Maine's Power Stage 2 Report: Options Development

EXECUTIVE SUMMARY

This report presents details relating to Stage 2 of the Maine's Power project, and describes various options for four major facilities in the town to reduce their greenhouse gas (GHG) emissions and improve reliability of their energy supply. To preserve confidentiality, these facilities are referred to as Sites 1 to 4. The information presented in this report builds on the baseline developed in Stage 1, and presents a detailed scoping of various energy options, including energy efficiency, demand management and distributed generation options using both renewable and non-renewable sources.

For energy efficiency improvements in each facility, the savings available depend on the likely future prices of both electricity and natural gas. High-case and low-case scenarios of future price rises are modelled, and annual cost savings are reported for each facility under each price scenario. The largest GHG savings are achieved for reductions in electricity use, due to its higher GHG emission intensity when compared to natural gas. In combination, the four businesses would save around 4,300 tonnes of GHG emissions per year for each 5% improvement in energy efficiency for both natural gas and electricity.

Demand management options can result in reduced energy costs, but in general do not have a large impact on GHG emissions. Detailed demand management approaches for the four facilities in Castlemaine cannot be provided with the information that is currently available. Identification of feasible demand management options will depend on outcomes of the pending energy audits at each site, and on the potential use of cogeneration in one or more of the sites.

Distributed generation options involving renewable sources include solar thermal preheating for boilers at Sites 3 and 4, solar photovoltaic systems and wind energy systems for electricity at all sites, a micro-hydro system at Site 2, and plasma arc and biogas production from waste at Site 1 and from residential waste in Castlemaine. Distributed generation options based on non-renewable energy include cogeneration at Sites 1 and 3, trigeneration at Sites 1 and 4, and conversion of diesel generators to natural gas at Site 4.

The solar resource (sunshine hours and average solar radiation levels) in the Castlemaine region is fairly poor compared to other areas in Australia, and in combination with the relatively high prices of current solar technologies, this means that solar options are not particularly economically attractive. <u>Solar photovoltatics</u> could be used at each site, and they represent a replacement of high-emission electricity, and so are relatively attractive in terms of emission reductions.

<u>Solar thermal</u> technologies could be used at Sites 3 and 4 to supplement or replace gas-fired boilers. However, since this technology involves replacement of relatively low-emission natural gas, these options are not particularly attractive in terms of emission reductions. Flat panel solar collectors are relatively inexpensive, but are too inefficient to have a large impact on the natural gas consumed by boilers. Parabolic trough collectors are more efficient and

would have a larger impact on the amount of natural gas consumed, but are much more expensive and require large amounts of land area.

There is insufficient data available to judge the level of wind resource available in the Castlemaine region. Initial estimates of wind-powered systems are based on data from Bendigo airport, which is the nearest point with high-quality data available. Two wind systems are evaluated, a series of small turbines and a single large turbine. Neither of these systems appears attractive in terms of economic evaluation, but they do provide substantial emission reductions. A more specific evaluation of wind-powered systems may well prove more attractive, both for economics and emission reductions, if a specific windy site in Castlemaine can be identified.

A micro hydro-electric option for Site 2 has been examined superficially. Since pump testing at the site involves high levels of energy consumption, it is possible to envisage a system that re-captures some of this energy, by using the tested pumps to deliver water into a turbine to regenerate electricity. However, initial indications are that such a system would be cost prohibitive and would produce only a minimal amount of reclaimed energy.

Treatment of waste at Site 1, along with residential waste from Castlemaine, is examined superficially with reference to both plasma arc and biogas generation technologies. Plasma arc technology is probably insufficiently developed in Australia to consider for use in Castlemaine. Biogas production from waste does represent an attractive emission reduction outcome, but we have insufficient detail to make a formal economic evaluation.

None of the renewable energy options include income from Renewable Energy Certificates (RECs) in their economic evaluations. This is because the future value of RECs is difficult to estimate, and it is unclear whether RECs will continue to exist after the introduction of emissions trading under the government's proposed Carbon Pollution Reduction Scheme. If RECs were incorporated into the economic evaluations, these renewable energy options would become only slightly more attractive economically.

Trigeneration involves the production of heat, electricity and cooling from a single source. This option has been examined superficially for Site 1 and Site 4, but initial judgements suggest that it is unsuitable for either site, since the ratios of required power, heating, and cooling are not a good match for trigeneration output. In addition, the cooling performance of trigeneration refrigeration units is quite poor compared to conventional electric-powered units.

Cogeneration involves the production of heat and electricity from a single source (in this case natural gas). Cogeneration could be owned and run by the business, or it could be leased from a third party (an energy retailer or a cogeneration supplier). Cogeneration for Site 1 has been examined in depth, and yields a positive economic evaluation and emission reduction outcome. Cogeneration for Site 2 has not been examined, since there is no demand for waste heat at that facility and initial indications are that transferring heat between sites is not viable. Cogeneration for Site 3 has been examined in depth, and again yields a positive economic evaluation and emission reductions.

Conversion of diesel generators to natural gas at Site 4 has been examined superficially, with initial indications that it would involve a high capital outlay and would not produce substantial emission reductions.

Where sufficient detail is available, these options are summarised in the tables below, showing the relative costs of generating electricity and comparative discounted payback periods.

Table 1: Cost of generating energy for various options (c/kWh)

Technology	Site 1	Site 2	Site 3	Site 4
CHP Cogeneration	5.32 - 9.47	N/A	6.87 – 9.01	N/A
Solar Thermal	N/A	N/A	2.48[a]	6.13[b]
Wind (large)	25.0			
Wind (small)	57.0			
Solar PV	23.6			

[a]parabolic trough collector; [b]flat plate collector

With regard to electricity generation options, Table 1 shows that natural gas CHP at Sites 1 and 3 is competitive with current prices for grid-delivered electricity, and becomes more attractive over time. In contrast, current high capital costs and poor resource availability make the renewable options considerably more expensive. This is reflected in much longer payback periods for these options, as shown in Table 2.

Table 2: Discounted payback for various options (years)

Technology	Site 1	Site 2	Site 3	Site 4
CHP Cogeneration	2.8 – 6.8	N/A	1.5 – 2.5	N/A
Solar Thermal	N/A	N/A	22.9 – 28.3[a]	53.0 – 64.0[b]
Wind (large)	17.4 – 26.5			
Wind (small)	29.3 – 45.0			
Solar PV	18.4 – 27.7			

[a]parabolic trough collector; [b]flat plate collector