Biogas Energy for an Innovative Pork Industry

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Overview

- Pork industry characteristics
- Current projects
- Results: Pork CRC feasibility studies by Feedlot Services Australia
Conventional Housing: Slatted floors

Pork industry characteristics
Conventional Housing: Slatted floors

Pork industry characteristics
Key Organic Wastes

Pork industry characteristics
Conventional Housing: Bedding

Pork industry characteristics
Key Organic Wastes

Pork industry characteristics
Definitions

• Farrow-to-finish
• Grower units
• Breeder unit
• Standard Pig Unit (SPU)

100 sow herd = 5 boars + 5 gilts + 17 lac sows + 83 ges sows + 177 suckers + 253 weaners + 249 growers + 330 finishers + 82 heavy finishers

1 sow ≈ 10SPU ≈ 900kgVS/year

Tucker et al., 2010
Percentage of Australian Herd

APL Pig Annual 2011-2012
Number of Establishments

- 1-49 sows: 1155
- 50-99 sows: 86
- 100-499 sows: 228
- 500-999 sows: 40
- +1000 sows: 55

APL Pig Annual 2011-2012
Number of Establishments: Energy

Combined thermal and electrical
Breeder pigs
Low manure volumes
High energy demand for heating (lamps)

Grower-finisher
High manure volumes
Minimal energy requirements

3.5km
major public road crossing
Coverage

- Biogas is being captured and burnt from 7.85% of the national herd (7.7% in +1000 sow category)

- Three carbon farming initiative eligible offsets projects

- To date, one piggery has generated 8,169 Australian Carbon Credit Units (ACCUs) (at $22.50/ACCU spot-price (CFI hub) = $184k) for an originally $1M capital project.

Carbon Banc/ CFI Hub Closing spot price
Tuesday 25 June 2013
Covered Lagoons
Biogas direct heating

Skerman et al, RIRDC, 2012
Biogas heating

Skerman and Collman, RIRDC, 2012
Power or CHP
Biogas cleaning

Skerman and Collman, RIRDC, 2012
BIOGAS CAPTURE AND ENERGY GENERATION FEASIBILITY STUDIES FOR FIVE PIGGERIES

Report prepared for the Pork CRC

by Eugene McGahan, John Valentine, Stephan Heubeck and Caoilinn Murphy
Project Outline

• Pork CRC research: Develop commercially viable options to reduce pork carbon footprint.

• Technical and economic feasibility of covered lagoon biogas energy – Assessed for 5 piggeries across Australia and New Zealand.
**Piggery 1 - Description**

- Multi-site farrow-to-finish SA.
- 3 grower units and 1 breeder site with pull plug system in conventional sheds.
- Weaners + 500 sows at breeder site on deep litter
- 11,892 SPU to ponds
- Breeder site feedmill on diesel power.
Piggery 1 - Findings

- Combined heat and power (CHP) deemed most feasible.
- Multi-site layout – added issues.
- Two CAP systems and two scenarios examined.
  - Scenario 1 – breeder site
  - Scenario 2 – breeder site and 1 grower site.
- Staged approach most viable.
- Scenario 1 – payback period 4.2 years, ROI 198%.
- Upgrade to scenario 2 – 100% offset LPG, 98% offset diesel and electricity at breeder site.

11,900 SPU (~1100 sow farrow-to-finish)
Piggery 2 - Description

- Grow-out SA
- 5112 SPU
- 5 conventional sheds with pull plug and mechanical ventilation
- Anaerobic pond never been desludged after many years
Piggery 2 - Findings

- Generator unit to produce electricity deemed most viable with retro-fitted long sludge retention pond.
  - Payback period – 8.45 yrs.
  - ROI after 10 years – 7.6%.
- Possibility of export excess to grid.
  - Payback decrease to 5.6 years.
- CAP and flare:
  - Payback period reduced to 7 years and ROI after 10 years of 20%, however the income from this system solely relies on continued ACCU credits under the CFI.

5112 SPU (500 sow farrow-to-finish)
Piggery 3 - Description

- 1200 sow multiplier unit WA
- 4646 SPU
- Plans to double sows on-site to 2400 (7089 SPU)
- Conventional sheds with flush drains
- Recently constructed 10.1 ML purpose built anaerobic pond – view to operate as covered pond for biogas
Piggery 3 - Findings

- 7 scenarios examined
- Scenario 3 – CAP and boiler (expanded operation) deemed most economically viable.
  - Payback period – 1.8 years.
  - ROI after 10 years – 597%.
- Staged approach most viable:
  - Stage 1 - CAP and boiler (expanded operation with screen)
  - Stage 2 – upgrade to CAP and CHP (expanded w/screen).

4646 SPU (~460 sow farrow-to-finish)
Piggery 4 - Description

- 720 sow farrow-to-finish piggery WA
- Pigs weaned onto straw until 18 weeks age, then housed in conventional sheds until finishing
- 4353 SPU to anaerobic ponds, with plans to expand by 500 sows breeding on-site – 5399 SPU (ponds)
- Conventional sheds with flush drains
- Existing anaerobic pond estimated at 7.4 ML.
- Feedmill on-site powered by diesel generator
Piggery 4 - Findings

- Producing electricity deemed most viable – using retro-fitted short sludge retention pond.
- Current operating capacity.
  - Payback period – 5.6 years.
  - ROI after 10 years – 108%
- Expanded operating capacity.
  - Payback period – 4.7 years.
  - ROI after 10 years – 151%

5399 SPU (~540 sow farrow-to-finish)
Piggery 5 - Description

- 600 sow farrow-to-finish piggery NZ
- 6975 SPU
- Conventional sheds - 75% pull plug system and 25% direct flush.
- Odour emissions from site issue with neighbours – odour reduction (covered pond).
**Piggery 5 - Findings**

- Farm manager stated preference for existing pond modified and covered
- Two options examined:
  - Option 1 – CAP and power as stand alone system
  - Option 2 – Add-on cost of biogas utilisation equipment
- Option 1 – not feasible.
- Option 2 – feasible
  - Payback period - 7.2 years.
  - ROI after 10 years – 64%.
## Summary of Outcomes

<table>
<thead>
<tr>
<th>Piggery</th>
<th>SPU number</th>
<th>Type of piggery</th>
<th>Total capital cost ($)</th>
<th>Payback period (years)</th>
<th>ROI (10 years) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piggery 1</td>
<td>11 892</td>
<td>Multi-site farrow-to-finish</td>
<td>410 935</td>
<td>4.2</td>
<td>198</td>
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<tr>
<td>Piggery 2</td>
<td>5112</td>
<td>Grow-out</td>
<td>279 448</td>
<td>8.45</td>
<td>7.6</td>
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<tr>
<td>Piggery 3</td>
<td>7089 (expanded)</td>
<td>Sow multiplier unit</td>
<td>170 179</td>
<td>1.8</td>
<td>597</td>
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<tr>
<td>Piggery 4</td>
<td>5399 (expanded)</td>
<td>Farrow-to-finish</td>
<td>345 636</td>
<td>4.7</td>
<td>151</td>
</tr>
<tr>
<td>Piggery 5</td>
<td>6975</td>
<td>Farrow-to-finish</td>
<td>298 319</td>
<td>7.2</td>
<td>64</td>
</tr>
</tbody>
</table>

11,900 SPU (~1100 sow farrow-to-finish)
General conclusions and recommendations

- Potential to offset energy use.
- 5 case studies – all economically feasible.
  - Short payback periods: 1.8 - 7.2 years
  - Substantial positive return on investment over 10 years
- All piggeries different – requires individual cost/benefit analyses.
  - Variety of influential factors on feasibility - piggery size, type, effluent management system, energy demands etc.
- The potential is there – Let’s encourage wider uptake!
Contributors

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