Farm scale Anaerobic Digestion

Presenter: RM Energy

Date: 21st May 2014
AD?

• Biodegradable waste broken down by micro-organisms in absence of oxygen.

• How does it work?
  – Ad produces biogas (mixture of methane and CO$_2$).
  – This is used to power a CHP engine which is connected to a generator.
  – Surplus heat can be used to heat water.
  – Concentrated digestate residue is an excellent odour-free organic fertilser (rich in nitrogen, phosphorus & potassium).
  – With larger systems, can upgrade the biogas to biomethane which can be used as fuel or injected into the gas grid.

• Reduces slurry storage requirements
• Widely used in Germany, Austria, Sweden & Denmark
## Typical agricultural AD feedstocks

<table>
<thead>
<tr>
<th>Feedstock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow/pig manure/slurry, poultry litter</td>
</tr>
<tr>
<td>Energy crop such as silage / fodder beet</td>
</tr>
<tr>
<td>Crop spoilage - potatoes / soft fruits / etc</td>
</tr>
<tr>
<td>Top foliage</td>
</tr>
</tbody>
</table>

### For 1,000 kWh/yr of electricity

- Slurry from 1 cow + 2.3 tonnes grass silage
- 3,200 potatoes
How good is Grass Silage?

- **Most productive** (compared to maize silage and wholecrop cereals) at typically ~18 fresh tonnes/acre/yr
- Production costs are lower than other forms of silage
- But methane yields are lower, so larger area required.
- But grass silage can be cropped 3x/yr.
Can cow slurry be used on its own?

- Yes . . . Some systems can work on slurry only.
- But . . . cow slurry has high water content . . . and the methane content is relatively low compared to other manures.
- So need greater quantities.

- The Biomethane Methane Potential (BMP) is significantly increased by the addition of energy crop such as silage.
- Pre-treatment of the feedstock can make extraction of the BMP more efficient.
- Using the heat by-product of an AD plant for this can qualify for RHI (Renewable Heat Incentive).
How much do you need?

- Depends entirely on the feedstock mix & BMP.
- For quite a large farm scale AD plant with 250kW capacity, something like . . .
  - 400 dairy cows producing ~20 tonnes wet slurry/day.
  - Approx 7,300 tonnes wet slurry/yr
  - 125ha (300 acres) of silage on 3 cut basis.
  - Approx 5,625 tonnes silage/yr.

- For a 75kW plant, something like . . .
  - Approx 150 dairy cows
  - Approx 7.5 tonnes wet slurry/day (2,700 t/yr)
  - 50ha (120 acres) of silage
  - Approx 2,250 tonnes silage/yr
How much do you need?

- If there is straw manure, poultry litter, or other feedstocks with good biomethane potential, this can help significantly especially in reducing the amount of silage required.

- As part of the feedstock assessment, typical samples are laboratory analysed.
How do you make money?

- **Generation Tariff**

<table>
<thead>
<tr>
<th>kW</th>
<th>FiT Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 250</td>
<td>12.13 p/kWh</td>
</tr>
<tr>
<td>250 - 500</td>
<td>11.22 p/kWh</td>
</tr>
<tr>
<td>&gt; 500</td>
<td>9.24 p/kWh</td>
</tr>
</tbody>
</table>

- **Export Tariff**

<table>
<thead>
<tr>
<th>Via FIT or ROOFIT</th>
<th>Via Power Purchase Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.77 p/kWh</td>
<td>~6.0 p/kWh</td>
</tr>
</tbody>
</table>

- **Savings by replacing grid-bought electricity with self-generated power.**
Renewable Heat Incentive (RHI)

- Some of the heat generated by the AD process and by the CHP engine is used parasitically and does not qualify for RHI.
- To qualify, heat must be deemed ‘useable’.
  - To heat ‘useful’ hot water.
  - To run an AD pre-treatment process to render the system more efficient.
  - To dry the digestate residue prior to spreading as fertiliser.

- RHI Rate

<table>
<thead>
<tr>
<th>Size</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any size for Biomethane</td>
<td>7.3p / kWth</td>
</tr>
<tr>
<td>For Biogas up to 200kWth</td>
<td>7.3p / kWth</td>
</tr>
</tbody>
</table>
Planning & Permitting

- ‘Permanent’ plants require full planning consent.
- Micro-AD plants (such as containerised systems) can be considered under Permitted Development Rights.
- SEPA needs to be involved (Waste Management Licence and/or Pollution Prevention & Control)
- Permitting is required for importing certain feedstocks such as food waste, abattoir waste, etc.
- If the main ingredients are slurries and manures produced on the farm then permitting is straightforward.
- Bringing in additional silage or other energy crops from neighbouring farms to feed the AD plant is OK as you are not importing organic ‘waste’. 
Sizes available

<table>
<thead>
<tr>
<th>Sizes available</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>8, 15, 21, 28, 65 kW</td>
<td>Containerised</td>
</tr>
<tr>
<td>75, 100, 150, 250 kW and upwards</td>
<td>‘Permanent’ installations</td>
</tr>
</tbody>
</table>

- **We work with identified best-of-breed within the AD sector, such as . . .**
  - SEaB Energy – containerised systems up to 65kW.
  - FLI Energy – from 75kW upwards.
Where are electricity prices heading?

• Continuing to trend upwards.
• Past 5 years has seen av of 6%/yr in real terms.
• Why will this continue . . .?
  – Growing pressures on national generation capacity.
  – Aging generation plant.
  – Slow decisions on building new capacity.
  – Increasingly energy hungry population.
Summary

- Renewable source of self-generated electricity and heat.
- FiT & RHI payments assured for 20 years (index linked).
- Surplus electricity sold to the grid.
- Excellent fertiliser in the digestate residue (reduced fertiliser bills).
- Option to upgrade biogas to ‘biomethane’ to use as fuel in vehicles or tractors, or export to the grid.
- Attractive return on your money.
- Proven technology widely applied in Europe.
- Clean, quiet, and essentially odour free.
- Long design life.
- Reduced CO₂ and methane emissions.
Bit of this . . . + Bit of that . . . = Some of this . . .

Thank you!