Bakers Research Note

Biogas Projects in Australia: Commercial Applications and Preliminary Project Risk Assessment

By Joseph Doan

Introduction

Biogas is a mixture of carbon dioxide and methane, generated when the biological material in organic waste is degraded by bacteria in the non-oxygen environment. This process is known as anaerobic digestion. Since biogas is produced from the waste treatment process where methane is captured and burnt, it is considered as a source of renewable energy.

Worldwide, biogas technology (also known as methane capture technology) has been extensively deployed. In Europe, Germany is the largest biogas producer. By the end of 2007, over 3,700 agricultural biogas plants were in operation, producing a total capacity of 1,270 MW of electricity. In countries such as Switzerland, Germany and Sweden, the methane in biogas is concentrated in order for it to be used as a vehicle transportation fuel[1]. Presently, projects from anaerobic digestion in the developing world can gain financial support through the United Nations Clean Development Mechanism. [2]

There are four basic design choices of biogas plant: Covered Lagoon Digester, Complete Mix Digester, Plug-Flow Digester, and Temperature-phased Anaerobic Digesters. The choice of biogas designs depends on the organic solid content of waste stream. As innovations in the area continue, more design choices will be available. For example, Spectrum Renewable Energy Ltd is building its BioBowser – a packaged modular biogas plant to manage small waste stream. The technology is currently undergoing industry trials. [3]

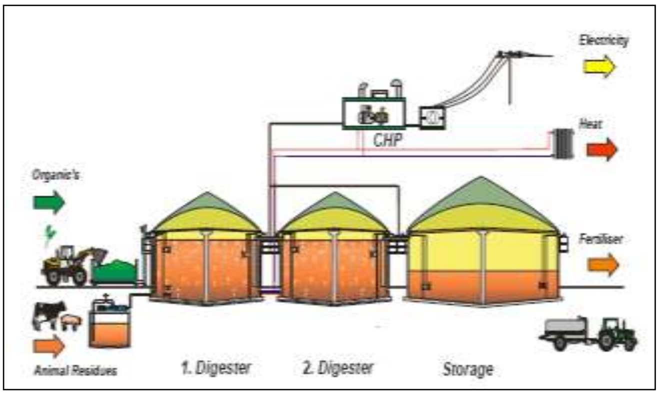

Figure 1: Schematic illustration of a biogas system Source: Biogas Nord

There are three usages for the biogas generated. The easiest and most economic way to utilize biogas is for direct burning applications in the premise, since investment costs is normally very low but energetic efficiency is very high. It is especially useful that the composition of natural gas and biogas are practically identical, so the existing natural gas burners can still be utilized when the biogas plant is in place. Another direct application is to convert biogas into heat and electricity to be used onsite. This can be accomplished with CHP (Combined Heat and Power station). Alternatively, the most common way to commercialize biogas is to convert it into electricity to feed to the grid.[4] The third option is to convert biogas to compressed natural gas (CNG) for transportation.

[1] http://www.nfuonline.com/x33964.xml
[2] http://cdm.unfccc.int/about/index.html
[3] SREL Company Presentation, Australian National Carbon Conference 2009
[4] http://www.environmental-expert.com/resultEachPressRelease.aspx?cid=28518&codi=31828

Biogas Projects in Australia

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The section below will discuss the current status and potential of commercial applications of biogas in Australia. Then, a framework for risk assessment of biogas projects with issues relevant to the case of Australia.

Commercial Applications of Biogas in Australia

Although biogas technology can be deployed with feedstock from any organic waste streams, it appears that, in Australia, major area of potential deployment is within the agriculture industry. The industry, as reported in the National Green House Gas Inventory, accounts for 16.3 percent of national inventory emissions in 2007[5]. There are particular regions in Australia that are highly populated with intensive livestock industries. These regions are Murray-darling region, South-East Queensland and Central Queensland, North of Adelaide, Southern New South Wales, Northern Tasmania and Hunter Valley[6]. Figure 2 illustrate the insensitivity of feedlots locations in Australia in those areas.

Methane recovery from animal waste is currently not widely practiced in Australia, mainly due to the large capital costs involved. At feedlots, solid cattle manure is usually composted in open air facilities, and sold as fertiliser. Waste from pig and dairy farms is typically kept in lagoon.

At the moment, the development of biogas industry in Australia is still in infancy. The only operating biogas plant at commercial scale in agricultural industry is at Berrybank Farm Piggery. The farm produces a daily average of 275 000 litres of sewage effluent with an organic solids content of approximately 2%. Using two-stage anaerobic digestion system, the pig effluent is transformed into odourless liquid fertiliser and methane gas which is converted in to low-voltage electricity. The farm utilises about 90% of electricity for on-farm activities and sells the remainder to the state grid[7].

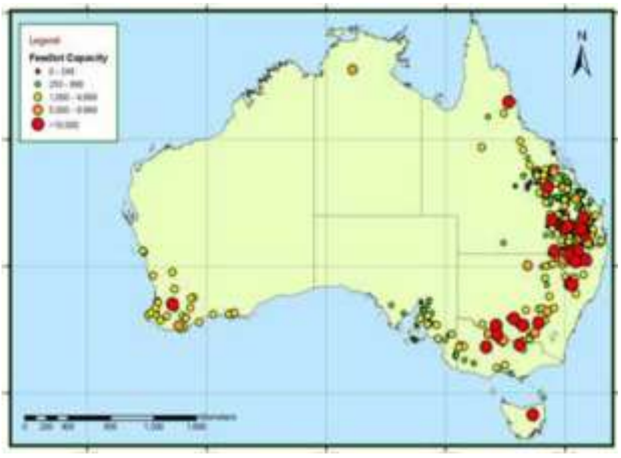

Figure 2: Location of feedlots in Australia
Source: ALFA

In North Victoria, Diamond Energy is the builder, owner and operator of two biogas assets in Shepparton and Tatura on Goulbourn Valley Water site. Each plant has a capacity of 1.1MW. To capture the waste water, the company apply the High Rate Anaerobic Lagoon technology[8]. Another anaerobic digestion biogas plant will also be deployed in South-Eastern Melbourne by Carbon Partners – a Szencorp Group company. It is claimed that the project has acquired relevant approvals and is “construction ready”[9].

Biogas Projects: A Preliminary Risk Assessment

Biogas Production Forecast

The first risk area lies in the reliability of biogas production forecast. Even with identical technology, the production potential can vary depending on various factors such as types of substrates and fermentation period. Due to the dynamics nature of

[5] http://www.climatechange.gov.au/inventory/2007/pubs/nggi_2007.pdf
[6] Assessment of methane capture and use from the intensive livestock industry, RIRDC Publication 2008
[7] http://adl.brs.gov.au/mapserv/biomass/factsheets/Atlas_007.pdf
[8] http://www.diamond-energy.com/projects.html
[9] http://www.warren.usyd.edu.au/bulletin/NO55/ed55art3.htm

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forecasting, sophisticated software are needed for this purpose. For example, in the United States, the AgSTAR Program, sponsored by relevant governmental agencies, has developed software called FarmWare to model gas production overtime[10]. In Australia, since there is no available software likes such, one alternative is to obtain expert's opinion on gas production potential for a specific project. Also, it is necessary to provide backup for fuel in case the biogas plants do not generate enough power during certain periods.

Construction risks

The second area of risk is construction of the biogas plants. To ensure that no additional costs are incurred and the project requires additional finance, it is normally expected by financier that fixed-price turn-key contracts are in place. Also, since delaying in construction affects the cash flow of the project, it is expected that there are monetary penalties for construction contractors for missing schedule. In addition, according to John Barker, corporate agribusiness manager at HSBC, the credentials of contractors must be examined carefully[11]. Project acceptance standard and warranties also need to be established. In Australia, Energen Solution was commissioned for the construction of The Tatura Biogas Power Station in 2007[12]. In the area of installation and maintenance for biogas system, Run Energy is one of the key players. [13]

Regulatory requirements

Third, the ability to successfully obtaining relevant authority permissions prior to financing a biogas project also represents a risk area. Due to various circumstances of possible biogas deployment and possible changes in legislations, it is advised that at the early stage of planning and construction, biogas plant developers should initiate conversation with local authorities where the plant will be located. However, the operation of the plant, it is regulated by State legislation. For example, in Queensland, the *Petroleum and Gas (Production and Safety) Act 2004* does stipulate that a major works authority be obtained and a Safety management plan be in place prior to commencement of operations at the plant.[14]

It should also be noted that different states may impose different level of regulation on a particular part of a biogas system, and this has important implication to the construction cost structure. Flaring system is one example. Biogas flares are used to safely burn biogas that is surplus to the demand of energy recovery plant. In Victoria, Energy Safe Victoria – a certifying authority has issued a draft Biogas flare system guideline. In New South Wales and Queensland, there are no defined requirements for biogas flares yet. However, as a minimum requirement, any biogas flaring systems, imported overseas or manufactured domestically, must comply with Australian Standard AS 1375 (Industrial Fuel Fired Appliances Code). In terms of cost, RIRDC (Rural Industries Research and Development Corporation) estimated that methane flaring system in Australia is up to ten times more expensive compared to ones in US due to environmental standards.[15] In case of converting biogas to electricity, it is estimated by GHD that power generation will cost approximately $1.5M/ installed MW.

Off-take agreements

[10] AgsStar Handbook, EPA US
[11] http://www.thebioenergysite.com/articles/215/banking-on-a-biogas-project
[12] http://ecogeneration.com.au/news/tatura_biogas_power_station/004335/
[13] http://www.invest.vic.gov.au/Assets/41/1/IV-RenewableEnergy-Sep06.pdf
[14] Petroleum and Gas Inspectorate, Safety and Health – Queensland Department of Employment, Economic Development and Innovation
[15] https://rirdc.infoservices.com.au/downloads/08-050.pdf

The fourth risk area relates to the certainty of revenue or cost savings generated by using or selling the energy output and fertiliser. Unless the generated energy and fertiliser are used onsite, off-take agreements are essential to make biogas projects bankable. If energy is used domestically either heat or electricity, a bankable biogas project should show how much of current energy consumption within the farms can be directly replaced by energy from biogas. While technically feasible, biogas-to-electricity assessment depends much on the infrastructure, the willingness of grid owner, and local legislation. To improve revenue certainty, contracts with local utility must be signed and debt payment schedule can be matched by terms in these contracts. It should be noted that electricity price varies significantly across Australia therefore plant location will affect the viability of biogas-to-electricity commercialisation. A successful case of biogas-to-electricity is the Diamond Energy with its ability to design the generation plants to generate and sell electricity into grid during times of peak demand. Thus, the company receives highest price for the electricity generated. Commercialisation of biogas-to-CNG only makes sense if a local market is available and a reasonable price can be achieved. At the moment, there is no record that the market or the price exists in Australia.

Financial Performance

Lastly, financial performance of biogas projects also represents an area of risk. Besides financial pro forma and general financial analysis, it is also essential to take into account any incentives or carbon credits the project might received. However, at the moment, there is no direct government support mechanism for biogas projects. While feed-in tariff for biogas is quite popular in Europe and USA, it is not available in Australia. Together with the high cost of installation, lacking of attractive feed-in tariff is deemed to be a reason of slow penetration of biogas technology into Australia. At the moment, it seems that most direct support schemes for biogas project have been closed. Indirect incentives for biogas investment in Australia includes the National Renewable Energy Target and States' RET schemes such as of Victoria and News South Wale. This may make it less attractive compared to other renewable energy sources which are eligible for grants and funding from the government.

Conclusion

Despite the widespread applications of biogas technology worldwide, Australia has a very limited portfolio of biogas projects. As the agricultural industry accounts for a large portion of national emission, there is significant potential for biogas plants, given its well-developed technology and proven results in other countries. In Australia, while there is no sign for the potential of biogas to CNG, past examples show that electricity generation from biogas is commercially viable. The major hurdle for applying the technology in Australia, from the author's view, is the matter of how to coordinate the biogas project seamlessly with all parties understand, are willing and able to mitigate the aforementioned risks.

For any questions regarding the research, please contact the author:

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