CASE STUDY

Melbourne Water Werribee Biogas facility

Werribee, Victoria

Host: Melbourne Water
Owner: AGL
Capacity: 3.8 MW
Location: Werribee Sewage Treatment Plant about 30 kms south-west of Melbourne
Operational: June 2001
Operator: AGL Energy Services
Power purchase arrangements: 100% to Melbourne Water
Manufacturer: Duetz
Packager: SE Power Equipment
Construction contractors: AGL Energy Services
Primary fuel: Biogas from anaerobic digestion of sewage sludge
Supplementary fuel: None

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WASTEWATER BIOGAS

Sewage wastewater can either be processed aerobically (in the presence of oxygen) or anaerobically (oxygen excluded). The anaerobic process produces methane, which in this project is collected and used to generate renewable power. If not collected and used for power production the methane would either be flared or vented to atmosphere with adverse environmental impacts.

WERRIBEE SEWAGE PLANT

The Werribee Sewage Plant has been transformed from an open lagoon treatment plant to an anaerobic plant. Portions of the lagoon receiving raw sewage wastewater are covered, oxygen is excluded, an anaerobic reaction is produced and methane is generated. In 1995 two 0.63 MW engines were installed. AGL has now installed two additional 1.25 MW reciprocating engine generating sets. Sections of the lagoons remain uncovered and pumps agitate these sections to introduce oxygen, further processing the wastewater, which is eventually discharged into Port Phillip Bay. The plant treats about 500mL of sewage per day.

POWER GENERATION AND SALES

There are two power supplies to the site, and each generator is connected to an incoming supply.

Power is generated at 415 volt and stepped up to 22,000 volts for connection to the Powercor distribution network. The power plant operates in base load mode and all power is sold to Melbourne Water.

GAS RETICULATION

The site is large, and extensive reticulation was required to deliver gas to the generating plant. Blowers are used to deliver the biogas at a low positive pressure. AGL has been responsible for the total site development and control of gas delivery to the plant.

SITE

The power generators are containerised and the gas processing plant including scrubbers and gas conditioning are contained in a central compound.

ENVIRONMENTAL IMPACT

At full capacity, Werribee produces around 25,000 MWh of green electricity per annum, which reduces greenhouse gas emissions by 20,000 tonnes per annum. In addition the capture of methane significantly reduces odours from the site familiar to Melbourne-to-Geelong travellers.

2.3 Waste-to-energy applications

Wastes have a diversity of physical and chemical properties and therefore a waste bioenergy resource needs to be matched with the appropriate energy conversion technology. For example, landfill gas projects will utilise reciprocating gas engines that are capable of being installed in a modular form and can accommodate some fluctuation in fuel quality. The waste materials covered in this Guide range from dry agricultural residues through to wet wastes, and the various urban wastes. The settings, scale of plants, energy conversion technologies and key participants will differ for each of these and consequently so will the viability parameters of different projects and the economic considerations and implications.

When talking about waste-to-energy applications, it is common to refer to a primary energy conversion process, an energy carrier and secondary energy conversion.

The Australian Business Council for Sustainable Energy has identified one hundred and two waste-to-energy projects that were operating in Australia at the end of 2004, with a total capacity of 917 MW. Of these, 115 MW can be classified as renewable waste-to-energy, 473 MW as renewable waste-to-energy cogeneration, 172 MW as fossil fuel waste-to-energy and 156 MW as fossil fuel waste-to-energy cogeneration. Details of renewable waste-to-energy projects are presented in Appendix 2.

Primary energy conversion of wastes of high calorific value generally occurs via one of combustion, gasification or pyrolysis. These are all thermal conversion processes, with the essential difference being the amount of atmospheric oxygen used in the process. The biochemical processes of fermentation and anaerobic digestion are generally chosen for primary energy conversion of wetter waste or mixed waste streams. These two processes utilise naturally occurring microbes and biochemical pathways to convert waste into energy carriers such as methane-rich biogas and ethanol. Refer to Section 4: Waste-to-energy technologies for more detailed information.

The energy carrier (steam, gasified waste, biogas, pyrolysis bio-oil) produced during the primary waste conversion process of combustion, gasification, pyrolysis, anaerobic digestion or fermentation is required to be converted into a usable form of energy, such as electricity and/or process heat, in a secondary energy conversion step. There are several mature and emerging secondary energy technologies.

Wastes such as vegetable oil and tallow may be converted via esterification to biodiesel, which in turn may be used as a transport or stationary energy fuel. Similarly ethanol may be used as a fuel or as a fuel additive.