Case Study: Biogas from farm wastes and agro-industrial biosolids

“Unlocking additional revenue from traditional rural land use - integrating forestry, biomass crops and bioenergy products.”

Jurgen H Thiele
16 May 2013
Case Study: Biogas from farm wastes and agro-industrial biosolids

an integrated development consultancy delivering clever and practical solutions

Civil Engineering
Environment | Transport | Water

Structural Engineering
Analysis & Design (Etabs, Revit & Other) | Seismic Assessment | Value Engineering | Safety Design | Damage Avoidance Technologies

Surveying
Advocacy | Asset Recording | GIS Data Collections | Laser Scanning | Lettable Area Survey | Land & Building Subdivision

Planning
Strategic Land Use | Statutory Planning | Business Case Feasibility

www.spiire.co.nz
Wastewater Value Recovery - the Project Implementation Path

- Economic Feasibility Study
- Construction Cost estimate

- Project Commissioning (mechanical, electrical, biological) - Project Operation Support

Construction project management and supervision support

- Project construction by client - appointed contractor
- Prelim design – Confirmation of Construction Costs by Client
- Detailed design by Client
Co-digestion is the biogas production from the combined processing of
- animal manure, biosolids
- added secondary digestion feed stocks

The purpose is a
- biogas production rate increase (additional revenue, $ earned/ $ invested)
- higher efficiency and beneficial use of feed stocks (additional revenue, gate fees, fertiliser production)

Added materials must be non toxic to process and environment and have a high digestibility.
Examples of suitable co-digestion feed stocks

<table>
<thead>
<tr>
<th>Co-digestion Feedstock</th>
<th>% DS range</th>
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<tbody>
<tr>
<td>Dissolved Air (DAF) float (dairy factory, meat processing)</td>
<td>10 – 20 % (high fat content)</td>
</tr>
<tr>
<td>Cheese whey</td>
<td>5 % (high sugar content)</td>
</tr>
<tr>
<td>Grease trap waste (municipal, commercial collection)</td>
<td>5 – 10 % (high fat content)</td>
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<tr>
<td>Municipal biosolids (primary sludge)</td>
<td>3-4 % (high fat content)</td>
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“Unlocking additional revenue from co-digestion feed stocks in New Zealand

about 3.5 PJ/annum (FRST Energy Scape Project 2008)

1 PJ/annum biogas equivalent to 108 million kwh power generation per year

1 PJ/annum biogas equivalent to 27.8 million liter diesel fuel per year

Estimate of Nett National methane bioenergy potential from each sector (given in PJ methane biofuel/year)
Note: The processing energy requirement (heat, power) is assumed to be covered from the produced methane and is already subtracted

Upgrading Municipal Digesters

Built in 1965

2 x 1360 m³

Mixed with biogas recirculation
Better mixing, Install Booster
Regional Opportunities

↓↓: Existing council digesters with potential co-digestion capacity

Regional breakdown of current Nett methane biofuel production potential from major wastes in regional areas. The process energy required for methane production (power, heat) is already subtracted.

The estimated total recoverable methane energy value for each region is given in PJ methane/yr in parenthesis. Values were calculated using MSW Scenario 1 and biosolids processing from domestic sewage + ICI sewage.

Case Study: Revenue Extraction Potential – Biogas from Co-Digestion Plants

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<th>Co-digestion Plant</th>
<th>Cattle milked (hd)</th>
<th>Energy price ($/kwh)</th>
<th>Construction costs (M $NZ)</th>
<th>Industrial Waste added (t/day)</th>
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On Farm Applications – Dairy Farm Cluster
Digesters – Value Proposition – Rural Land Owners

Dairy cows milked in 3 km radius from central Co-digestion plant

7,400 +/- 500 hd
“Unlocking additional revenue from biomass crops and bioenergy products.” – Value Proposition to Dairy Farmers

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Off Farm Applications – Regional Digester Facilities – Value Proposition to NZ Pork Industry

- 5 -10 Pork Producers
- 80- 90 t/day piggery effluent
- About 5 food processing industries (seasonal)
- 10-20 t/day food industry processing waste
- 10 – 40 km Distance to Regional Facility
- Regional Digester Facility close to a major heat user

The Christchurch Hub Project

- Digester size: 20 – 40 days residence time
- Digestate storage: 30 days
- Digestate: returned to farms
- Biogas use: heating and co-generation

Source: Thiele JH (2010). Feasibility Study for Construction and Operation of a Regional Digester Facility. Feasibility Study for the Energy Efficiency and Conservation Authority, the NZ Pork Industry Board and the NZ Department of Corrections, EECA website
“Unlocking additional revenue from biomass crops and bioenergy products.” – Value Proposition to New Zealand

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<tr>
<td>Regional Digester Facility, Pork Industry</td>
<td>0</td>
<td>0.15 (diesel)</td>
<td>5 - 6</td>
<td>10 - 20</td>
<td>80</td>
<td>0</td>
<td>Heating fuel, 6,000,000</td>
<td>3 – 4</td>
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<td></td>
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<td></td>
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Estimate of Nett National methane bioenergy potential from each sector (given in PJ methane biofuel/year)

Note: The processing energy requirement (heat, power) is assumed to be covered from the produced methane and is already subtracted

|-------------------|---------------------------|--------------------------------------|-------------------------------|----------------------------|----------------------------|--------------------------|
1. Income from attractive gate fees
2. Best practice manure management
3. Rural bioenergy production
4. Attractive “economy of scale”
5. Valuable fertiliser production (“free”)
6. Land use possible for energy crops

“Unlocking additional revenue from co-digestion feed stocks – Benefits to Land Owners

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<td>2. Diversion of industrial waste from landfills</td>
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Map: Estimate of Nett National methane bioenergy potential from each sector (given in PJ methane biofuel/year)
Summary and Conclusions

In New Zealand

1. Rural, industrial and municipal landowners are likely to compete in future for good quality, low cost materials that are suitable for bioenergy extraction by co-digestion.

2. Very attractive prospects exist for dairy farmers to double the on-farm electricity production capacity with good economy of scale and lower electricity production costs when situated close to dairy and meat processing factories.

3. The NZ pork industry is in a unique position to utilise co-digestion systems for reduction of pig slurry treatment costs (odour reduction) close to population centres.

4. Biogas from co-digestion schemes is a cost effective and flexible, high value fuel for direct applications in the heat, electricity generation and rural transport (farming) sector.

5. Fertiliser sale is the added benefit for rural co-digestion plant operators/land owners and a significant competitive advantage.
Questions ?
Ideal Co-substrate Mix Composition

Water

salts

fat, oil & grease

volatile solids

proteins

carbohydrate

dry matter

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
The Wastewater Value Recovery Team

- Originated from the Waste Solutions Team
- Focus on New Zealand and Australia
- Waste Treatment Infrastructure Innovations