Castlemaine waste to energy precinct

Pre-feasibility Study

September 2015

MASG COMMUNITY RENEWABLES

MOUNT ALEXANDER SUSTAINABILITY GROUP INC

Acknowledgements

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- Project Funders
- Mount Alexander Shire Council
- Coliban Water
- Local business in the industrial precinct and across the town
- Melton/Surbiton WWTP site
- Yarra Valley Water
- MASG membership and wider community
- ECO2Sys
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- Waste collection groups including: Vatmi, Transpacific Greenaway, Bins Direct, Suez

Disclaimer. This report has been prepared to meet the goals outlined in the MASG Scoping Document –'*Scoping Document for First Cut/High Level Review – Bio Energy Opportunity Precinct 2'.* This report does not constitute financial advice, nor should it be seen as suggesting the financial or operational feasibility of any pilot or larger projects.

Incomplete Data. This report has been compiled with data that contains high level estimates and verbal price indications. Costs for plant and equipment used in any simple payback period are gross estimates only.

Caution: During the research phase of this report a combination of industry feedback and evidence of problems with operating bio-digesters, indicates that operation of such plant and equipment can be complex. In particular problems appear to be around the vulnerability of bacteria coming into contact with mixed or harmful components in the waste streams. The author recommends engagement of appropriately qualified experts during subsequent feasibility studies particularly into studies into bio-digester projects.

Assumptions: Through the report the prices for gas and electricity produced from options 1 to 3 have been valued at a fixed price with no allowance for CPI or predicted gas or electricity price rises.

Document Revision Control

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22nd June 2015	Initial draft for review and in-house release	V0.008
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1 Executive Summary

Intent

Early in 2015, MASG received philanthropic funding for a high level study (pre-feasibility) to investigate the potential of waste to energy projects in the Castlemaine township, focusing on the industrial zone at the southern end of the town (Precinct 2). The project goals were to identify and map waste streams, assess current energy use profiles, and propose opportunities most likely to provide a reliable, viable and commercially attractive outcome.

This initial report will be used to determine which if any opportunities could be taken to the next stage with a more detailed feasibility study.

An exhaustive process was required to gather the information from the organisations involved in the respective waste streams. These included but were not limited to the council (landfill site), local water authority (waste water treatment plant) and local industry (generators of waste). In addition, high energy users from local industry were identified.

How much energy could we produce from the waste?

Four distinct waste streams provide the opportunity for conversion to energy, as shown below, reflecting current waste streams and two future scenarios (five and ten year projections).

Waste type *[e - Electrical energy value]	**2015 (current)**	**2020**	**2025**
Sewer and FOG[1] waste [up to 500kWe]	No energy or outputs from waste apart from 45t of active soil conditioner.	Bio-digester, generates up to 500kW of electricity. Improved soil conditioner	Ongoing improvements, increase value of soil conditioner. Investigate other bi-product schemes
Landfill gas waste [~100kWe]	Not captured	Capture LF gas, generate heat and electricity for local use	Use electricity and heat on site for other waste processing
Green and Woody waste [~100kWe]	Used as landfill phytocap and general soil layer	Sort waste and make compost, bio-char, and woodchips for heating fuel	On going improvements, investigate adding wood pellet manufacture and agriculture waste
Municipal waste, demolition waste	Going to landfill	Halve waste, increase recycling. Investigate options	No waste to landfill. Install waste processing and waste to energy plant or leached-bed plant

If we extracted the energy from: our sewage, the waste that goes to landfill and our landfill emissions, it would provide around 1,620 GJ of energy per week, which is equivalent to approximately 2.5 MW of combined heat and electrical generation capacity.

This is around ten times the energy used each week at the industrial precinct near the landfill and waste water treatment plant. Or to look at it another way, all of this waste could provide continuous generation

[1] FOG – Fats Oils Grease

capacity of up to 1.5 MW of heat and up to 1MW of electricity. 1MW of electricity generation is enough to power around 400 homes[2].

Moving to Zero Net Emissions within 10 years?

Many communities around Australia[3] and internationally[4] are implementing their vision to move to 100% renewable energy (RE) within 10 or 15 years. MASG's membership have a vision to move to zero net emissions with 10 years (by 2025), and through community activities are seeking to extend this vision across our wider community.

Initial estimates propose that for our town to move towards 100% renewable energy, we would need ~20MW of local generation (a large share being required by one major industry facility). The renewable energy could be sourced from a combination of bio-fuels, wind, solar and hydro power, starting with the conversion of readily available waste streams to energy, and draw on off-sets from bio-sequestration (soil carbon and trees) or green power.

Avoided greenhouse emissions from RE projects at Precinct 2

Based on the estimates for CO2e avoided through the proposed renewable energy projects, which indicated that for every 100kWe of renewable energy generation, 850 tonnes[5] of greenhouse gas is avoided per year (using 2014 National Greenhouse Account Factors: Vic ave. 1.18kg/kWh). Hence for the two major project options (bio-digester @ 500kWe and landfill gas @ 100kWe) a total of 5,095 tonnes of CO2e emissions could be avoided per year.

How much waste does our town generate?

Each week our town generates some waste that is recycled and some waste that goes to land fill. The weekly recycled streams include:

- 100 t (tonnes) of curb-side recycling from homes and businesses,
- 1 t of food waste from businesses,
- 20 ML of sewage that is treated and the water returned to the environment, and the sludge is used as soil conditioner on local farms.

Waste going to landfill each week includes 80 to 100t from domestic, commercial, demolition and industrial sources, plus 24t of green and woody waste.

What 'waste-to-energy' technologies do we need, and what are the economics?

There are many technology options to convert waste to energy. Selecting the most suitable ones depends on factors such as:

- Matching supply with demand,

[2] http://environmentvictoria.org.au/content/energy-efficiency
[3] ZNET – Uralla http://z-net.org.au/ Yackandandah, Newstead, http://totallyrenewableyack.org.au/ Lismore, Coffs Harbour
[4] Germany Feldheim, Wildpoldsried USA Burlington, Rock Port Missouri, UK Isle of Eigg
[5] For each 100kWe of RE generation (or 720 MWh pa, using conservative 20hrs/day 360d/y) and using 1.18kg/kWh, this equates to 849 tonnes of avoided Co2e emissions

- Type and volume of waste,
- End use requirements,
- Environmental regulations,
- Investment appetite and
- Social licence to adopt new technologies.

In some cases, projects may be more commercially attractive when energy is generated and used on site, particularly where multi-product revenue streams are achievable. This is because:

- Electrical energy can have high commercial value when used on site ('behind-the-meter'), rather than sold into the grid at a lower price,
- Gas and heat are valuable forms of energy and both can be used on site, avoiding transport costs,
- The economics of a project can be substantially enhanced by the avoidance of alternative disposal costs of feed-stock or waste streams, through energy recovery.

Project options

Three meritorious projects have been identified in order of priority, with each worthy of further evaluation:

1. **Bio-digester**

   Located at or beside the Waste Water Treatment Plant (WWTP) a new bio-digester and would replace the current solids processing component of the WWTP.

   > *A bio-digester or digester is an airtight chamber in which anaerobic digestion of manure, bio-solids, food waste, other organic wastewater streams or a combination of these feed-stocks occurs. This process produces commodities such as biogas (a blend of methane and carbon dioxide), and fertilisers*[6]

   Additional waste input streams could include Fats, Oils & Grease (FOG) from grease traps, abattoir and meat waste. It is estimated that the system could generate up to 500kW of electricity, and heat that can be used to warm the digestion process or for other uses at the WWTP. Simple Payback calculations (not an IRR calculation) would be dependent on many factors such as cost of capital equipment (capex), operational expenditure (opex), revenue streams that may include gate fees, creation of Large Generation Certificates (LGCs), off-setting the cost of electricity and sale of excess electricity to the grid.

2. **Landfill gas**

   In the near future, landfill gas extraction infrastructure will need to be installed at the landfill. The size of our landfill is potentially too small to be commercially viable for a third party such as Land Fill Management System (LMS) to install generation equipment and sell the electricity to the grid, so instead the gas would be flared. If the gas could be piped to a neighbouring site such as the WWTP, and a use for the electricity or heat found, then there may be a business case. Initial estimates are that there may be enough gas for a 100kW generator to operate continually. Alternatively if a use for the heat and or electricity at the landfill site, such as for the wood chipping plant or a future waste sorting facility, then this may support a viable business case as well as assist the other on site operations.

[6] American Bio Gas Council – Primer on bio-digesters

3. **Wood chips and bio-char from our wood waste**

   The landfill receives around 1,200 tonnes a year (or 12t/wk) of timber and woody waste. This is currently chipped and goes onto capping at the landfill. This waste stream could be processed for a combination of wood chips and bio-char and the waste heat used in another process.

Two other projects have been put forward as secondary options to review in more detail later:

- Bio Gas generation from the woody waste, and
- High Temperature or Leach Bed conversion of 80t/wk of municipal landfill waste.

Are all the options practical, or do they compete with each other?

With limited 'on-site' demand compared to size of waste streams, some options could compete with others to supply existing energy used on site. An example of this would be if the landfill gas was piped to the WWTP for electricity generation, that may then reduce the viability of the bio-digester because there will no longer be a demand for electricity on site.

Attracting new business to the industrial park may be a potential opportunity to utilise some of the large amount of heat that can be generated directly on site either as a bi-product from the electricity generation or direct combustion. Cheap heat is an attractor for new industry and could been seen by council to be a strategic value for boosting local economic development. Alternatively, the electricity can be exported to the local grid, or wood chips or wood pellets[7] could be manufactured and used around the town for heating in winter. There are many uses for cheap heat.

What's the background detail on these high level estimates?

Without further detailed analysis, scoping studies or being able to supply any detail to equipment suppliers, indicative pricing and estimates are the best that can be provided at this stage.

The next stage, a full feasibility study, would include examining selected options in more detail, inviting suppliers to site, and undertaking a more detailed market analysis for the energy outputs. This will in turn provide more detailed financial and market information so estimates can be firmed up.

Recommendation

With indicative payback periods from 1.5 to 9 years (for estimated capex of $500k - $7,000k, refer Section 5), the MASG project team recommends that the findings of this pre-feasibility study be considered as a basis for attracting further funding support to undertake a detailed feasibility study for both the bio-digester and landfill gas to energy projects.

[7] Initial discussions indicate that the viability of wood-pellet production may be considered marginal until there is a larger customer base.