BIOGAS IN SOCIETY
A Case Story

PROFITABLE ON-FARM BIOGAS IN THE AUSTRALIAN PORK SECTOR

IEA Bioenergy Task 37

IEA Bioenergy: Task 37: February 2018

SUMMARY

Methane emissions from uncovered anaerobic ponds contribute about 60–80% of the total on-farm greenhouse gas emissions for Australian pork production. Capturing and using this methane as a source of heat and electricity on-farm improves environmental and business performance of the piggery.

Covered anaerobic ponds are the most common digester technology used to capture manure methane at Australian piggeries. These on-farm biogas production systems rely on offsetting on-farm energy costs (primarily electricity, LPG and diesel used for electricity generation) and selling surplus power to the grid for their basic financial viability. This ensures that the capital investment is met within the first decade of operation, regardless of possible changes in Government policy relating to carbon credit systems.

▲ **Figure 1:**
Covered pond at an Australian piggery

Figure 2: ►
Centrifugal fan-type blowers at Australian piggeries to pump biogas from a covered lagoon to a boiler, engine or flare

TECHNICAL OVERVIEW

It is common practice for Australia's pig producers to collect and treat effluent (primarily manure and waste feed) flushed from the sheds housing the pigs in anaerobic ponds. To capture methane, the ponds are usually covered with a high density polyethylene (HDPE) cover, which is trenched in around the crest of the pond embankment to form a gas-tight seal, (Figure 1). There are fewer mixed and heated digesters at piggeries in Australia. In contrast to heated/mixed digesters, the volume of biogas produced by covered ponds varies with seasonal temperature changes, but Australia has a reasonably temperate climate, so that in colder months the biogas produced is about 20% less than the average yearly flow, and during warmer months about 20% more than the average yearly flow.

A blower (Figure 2) is generally used to convey the biogas through sealed pipework (underground HDPE, PVC; above-ground stainless steel) to a generator engine or boiler. Australia has relevant standards that direct the zoning for electrical equipment in the vicinity of a biogas system. Importantly, biogas equipment described here usually operates at low pressure (<100kPa or 14.5Psi), including the covered pond where the pressure rarely exceeds 50 pascals (0.007Psi) even when visibly inflated.

Figure 3 summarises the equipment commonly used on Australian piggeries. Coarse solids in flushed piggery effluent, such as barley husks and pig hair, may be removed from the effluent stream with a solids screening step; this reduces accumulation of solids as a floating crust layer under the cover.

To protect engines or boilers, corrosive ingredients from the biogas are often removed before use. This is typically done by contacting the biogas with a solid cleaning-medium (Figure 4) containing iron oxide, which strips corrosive hydrogen sulphide (H_2S) from the biogas. Usually these cleaning systems use solid media that become spent with use and require replacement, contributing to the operating costs. More recently, biological oxidation in an external vessel has become more popular with piggery biogas installations, due to low operating cost and effectiveness in removing H_2S.

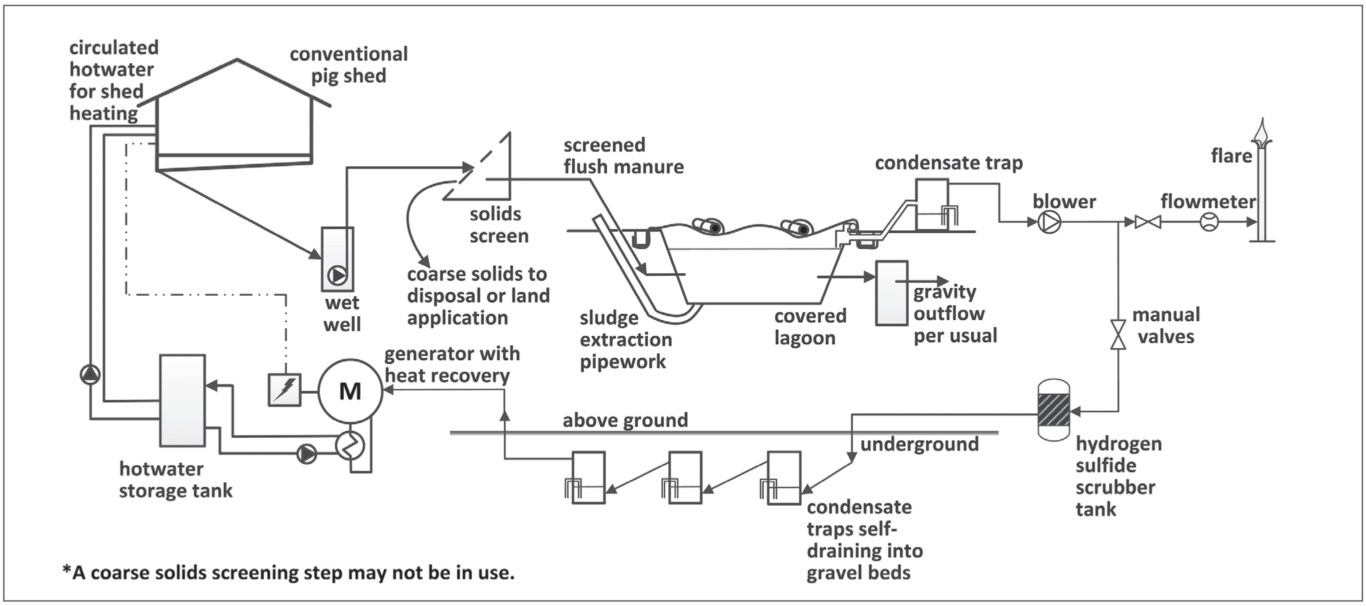

Figure 3: A schematic overview of a covered lagoon biogas set-up at a piggery

Where biogas is conveyed in long sections of underground pipework, cooling of the biogas to the soil temperature has also been used to condense moisture with the pipeline; this is laid at a gradient sufficient to allow drainage of the condensate to a collection point. Biogas is also chilled at some piggeries above-ground using chilled water before being sent underground (Figure 5).

▲ **Figure 5:** Equipment used to encourage condensation by cooling the biogas and for collecting the condensate that forms before the biogas enters underground pipework

▲ **Figure 4:** Biogas cleaning equipment

UTILISATION OF BIOGAS

Biogas is used at Australian piggeries to produce electricity with biogas-fired generators. The financial benefit in Australia is in displacing incurred electricity purchase more so than sale of electricity as electricity is sold back to the grid at a much lower price (as little as 2–3 AU cents per kWh) than that paid for electricity purchased from the grid.

To recover and use waste heat, biogas-fired engines at Australian piggeries are commonly fitted with heat exchangers on the engine cooling circuit. The waste heat is then recovered in the form of water at 70–80°C, which is used for under-floor heating in farrowing sheds, or for compartment heating in weaner sheds. This reduces or eliminates grid electricity, LPG or diesel generator power usage.

FINANCIAL BENEFITS

Direct on-site use of biogas energy provides the greatest financial benefit. This is clearly shown in Figure 6, which presents an estimated percentage breakdown of the financial benefits of piggery biogas (the relative $-value of savings or earnings).

There are currently two renewable energy initiatives, which have assisted pork producers to adopt biogas projects.

1. **The Emissions Reduction Fund (ERF)** has provided carbon credits, a tradeable financial product, which can be sold for income.
2. **Renewable Energy Certificates (RECs)** have been earnt and sold for producing renewable energy. Like carbon credits, the value of RECs has been and will continue to be subject to market conditions, but has typically paid for the operating and maintenance of the combined heat and power units.

Therefore, the economic feasibility of biogas projects is best assessed without initially considering the income from these sources.

Table 1 presents five feasibility studies for a variety of Australian piggeries. All of these prospective projects were found to be economically feasible at the time of the studies, with some showing short payback periods of 1.8–4.7 years, and all delivering a substantial positive return on investment over a 10 year project life.

Table 1: Results from five feasibility studies of various Australian piggeries

Piggery	– Standard Pig Units (SPU)*	Payback period (years)	10 year return on investment (%)	Total capital cost (AUD)
Multi-site farrow-to-finish	12,692	4.2	198	411,900
Grow-out unit	5,112	8.5	7	279,400
Sow multiplier	7,089	1.8	597	170,200
Farrow-to-finish	5,432	4.7	151	345,600
Farrow-to-finish	6,975	7.2	64	298,300

* A standard pig unit (SPU) has a waste output (volatile solids production) equivalent to a typical 40 kg (live weight) grower pig. Expressing piggery capacities in terms of SPUs provides a measure of the piggery waste production for various types of production units (e.g. breeder, grower and farrow to finish). For example, a typical 100-sow farrow-to-finish piggery has a capacity of about 1000 SPUs.

Source: Pork CRC http://porkcrc.com.au/wp-content/uploads/2013/08/4C-102-Final-Report-130420.pdf

FUTURE DEVELOPMENTS

There are about 20 piggeries in Australia, representing 14% of total Australian pork production, currently capturing and using biogas. Several additional piggeries are in the process of developing or constructing new biogas systems. By 2020, it is anticipated that 30% of total Australian pork production will be sourced from piggeries employing biogas systems. Future development may explore the upgrading and use of excess biogas into biomethane for vehicle fuel use or for transportation to third party end-users. Natural gas grids are not typically located in close vicinity to Australian piggeries. There has also been increasing interest to combine waste streams from a range of industry sectors, particularly in the last 5 years. Given Australia's vast agriculture and food processing sector, there is potential for the biogas generation to be centralised at a processing facility at regional towns and use a range of organic waste to power whole communities. However, there are a number of barriers, which need to be addressed for developments to be realised. These include relatively large distances between farms and processing plants, lack of consistent guidelines for digestate utilisation and fragmented supply chains. Recent projects, which focus on a range of livestock and food processing sectors have therefore focussed on waste mapping, aggregation and co-digestion opport-unities and the development of business models based on techno-economic feasibility.

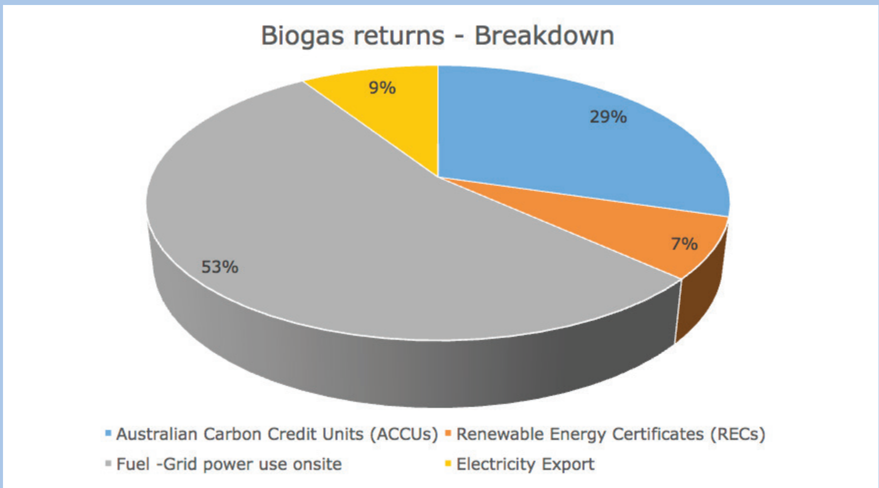

Figure 6: A percentage breakdown of the dollar value of savings/earnings to a pork producer implementing a biogas project. The relative value for carbon credits and RECs given in Figure 6 represents the observed return from these initiatives for existing piggery projects within the year 2012–13.

IEA Bioenergy task 37 "Energy from Biogas" http://task 37.ieabioenergy.com

Additional information and contacts

The information and images contained in this report was sourced from

- The Pork CRC's Bioenergy Support Program http://porkcrc.com.au/research/program-4/bio-energy-support-program/
- APL Code of Practice for On-Farm Biogas Production and Use (Piggeries) http://australianpork.com.au/wp-content/uploads/2013/10/2011_1013-423-CoP-Final-April15.pdf

and was compiled by **Bernadette McCabe** with contributions from **Stephan Tait** and **Alan Skerman**.

For further information contact:

Bernadette McCabe – IEA Bioenergy Task 37 member for Australia

Further Information
IEA Bioenergy Website
www.ieabioenergy.com

Contact us:
www.ieabioenergy.com/contact-us/

IEA Bioenergy Task 37

IEA BIOENERGY

The IEA Bioenergy Technology Collaboration Programme (www.ieabioenergy.com) is a global government-to-government collaboration on research in bioenergy, which functions within a framework created by the International Energy Agency (IEA – www.iea.org). As of the 1st January 2016, 23 parties participated in IEA Bioenergy: Australia, Austria, Belgium, Brazil, Canada, Croatia, Denmark, Finland, France, Germany, Ireland, Italy, Japan, the Republic of Korea, the Netherlands, New Zealand, Norway, South Africa, Sweden, Switzerland, the United Kingdom, the USA, and the European Commission.

The mission of IEA Bioenergy is to increase knowledge and understanding of bioenergy systems in order to facilitate the commercialisation and market deployment of environmentally sound, socially acceptable, and cost-competitive bioenergy systems and technologies, and to advise policy and industrial decision makers accordingly. The Agreement provides platforms for international collaboration and information exchange in bioenergy research, technology development, demonstration, and policy analysis with a focus on overcoming the environmental, institutional, technological, social, and market barriers to the near- and long-term deployment of bioenergy technologies.