Investigation into Operating a Food Waste Biodigester at Warrnambool Community Garden

Bruce Campbell Community Development Services
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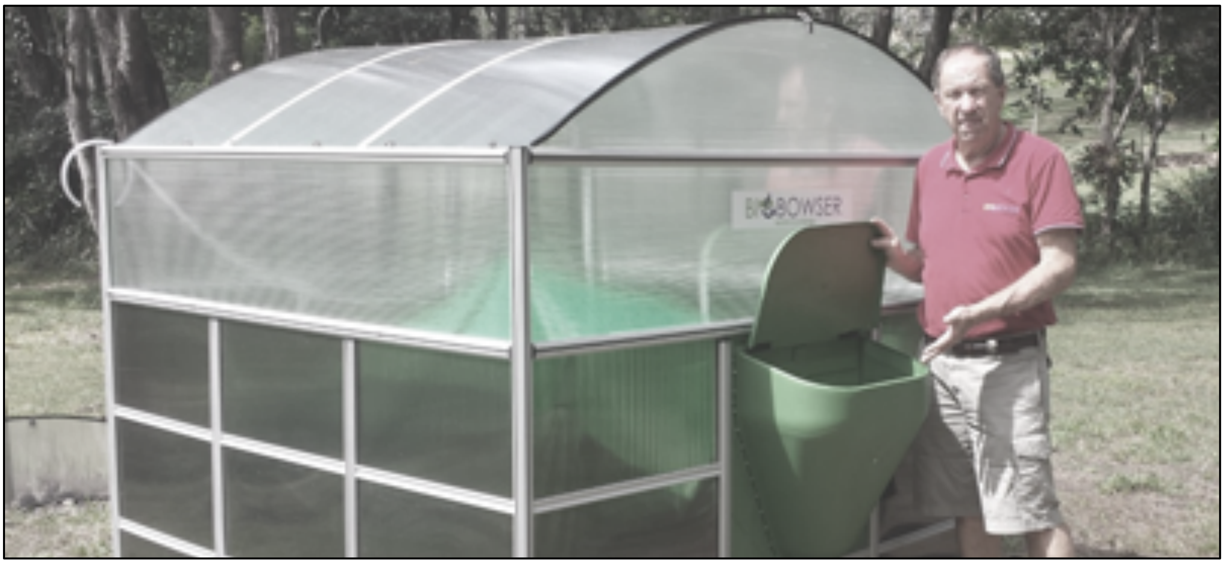

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REPORT

1. **Executive Summary**

1.1. It is not financially viable (outside of a funded project) for Warrnambool Community Garden to operate a biodigester to process most of the retail food waste available in Warrnambool.

1.2. There are at least six tonnes of retail food waste available every week in Warrnambool to feed a biodigester. Most businesses approached would like to have their food waste recycled and most would provide food waste for a biodigester.

1.3. There is also about six tonnes of manure available from the Warrnambool saleyards that could feed a biodigester.

1.4. Broadly, there are two types of biodigesters: aerobic (using air) and anaerobic (not using air).

1.5. The mix of food waste and manure available is well-suited to an anaerobic digester. An aerobic digester would need additional carbon material at a 1:1 ratio to other feedstock.

1.6. There are low and high tech anaerobic and aerobic biodigesters. The high tech systems cost about $100,000 (aerobic) and upwards to an estimate of $450,000 (anaerobic). A small low tech anaerobic digester and associated equipment to process 5 m3 food waste per week could cost about $5,000 to purchase and install.

1.7. Aerobic digesters can produce high quality compost. Anaerobic digesters produce liquid and solid fertiliser and gas that can be burned for heat or electricity generation.

1.8. During the course of this project an application was submitted to DELWP for funding to run a two-year demonstration site at Warrnambool Community Garden showing a range of composting systems, including a small anaerobic biodigester.

2. **Consult with WCC, EPA and any other authorities regarding required permissions or restrictions for operating a biodigester at WCG.**

2.1. Information from EPA and Warrnambool City Council indicate that the scale of the project may give rise to Planning issues (eg. the land is zoned Public Park and Recreation). A smaller project is likely to have less or no barriers compared to a larger 6 - 12 tonne/week project.

3. **Consult with Warrnambool food businesses to ascertain interest in being involved in the proposal, estimates (kgs) of food and coffee waste available per week, ease of any gearing up or practice changes required to provide**

food waste on a daily basis, estimates of any financial savings businesses may make and whether some of these could be passed on to WCG, best procedures for collecting food waste, and non-financial benefits of being involved in the proposal.

3.1. Thirty-one food businesses were consulted. Of these, 25 indicated they would / probably would / maybe would participate in a waste food collection and recycling project.

3.2. Reasons for not wanting to participate were mostly that they already had a system in place for recycling food waste or, in one instance, a business did not have room to separate the relatively small amount of food waste generated.

3.3. Of the 25 interested businesses, 3 generated very small quantities of food waste that would be very uneconomical to collect so these have not been included in calculations, leaving 22 potential businesses that would participate in a food waste project.

3.4. Estimates were generated for a further 7 food businesses, bringing the total potential project businesses to 29.

3.5. These businesses comprised 6 cafes, 4 restaurants, 7 hotel or sporting club bistros, 4 supermarkets, 3 bakeries and 5 fish & chip / hamburger takeaways. Warrnambool and District Food Share, South West Healthcare and Warrnambool Saleyards were also consulted.

3.6. The Appendix 'Food Waste Available, Electricity & Gas Calculations' lists the businesses and organisations and their estimated quantities of various food (and other bio-digestible) waste per week. Food waste totals approximately 15,000 litres and manure approximately 20,000 litres per week, totalling approximately 35,000 litres or 12 tonnes per week that is available <u>now</u> for collection and recycling from these businesses / sources

3.7. Presumably more food waste is also available from businesses / sources that were not surveyed or estimated.

3.8. Some businesses / sources stated that quantities of food waste available for recycling would likely increase over time as it was directed towards a biodigester and away from other recycling avenues (eg. giving to a farmer for stock food).

3.9. Most businesses / sources thought it would be fairly straight forward supplying food waste. All said that a pick up service must be reliable and at a similar standard to their current service, eg. replacement bins and oil drums are clean. Some businesses / sources would require a new set of bins or would need the bins collected daily whereas currently that is not necessary. Only two businesses thought staff training would be an important factor but if a biodigester project gets off the ground it would be in the interests of the project to offer staff training to minimise waste contamination.

3.10. No businesses would commit to paying for waste food collection but it is clear that there would be room to negotiate this for larger waste generators. For example, two bistros each pay to have 7 bins of food waste collected every week and one cafe/restaurant estimates removing food waste from its general waste skips would save $600-800 per month.

3.11. All businesses / sources are very supportive of trying to reduce food waste going to landfill. Many are already doing this and others would if they could (eg. be assisted through a waste collection project).

3.12. Most businesses with waste cooking oil either have it collected for free by an oil collection business, give it away to individuals making bio-diesel or, in one case, sell it. One business struggles with how to dispose of its used cooking oil and a biodigester project would be able to assist with this.

3.13. Warrnambool saleyards also has between 20 and 40 m3 (depending on time of year) manure available and 65m3 pure pine sawdust / urea available in April each year.

4. Conduct internet and telephone research to ascertain a range of biodigesters that may suit the proposal. This would include purchase, installation, maintenance and running costs; through put capacity; ease and labour intensity of management; odour issues; quality of compost produced; safety; footprint; associated equipment required; and any other relevant factors.

4.1. Considerable internet research was conducted along with email and phone research with Kelly Wickham (a sustainable energy expert with DELWP), Charles Ling (researcher, University of South Australia) and biodigester manufacturers / designers: Tony Stone (Gekko Systems, Ballarat), David Halliday (Active Research), Ron Lakin (Biobowser) and Andrew Green (Hotrot).

4.2. Broadly, there are two categories of biodigesters: aerobic (using air) and anaerobic (not using air).

4.3. Aerobic Digesters:

4.3.1. Aerobic digesters (or composters) produce compost, carbon dioxide and water vapour.

4.3.2. Aerobic digesters can very quickly turn food waste into compost. If food waste is put through a dewaterer (dehydrating unit) first then this makes digesting even faster. The commercial versions of these machines are used by hotels, mining companies etc that want to reduce the cost of sending food waste to landfill.

4.3.3. Some units, such as the domestic scale CLO'ey or commercial scale The Rocket have a relatively high energy requirement. Because of this Charles Ling of University of South Australia states that their carbon footprint is similar to the waste being sent directly to landfill (his estimate is that they produce 700kg carbon dioxide per tonne of food waste.)

4.3.4. Some units, such as the variously sized OSCA digesters made in Australia claim to have very low energy requirements and can turn waste into high quality compost in two weeks continuously. There is at least one OSCA unit that is powered by solar panels. Charles Ling says OSCA is a very good system with a carbon footprint of about 70kg carbon dioxide per tonne of food waste.

4.3.5. OSCA claims to have very low maintenance requirements because their units are very robust and designed not to fail.

4.3.6. Most manufacturers claim the compost produced is 'high quality' or 'useful'.

4.3.7. Manufacturers claim their machines are easy to use.

4.3.8. There is a range of other equipment that might be required in association with an aerobic digester. Apart from a dewatering hydrator, this equipment is the same as for an anaerobic digester and is discussed below.

4.3.9. A 0.6 cubic metre/day capacity OSCA II system would cost around $100,000 plus freight and installation.

4.4. Anaerobic Digesters:

4.4.1. Anaerobic biodigesters produce carbon dioxide, methane and fertilizer (liquid and or semi-solid) of varying quality. The methane can be burned for heating or can be used to power a gas generator than can produce electricity.

4.4.2. Commercial anaerobic digesters can be fairly low tech like the Biobowser (simply put, it's a bag in a hothouse) or very high tech such as the Active Research system installed at Federation Square for 3 years or the Gekko system recently installed near Ballarat to deal with manure from up to 500 pigs.

4.4.3. The small, low tech systems are relatively cheap to purchase. For example, a 5 cubic metre/day capacity Biobowser would cost less than $5,000 to purchase including a small motorised macerator, site preparation and transport. This system produces gas that can run, for example, a BBQ.

4.4.4. A larger Biobowser unit could run a gas-fired generator and produce electricity. Ron Lakin of Biobowser estimates the quantity of food waste and manure quantified through this project would require a unit costing between $500,000 and $1 million.

4.4.5. It seems that the low tech systems are used for relatively small amounts of waste, eg. up to 5 cubic metres/day.

4.4.6. High tech systems are relatively expensive to purchase. For example, Gekko Systems estimates a 5-10 cubic metre/day capacity unit with a gas-fired generator would cost between $100,000 and $300,000 installed. Active Research estimates a 5-7 cubic metre/day capacity system would cost between $200,000 and $300,000. These systems more effectively produce biogas which generates useable heat and/or electricity.

4.4.7. A 5 - 10 cubic metre/day capacity high tech digester is small and has poor economy of scale. For example, Active Research estimates that a 5-7 cubic metre/day capacity system would produce biogas at $7.10 per cubic metre whereas 'a large unit' can produce it at $0.60 cubic metre. Gekko says a 100 cubic metre unit is more viable than smaller capacity units.

4.4.8. Charles Ling states that well-sealed anaerobic systems produce between 0kg and 70kg carbon dioxide per tonne of food waste.

5. Quantify required mix of inputs to produce good to best quality compost – i.e coffee, food waste, carbon.

5.1. Responses from various informants regarding various digesters are:

5.1.1. Gekko anaerobic digester: Manure and food are good and will produce high quality liquid and solid fertilizers. Sawdust (eg. available from Warrnambool saleyards) is hard to break down.

5.1.2. Active Research anaerobic digester: encourages a focus on gas production rather than compost because "there is so much compost [in Melbourne] you can't give it away". Various food wastes and other feedstock produce various amounts of biogas: Manure - 25-30 m3 gas/tonne; Fruit & Veg - 100 m3 gas/tonne; Bakery - 250-300 m3 gas/tonne; Fat & Grease - 850-900 m3 gas/tonne; Glycerol (a by-product of making bio-diesel and other processes) - 1,000 m3 gas/tonne.

5.1.3. Inoplex Pty Ltd anaerobic digester: "the food wastes [quantified through this project] look a robust combination ... and with the manure should make up a nice project." "The digester discharge can be used as a slurry with water and broken down solids, which is potentially an excellent soil conditioner (fertiliser)." This can also be separated into liquid and solid streams, with less than 1m3 solid soil conditioner produced per day (after most of the waste has been turned into biogas).

5.1.4. Biobowser anaerobic digester: Based on the available wastes identified through this project, we "have a great mix of feedstock for bio digestion". Quality of digestate (slurry) not described.

5.1.5. OSCA aerobic digesters: OSCA processes organic waste streams including food waste (food preparation waste, plate scrapings, bones, seafood, etc.), agricultural waste, compostable packaging, paper and cardboard, manure, and green waste. OSCA can produce a high quality, safe and immediately usable compost within 10 - 14 days. Probably requires 1:1 ratio food waste to carbon. Oils may not be a good feedstock.

5.1.6. Hotrot aerobic digester: No oils in feedstock. 1:1 ration food waste to carbon. Produces a highly stable and useable compost.

6. **Quantify estimated biodigester compost output in terms of quality, quantity and potential value, including whether compost could be wholesaled or retailed.**

6.1. If compost production is the goal, aerobic digesters potentially produce higher quality compost than anaerobic digesters, if they are fed the right mix of feedstock.

6.2. The aerobic composting process reduces feedstock by between about 50% to 90%, depending on the system with the remaining percentage being either immediately useable or soon useable compost.

6.3. Aerobic digesters produce either a slurry or separated liquid and solid products that can be used as soil conditioners (fertilizer). Some systems use some of the liquid produced to help the next batch of feedstock compost faster.

6.4. David Halliday of Active Research says "the market [Melbourne] is flooded with cheap, poor quality compost".

6.5. Based on the OSCA II aerobic system which produces 30% to 50% compost per volume of feedstock, this 4 m3 digester would produce 1.3 m3 to 2 m3 of compost per week. The company states this is high quality compost.

6.6. Based on information from Biobowser, its 5 m3 system would produce about 1000 litres of liquid fertilizer per week, with quality unknown.

6.7. Inoplex states that feedstock of about 1 tonne of food waste and about 3 tonne of manure per day (as is available to our project) would be transformed 80% into biogas, leaving 20% as either a slurry or, if separated, into liquid fertiliser (approximately 5 m3 per day) and solid fertiliser (approximately 0.8 m3 per day), with quality unknown.

6.8. Bells Landscaping retails compost for $70 / m3 and at the same rate up to at least ten m3. Camperdown Compost Company sells compost for $30 / m3. If Warrnambool Community Garden had an OSCA II digester producing 2 m3 per week and selling it at, say, $50 / m3 this would gross about $100 per week. Potentially an arrangement could be made with a or some landscape gardening business/es to supply them with compost. Retailing would probably require bagging the compost into smaller quantities.

7. Quantify estimated greenhouse gas savings from redirecting food waste from landfill to the biodigester.

7.1. 5.65 tonnes of food waste per week were identified through this project, excluding used cooking oils that typically (but not always) are recycled. According to Watch My Waste (an RMIT research website) this equates to 10,735 kg GHG emissions if sent to landfill, or the equivalent electricity use for an average household for 958 days or 2.63 years. If 5.65 tonnes of food waste were diverted from landfill every week for a year, this would equate to the amount of electricity required for about 136 households. See the attached data sheet: Biodigester Feedstock.

7.2. 5.65 tonnes of food waste identified through this project is not all the food waste produced in Warrnambool. It should be possible to estimate Warrnambool's total retail / commercial food waste by extrapolating for this project's findings.

8. Consult with WCG senior members and employees to ascertain possible locations at WCG for a biodigester.

8.1. Discussions were held and the most feasible locations for a large (ie. 10-12 m3 capacity) biodigester were thought to be either in the south-east corner utility area or adjacent to this area to the south, outside WCG's boundary fence.

8.2. Subsequent discussions relating to a grant application submitted for a multifaceted food waste composting project that would include a small (ie. up to 5 m3 capacity) biodigester have left open the location of it and other composting systems.

9. Estimate hours required to manage the 2-year project, including overall project management from commencement.

9.1. A project budget for a 2-year multi-faceted composting demonstration site, including a small biodigester, was prepared as part of a funding submission to the Virtual Centre for Climate Change Innovation (VCCCI) within DELWP.

10. Produce operating budgets for during and after the trial period.

10.1.1. This was not deemed necessary due to the change in focus from a large biodigester to a smaller digester as part of a multi-faceted composting demonstration site.

11. Explore governance & management of the project under WCG current governance and management structure.

11.1. This was not deemed necessary at this stage.

12. Explore what needs to be in an MOU between partners/businesses and WCG.

12.1. MOU's would need to include agreement on the following matters:

- Approximate volume of food waste to be collected per collection
- Collection days and times
- Type and size of bins / containers to be collected
- Replacement bins for those collected, including cleanliness
- Fee payable (if any) per volume or bin / container
- Staff training to be provided
- Assistance with redesigning waste management systems and facilities if required
- Reporting (eg. providing businesses with a periodical report of the GHG emissions they have avoided)
- Duration of MOU
- Dispute resolution procedures
- Other as determined

13. Produce a report on the above with recommendations

13.1. The project found that purchasing a biodigester (aerobic or anaerobic) of sufficient size to digest identified food waste would be relatively expensive: somewhere between $100,000 to $1million. A range of $300,000 to $450,000 was fairly commonly stated for anaerobic digesters.

13.2. Some digesters have a high energy requirement making their carbon footprint similar to sending the waste they use directly to landfill

13.3. Selling electricity to the grid generated from gas produced by an anaerobic digester fuelled by waste identified in this project could earn $5,824 per year.

13.4. Selling high quality compost from an aerobic digester may earn up to $5,000 per year if there was a reliable wholesale purchaser.

13.5. The potential income that might be earned from biodigester products would not be sufficient to pay for collecting food waste (2 hours minimum per day), operating the digester (1-2 hours estimated per day), selling compost (unknown), management including business relationships (unknown) and conducting repairs and maintenance (unknown but more with an anaerobic system including a generator than with an aerobic system).

13.6. While anaerobic digestate (the end waste product) is useful fertiliser, good aerobic systems can produce high quality compost.

13.7. Financially viable biodigesters operating in Australia are much larger than one Warrnambool Community Garden could accommodate or manage.

13.8. A smaller biodigester is likely to face less, or no, planning issues than a larger biodigester.

13.9. Warrnambool Community Garden could site and manage a small biodigester and run a trial food waste collection and recycling project if sufficient funding was found. An application to VCCCI for funds to do this, as well as demonstrate other composting techniques, was submitted during the course of this project.

JUNE 8 2016 - 8:34AM

More details on how fruit and vegetable waste is being converted to power

- **Murray Trembath**
  Local News
- FACEBOOK SHARE
- TWITTER TWEET
- EMAIL

Innovative project: The 100 kilolitre tank used in the process. Picture: John Veage

This is the 100-kilolitre, purpose-built holding tank being used in an innovative project to convert fruit and vegetable waste from Sutherland Shire shops into power.

Leader readers asked for more information about the process following our recent report on the trial of the scheme.

See over:

BIODIGESTER FEEDSTOCK IN LITRES THAT IS AVAILABLE, ACCESSIBLE & IN REASONABLE QUANTITIES PER WEEK, inc Biogas Yields and GHG avoided