Biogas Energy for an Innovative Pork Industry

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The University of Queensland

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Established and supported under the Australian Government's Cooperative Research Centres' Program

Overview

- Pork industry characteristics
- Current projects
- Results: Pork CRC feasibility studies by Feedlot Services Australia

Conventional Housing: Slatted floors

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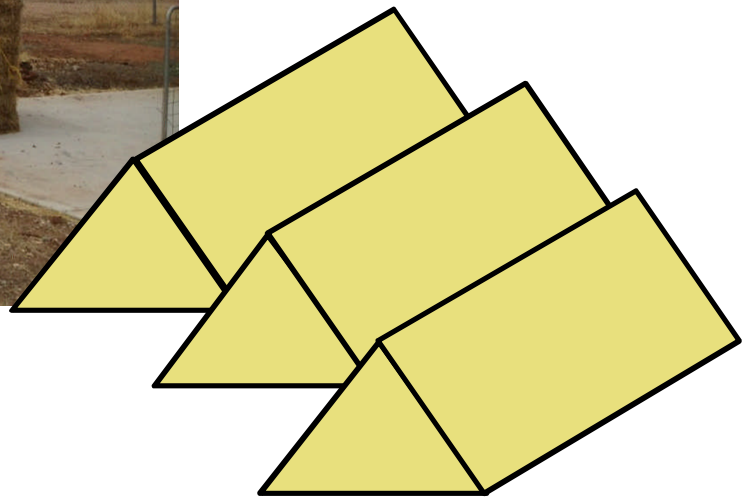
Key Organic Wastes

Conventional Housing: Bedding

Key Organic Wastes



Definitions

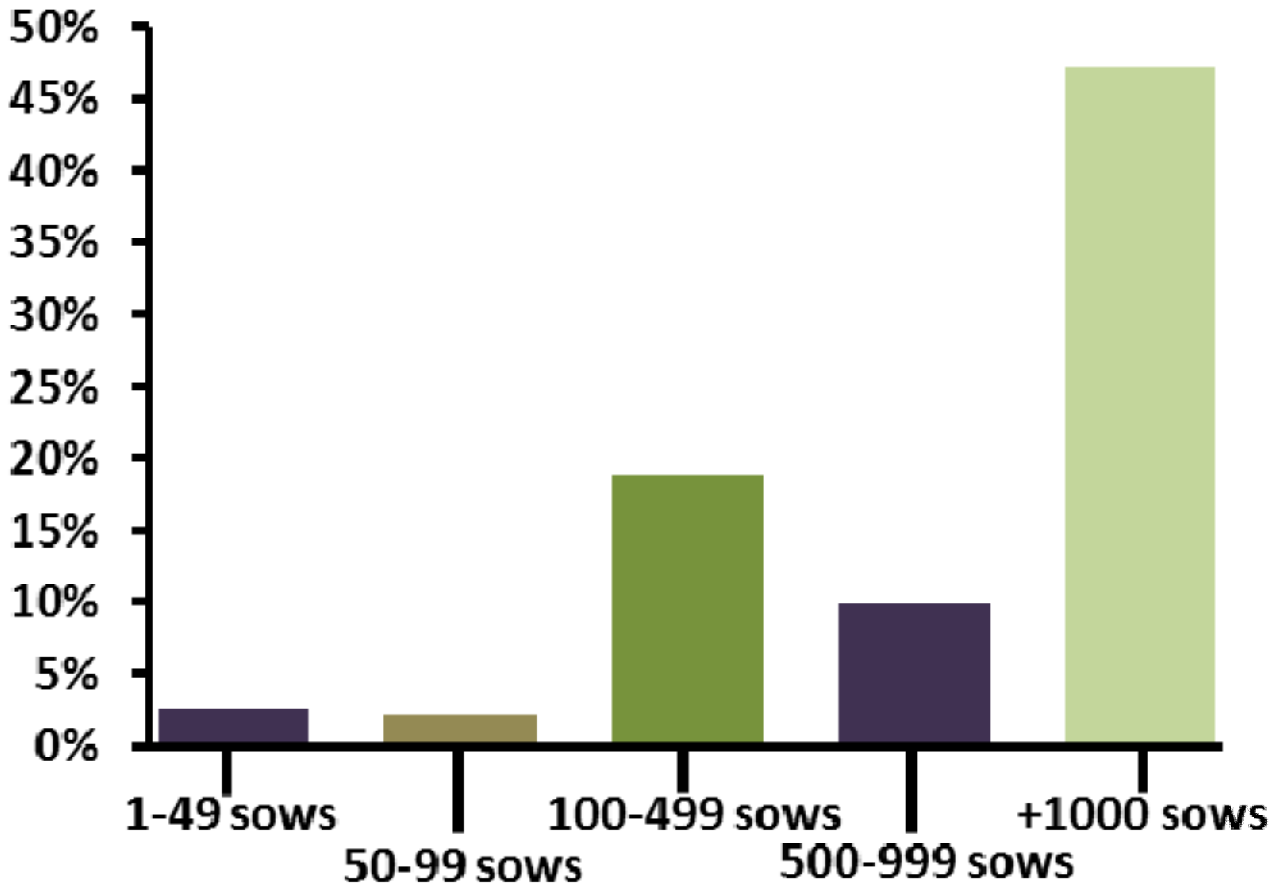
- Farrow-to-finish
- Grower units
- Breeder unit
- Standard Pig Unit (SPU)

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

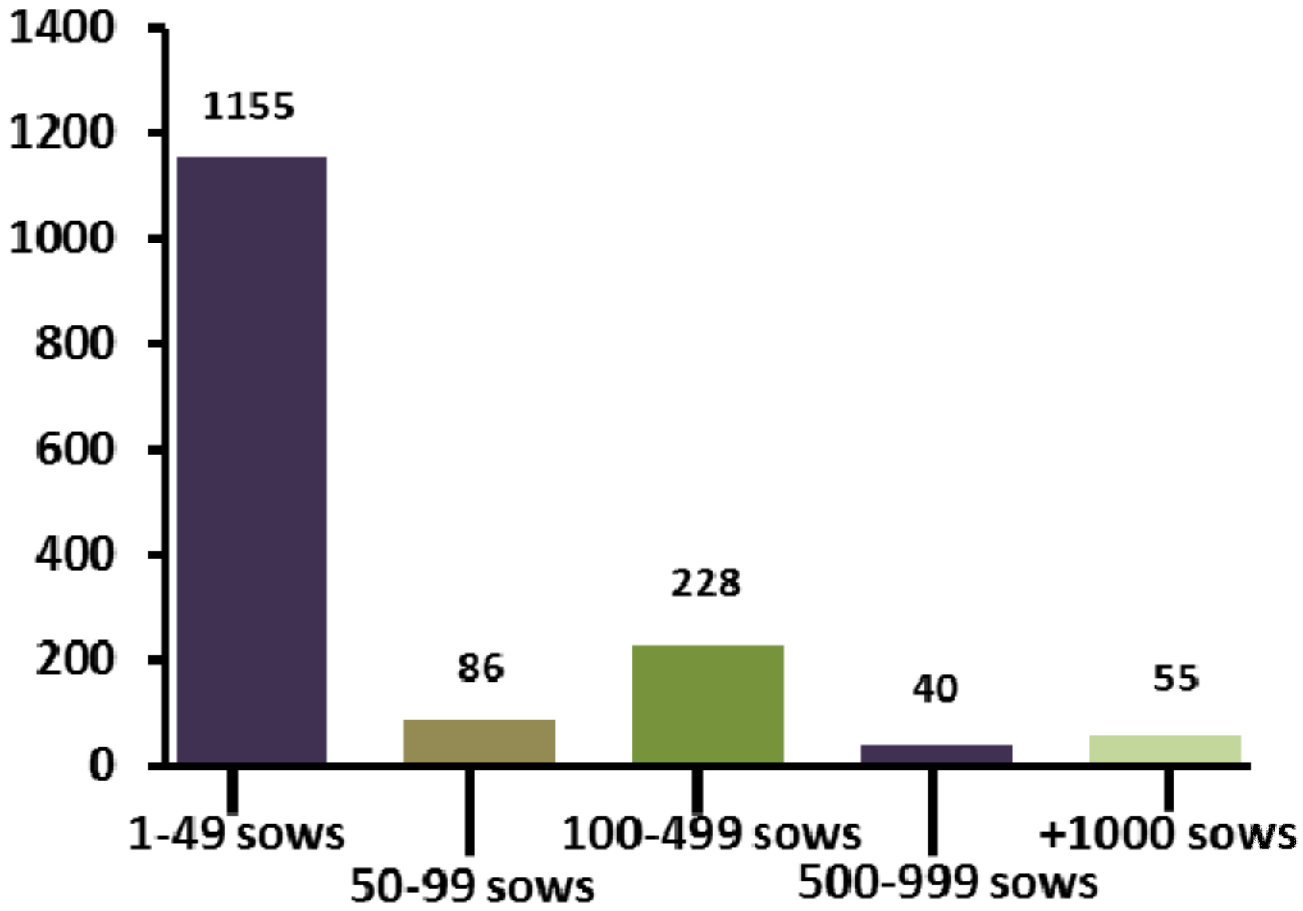
Tucker et al., 2010

Percentage of Australian Herd



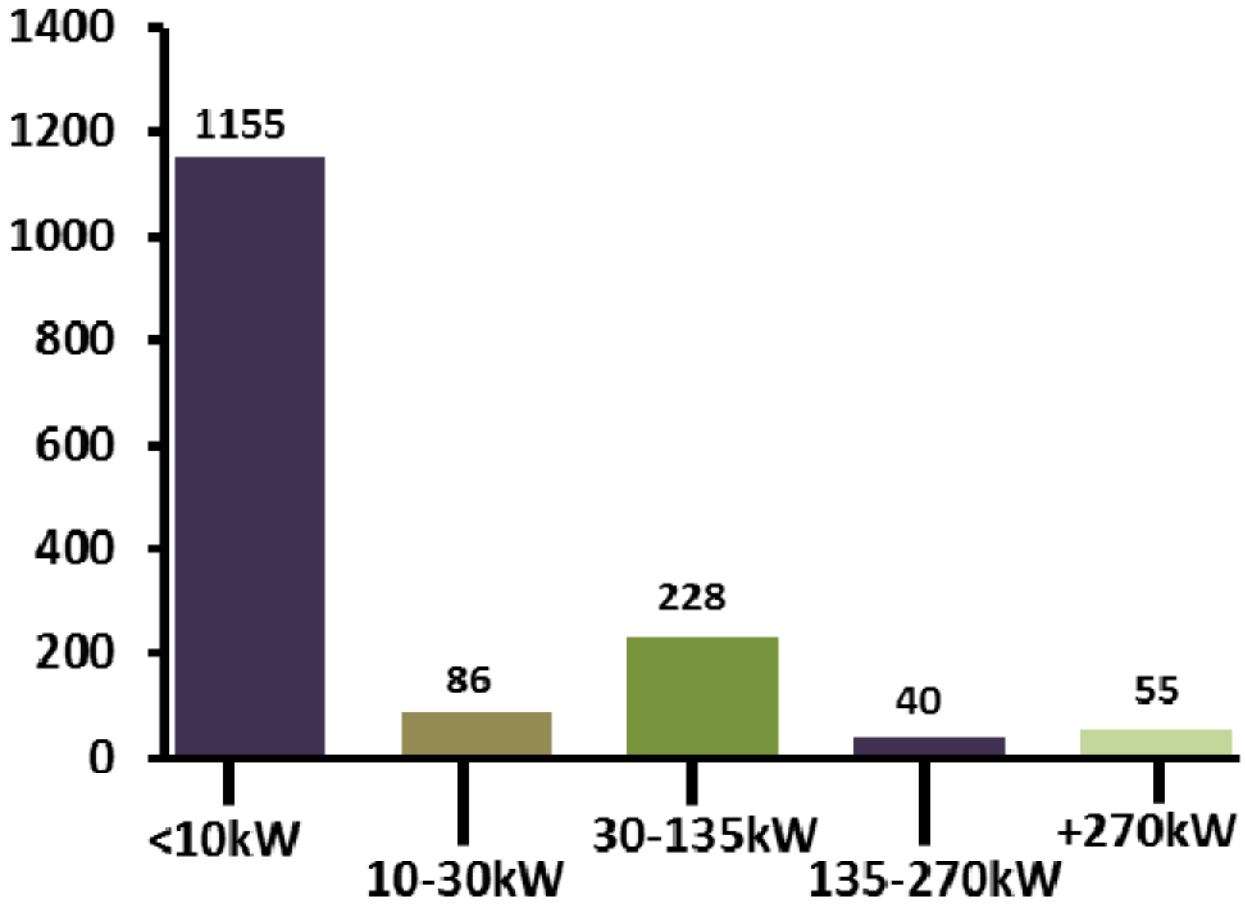
APL Pig Annual 2011-2012

Number of Establishments



APL Pig Annual 2011-2012

Number of Establishments: Energy



Combined thermal and electrical

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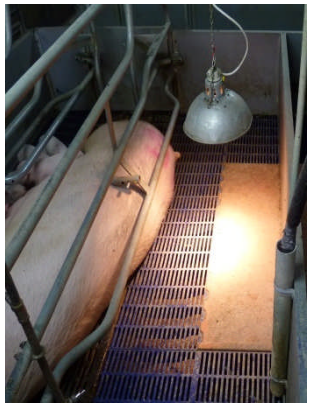
Grower-finisher
High manure volumes
Minimal energy requirements

Breeder pigs
Low manure volumes
High energy demand for heating (lamps)



major public road crossing

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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

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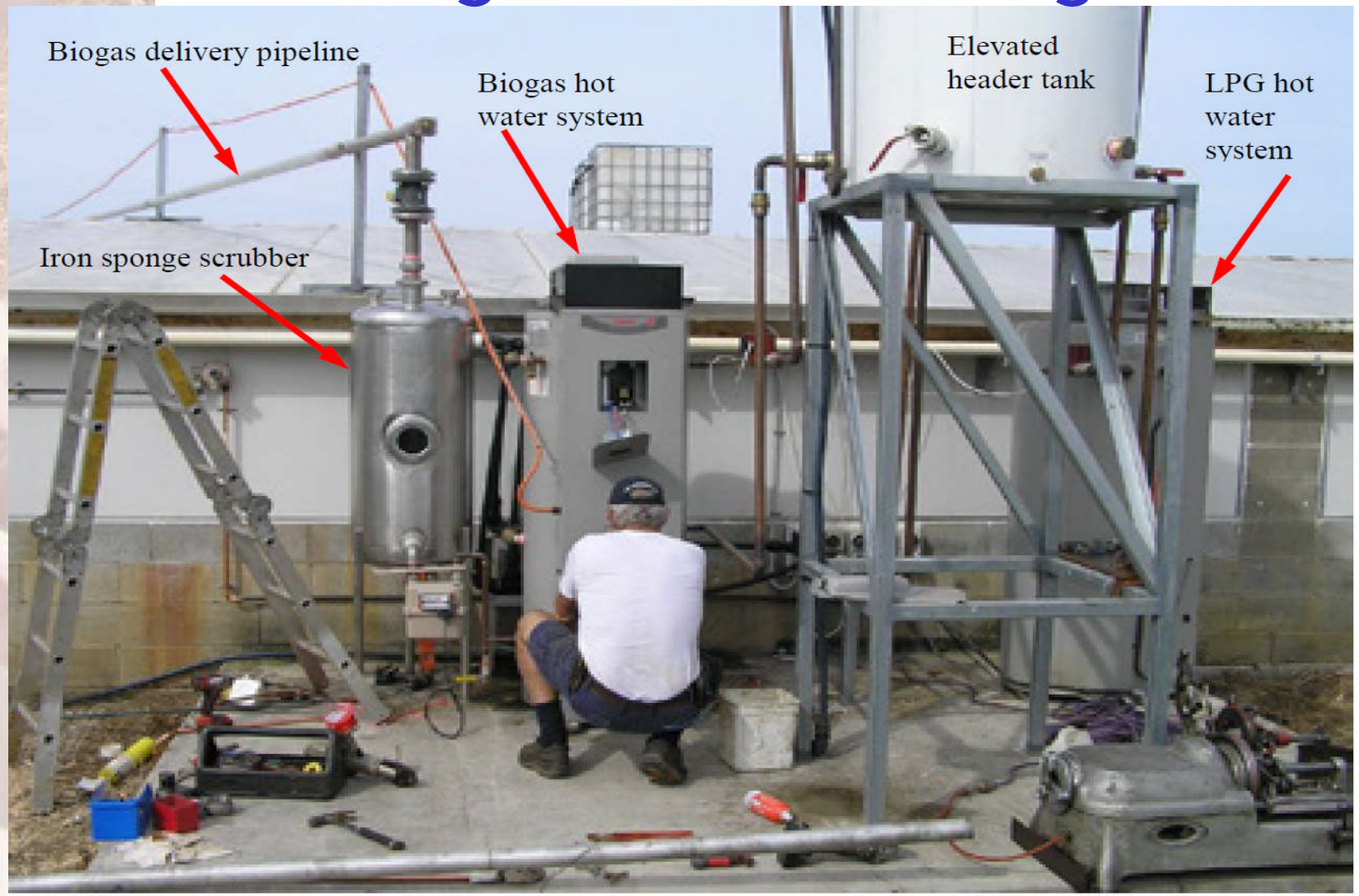
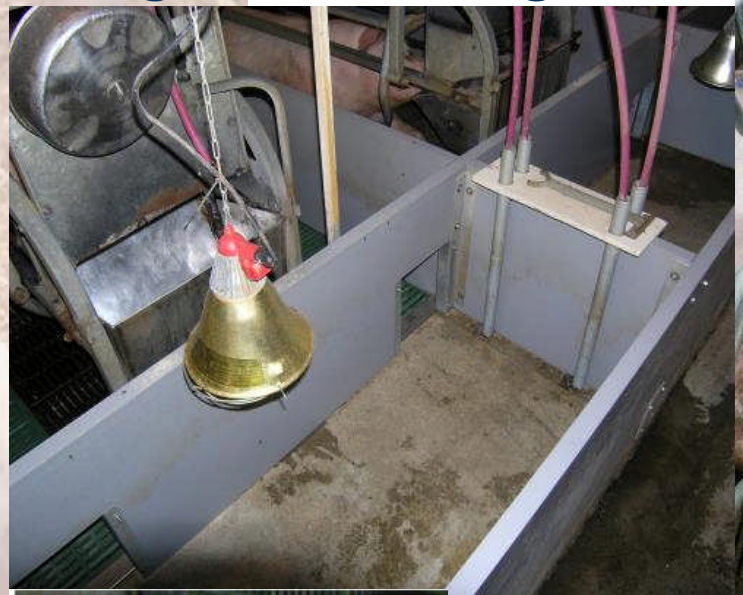
Flares

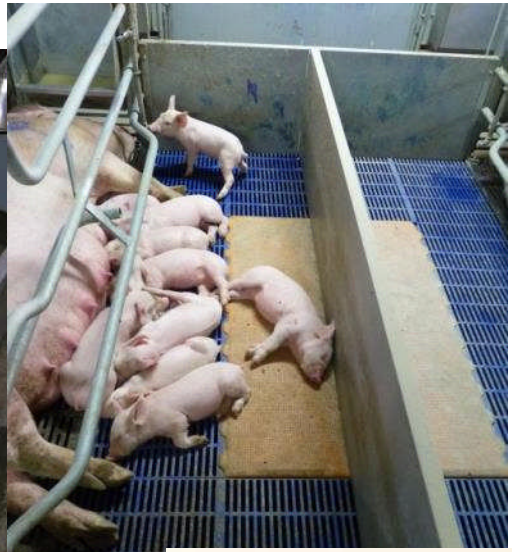
Biogas direct heating



Skerman et al, RIRDC, 2012

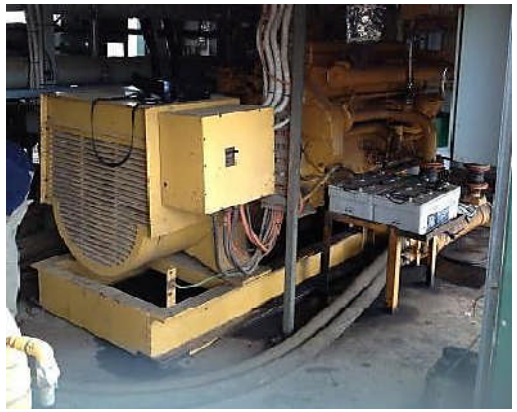
Biogas heating





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

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

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

- Tom Smith (Kia-ora)
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