Transforming Ireland
Mobilising Innovation and Enterprise to Become a Prosperous Low Carbon Society

Harnessing the Energy Within
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UCD Earth Sciences Institute
with TCD TrinityHaus
In conjunction with the TCD-UCD Innovation Alliance Public Lecture Series
Kedco Plc

Provide platforms to harness energy within organic feedstocks
Using Gasification and Anaerobic Digestion
The Competence Centre for Biorefinery and Bioenergy

Developed by EI, IDA and Industry Partners

The Vision of the Bioenergy and Biorefinery Competence Centre is to provide cutting edge research and development outputs to support a sustainable and competitive Irish biomass (bioenergy and bioproducts) industry.
Irish Photovoltaic Cells

Evolved in Ireland
For Ireland
Biogas plant
Potentials of Biogas Technology

Biomethane is

like natural gas – but home produced
like natural gas - but supply secure
like natural gas - but permanently economical
Biogas potential

- Energy Crops: 44%
- Agricultural slurry: 23%
- Side products from plant production: 23%
- Sewage sludge: 3%
- Communal Landfill and land maintenance: 5%
- Organic waste from households and industrial municipalities: 2%
- Landscape: 0%
Heat Utilisation options through gas pipelines
Lessons from Germany regarding heat losses

- The degree of utilization of residual heat generated in power production at the CHP, may significantly impact the profitability of a biogas plant.
- About 90 percent of all biogas plants are more than 4 kilometers away from large potential heat consumers, such as residential houses, companies, swimming pools, schools, kindergartens and churches.
- Plants should be established where possible as close to potential customers to reduce heat loss in transportation. The further distance, the larger the heat loss. It is not economically viable to relocate CHP units or heating pipes in the vast majority of cases in Germany.
Lessons learned from Germany

• In establishing Biogas Plants proper consideration should be given to the location of the CHP so that the heat created in electricity generation can actually be used. The transport of biogas is cheap and the energy loss in transportation is minimal.

• The advantages at a glance:
  • Cost savings through installation of local heating rather than gas pipelines
  • Minimize heat loss
  • Increase the overall efficiency of the biogas plant
  • But with the waste heat from CHP's one with 150 kW el capacity 130,000 liters of heating oil could be saved per year!
Feedstock flexibility for Biogas plants

**Organic waste**
- Old bread
- Apple pulp
- Brewers grain
- Bio waste
- Separation fat
- Flotation fat
- Vegetable waste
- Grain cleanings
- Distillery grains
- Glycerin
- Coffee draff
- Coco shells
- Potatoe greens
- Potatoe peelings
- Leaves
- Molasses
- Wey
- Rapeseed cake
- Grass cuttings
- Onion peelings

**Energy Crops**
- Grass silage
- grass silage
- Fodder beet
- Triticale
- Wheat
- Potatoes
- Clover
- Barley
- Sugar beet
- Maize silage
- Sunflower silage
### Biogas yields from different substrates

<table>
<thead>
<tr>
<th>Substrate</th>
<th>Gas yield m³N biogas /t substrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow manure (9% DM)</td>
<td>30</td>
</tr>
<tr>
<td>Pig manure (7% DM)</td>
<td>30</td>
</tr>
<tr>
<td>Chicken manure (15%DM)</td>
<td>58</td>
</tr>
<tr>
<td>Grass silage (25%DM)</td>
<td>151</td>
</tr>
<tr>
<td>Maize silage (30%DM)</td>
<td>200</td>
</tr>
<tr>
<td>Cereal straw</td>
<td>300</td>
</tr>
<tr>
<td>Wheat whole grain (85%DM)</td>
<td>700</td>
</tr>
</tbody>
</table>
Potential Future Developments

- Increased efficiency through digestive enhancers and enzymes
- Biorefining of Digestate
  - Bioplastics
  - Nutraceuticals
  - Nutritional products
Biofuels in Comparison

Biokraftstoffe im Vergleich
So weit kommt ein Pkw mit Biokraftstoffen von 1 Hektar Anbaufläche

- Biomethan: 67,600 km
- BtL (Biomass-to-Liquid): 64,000 km
- Rapsöl: 23,300 km + 17,600 km*
- Biodiesel: 23,300 km + 17,600 km*
- Bioethanol: 22,400 km + 14,400 km*

Pkw-Kraftstoffverbrauch: Otto 7,4 l/100 km, Diesel 6,1 l/100 km

* Biomethan aus Nebenprodukten (Rapskuchen, Schlempe, Stroh)

Quelle: Fachagentur Nachwachsende Rohstoffe e. V. (FNR)
Examples of feed in tariff in Europe

<table>
<thead>
<tr>
<th>Country</th>
<th>Price for biogas € per kw</th>
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<tbody>
<tr>
<td>United kingdom</td>
<td>€0.18</td>
</tr>
<tr>
<td>Germany</td>
<td>€0.18-0.28</td>
</tr>
<tr>
<td>Austria</td>
<td>€0.16-0.18</td>
</tr>
<tr>
<td>Italy</td>
<td>€0.22-0.28</td>
</tr>
<tr>
<td>France</td>
<td>€0.16 (30% capital grant)</td>
</tr>
<tr>
<td>Latvia</td>
<td>€0.15-0.20 (linked to gas price)</td>
</tr>
<tr>
<td>Czeq republic</td>
<td>€0.16-€0.18</td>
</tr>
<tr>
<td>Ireland</td>
<td>€0.12</td>
</tr>
<tr>
<td>Spain</td>
<td>€0.14-€0.16</td>
</tr>
</tbody>
</table>
Anaerobic Digestion – Shared Goals

What Anaerobic Digestion Could Deliver Nationally

1. By 2020 anaerobic digestion will be an established technology in this country, making a significant and measurable contribution to our climate change and wider environmental objectives. It will produce renewable energy in the form of biogas that will be used locally or injected into the grid for heat and power and for transport fuel. At the same time, it will capture methane emissions from agriculture. It will also divert organic waste, especially food waste, from landfill. The digestate will provide organic fertiliser and soil conditioner for agriculture and land use. Anaerobic digestion and its products will be used in a way that is both beneficial to the environment and cost effective for that particular location.

This is good news for the environment and for the UK economy
COMPARISON CASE STUDY ON 380KW PLANT

- **UK Farmer**
  - Capital costs €1.3m
  - Electricity sales €523,000 uk price €0.18a kw
  - Potential heat sales €73,000
  - Cost of feedstock
  - Grass silage 8000 tonne @€25 €200,000
  - Maize silage 1300 tonne @€30 a €39,0000
  - Slurry 4000 tonne
  - Net profit €169,000

- **Irish farmer**
  - Capital costs €1.3m
  - Electricity sales €349,000
  - Potential heat sales €73,000
  - Cost of feedstock
  - Grass silage 8000 tonne @25 €200,000
  - Maize silage 1300 tonne@€30 €39,000
  - Slurry 4000 tonne
  - Loss of €29,000
Land use in Ireland

Land area 6.9mha

Agricultural 4.3mha
Forestry 0.7mha
Other 1.9m ha

Pasture, hay and silage 3.4mha
Rough grazing 0.5mha
Arable crops 0.4mha

91%
The potential in Ireland to produce home grown electricity from grass

- 1 ha of grass land can produce 2.5kw of electricity constantly (90% available)

**Example** 10% of grassland 3.4mha = 340,000ha x 2.5kw = 850,000kw = 850mw

- The average demand in Ireland for electricity 3080mw
- Grassland alone could produce up 28% of average electricity requirements
- Approx 150ha of grass for approx 0.38mw plant
The potential in Ireland to produce home grown electricity from grass

- A 380kw plant will require feedstock to the value of €240,000 per year. This feedstock must be produced locally.
- 2400 plants would add an extra €576,000,000 to the rural economy per annum.
- Presently the money required to buy the feedstock to generate this amount of electricity is currently leaving the country.
Livestock figures in Ireland

Source national statics

<table>
<thead>
<tr>
<th>Livestock Figures</th>
<th>2007</th>
<th>2000</th>
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</thead>
<tbody>
<tr>
<td>Cattle Numbers</td>
<td>6,572,500</td>
<td>7,037,435</td>
</tr>
<tr>
<td>Sheep</td>
<td>5,344,500</td>
<td>6,891,534</td>
</tr>
<tr>
<td>Pigs</td>
<td>1,620,100</td>
<td>1,722,108</td>
</tr>
<tr>
<td>Horses &amp; Ponies</td>
<td>86,700</td>
<td>69,937</td>
</tr>
<tr>
<td>Poultry</td>
<td>11,884,100</td>
<td>13,960,771</td>
</tr>
</tbody>
</table>
Potential electricity produced from cattle slurry

- The average electricity requirement is 3080kw
- Cattle can produce 17% of Ireland average electricity requirements

6572,500 cattle Ireland
10 cattle slurry can produce 0.8kw (based on 180 days housed)
Cattle produce 525mw
The potential electricity produced from pig slurry

- The average electricity requirement is 3080mw
- Pigs can produce 1% of Ireland requirement

- There are 1620100 pigs in Ireland.
- 100 fattening pigs can produce 2kw.
- Pig in Ireland can produce 32mw of power.
The potential in Ireland to produce electricity from arable land

- The average use of electricity in Ireland 3080mw
- Arable land can produce 3.2% of Ireland average electricity needs
- Feedstock costs would \( (240,000 \times 263) = €6312000 \)
- This equates to 263 (380kw biogas plants)
summary of agricultural potential to produce electricity

- Grassland 850mw
- Arable land 100mw
- Cattle slurry 525mw
- Pigs slurry 32mw
- Total mw potential from agricultural 1507mw
- This equates 49% of average electricity needs

The untapped energy on this island
UCD Earth Sciences Institute with TCD TrinityHaus

Transforming Ireland Seminar Series

In conjunction with the TCD-UCD Innovation Alliance Public Lecture Series
With the support of Business in the Community Ireland and in collaboration with
Comhar Sustainable Development Council, Environmental Protection Agency,
Geological Survey of Ireland, Sustainable Energy Authority Ireland, Dublin City Council,
Met Éireann, Enterprise Ireland, Marine Institute and Teagasc

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