Climate Change Research Strategy - Energy Efficiency Solutions

Feasibility Case Study – Silvermere Holsteins, Cowra

Silvermere Holsteins is a 320 head dairy operation in Cowra, NSW where a study was conducted to assess the feasibility of installing a biogas plant to provide renewable electricity to the site.

The NSW DPI Energy Efficiency Solutions project conducted feasibility studies to assess the technical and commercial feasibility of proposals that would address the cost, reliability and sustainability of energy use on farms. Proposals were sought through public advertisements and more direct engagement with associations and networks. An independent advisory group identified ten priority proposals through a merit selection process, then an independent expert assessor was matched to each priority proposal to undertake a detailed feasibility study. This case study summarises the context, proposal and results of the Silvermere Holsteins feasibility study.

Context

Silvermere Holsteins is a dairy operation in Cowra, inland New South Wales. The operation is an exemplar within the industry, achieving high milk yields throughout the year. This is achieved through a combination of careful crop management and the provision of cow housing and cooling systems which maintain cow comfort and health throughout the year. The systems employed at Silvermere Holsteins efficiently use resources including water, land, staffing and the dairy herd, though it is noted the dairy has high electricity usage compared to a typical dairy farm due to the cow housing system.

Silvermere Holsteins uses electricity for all stationary energy needs and diesel for mobile plant. The site has reduced the environmental impact of the energy supply in recent years by installing a large solar photovoltaic (PV) array which offsets approximately one third of site electricity consumption.

Proposal

Cows are housed at the site, so most manure is captured by washdown and processed in the effluent systems. The processing of manure in the effluent systems results in production of biogas, a mixture of predominantly methane and carbon dioxide. This presents an opportunity to install equipment to capture the biogas and use it as a fuel to generate electricity. Reducing consumption of grid electricity would reduce energy costs and emissions. This system would also reduce the emissions associated with the effluent system.

An investigation of the site energy needs, the available effluent resource and locally available biogas capture and generation technologies and costs showed that likely the most suitable system would include a covered anaerobic lagoon (CAL), paired with a 60 kW (electric capacity) engine generator. Other anaerobic digester and generator technologies were considered, however, the proposed system was selected based on modelling of the operational and economic performance of the various options.

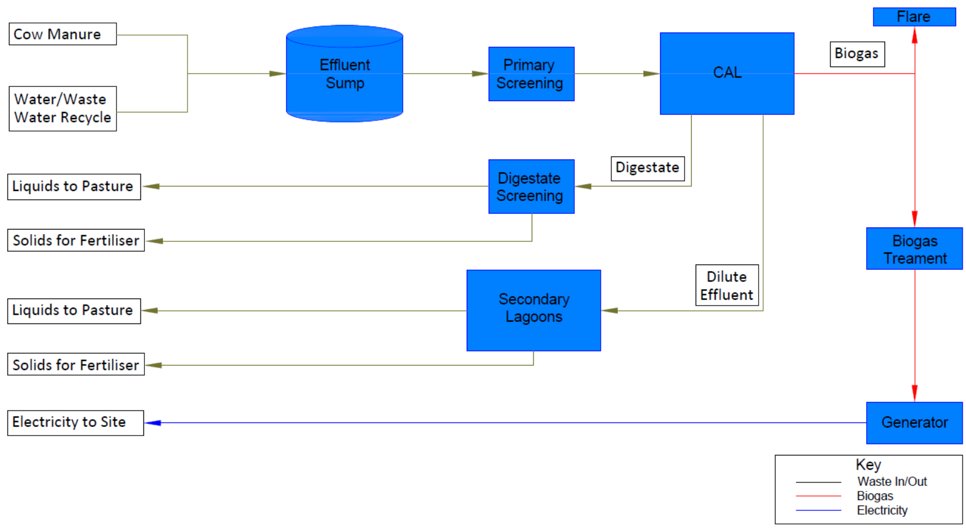
Integration with site systems

The CAL would be integrated in the existing effluent pond system such that it received the effluent immediately downstream of solids screens. The remaining solids in the effluent would then break down in the lagoon via anaerobic processes over a period of about five weeks, producing biogas, which would float to the surface and be captured by the lagoon covering. The biogas captured in the lagoon would be piped to the engine generator via gas cleaning equipment including an H2S scrubber and a dryer. The processed effluent would overflow from the CAL into the remainder of the existing pond system to complete further breakdown of solids via a mostly aerobic process.

To maximise return on investment, operation of the engine generator would be managed by an intelligent controller, set up to load match to maximise on-site use of the generated electricity, with a preference for high electricity-cost periods. Based on the expected parasitic load of the auxiliary equipment (such as the blower, scrubber and dryer), the system would have a net electrical output of approximately 50 kW.

Electricity from the generator would be fed into site electrical systems at the milking shed, where equipment loads are highest, and from where there is a sizable electrical connection to the main site switchboard. This would allow electricity to be distributed to any part of the site where there was demand or exported to the grid if generation exceeded site demand.

Schematic diagram of proposed system



Estimated costs and benefits

Project cost excl GST	$1.0 million
Electricity cost savings	$48,000 p.a. (76%)
Electricity (grid) use reduction	870 GJ p.a. (92%)
Maintenance costs	$5,000 p.a.
Emissions reduction	1,160 tCO_2e p.a. (84%)
Simple payback period	24 years

Other benefits associated with the proposed biogas system include:

- Increased energy security for the site.
- Increased resilience against future energy price increases.

Key findings

The payback period of this proposal is long and is affected by several factors:

- High effluent water volumes: the effluent system has a high volume of water passing through it (with a large portion of recycled water) which requires a large CAL in order to achieve the hydraulic residence times required for the anaerobic digestion processes.
- Biomethane potential: ideally conduct laboratory tests of effluent to establish how much methane would be produced.
- Potential electricity cost savings are reduced by the existing solar PV array: given the existing solar PV array offsets approximately one third of total equipment demand, this reduces the cost savings that can be achieved by the biogas system.
- No value for exported electricity: the current electricity supply contract for the site does not provide payment or credit for any electricity exported to the grid, so any excess generation capacity cannot be used to generate additional revenues or offset costs during times when demand exceeds generation.

Replication potential

The proposal has the potential to deliver significant greenhouse gas emissions savings, and under different circumstance the return on investment would likely improve. In a scenario where the site did not have solar, the site received payment for export of electricity of 8c/kWh, and the upper limit of the range of biogas availability was used, the simple payback of the system would reduce to approximately nine years.

Acknowledgments

The Climate Change Research Strategy (CCRS) is an initiative of the NSW Department of Primary Industries (DPI), supported by an investment from the NSW Climate Change Fund. The Energy Efficiency Solutions project is one of seven CCRS projects. More information is available online here: https://www.dpi.nsw.gov.au/climate-and-emergencies/climate-change-research-strategy

The objective of the Energy Efficiency Solutions project is to help energy-intensive farms identify options to improve their energy efficiency and reduce costs. The project is led by NSW DPI, advised by a steering committee. NSW DPI contracted the Australian Alliance for Energy Productivity (A2EP) to provide management services for the conduct of ten feasibility studies. This case study summarises the findings of a detailed study that was undertaken by independent expert consultants, DETA Consulting.

DOC21/42694