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Pork CRC
CRC for High Integrity Australian Pork

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Project Number & Title

Project 4A-101 112

ALGAE FOR ENERGY AND FEED: A WASTEWATER SOLUTION. A REVIEW

Project Leader

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Background

The objective of this project was to conduct an integrating review that encompassed both the priorities requested under Program *4A Future Feeds for Future Needs* with aspects of *Program 4C Carbon-Neutral Pork Production.* The Program 4A review was of the techno-economic and life cycle assessment of algal growth systems and processes suitable to produce algae as a feed source for pigs; review of pig nutrient requirements and the identification of suitable algal species that meet these nutritional requirements. The Program 4C component was to review current knowledge and future integrated piggery waste management/bio-energy systems and their potential to impact the growth of micro-algae on piggery waste to maximise nutrient and energy recovery from piggery waste streams.

Methodology

An expert group conducted the review, managed by Flinders University, comprising Neil Buchanan, Dr Natalie Bolton, Ryan Cheng, Dr Ivo Svoboda (Flinders); Prof Michael Borowitzka & Dr Navid Moheimani (Murdoch University); Dr Tim Grant (Life Cycle Strategies), Dr David Batten (Temaplan Group). The review considered current local and international slurry handling & management practices including anaerobic digestion (AD); aerobic treatment which would facilitate algal culture; performance of algal culture systems for feed, wastewater treatment and fuel; pig and human health benefits and risks associated with adoption of wastewater grown algal technologies and a streamlined life cycle assessment (LCA) of integrated wastewater treatment, GHG abatement and algal technologies for feed and fuel. The overarching objective maintained throughout was to inform the future research required to *'turn possibility into reality'*.

Key Findings/Conclusions

Pig slurry should be viewed as a resource rather than a waste management cost and problem within the Australian pork industry. The overwhelming majority of pork producers use lagoon systems for wastewater treatment. A small minority have covered anaerobic lagoons to reduce emissions of the GHG methane from slurry. The LCA analysis indicates that rather than 'flaring' this renewable energy source the industry should be encouraged to exploit biogas for water or space heating or in combined heat and power systems thereby reducing fossil fuel usage and associated GHG emissions. The review identified high ammonia and suspended solids concentrations in slurry as major inhibitors of algal growth; recommending the integration of controlled, closed vessel aerobic treatment to biologically convert the ammonia to nitrate, followed by solids separation to enable microalgal growth on anaerobic digester effluent. The LCA indicates that further wastewater treatment by microalgae, followed by additional energy recovery via co-digestion of the algal biomass with pig slurry is the option most likely to achieve the Pork CRC aspirational GHG emission target of 1kg CO_2e kg $HSCW^{-1}$ by 5% of the Australian pork industry. This approach may also enable subsequent research, on what is a less mature technology, on growing algae for pig nutrition. Improved disinfection of wastewater with reduced ammonia for piggery reuse was realised and highlighted in the review as an additional benefit for pig health and profitability.

Potential Users of Information (including value assessment)

The review clearly articulated the research needs to exploit pig slurry as an energy source, recycle nutrients and water and improve pig health via the practical application of algal technology. The LCA supported this approach to assist in meeting the aspirational target of 1kg CO_2e kg $HSCW^{-1}$ by 5% of the Australian pork industry. Considering the fate of pathogens the reuse of inadequately treated wastewater for shed flushing and washdown exposes both pigs and humans to these and commensal organisms. Evidence suggests that reducing ammonia and pathogens in effluent used for flushing would reduce pig morbidity, decreasing feed costs from the associated lower growth rates which delay attainment of slaughter weight. Preliminary analysis for a 2000 sow farrow-finishing unit suggests, potential reduction in operational costs in excess of $600k per year if wastewater low in ammonia, commensals and pathogens is used for shed flushing and washdown.