

## **Pork CRC Program 4 Leader profile Dr Stephan Tait**

Dr Stephan Tait, who succeeded Dr Rob Wilson on July 1 as Leader of Pork CRC Program 4 '*Carbon conscious nutrient inputs and outputs*', has been actively involved in the CRC for High Integrity Australian Pork, with specific strategic advice, coordination and collaboration within the '*Carbon neutral pork production*' Subprogram.

This Subprogram encourages novel research and development to maximise methane production from effluent ponds to reduce carbon emissions, together with effective on-farm utilisation of the gas for heat and power.

Stephan, who has a Bachelor of Engineering and a PhD in Chemical Engineering from University of Queensland, was awarded a Pork CRC Research Fellowship in 2012 to lead the Pork CRC's Bioenergy Support Program, which has successfully encouraged and promoted commercial on-farm uptake of renewable energy production and use and nutrient recovery utilisation from waste technologies in Australia and New Zealand.

Currently, around 18 biogas systems are established across Australia. The reduction of GHG emissions from just seven farms contracted under the Federal Government Emissions Reduction Fund, has abated 0.5 million tonnes of CO<sub>2</sub>, worth \$7.1 million in carbon credits.

Stephan's enthusiastic extension of R&D outcomes to the commercial pork industry and the practical on-farm adoption of novel technology via two early adopter demonstration farms, has been the key to the success of this support program.

He has also been instrumental in four pilot to full scale technology testing programs, in conjunction with some of the largest pork producers in Australia.

A significant contribution by Stephan with Australian Pork Limited has been through communicating with and educating federal government regulators on the technical aspects of renewable technologies and projects associated with the Carbon Farming Initiative.

Stephan has also facilitated workshops with gas safety regulators across Australia, which led to the development of practical on-farm safety policies and regulations for the adoption of biogas production and use in agriculture – *Code of Practice for on-farm biogas*. Regulators have recommended this code be included in some state-based safety legislation and it has been proposed as a likely future Australian Standard.

Stephan has also co-authored new design guidelines for anaerobic ponds which are now utilised by more than 60% of Australian pork farms.

### **Research focus**

His research has focused on the utilisation of waste streams and wastewater as an energy source, nutrient recovery and water re-use, with a particular emphasis on agricultural wastes.

Stephan is involved in a number of large research projects funded by Pork CRC, APL and collaborating rural RDCs, commercial and government institutions and Federal Government. These have attracted about \$1million in external funding and cover diverse research areas, including the understanding of the biology of anaerobic systems, development of low cost solid waste digestion and nutrient recovery, enhanced energy recovery through anaerobic co-

digestion, low cost biogas purification and gas safety requirements. Stephan also supervises PhD and Masters students through these projects.

Stephan was Project Leader for an \$840,000 project, 'Anaerobic treatment for emissions reduction from solid manure residues', with the Federal Government's 'Filling the Research Gap' under the National Agricultural Manure Management Consortium. This was co-funded by Pork CRC, Australian Egg Ltd and a commercial supplier of bioenergy and engineering infrastructure.

Other waste to energy projects include:

- Waste to Revenue: novel fertilisers and feeds (APL).
- Fertilisers from piggery liquid and solids via nutrient extraction and solid formulations (APL).
- Enhanced energy recovery in Australian industry through anaerobic co-digestion (Pork CRC).
- Enhanced methane production from pig manure in covered lagoons and digesters (Pork CRC).
- Assessing stimulation and inhibition of anaerobic lagoons (Pork CRC).
- Bio-upgrading piggery biogas by growing algae for value-add end uses (Pork CRC).
- Assessment of low cost biogas purification media (Pork CRC).

Two further collaborative projects were:

- On-farm evaluation of a pond-less piggery treatment system.
- Options for cost effective and efficient use of piggery biomass energy.

A significant development has been a safe method for biological scrubbing of methane produced from effluents to eliminate hydrogen sulphide. This has resulted in a significant reduction in the cost of removing H<sub>2</sub>S from biogas and is now being considered, and in one situation accepted, by a State Fuel Gas Safety Regulator. The method was developed from on-site testing, fine-tuning and collaboration at the two Bioenergy Support Program demonstration sites and is now being used at on-farm scale biogas projects.

### **Industry impacts**

Although essentially a research-focused academic, Stephan dedicates much of his time and energy developing and delivering a range of undergraduate, postgraduate and professional development course materials for technology transfer and industry use.

Stephan is a popular and regular contributor to the annual Pork CRC supported Roseworthy, SA, course, '*The Science and Practice of Pig Production*', this year attended by 35 people, including pork industry and farming personnel, postgraduate students and undergraduate students.

Stephan also contributed a column, "It's a Gas", highlighting new research and development, in Australian Pork Newspaper.

Technology feasibility reviews have been undertaken for piggery clients across Australia, from desktop findings and recommendations to technology testing and on-farm adoption.

Stephan has also contributed to the Pork CRC/APL 'Roadshow's across the country, delivering to grass-roots producers the results from his research and answering site-specific queries about the adoption of biogas technology. Stephan and his students are regular contributors to industry scientific conferences and events, including Australian Pig Science Association, Pan Pacific Pork Expo and Bioenergy Australia.

### **Wilson words**

According to Dr Rob Wilson, Stephan's quiet and unassuming approach to significant industry issues has gained him the respect of the smaller family farm operators and the large integrated pork enterprises.

Dr Wilson, who said he was confident Stephan would do an excellent job leading Pork CRC Program 4, has outlined below some outcomes and directions for the three Subprograms.

#### **4A – 'Future Feeds For Future Needs'**

Dr Navid Moheimani's research team at the Algae R&D Centre at Murdoch University, WA, has successfully isolated two macroalgae species that can grow on diluted anaerobic digestion piggery effluent (ADPE), containing up to 250mg Nh<sub>4</sub> nitrogen per litre. The biochemical composition and chlorophyll content of the macroalgae has been analysed and biomass productivity using algal mats in a new bioreactor is now being studied.

Navid's group has also investigated the growth of microalgae in ADPE, using tubular photobioreactor and open ponds. Both systems were successful in treating ADPE using microalgae of which *Chlorella* sp. was the most dominant, but overall there was a 2.1 increase in biomass productivity in the Biocoil compared to the raceway pond. There was no differences in the ammonium removal rate however between the two treatment systems.

#### **4B – 'Enhanced Use Of Traditional Protein And Energy Sources'**

While earlier Pork CRC projects showed that reducing milled grain particle sizes improved feed efficiency for weaner and grower pigs, a large program (4B-112) followed this work to investigate and optimise particle size distribution for grains and protein sources. Led by PhD student Giang Nguyen, together with Dr Peter Sopade and Prof Michael Gidley at University of Queensland, the project has concluded and the final report is being reviewed by Pork CRC.

The project showed particle size management continues to be an important and potentially overlooked aspect of feed quality. A prototype hand-held on-site sieving device offers the potential for on-site adjustment of milling parameters, in particular to reduce the levels of particles larger than 1 mm.

Further investigations continue with project 4B-124, which is looking at the potential to re-engineer grain grinding and/or sieving equipment in commercial feedmills.

#### **4C – 'Carbon Neutral Pork Production'**

Alan Skerman at Queensland Department of Agriculture & Fisheries is providing practical and essential information to producers interested in biogas through the Bioenergy Support Program, with ongoing support from Dr Stephan Tait. Alan has updated the list of biogas equipment and service suppliers and has successfully completed the first methane potential

analysis of effluent samples from a southern Queensland producer using the AMPTS 11 testing equipment.

Pork CRC project 4C-109 is looking to enhance methane production in covered ponds and digesters using the inhibition test developed in an earlier project (4C-105), has shown that the observed inhibition was considerably less than expected than from acute inhibition, being only 45 – 55%. High ammonia, nitrogen or sodium levels would have been expected to inhibit around 90% of biogas organisms. This suggests microbes could be much more resilient when exposed to inhibitors over extended periods of time, even if the inhibitor concentration is high. Microbial concentration analysis is continuing to clarify whether the microbial community is similar to that in the control digester or if the promoted resilience has resulted in a unique microbial population.

Pork CRC project 4C-117 was the first to establish a life cycle assessment of greenhouse gas emissions across the Australian pork supply chain. A comprehensive and fascinating report.

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