes per year (a 43% reduction) due to higher diversion of food and increased other recycling. The net cost increase is estimated as low as $59,630 per year if the organics processing facility was located at Hamilton and would be $144,870 per year if located at Heywood. The net cost increase per additional household using the service is expected to be as little as $15 per year if the facility is located at Hamilton and $37 if it is at Heywood. This is because of lower transport costs to a Hamilton facility and lower organics recovery costs relative to landfill costs.

The preferred options are either a compulsory FOGO service provided weekly and with garbage collected fortnightly, or a well-promoted optional FOGO service provided fortnightly. These have the potential to divert significant amounts of food and garden organics and have lower costs per tonne and per participating household. The compulsory FOGO service will achieve the most significant diversion from landfill.

5.3 Shared or separate facility?

The assessment considered the capital and operating costs at different scales of operation and with transportation costs from the major townships to the potential sites. It also included assessment of the costs associated with transporting FOGO alone and both FOGO and drop-off garden organics to the sites. It was also assumed that shredded drop-off organics from either Portland or Hamilton would be needed to bulk up and blend FOGO from one or both Councils.

As current green waste transfer stockpiling and shredding operations are more cost-effective than proposed processing facilities, it is assumed this will continue at the smaller transfers stations and either Hamilton (if a shared site is at Heywood resource recovery centre) or Portland (if the shared site is at Hamilton).

If separate individual sites are used, it is assumed drop-off organics from both sites will be used in aerobic composting processes to bulk up FOGO material and avoid the need to shred FOGO prior to composting. As noted previously, FOGO material cannot be stockpiled for more than 24-48 hours due to odour risk and it would be expensive to have equipment on-site to shred FOGO material as it is received. Unshredded FOGO material can be mixed with shredded garden organics to reduce odour risks and larger particles can be screened out after the ‘hot’ composting phase has reduced the odour potential of materials. Screened woody material can be stockpiled for grinding as it has low odour risk.

The most cost-effective option would be the operation of two smaller-scaled aerobic composting facilities at Heywood transfer station and within the Hamilton landfill precinct (i.e. at the preferred undeveloped landfill area or alternatively at the AMF site or Wannon Water’s vacant site).

There is a farm house within 500m of the Heywood site, so. EPA may not permit processing of more than 5,000 tonnes per year of material and may require more expensive controlled composting for processing FOGO materials. The Heywood site is not suited for a larger shared facility. An EPA RD&D approval may be required to prove that a facility can operate at the site without odour impact. However, the high costs of transporting organics mean that it would be cost-effective to process GSC’s organics at Heywood unless the technology required to process FOGO at Heywood costs more than $25 per tonne than a shared facility at Hamilton.

If a shared facility is established, the Hamilton landfill precinct is suggested as the preferred site. Hamilton has advantages including: the location of the site proximate to a major collection area; the ready availability of shredded drop-off organics to blend with FOGO and industrial organics; the potential to share staff and equipment with the Hamilton resource recovery centre; and potential access to Moyne and Councils to the north (although these Councils do not currently propose to introduce kerbside organics services).

In the future, Hamilton landfill will need compost for site rehabilitation creating a 'market' for the products and potentially reducing landfill rehabilitation costs. The Hamilton precinct also has the potential for cooperation with the proposed AMF meat works. More detailed design and costing of composting facilities at the two sites may be required before a final decision about the preferred site is made.

The use of a central equidistant facility will be more expensive than either two separate sites or a shared site at Hamilton. This is because of the additional cost of purchasing or leasing a site, likely higher site establishment costs (access roads, power, staff amenities and so on), higher operations costs associated with remote staffing and the lack of opportunity to share staff and equipment with the existing resource recovery centre facilities.

5.4 External funding opportunities

These costings do not consider the potential for external funding support for organics processing infrastructure or potential income from the sale of Australian Carbon Credit Units (ACCU) through the Emissions Reduction Fund (ERF) or other mechanisms. These could reduce the net costs of the different options and should be considered if GSC and SGSC decide to develop organics processing infrastructure.

In February 2017, the state government announced a $2.0 million *Waste to Energy Infrastructure Fund*. This is designed for the waste management sector, councils, water authorities and businesses with proposals for new or upgraded projects that can be commissioned by 31 December 2019. The fund offers up to $1:$2 (33%) funding for local government projects and $1:$3 (25%) funding for industry projects.

If funding was obtained for a covered aerated windrow or bay facility it would reduce the cost of a municipal facility by $4-$8 per tonne for a 10,000 tonnes per year facility over a period of ten years.

For a Smartferm or BigChar facility the cost reductions would be around $4.50 per tonne and $12 per tonne respectively, further reducing the net costs of such facilities to as low as $25 per tonne for both under 'best case' conditions.

GSC and SGSC could also produce a business case and seek matching funding through the Victorian Government's Sustainability Fund or Rural Development funding or the federal government's *Building Better Regions Fund*.

Another potential source of external support is the Australian Renewable Energy Agency (ARENA), an independent agency funded by the federal government to provide funding support for the development of renewable energy projects. Funding is available for small-scale bioenergy projects including feasibility assessments, trials and pilot facilities that have a strong prospect of commercialisation. Organisations can submit an expression of interest (EoI) outlining a proposed project to ARENA at any time using a standard form. ARENA staff provide feedback on the project's eligibility for funding and suggested requirements for a full proposal. Funding requests for less than $500,000 can be made any time without the EoI process although it is recommended applicants consult ARENA staff prior to a submission.

The Victorian government has committed to state-based renewable energy targets of 25% by 2020 and 40% by 2025. This will drive investment in renewable energy projects and likely improve market prices for renewable energy.

6 Triple bottom line assessment of options

Blue Environment has assessed the comparative financial, socio-economic and environmental outcomes of the different technical options considered. The relative performances of different options against assessment criteria are shown in Table 11.

This assessment suggests that:

1. All the technologies will deliver significant triple bottom line benefits.
2. All the technologies will achieve the same environmental benefits associated with diversion of organics from landfill. This is a significant environmental benefit due to the reduction of greenhouse gas emissions and reduced pollution risks.
3. Similarly, all technologies would support a FOGO service and have the same socio-economic benefits and costs associated with providing such a service.
4. Although small-scale AD units potentially have higher technical risks and will only be viable if a user of heat and power can be secured, they have higher triple bottom line benefits than aerobic composting, mainly due to water use, renewable energy generation and reduced odour risk. Composts and fertilisers from AD units are also likely to have higher market value and soil improvement benefits than aerobic composting.
5. Small-scale thermal units generate more renewable energy per tonne than AD but are less suited to FOGO and 'wet' liquid commercial organic wastes. There may also be concerns on the potential of toxic emissions or other pollution that would need to be addressed.
6. There may be minor 'ecotourism' benefits associated with AD or thermal systems as these would be novel and may attract visitors from other municipalities.

Table 11: Triple bottom line assessment of processing technologies showing comparative performance against assessment criteria

Assessment criteria	Aerobic composting (covered aerated windrow or bays or Vertical Composting Units)	Anaerobic digestion (Smartferm for FOGO and commercial organics or hybrid wet-dry system for FOGO with Australian Meat Farmers waste treatment)	Thermal energy recovery (BigChar for FOGO and woody biomass or small-scale combustion or pyrolysis/gasification for woody biomass)
Financial			
• Capital costs	Moderate	Moderate – high	Moderate – high
• Operating costs	Moderate	Low	Low
• Market risk	Low	Moderate. Needs a partner with need for power and heat.	Moderate – high. Needs a partner with need for power and heat.
• Technical risk	Low. These are proven technologies.	Moderate. No reference plants in Australia.	Moderate – high. Concerns regarding emissions controls need to be addressed.
Socio-economic			
• Convenience, but also cost, of a FOGO service	Same for all technologies. Provision of a FOGO service gives residents a convenient way to have garden and food waste recycled/recovered and many in the community will be glad to divert organics from landfill. However, the service may increase net service costs, particularly if large quantities of 'additional' garden organics are recovered by the service. Households that do not generate large amounts of organic wastes will effectively cross-subsidise households that make full use of the service to dispose of garden waste. This can be addressed by providing smaller organics bins as the 'baseline' service and offering larger bins at a higher 'fee-for-service' rate.		
• Reduction in businesses' waste disposal and energy costs	Moderate. A composting facility could create cheaper management options for grease trap, wastewaters and other commercial organic wastes.	Moderate – high. In addition to providing lower cost opportunities for waste management, on-site energy costs can be reduced for co-located facilities.	Low – moderate. Smaller scale thermal facilities cannot readily process wet organics so opportunities for commercial organics are limited. Woody biomass could fuel commercial or community heating and power projects.
• Potential odour and amenity risks	Moderate – high	Low – moderate. Odour risks will occur at receival of organics and removal of solids from AD units.	Low – moderate. Storage of woody biomass poses little odour risk but storage of FOGO or other wet organics poses significant odour risk.
• Other pollution risks	Moderate. Stormwater pollution, litter and dust can result from open receival of materials and windrow management of maturing composts. These risks can be managed.	Low – moderate. Note that solids from AD plants need to be managed as an immature compost with appropriate management to avoid water pollution, litter and dust.	Moderate – high. There is potential for the formation of toxic gases and tars during combustion, pyrolysis and biochar production.
• Investment and new	Moderate – high	Moderate – high. The SmartFerm technology	Low – high (depending on technology; small-

Assessment criteria	Aerobic composting (covered aerated windrow or bays or Vertical Composting Units)	Anaerobic digestion (Smartferm for FOGO and commercial organics or hybrid wet-dry system for FOGO with Australian Meat Farmers waste treatment)	Thermal energy recovery (BigChar for FOGO and woody biomass or small-scale combustion or pyrolysis/gasification for woody biomass)
employment creation during construction		is a demountable shipping container with lower construction costs, but building storage bunkers for the materials to reduce odour risks is likely. An AD facility at Australian Meat Farmers will need to be custom built with greater investment and result in employment.	scale combustion boilers and gasifier units have lower construction costs).
• 'Ecotourism' (i.e. other parties visiting region to see the facility)	Low – moderate. Covered aerated systems may be of interest to some other Councils but other examples are available.	Moderate. An AD unit would be of interest to other municipalities and potentially businesses.	Moderate. Such technologies would be of interest to other municipalities and potentially businesses.
• Likely community acceptance	Moderate. Depending on where the site is located there may be opposition to establishing a composting facility due to odour concerns.	Moderate – high. Provided the unit is well-sited, community support for a system that diverts organics and converts it into renewable energy and compost products is likely to be high.	Moderate – high. Some environmental organisations are hostile to thermal energy recovery due to concerns about emissions or energy recovery from ex-native forestry waste. However, woody waste biomass from waste and plantations should not cause concern.
Environmental			
• Avoided greenhouse gas emissions from landfill	Same benefits for all technologies with net savings of 0.5-1 tonne CO_2-equivalents per tonne of garden organics and 1.0-2.2 tonnes CO_2-equivalents per tonne of food organics diverted from landfill depending on levels of gas capture and oxidisation at receiving landfills.		
• Reduced emissions from energy recovery	Nil. There is no energy recovery and composting facilities are net users of energy.	Moderate. AD facilities extract limited amounts of biogas from inputs and solid outputs typically require further composting.	Potentially high. Combined heat and power units can achieve high levels of energy recovery and substitute for fossil fuel energy sources.
• Embodied energy 'in' processing facility and equipment	Moderate	High	High
• Water consumption	Net user of ~500-1,000L per tonne of organic input.	Net producer of wastewater. This can be used for irrigation after treatment.	No additional water use or generation

Assessment criteria	Aerobic composting (covered aerated windrow or bays or Vertical Composting Units)	Anaerobic digestion (Smartferm for FOGO and commercial organics or hybrid wet-dry system for FOGO with Australian Meat Farmers waste treatment)	Thermal energy recovery (BigChar for FOGO and woody biomass or small-scale combustion or pyrolysis/gasification for woody biomass)
• Net energy consumption	Net user of energy for vehicles, shredding and aeration equipment and so on.	AD facilities are typically net energy generators depending on internal energy demands.	Net energy generators.
• Resource conservation	Moderate. Composts can reduce the need for synthetic fertilisers.	High. Energy substitutes for fossil fuels. Composts reduce the need for synthetic fertilisers.	High. High energy yields substitute for fossil fuels. Biochar can reduce the need for synthetic fertilisers.
• Soil improvement	Moderate – high. Composts can improve soils.	High. Higher-nutrient humified composts are produced. Yields of compost per tonne of solid input will be similar to fully aerobic composting.	Nil if biochar is not produced. Low if biochar is produced. Only about 10% of inputs will be converted to biochar and markets are currently mainly for domestic gardens.

7 Community engagement and communications plan

The viability of municipal organics recovery systems will be improved if:

- household participation and diversion rates are high
- contamination levels in organic materials are low
- the amounts of 'additional' organics (materials currently managed on-site or otherwise not disposed via kerbside garbage) are minimised
- there are local markets for any recycled organic products.

Effective community engagement and communications have a role to play in achieving each of these objectives.

This section outlines and assesses community engagement and communications strategies that can be used to improve the viability of any future FOGO services. It is written assuming a FOGO service is to be introduced. It draws on the recent experiences of municipalities in central and north east Victoria, NSW and Adelaide in introducing effective FOGO systems. It provides a framework for an effective community engagement strategy.

7.1 Overall objectives

The overall objective of the community engagement and communications plan is to ensure the FOGO service, if introduced, achieves high levels of participation and diversion of garden and food organics and low levels of contamination.

To reduce collection and processing costs the plan should also promote food and garden waste reduction and good on-site management of organics.

7.2 Promoting behaviour change – key decisions

The following discussion considers factors and key decisions that can affect the performance of FOGO services. The community needs to be informed and consulted about the Councils' preferred FOGO system.

'Optional' or 'Compulsory' service

Optional FOGO services (where residents opt to use the service for a fee) typically have lower levels of household participation, but higher levels of organics recovery per participating household and lower levels of contamination than Compulsory services (where all residents are charged for the service and receive a bin, although some may choose to not use the service on a regular basis).

Levels of participation under an optional service vary across Victoria with most achieving participation levels of around 40% over time. Note that some Councils such as Boroondara and Bayside have achieved participation levels of 70-80% with optional services, but this may be because they are 'leafy' and higher income areas. The Optional service has advantages for a garden only service because it allows a direct fee-for-service and reduces the quantities of 'additional' organics (i.e. organics that are not currently disposed to kerbside waste and therefore add to the costs of organics recovery services without diverting materials from landfill). However, Optional services are less effective for diverting food because fewer households have access to the service.

A Compulsory FOGO service is recommended as the preferred option, potentially with discounted services to lower-income households and a baseline service offering a smaller volume (e.g. 80L or

120L) FOGO bin with the option of a larger bin on a fee-for-additional-service basis for those wanting to recycle more garden organics through the service.

'Fortnightly 'or 'weekly' FOGO and garbage services

Fortnightly FOGO services can reduce participation in food organics recovery because of actual and perceived levels of odour from the bins. Weekly services typically achieve higher levels of participation and food diversion rates but incur higher collection costs and greater risk of 'additional' garden organics being disposed of to the service. This can be minimised by reducing FOGO bin size and/or providing a fortnightly rather than weekly garbage collection service.

Providing a fortnightly garbage service can result in community opposition from those who feel they need a more regular service (e.g. larger sized households, families with children in nappies and those who do not recycle well).

Over the past 18 months, Councils in central and north east Victoria have introduced weekly FOGO and fortnightly recycling and residual garbage collection services. Some Adelaide municipalities have also introduced similar services which have been operating successfully for several years. These Councils have experienced 30-60% by weight reduction in landfilled household garbage due to food and garden organics diversion as well as greatly improved recycling by households that were previously not recycling but were 'forced to' by less frequent garbage collection.

It is recommended GSC and SGSC consider the introduction of a weekly FOGO and fortnightly garbage collection service.

Bin format options and incentives

As mentioned previously, an objective of a FOGO service is to avoid 'additional' organics being disposed of to the service without matching diversion from landfill unless the service user pays for this additional material. The best way to achieve this is to provide a baseline or standard service with lower volume FOGO and garbage bins and charge more for households requesting larger bins for either service. For example, a 120L weekly FOGO and 120L or 180L fortnightly garbage as a baseline, slightly reduces the total bin volume offered.

It is also possible to reward lower waste generating households by allowing cheaper and smaller bin options. If a fortnightly garbage collection service with a small bin is provided it may also be possible to allow households that manage organics on-site to 'opt out' of the FOGO service at a reduced fee.

Are kitchen food scrap bins and bio-bags worthwhile?

Many Councils have found that providing 5-10L food scrap bins and/or compostable biobags can improve participation and food diversion rates. Bins act as reminders to householders to divert food organics and biobags reduce odour and mess in both kitchen and FOGO bins. If used, biobags should be fully compostable to the Australian Standard and be clearly identifiable by colours and/or patterning on bags. This allows organics processing facilities to remove bagged contamination (anything in a non-FOGO service bag) before processing.

The costs of bins and bags add less than $10 per participating household per year and are recommended.

A further recommendation if bio-bags are used is to consider providing a years' supply of bags when FOGO bins are delivered, and either provide additional bags every year or allow households to order additional bags either for free or on a fee-for-service basis. Providing free bags is preferable because otherwise some households may use non-compostable bags. Many non-compostable shopping bags are labelled 'degradable' but this only means that over time they disintegrate when exposed to light and air and are considered contamination by the facility.

Waste reduction initiatives

As mentioned previously, the costs of providing a FOGO service are increased if households use it to dispose of garden and food organics that they do not currently dispose to their garbage bin. In addition to providing smaller volume bins as standard service and charging more for those wanting larger or additional bins, it is recommended the roll-out of a FOGO service is combined with community education about how to reduce food and garden waste. Key messages include:

- Methods for reducing food waste. The *Love Food Hate Waste* campaign delivered by Sustainability Victoria provides information and resources for Councils to promote food waste reduction (*www.lovefoodhatewaste.vic.gov.au*). Home composting and worm farming can also be promoted to manage food waste on-site and improve soils.
- Methods for reducing garden waste. For example, reducing lawn areas and selecting plants that need less trimming and pruning. Home composting and mulching can also be promoted to manage garden waste, improve soils and conserve moisture.

Promoting other recycling

Previous waste audits suggest most households are good at recycling but a 'recalcitrant' proportion of the population are not and are the main contributors to the 20-25% by weight of household garbage that could be recycled through kerbside recycling systems. These 'non-recyclers' are less aware of what can be recycled and are less swayed by messages about environmental benefits. They are more likely to respond to messages about convenience, cost savings to the community and the fact that most people are good recyclers (i.e. recycling is 'the norm') (SV, 2015).

Councils in north east Victoria have found recycling rates for packaging and paper have improved following the introduction of a fortnightly garbage service which reduced the volume of garbage that could be collected. As well as improving environmental outcomes, this provides a direct financial benefit to Councils because recycling is cheaper than landfill disposal.

It is recommended GSC and SGSC promote recycling as part of any roll-out of a FOGO system with key messages focusing on the range of materials that can be recycled, the convenience of the recycling service, cost-savings to the community and social norming such as the fact that over 80% of people are good recyclers.

Avoiding confusion

Councils previously trialling or introducing FOGO services have found contamination from food packaging can be high if the term 'food waste' is used. There can also be confusion about what is compostable resulting in items such as synthetic wipes, non-compostable 'degradable' plastics and nappies disposed of in bins. Other common risks to services are the inclusion of: garden waste in plastic bags; treated and painted timber; synthetic fibres; and plastic and inert garden waste.

Educational materials about the FOGO service should clearly state what can and cannot be included and use very specific terminology such as 'compostable food and garden organics', 'fruit and vegetable trimmings and scraps', 'no bin liners' and 'no plastic or glass'.

It is also recommended Councils adopt the Australian Standard for bin colours with black or dark green bin bodies and a lime green lid for the organics service, a yellow lid for recyclable packaging and paper and a red lid for garbage. This colour system is progressively being adopted nationally and should reduce confusion about services from tourists and holiday makers to the region. Both GSC and SGSC have compliant bin colours for garbage and recycling, and SCSC has adopted the compliant colours for their existing FOGO service.

Listening to 'dissenters'

Changes in kerbside waste services will almost inevitably result in some community objection or dissent. Common reasons for opposing change are concerns about: increased service costs; storage room for a third bin; odour from FOGO bins or garbage bins collected fortnightly; the inconvenience of having to put out and bring in a third bin; the need for a service by those who already compost on-site and do not add organics to their garbage and feel everybody else should do the same; and the potential for large waste generators to 'free load' on those who do not produce much waste. A 'red-herring' argument that is often raised is a belief that materials will not be recycled and will all go to landfill anyway.

It is important to listen to and address these concerns through strategies such as:

- allowing community feedback when the intent to introduce a FOGO service is announced
- countering arguments by promoting the community and environmental benefits of FOGO services and showing how three smaller bins only occupy slightly more space than two larger bins
- offering service fee discounts to lower-income households
- introducing financial incentives and 'fee-for-additional-service' that reduces costs to low waste generators and ensures those using the service for 'additional' garden waste pay for this
- potentially allowing those who manage all organics on site to 'opt out' of the service with or without a financial reward
- promoting home composting and worm farming as options for avoiding need for the third bin by those who do not want it
- providing or promoting use of or bio-bags and de-odourising nappy bags to manage odour concerns
- offering the option of larger volume or additional garbage, FOGO and recycling bins on a fee-for-service basis
- offering the option of a larger volume garbage bin without additional costs to households with children in nappies.

Dealing with misuse/contamination of services

Physical and chemical contamination of FOGO materials can damage processing equipment, increase pollution risks and management costs and devalue products. Some contamination is inevitable and processing facilities will need to have systems for managing this. However, gross contamination of loads is typically caused by a few households per collection truck load using the service as a *de facto* garbage bin. Only one or two heavily contaminated bins per 100 households can lead to unacceptable levels of contamination although often these can be isolated from loads during pre-sorting at the processing facilities.

It is recommended the community engagement and communications plan adopts the following methods for managing contamination:

- Implement procedures for processing facility operators to inspect each received load for contamination and record the service areas where it was collected. This allows poorly performing areas to be identified.
- Implement procedures for collection vehicles to have on-board closed circuit television (CCTV) cameras to allow inspection of materials by drivers and reporting of contaminated loads. Systems that photograph the content of each bin and record their global positioning coordinates are available and can be used to identify and prove bin contamination.
- Where a household or street has been identified as a source of contamination, distribute reminder messages about the correct use of the FOGO bin and the costs to the community of

the misuse of the service. Some Councils have periodic 'bin blitzes' where bins in areas known to be underperforming are manually inspected and households with contamination in their bins are given reminder notices. Some Councils reinforce this by tagging bins with 'Not for collection until contamination is removed' stickers to inform drivers not to collect the bins and also send a strong message to the household (and their neighbours).

- Where households are identified as repeat offenders Councils could consider confiscating their bin and suspending their service and provide the option of paying to have the service resumed. The option of doing this should be included in Councils' local laws and well communicated when the FOGO system is introduced.

It is also recommended Councils publicise both good and bad performance and report contamination levels in different areas. Consideration should be given to publicising any prosecutions of those repeatedly misusing systems to reinforce the message that contamination is not acceptable.

Other methods used to reduce contamination used by Councils include:

- School education programs to educate students and parents about how to correctly use the service and 'deputise' them to make sure their household does the right thing.
- School and community tours of the organics processing facility. Participants are shown how contamination spoils the process and are provided with information about how to use services correctly.
- 'Bin lotto' (used by Goulburn NSW) where biobags provided by Councils have an identifying number. Bags identified as contaminated can be traced back to households that then receive a reminder notice. Council also randomly selects bags and the household producing the first contamination-free bag receives a gift voucher from a local business and this is publicised in the local newspaper.

Examples of community education materials that might be available to GSC and SGSC include:

- Metropolitan Waste and Resource Recovery Group's (MWRRG) 'Back to Earth' program (*www.backtoearth.vic.gov.au*). This promotes correct use of bin systems, home composting and worm farms and use of compost products. These materials have been adapted by Goulburn Valley Councils and graphics and text are available to Councils to use with permission from the MWRRG. Non-metropolitan Councils can use the resources and be listed on the website.
- The Halve Waste program (*www.halvewaste.com.au*). This was developed for Albury City Council and adapted for some north eastern Victorian Councils. The website and materials are maintained by a private firm and licensing fees are likely to apply. The campaign is well-resourced and has included regional television advertising featuring celebrities.
- City of Greater Bendigo has recently introduced a FOGO service and has produced a user guide (*www.bendigo.vic.gov.au/media/1245*).
- Goulburn Valley Waste and Resource Recovery Group is developing four short videos on correct use of kerbside services under a Sustainability Victoria supported project and these should become available later in 2017. These can be linked to Councils' websites.

7.3 Suggested framework

The community engagement and communications program should have the following elements.

Identified target audiences

The main audience for an engagement program is obviously householders in serviced areas. Other key audiences include:

- businesses with recoverable organic wastes
- tourists and holiday makers
- owners of B&Bs and rentals.

The last two groups need to be targeted to avoid non-residents misusing FOGO and other recycling services.

Another audience is the local media. It is recommended they are directly briefed about the proposed service change, with Council officers initiating meetings with editors and journalists/reporters to explain what is happening, when and why. It is recommended Councils provide a direct and ongoing point of contact who can answer any questions. This is to avoid negative reporting of the service change. Media releases and advertising should be used to promote the positives of the service change.

Key messages

Prior to roll-out

Prior to the roll-out of a service it is recommended Councils notify the community of their intent to provide an optional or compulsory FOGO service and the bin format/service options and charges. Residents can be invited to nominate which service option they are likely to choose.

On-line and mail-back surveys, public forums and 'listening post' public displays could be used to allow community feedback about the proposed service and gauge the levels of support for (and opposition to) an optional or compulsory service. Responses to 'dissenters' should be developed and publicised as a Q&A sheet and can also be used to respond to queries and complaints after a system is introduced.

At this stage, messages about the benefits of a FOGO service should also be activity promoted. Customer service staff need to be prepared for questions from the community, and all Council staff and councillors should be briefed to ensure consistent information is provided across the organisations.

During and after roll-out

If a FOGO service is introduced the primary messages are:

- how to correctly use the service – what can and cannot be placed in FOGO bins and correct presentation of bins
- service options – what bin sizes are available and at what costs, availability of kitchen food scrap bins and biobags
- collection dates
- how residents can obtain information about the service
- how residents can provide feedback to Council.

Other messages include:

- the environmental and financial benefits of diverting organics from landfill
- socio-economic benefits such as local investment and employment
- the convenience and value-for-payment of the service (e.g. “for only $1.50 per week Council will provide a third bin and collect food and garden organics for recycling”)
- the value of compost products (if these are made and marketed).

Channels of communication

The key channel of communication needs to be direct mail by Council. Initially it is suggested to notify householders of intended changes to kerbside services with an explanation of why the changes are being made. If the service is optional or different bin sizes are available, a return form for residents to select options other than the default /standard service can be provided at this stage.

This can be supported by the following communication channels:

- Council newsletters
- feedback surveys conducted both on-line and though land mail
- public displays
- local media
- information packs delivered with the bins
- stickers providing information on or inside bin lids
- tours to processing facilities
- community organisations and networks
- schools
- real estate agencies
- reminder notices
- satisfaction surveys
- displays and promotion of use of recycled organics products.

Community surveys

Community surveys can be conducted before the roll-out of a FOGO service and then periodically afterwards as a separate survey or questions included in Councils’ annual community satisfaction surveys to gauge levels of support for the service.

Surveys can be either:

- Optional-response through on-line or mail-back surveys. These have the advantage of being relatively cheap but mean the respondents ‘self-select’ and Councils may get over-representation from some sections of the community and little response from others. On-line surveys are particularly susceptible to coordinated responses by interest groups (such as local community and environment groups) and this may bias samples if numeric quantitative data is sought. Such surveys are not recommended if quantitative data is needed. However, if the purpose of a survey is simply to allow different voices to be heard and issues raised, they can be a useful tool. Such surveys can receive high response rates if they are made simple and are directly relevant to the respondent. For example, general questions about support for a FOGO service might get a low response. However, questions about specific service levels and the proposed fees presented as an ‘order form’ if a service is introduced is likely to get a higher rate of response from those who are not content with the proposed baseline/standard service.
- Targeted surveys using telemarketing cold calling to ensure a random selection. Such surveys are needed if quantitative data is needed (e.g. ‘the number of households supportive/not supportive of a FOGO service). They are generally more expensive with at least 300-500 responses needed

within smaller communities to achieve a representative sample, which can require over 1,000 calls. Targeted surveys may also not identify 'outlier' issues unless a wider range of respondents are surveyed.

For the purposes of a FOGO survey it is suggested:

- Prior to the introduction of a FOGO service on-line and mail-back surveys should be sufficient to allow community members have their say about the nature of proposed FOGO services. It is proposed that this could be designed to ask respondents to nominate their preferred service option for different fees, including a 'I do not want a FOGO service' option. Residents would be told that if they did not complete the survey they would receive the standard service. This will help to gauge the extent to which people would prefer an optional service and what levels of services at different fees are likely to be demanded.
- After a service is introduced questions about the service should be included in Councils' community satisfaction surveys.

Community workshops and forums, focus groups and 'listening posts'

Community workshops and forums can be used to give residents an opportunity to hear more as well as have their say about proposed service changes. The value of these is questionable. Such sessions generally attract a relatively small and not always representative proportion of the community and can be dominated by a few 'loud' voices.

Focus groups, where randomly selected members of the community are invited to attend sessions to 'workshop' options could be conducted. These have the advantage of getting a more representative sample of attendees and can be useful to get a discussion of key issues and would allow the facilitator and other attendees to explain aspects of the proposed service changes and gather around-the-table discussion feedback from attendees. Focus groups take more effort to organise, but are likely to yield more representative feedback and reduce the risk of interest groups 'hijacking' public forums.

Another approach is to set up 'listening posts' where displays of new bins, kitchen tidies and biobags and information about the service are set up in a public space, such as shopping centres, public libraries and recreation centres. Passers-by are invited to discuss the proposed changes and to complete feedback surveys. City of Greater Dandenong used this approach and found it useful in reaching sections of the community unlikely to attend forums and focus groups. Such listening posts require more staff time if the display is permanently staffed (they may need to be staffed for a period of a week and on weekends or nights).

It is suggested on-line and direct mail surveys are used to promote and obtain feedback on any proposed FOGO system.

If community forums are to be held, it is suggested focus group sessions are also conducted to determine whether responses from open community forums are representative of the wider community.

Preparing for roll-out

The following issues need to be addressed:

Additional resourcing

Additional Council resources needed leading up to and during roll-out include project officer or contractor time to:

- Process households' 'orders' for different bin format/service options and develop databases to ensure each house receives what they ordered. Most households will typically opt for the 'default' option in which case they do not have to submit an order.
- Coordinate the delivery and distribution of FOGO bins, kitchen food scrap bins and biobags (if provided), and information about the service. It is recommended that roll-out is staged in different collection areas over 4-8 weeks, with an initial roll-out in a smaller area serving as a trial for other areas.
- Deal with additional calls from residents to Council about the service. All calls and responses by Councils should be recorded in a database available to others fielding similar calls to make sure consistent advice is being provided. Q&As with anticipated issues can be expanded as new issues and responses are added.
- 'Trouble shoot' during the roll-out of services. This includes liaising with community members with serious concerns and making sure the bin supply contractor deals with any mis-deliveries of bins. It also involves briefing and maintaining contact with local media to ensure negative publicity is minimised and positive results are promoted.

Coordinating bin delivery dates

This is a vital component of a FOGO roll-out as it ensures residents will have the bins when they need them. If they are delivered too early (before collection services start) this may lead to confusion. If they are not delivered in time then residents may be upset that they are being charged for a service they cannot use. Bins can be delivered to kerb with information packs and, if providing, kitchen scrap bins and biobags.

Q&As

It is recommended Q&As of anticipated issues, and 'new' issues that arise, are developed, maintained and distributed throughout roll-out to ensure Council officers, service desks, Councillors and local media have ready access to consistent messages about the service.

Incident reporting and response

It is recommended that a database is maintained of all queries, complaints and other incidents, including Councils' responses to these. This helps to ensure all incidents are addressed and that Council has a record of how they were dealt with. It also ensures responses are consistent.

Briefing Councillors, senior management, Council staff and local media

Both prior to and during roll-out it is recommended that all Councillors, senior management, Council staff and local media are briefed about the service and the status of the roll-out. In smaller communities, many people will know someone who works for Council and a potential source of mixed-messages or misinformation is from uninformed Council staff 'making it up' when asked. This risk is reduced if Councillors and staff are aware of the 'right' answers to give when asked. Similarly, briefing the media should avoid them reporting misinformation from uninformed sources.

Liaison with collectors and processors

Other Councils who have introduced FOGO services consistently state that collection contractors and processors have a vital role to play in identifying issues, such as bad habits and contamination, early and on an ongoing basis. They have also stressed the need to have cooperative contractors who are willing to tolerate 'out of scope' levels of contamination during the early stages of a FOGO roll-out while teething problems are overcome. During roll-out it is suggested Council officers maintain frequent (e.g. several times per week) communication with collection and processing contractors about any issues and incidents, and particularly about contamination levels from different collection areas.

Monitoring and reporting performance

The following performance measures and methods are suggested:

Quantities of landfilled waste in total and per household

This can be measured through landfill weighbridge and gate fee data. This is a key statistic to report to Councillors and the community as it can demonstrate the effectiveness and benefits of introducing the service. The data can also be used to estimate greenhouse gas abatement achieved through the FOGO service.

Quantities of recovered organics in total and per household

This can be obtained from weighbridge data at organics processing facilities or an estimate based on received volumes or output at facilities without weighbridge facilities. This data tells how much organic waste has been processed and, when compared to changes in landfilled garbage data, can provide an indication of how much 'additional' organic waste is being captured through the service.

Improved recycling

An anticipated outcome of the introduction of a FOGO service is some improvement in the quantities of recyclables recovered due to publicity about recycling services and potentially a move to a fortnightly garbage collection service. This data can be obtained from materials recovery facility operators' weighbridge data. Periodic audits of garbage can be compared to historic audit data to see whether the amounts of recyclables in garbage falls because of changes to kerbside services. This is also important information to report to Councillors and the community as it is a clear financial and environmental benefit of moving to a FOGO service.

Use of service

It is suggested collection vehicles are fitted with accurate bin-lift counters to record how many households are regularly using the FOGO service. Low rates of use by households suggests lower rates of food recovery (most households will want food waste collected weekly rather than fortnightly due to odour concerns). Similarly, the weights of organics collected from specific collection areas could be used to identify areas with high and low yields of organics. These data could be used to identify areas with lower usage rates and these could be targeted for reminder notices and more directed promotions about the FOGO service.

Contamination rates

This is an important statistic and monitoring tool. It is suggested Councils require collection and receival contractors to record contamination rates from different areas and give drivers of collection vehicles authority to either tag bins or leave households a postcard notifying them unacceptable levels of contamination were noted in their bins. Drivers should be encouraged/required to record and report the addresses of contaminated bins so that Councils can follow up with formal reminders and potentially prosecute repeat offenders. CCTV systems for recording contamination in bins could be considered.

If the collection contractor does not record contaminated bin details, the sources of contamination can only be identified to a collection area if the processing facility operator reports contaminated loads and details. Councils can conduct 'bin blitzes' in areas with repeatedly high contamination rates and should report results to the local media.

Incidents, reminders and enforcement measures

Recording the number of incidents, reminder notices and stronger enforcement measures (such as bin confiscations) provides data indicating detected levels of non-compliance. If these arise it may indicate a need for more concentrated education and publicity about correct use of the FOGO system.

Recycled organic production and sales

Processing facility operators could be asked to provide information about the quantities of outputs and the sales of these. This can help to identify whether the operator is having trouble selling products, and poor or low price sales could indicate a need for more concentrated promotions of products to the community and other markets. Ensuring products are being sold is also a way of monitoring whether sites are building up unsustainable stockpiles of materials that may become a liability to Councils if the stockpiles are on Council sites and a facility operator ceases operations. Conversely, good production and sales figures can be reported to Councillors and the community to reinforce the message that their efforts to recover organics is having benefit.

Energy generation
Operators of AD or thermal facilities could be asked to report on energy generation rates. Similarly, this data can be reported to Councillors and the community to demonstrate the benefits of their organics recovery efforts. It could also be used to monitor whether the facility is achieving stated objectives for levels of energy recovery.

7.4 Costing of a community engagement and communications program

An estimate of the likely costs of a community engagement and communications program for an individual Council is shown in Table 12. There may be some cost savings if resources are shared across GSC and SGSC. It has been assumed most of the work will be undertaken in-house and from SV and MWRRG's existing education and promotional materials will be adapted where possible.

Table 12: Indicative costing of a community engagement and communications program for each Council

Item/details	Indicative budget ($)
Project officer additional time – total six weeks	$11,500 including on-costs
Support/service staff additional time – 1.0 EFTE additional for three months during roll-out. This includes database work, preparation of Q&As and providing additional customer services support	$20,000
Preparation of communications and media plans	$10,000
Preparation and distribution of promotional materials	$60,000
Advertising	$20,000
Workshops, forums and events	$8,000
TOTAL	$129,500
Annual maintenance of materials, monitoring of performance	$10,000-$20,000

8 Key findings and preferred options

This report summarises work undertaken by Blue Environment to assess the viability, likely costs and preferred options for a shared organics processing facility. Key findings are discussed under the following headings

8.1 Recoverable organics

Blue Environment has identified the sources of organics within the area. This suggests a shared facility attracting SIW and PIW organics identified as readily available would need a processing capacity between 6,500 and 14,000 tonnes per year. If FOGO material from Moyne and Warrnambool were also secured the required processing capacity would increase to up to 21,000 tonnes per year. This would improve the economies of scale of the facility.

However, due to the uncertainty regarding the availability of this material, our costing of future processing options has considered only GSC and SGSC's organics and the identified recoverable SIW and PIW organics. The main source of PIW organics identified is Cleanaway, which currently sends around 10,000L per month of grease trap waste to Camperdown Compost. This material could be a source of gate fee income as well as a good source of moisture and nutrients for a future composting facility.

The proposed AMF meat works at Hamilton will generate significant amounts of wastewater with organic and nutrient load, as well as paunch and holding-yard wastes. The solid component (paunch and yard waste) may be suited to a composting facility but the volumes of wastewater requiring treatment will far exceed the capacity of the available organics to absorb it. If the meat works is developed, it is suggested SGSC and GSC work with AMF to further explore opportunities for installing an AD system that treats wastewater and has capacity to extract gas from municipal organics, with heat and potentially power used on-site by AMF.

For the purposes of comparative analysis, costings have been based on facilities designed to receive 5,000 and 10,000 tonnes per year.

8.2 Preferred technologies

Blue Environment has reviewed technologies appropriate to the scale and types of feedstocks likely to be available to any organics processing facility.

This review has found:

- Unless the AMF meat works is developed, aerobic composting is the most appropriate technology for the types of waste to be processed. If AMF proceeds with the development options for AD systems should be investigated further.
- Two alternative technologies (Smartferm AD and Big Char) may be cost-competitive. However, these will need partners who need heat or combined heat and power from the units and have higher technical and commercial risk than composting options. It will not be economically viable to connect these small facilities to the power grid.
- It is recommended small-scale AD and pyrolysis/gasification should be considered in any future tendering for equipment or services, and the supplier should be invited to provide a more detailed quote.
- Thermal energy recovery technologies are unlikely to be commercially viable at the likely scale of operation for FOGO and other 'wet' and variable organics. Most technology providers contacted suggested minimum scale facilities of 15,000 tonnes of dry woody biomass and 30,000-50,000

tonnes of GO and FOGO inputs. Although small amounts of municipal organics could potentially be absorbed into a large facility, it is not a good feedstock due to high and variable moisture content and the potential for contamination. Facilities processing FOGO materials are likely to need emissions control and treatment systems that add greatly to capital and operating costs.

- Based on information provided by supplier, Big Char CCT, one thermal system may be viable. The Big Char CCT system is a small-scale pyrolysis unit focusing on biochar production, and potentially providing on-site use of heat and power. There is some uncertainty regarding the validity of the costing provided as other pyrolysis technology suppliers suggested higher costs, and the viability of the operation relies on sales of biochar at $150 per tonne. Such systems would benefit from being co-located with a user of heat and potentially power from syngas. There is also some technical and potentially environmental uncertainty and risk associated with this option regarding emissions to air, and potentially the formation of toxic organic compounds in 'tars' and biochar products that would need to be addressed. An issue for this, or any thermal system, is how materials will be stored and fed to the unit. Hoppers storing FOGO or other wet material pose an odour risk and materials will need to be shredded and potentially blended with woody biomass before processing. It is recommended suppliers of small-scale pyrolysis are considered in any future tendering for organics processing equipment or services, but that they are asked to demonstrate effective pollution management and end-product quality for a facility processing FOGO. Other SIW and PIW would not be suited to such a technology.
- There are a range of aerobic composting systems available. EPA Victoria guidelines for composting facilities recommend controlled air management of FOGO materials. At a minimum, a processing facility will require aerated covers during the 'hot' primary composting stage. The preferred technologies are aerated covered windrows or bays.
- A case could be made to EPA for uncovered aerated pile composting for facilities processing less than 5,000 tonnes of materials per year and with separation distances of at least 500m. An RD&D application for a trial of this technology is recommended if GSC and SGSC each decide to establish separate organics processing facilities.

8.3 Preferred siting

This assessment found the preferred sites to be:

- Hamilton landfill precinct for SGSC or a shared facility. There are several potential sites in this area. The Council-owned land south of the current landfill is preferred unless Australian Meat Farmers agree to a co-located facility at their proposed meat works.
- Heywood transfer station for GSC. This site has restrictions due to the proximity of a farmhouse and an EPA RD&D approval may be required to demonstrate that FOGO can be processed at the site.

Other sites may also be located and developed. If energy recovery options (e.g. AMF AD, Smartferm AS, Big Char pyrolysis) are developed, they will need to be co-located with a user of heat and power.

A central 'equidistant' site for a shared facility was recommended by a previous study, but this is likely to incur higher overall costs associated with the procurement or leasing and establishment of a site and higher operating costs associated with more remote staffing and the inability to share other waste and resource recovery resources. An advantage of Heywood transfer station and Hamilton landfill resource recovery centre is that staff and equipment at the existing facilities could be shared with an organics processing facility.

Blue Environment conducted a net cost assessment comparing the net costs of the following options:

- separate smaller scale facilities at Heywood transfer station serving GSC and at Hamilton landfill serving SGSC
- a shared facility at either of these sites
- a shared facility at a central 'equidistant' site.

Capital and operating costs at different scales of operation and transport costs from major townships to the sites have been considered.

The estimated costs associated with transporting only FOGO and both FOGO and drop-off garden organics to sites were considered. It is assumed that shredded drop-off organics from either Portland or Hamilton would be needed to bulk up and blend FOGO from one or both Councils. Current green waste transfer stockpiling and shredding operations are more cost-effective than proposed processing facilities, so it is assumed this will continue at smaller transfers stations and either Hamilton (if a shared site is at Heywood resource recovery centre) or Portland (if the shared site is at Hamilton). If separate individual sites are used, it is assumed drop-off organics from both sites will be used in aerobic composting processes to bulk up FOGO material and avoid the need to shred FOGO prior to composting.

This assessment suggests:

- The most cost-effective option may be operation of two smaller scaled aerobic composting facilities at Heywood resource recovery centre and within the Hamilton landfill precinct (i.e. at the preferred undeveloped landfill area, or alternatively at the AMF site or Wannon Water's vacant site).
- If a shared facility is established, the recommended preferred site is Hamilton. The advantages of this siting include:
    - the location of the site proximate to a major collection area
    - the availability of shredded drop-off organics to blend with FOGO and commercial organics
    - potential to share staff and equipment with the Hamilton resource recovery centre
    - potential access to Moyne and Councils to the north
    - Hamilton landfill will also require compost for site rehabilitation creating a 'market' for products and potentially reducing landfill rehabilitation costs
    - the Hamilton precinct has the potential for cooperation with the proposed AMF meat works.
- If a proposed AMF meat works at Hamilton is developed, it may be viable to co-locate an AD unit at or near the site to treat AMF's wastewater, paunch (stomach contents) and holding-yard wastes as well as FOGO and SIW and PIW organics. AMF anticipates large volumes of wastewater, and an AD facility capable of processing FOGO may need to be an adjunct system to a larger aqueous AD system.

A comparative analysis of the net costs of management and preferred siting options found:

- Any expansion of current kerbside organics services will result in a net increase in waste and resource recovery costs relative to the 'business as usual' base case. This is because, although FOGO systems can significantly reduce waste to landfill and favoured organics processing options are cheaper than landfill on a per tonne basis, providing a kerbside service will increase the amounts of garden and some food organics collected at kerb. If a service is provided people will use it to dispose of garden organics they do not currently dispose to kerbside garbage.
- The least total cost increase would be incurred for an optional garden organics service but this would not divert much waste from landfill and would have a high cost per tonne and per participating household.

- The preferred options are either a compulsory FOGO service provided weekly and with garbage collected fortnightly or a well-promoted optional FOGO service provided fortnightly. These have potential to divert significant amounts of food and garden organics and have lower costs per tonne and per participating household.
- Modelling suggests that for SGSC, the net cost increase per additional household receiving either an optional service with higher participation rates or a weekly compulsory FOGO service and fortnightly garbage service could be as little as $37 per participating household per year if materials are processed at the Hamilton landfill site. This is because of low transport costs from the main population centre of Hamilton. This suggests the current user fees for an optional service ($85 for bin purchase plus $83 per year) could be reduced and this may increase participation. A weekly FOGO service will achieve significantly higher diversion of organics from landfill.
- The cost to GSC residents will be higher due to the transport distance to Heywood or Hamilton. The net cost of introducing an optional FOGO service with processing at Heywood transfer station is estimated to increase net costs by around $63 per participating household per year. A compulsory weekly FOGO service with fortnightly garbage is estimated to increase costs by $49-$54 per participating household per year.

The costings do not consider the potential for external funding support for organics processing infrastructure or potential income from the sale of ACCU through the ERF or other mechanisms. These could reduce the net costs of options and should be considered if GSC and SGSC develop organics processing infrastructure. However, ACCU/ERF compliance auditing and reporting costs may be too high for only a 5,000-10,000 tonnes per year facility.

All the short-listed organics processing technologies will have similar environmental benefits associated with diverting organics from landfill and producing soil conditioner products. Options generating usable renewable energy (Smartferm and BigChar) will have additional benefits. Environmental risks associated with air emissions from pyrolysis need to be addressed by the supplier.

Unless organics are secured from other municipalities or businesses and generate gate fee revenue all of the technologies will have similar and limited benefits to the local economy. Most require fairly low capital investment and will create similar levels of limited full and part-time employment during their operation. The cost of providing a FOGO service is likely to cost all households less than $1.50 per week if charged on a net cost basis.

An optional service could be charged on a user-pays basis. This reduces social costs but results in reductions in landfilled waste of less than 15%.

It is recommended:

- GSC and SGSC consider this report and the cost implications of the recommended options.
- Councils run an expression of interest process seeking site-specific information from the suppliers of the following technologies:
  - Smartferm AD, a small-scale solid/dry AD system producing heat and power on a co-located site
  - Big Char pyrolysis, a small-scale thermal system producing biochar, heat and potentially power on a co-located site
  - aerated covered composting using windrows (e.g. GORE system) or bays (e.g. Spartel)
  - aerated uncovered composting (if EPA allow this technology to be used for FOGO on a small-scale i.e. <5,000 tonnes?) (e.g. MAF/C-wise)
  - Anaeco/Di-Com and other suppliers regarding the potential for an AD system to be co-located with the proposed AMF meat works.

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Note: where available and used as a reference, links to technology suppliers' webpages are provided in Appendices A and B.