Department of **Agriculture and Food**
Department of **Regional Development and Lands**

GOVERNMENT OF WESTERN AUSTRALIA

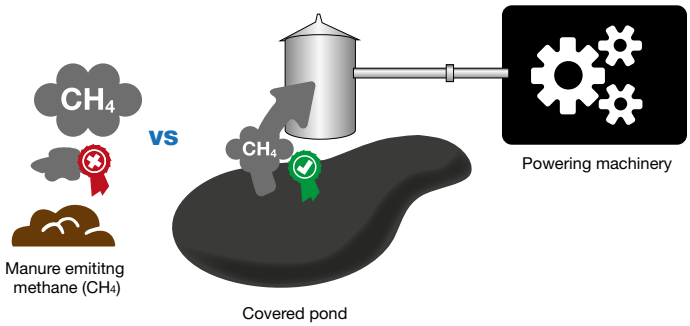
ROYALTIES FOR REGIONS

Carbon Farming in WA

Fact sheet No. 18

Practice: **Biogas generation and destruction for manure management**

Description of practice



Biogas generation systems can reduce greenhouse gas emissions (GHGE) and improve farm productivity for intensive livestock farmers (mainly pork and dairy farmers). With a biogas generation system, large volumes of manure are digested under low-oxygen conditions to produce biogas that is subsequently combusted to destroy methane and produce heat or electricity. The waste sludge is normally returned to the land as fertiliser, either as slurry or pellets.

The destruction of methane will increase farm viability by attracting Australian Carbon Credit Units (ACCUs) under the Emissions Reduction Fund (ERF). The ERF has four approved methodologies for the destruction of methane by pork and dairy farmers, which include covered anaerobic ponds and engineered bio-digesters. These methods set the upper limit of the abatements that may be claimed by determining the baseline emissions that would have occurred with uncovered waste ponds.

The simplest method is to capture the gas and combust it in a flare. More complex systems offset energy costs either by combusting the gas to produce heat or by combusting it in a generator for the cogeneration of heat and electricity. If the energy generated exceeds farm requirements, the excess may be exported to the grid.

Outline of procedure

Biogas generating facilities are usually added to existing manure storage ponds. The process of using biogas is as follows:

- Waste ponds are covered to prevent methane escaping into the atmosphere. The cover consists of an impermeable membrane stretched across the pond. It is sealed at the edges in anchor trenches with gas-collecting pipes located underneath the cover. A mechanism must be installed to drain rainwater so it does not pool excessively and collapse the cover.
- Biogas is collected and piped away from the pond.

The Department of Agriculture and Food is the lead agency and is working with the Department of Regional Development and Lands to deliver this Royalties for Regions funded project.

For more information please refer to agric.wa.gov.au

More Information

Contact
Henry Brockman
Department of Agriculture and Food

Telephone
(+618) 9892 8435

Email
henry.brockman
@agric.wa.gov.au

- Biogas is combusted, converting methane to carbon dioxide and water. The remaining waste solids are a concentrated form of nutrients that can be used as fertiliser.

Pond sludge management changes with the addition of a cover. Uncovered ponds are desludged every five to 10 years, with the waste dried and used as compost. Covered ponds should allow for a 'hydraulic residence time' (also known as retention time) of between 30 and 60 days and a mechanism should be installed to desludge the pond after 30 days. Management of the ponds also will depend on the nature of feedstock, which differs between the pork and dairy industries, with feedstock in the dairy industry having higher water content. Both may contain straw, which affects the degree of 'crusting' (blockages due to straw and other floating matter) in a pond.

Burning the biogas (either through a flare or a boiler) converts methane to carbon dioxide, which has a much lower global warming potential. The simplest operation is to flare the gas (just burn it). While this practice is enough to earn ACCUs, it is not the optimum use of biogas. Installing a boiler to heat water, or a gas-fired generator to produce heat and electricity (with excess electricity being exported to the grid), fully utilises a biogas system.

Work done to date

Four methodologies for the destruction of methane from manure have been approved under the ERF:

- destruction of methane generated from dairy manure in covered anaerobic ponds.
- destruction of methane from piggeries using engineered bio-digesters.
- destruction of methane generated from manure in piggeries (two of the four methodologies).

Australia lags behind the rest of the world in the uptake of biogas anaerobic digesters. Currently, Western Australia (WA) has only one demonstration system that flares the bio-gas—a piggery at Medina run by the Department of Agriculture and Food, Western Australia (DAFWA).

Research on the addition of crop waste to digestion ponds to increase productivity has been carried out.

Wu et al. (2010) found that the addition of ground corn stalks, oat straw and wheat straw at a carbon/nitrogen ratio of 20:1 increases methane production in anaerobic digesters. Craggs et al. (2008) estimated that the annual biogas released from an 8000-head piggery and a 700-head dairy was 0.84 and 0.032m^3 per square metre respectively, with average methane content of 74%. This could produce 1650 kWh/day for the piggery and 135 kWh/day for the dairy, with a reduction in GHG emissions of 8.27 and 0.68 tCO_2-e.

Industry specific tools to calculate GHG abatements under the ERF initiative for the destruction of methane have been developed by the pork and dairy industries. These include 'PigGas' for the pork industry and 'Dgas' for the dairy industry. Other publications include the *Effluent and manure management database for the Australian dairy industry* and the *Code of practice for on-farm biogas production and use (piggeries).*

Current level of adoption

The use of biogas in piggeries is rising. It is estimated that 7% of piggeries in the eastern states use biogas generation systems and a further 16% are planning to install systems in the near future (Australian Pork Ltd 2014).

Industry activity

Producer-owned Australian Pork Ltd (APL) has three environmental objectives for the pork industry:

- lowering greenhouse gases
- reducing the industry's carbon footprint
- improving climate change adaption.

APL has set an industry goal of 1 kg of CO_2- e per kilogram of pork produced and is actively seeking to increase the number of farms with covered ponds using biogas.

Guidelines and protocols have been developed to facilitate the uptake of biogas in the pork industry and APL is involved in managing and directing the National

Agricultural Manure Management Program, which aims to collect data and identify gaps in research that are a barrier to the adoption of GHG-reducing activities.

Dairy Australia has literature available to farmers on the development of anaerobic ponds and biogas usage, but not for covered ponds harvesting methane.

Benefits

- Commercial
  - destroying methane via a biogas system attracts ACCUs through the ERF
- intensive livestock farmers can potentially offset the cost of energy bills with on-farm generation and may even generate an income through selling electricity back to the grid (depending on size and the availability of infrastructure).
- Co-benefits
  - Covering manure ponds reduces odours.
  - Sludge waste may be pelletised and sold as a nutrient-rich fertiliser. For example, specialist equipment company Satake Australia has a facility in South Australia that is capable of producing 7.5 t of finished product per hour across a range of fertilisers.

Opportunities

- Methane destruction is on the positive list for the ERF; in other words, the practice is eligible for carbon credits.
- Biogas generation is suitable for integration into current farming systems. After some infrastructure expenditure, a system to destroy methane can reduce running costs and control odour, as well as provide a potential source of income.
- In WA, about 40 piggeries and 30 dairies are large enough to make biogas generation profitable.

Risks

- Price volatility for ACCUs.
- Underestimation of GHG emissions from waste ponds (Chung et al. 2013)
- Although technology associated with anaerobic ponds and biogas systems has been developed over the past 40 years, the systems are not fail safe:
  - badly designed systems may lead to extensive crusting and blockages
  - methane inhibitors introduced to maintain livestock health by reducing swine diarrhoea can 'kill' ponds.

Case studies

Dairy

In 2009 a demonstration dairy in Terang, Victoria, covered its manure pond to destroy methane by flaring. The system cost $105,000, with the cover costing $35,000 or $23/m^2 . As this was a research system, the monitoring capabilities were far greater than would normally be installed, meaning costs are not necessarily indicative.

According to Oliff & Barber (2012) a covered pond in Western Victoria handling the average effluent of 258 cows per day generated enough gas to drive a 3.3 kW generator and saved $4,800 per year in electricity cost (at $0.25/kW).

In New Zealand, a trial by the National Institute for Water and Atmospheric Research in 2012 paid NZ$40 000 to cover the pond of a 480-cow herd but in this instance labour costs were lower than normal.

These examples suggest a set-up cost of $85–$300 per cow. However, as dairy cows are grazers, only 10% of their manure can be easily captured, unless the length of time they remain in the yard can be increased.

Pork

Berrybank Piggery in Victoria uses a biogas system to produce electricity, recycle and conserve water, and turn waste into fertiliser for profit. They estimate that the $2 million outlay earns $435 000 per year and paid for itself in six years. Their 15 000 pigs produce 2900 kWh of electricity per day and the covered pond has reduced odour and problems with groundwater contamination.

Blantyre Farm in New South Wales (NSW) has installed a biogas system for a 22 000

sow farrow-to-finish property. The system, installed by Australian company Quantum Power, includes a 4 km pipe that brings the gas to a central location from the grower and farrow operations. It was the first piggery in Australia to be approved for the generation of ACCUs via the Carbon Farming Initiative (CFI). Historically, their electricity bill was $15 000 a month but, after installation and abatements, they earn $5000 a month. They are reported to be making $150 000 a year from carbon credits and with other savings expect to see their $1 million investment paid back in less than three years.

Australian Pork conducted six case studies using the PigGas calculator for estimating emissions from individual piggeries. They examined a range of operations from small free-range properties to large intensive properties. The best outcome was for the large farm where emissions were decreased by 87% if the waste ponds were covered and the methane combusted to produce electricity and heat.

Key contact – Australia

Hugh Payne (DAFWA, Perth)

Stephan Tait (Advanced Water Management Centre University of Queensland, Brisbane)

International work

Work is being conducted in Europe, US and New Zealand, among other places. However, differences in temperature and available space suggest data should be collected under Australian conditions.

Stakeholders

- Department of Agriculture and Food, Western Australia (DAFWA)
- Australian Pork Ltd
- Dairy Australia

Next steps

Anaerobic digestion biotechnologies (Sasha Jenkins), Medina Research Station

Key references

Australian Pork Limited annual report 2012–13.

Birchall, S, Dillon, C & Wrigley, R 2008, *Effluent and manure management database for the Australian dairy industry*, Dairy Australia, Melbourne, 236p.

Chung, ML, Shilton, AN, Guieysse, B & Pratt, C 2013, 'Questioning the accuracy of greenhouse gas accounting from agricultural waste: a case study', *Journal of Environmental Quality*, vol. 42, pp. 654–9.

Craggs, R, Park J & Heubeck, S 2008, 'Methane emissions from anaerobic ponds on a piggery and a dairy, *Australian Journal of Experimental Agriculture*, vol. 48, pp. 142–6.

Dairy Australia, 2004. Fact sheet no. 5, Eco-efficiency for Australian dairy processors.

Davidson, A, Yap, M, Ponder, S & Jeffrey, G 2013, *Industry code of practice for the production and use of on-farm biogas*, 1st edition, Prime Consulting International (Australia) Pty Ltd, 60p.

Department of Climate Change and Energy Efficiency (DCCEE) 2012, *The Carbon Farming Initiative handbook,* Canberra.

Heubeck, S & Craggs, R 2012. Biogas on the farm – why and how? NIWA.

Olliff,R., Sheba, L. & Barber, M 2012. Creating electricity from effluent. RIRDC Publication no.12/032

Wilkinson, KG 2011, 'A comparison of the drivers influencing adoption of on-farm anaerobic digestion in Germany and Australia', *Biomass and Bioenergy*, vol. 35, pp. 1613–22.

Wu, X, Yao, W & Zhu, J 2010, 'Biogas and CH4 productivity by co-digesting swine manure with three crop residues as an external carbon source', *Bioresource Technology*, vol. 101, pp. 4042–7.