Seminar on the Production and Use of Biogas

Production and Use of Biogas: EU Regulations and Research

David Baxter

(With input from Kyriakos Maniatis: EC-DG TREN)
Contents of Presentation

• Outline of EU Policies & Targets Related to Renewable Energy
• EU Biogas Production Data and Targets for the Future
• A Selection of EU IEA-Member Country Data & Scope of Legislation
• EU Research Projects
• A Summary of FP6 Funding
• Useful Contact Details and References
EU Policies and Targets: Energy (1)

- **RES White paper 1997**: increase share of RES from 6% to 12% of gross consumption by 2010
- **Action plan for Energy Efficiency target**: to reduce energy intensity by a further 1 % point per year until 2010
- **Comply with EU commitments under the 1997 Kyoto Protocol** on reducing greenhouse gas emissions
- Johannesburg “coalition of the willing” to work to increase the use of RES using targets and timetables
EU Policies and Targets: Energy (2)

- Directive 2001/77/EC of 27.09.01 on RES-e: to establish a framework to increase the share of green electricity from 14% to 22% of gross electricity consumption by 2010.

- Directive 2002/91/EC of 04.01.03 on the energy performances of buildings: saving potential of 22%.

- Directive 2003/30/EC of 08.05.2003 on the promotion of liquid biofuels for transport: targets: 2% by 2005; 5.75% by 2010.

EU Policies and Targets: Energy (3)

- **Waste Incineration (2000/76/EC)**
  Limits on emissions from thermal treatment of Waste materials (effective 12/2005)

- **Landfill (1999/31/EC)**
  Reduced landfilling of biodegradable component of waste by 65% by 2016

- **Integrated Pollution Prevention and Control (96/61/EC):** special provision for RES
EU Policies and Targets: Biogas

There is no particular policy on biogas, it is a component of the general bioenergy "cocktail" ...so it is covered by all policies related to RES and bioenergy.

Landfill gas is covered by the policies on waste management but its applications falls under the energy policies.
The RES Directives & Energy from Waste

Waste is a valuable resource!

- The Biodegradable fraction of MSW is a RES. (e.g. classified as 50% in the NL)
- Energy and fuels from waste is thus covered by the Directives.

- One of the main problems is how to determine the biodegradable fraction of waste streams?
- Need for Standards??

Kaiserslautern, DE
EU Biogas Production Data and Targets for the Future
# Sources of European Biogas Production

<table>
<thead>
<tr>
<th>Source</th>
<th>Installations</th>
<th>Production Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landfill</td>
<td>450</td>
<td>38%</td>
</tr>
<tr>
<td>Urban Sewage</td>
<td>1600-1700</td>
<td>33%</td>
</tr>
<tr>
<td>Industrial Sewage</td>
<td>420</td>
<td>24%</td>
</tr>
<tr>
<td>Agricultural Biogas</td>
<td>1600-1700</td>
<td>2%</td>
</tr>
<tr>
<td>Methanisation of Municipal Waste</td>
<td>65</td>
<td>2%</td>
</tr>
<tr>
<td>Collective Co-digestion</td>
<td>55</td>
<td>1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>~ 4250</td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Source: EurObserver – Biogas Energy Barometer, August 2004
Crude Biogas Production (Units = ktoe)

<table>
<thead>
<tr>
<th>Country</th>
<th>2002</th>
<th>2003*</th>
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<tbody>
<tr>
<td>UK</td>
<td>1076</td>
<td>1151</td>
</tr>
<tr>
<td>Germany</td>
<td>659</td>
<td>685</td>
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<td>France</td>
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<td>Spain</td>
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<tr>
<td>Italy</td>
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<td>Belgium</td>
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<tr>
<td>Greece</td>
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<tr>
<td>Ireland</td>
<td>28</td>
<td>28</td>
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<tr>
<td>Finland</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Luxemburg</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2999</strong></td>
<td><strong>3219</strong></td>
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</tbody>
</table>

* estimated

Source: EurObserver - Biogas Energy Barometer, August 2004
## Energy Production from Biogas (Units = ktoe)

<table>
<thead>
<tr>
<th></th>
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<td>Germany</td>
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<td>168</td>
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<td>320</td>
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<td>19</td>
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<td>5</td>
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<td>Ireland</td>
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<td>9</td>
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<td>Greece</td>
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<td>6</td>
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<tr>
<td>Luxemburg</td>
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<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>Portugal</td>
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<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>766</strong></td>
<td><strong>397</strong></td>
<td><strong>1163</strong></td>
<td><strong>809</strong></td>
<td><strong>417</strong></td>
<td><strong>1226</strong></td>
</tr>
</tbody>
</table>

Source: EurObserver - Biogas Energy Barometer, August 2004
## Biogas Production Potential by the Year 2020 (Units = ktoe)

<table>
<thead>
<tr>
<th>Country</th>
<th>Potential in 2020</th>
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<tbody>
<tr>
<td>France</td>
<td>3682</td>
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<tr>
<td>Germany</td>
<td>3419</td>
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<tr>
<td>UK</td>
<td>2271</td>
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<td>Italy</td>
<td>1626</td>
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<tr>
<td>Spain</td>
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<td>Netherlands</td>
<td>1172</td>
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<tr>
<td>Ireland</td>
<td>1028</td>
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<tr>
<td>Belgium</td>
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<tr>
<td>Denmark</td>
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<td>Austria</td>
<td>526</td>
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<tr>
<td>Sweden</td>
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<td>Portugal</td>
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<tr>
<td>Finland</td>
<td>263</td>
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<tr>
<td>Greece</td>
<td>167</td>
</tr>
<tr>
<td>Luxemburg</td>
<td>31</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17987</strong></td>
</tr>
</tbody>
</table>

Source: Solagro/EurObserver - Biogas Energy Barometer, August 2004
Trends in Growth of Biogas Production

- Actual Amount
- EU Target
- Solagro Study (30% annual growth rate)
- Trend with 25% growth rate
A Selection of EU IEA-Member Country Data & Scope of Legislation
Individual Country Positions: Netherlands

Output: 2002

Gross production - 149 ktoe (inclusive 14 ktoe flared) (data from NOVEM)

- 37 ktoe heat
- 304 GWh electricity ( = 27 ktoe)
- 38 million m³ injected into natural gas network

Legislation

- Manure Regulation (1977) - list of types of manure
  - restricted allowance for co-digestion
  - digestate from co-digestion allowed to be used or sold for land improvement
- Target of 10% for renewable energy in 2010: 7% of electricity from renewable fuel
  (13% electricity now consumed is green, but only 3.3% generated in NL - expected that NL will purchase “green certificates” from outside EU)
- Green electricity free from ECO-tax applied to fossil fuels
- Liberalisation of energy market from 01.07.2004
Individual Country Positions: Sweden (1)

Output: 2003

Gross production - 147 ktoe (data from STEM)

?? ktoe heat
120 GWh electricity ( = 10.3ktoe)
?? million m³ injected into natural gas network
110 GWh (9.5 ktoe) vehicle fuel

Policy/Legislation

• Targets: 7.4% renewable electricity (2003); 16.9% (2010)
• Biogas for heat production is not taxed
• Green certificates for electricity production (from 2004): 27 €/MWh (market price for electricity ~ 20 €/MWh)
• Biogas for vehicles not taxed; natural gas is taxed - difference is equal to upgrading cost of biogas to pipeline quality
• For EC Biofuels Directive, approximately 2/3 supplied by ethanol, 1/3 biogas (mainly for buses and local distribution); on target for 3% in 2005, but growth rate too low to meet 5.75% by 2010
Individual Country Positions: Sweden (2)

Effects of Policy

Market price for biogas as transport fuel ~ 60 €/MWh (attractive !!)
Biogas mainly from sewage sludge, but large interest in plants for digestion of MSW (due to landfill restrictions)
Interest in agricultural biogas limited due to low electricity price and uneven demand for heat on farms - but green certificate system could change this situation.

Research

Government-funded, 3-year project (1.65 MEuro) started in 2004:

Objective: improvement in cooperation between regions with a view to facilitating more widespread use of biogas as a vehicle fuel.
The Swedish Association for Biogas (SBGF) will administer the project.
Individual Country Positions: Austria

Output: 2003

Gross production - 64 ktoe (data from EurObserver)

8 ktoe heat
221 GWh electricity ( = 19 ktoe)

Legislation

- Eco-electricity law (BGB1 I 149/2002): defines conditions, inputs etc.
- Regulation (BGB1 II 508/2002): sets prices for eco-electricity from biogas plants for export to grid
  Plants must be commissioned by 31.12.2004 and in operation by 31.12.2006
  Prices guaranteed for accepted plants for 13 years (~120 plants in operation; ~40 plants under construction
- Biogas carries ECO-label, but digestate disposal is a problem
Individual Country Positions: UK

Output: 2002

Gross production - 1076 ktoe (data from DTI)

?? ktoe heat
3076 GWh electricity ( = 265 ktoe)

Most electricity production from landfill (2679 GWh)

Legislation

• The Renewables Obligation Order (SI 2002/914: 01.04.2002)
  Covering biogas (landfill and sewage), wind, geothermal, hydro, biomass
  (including energy crops and co-firing), tidal, wave, PV, ...
  Target: to provide 10% of UK’s electricity from renewables by 2010
  (this means building 1.25 GW extra capacity/year !)
  Control: by “Renewable Obligation Certificates” (ROCs) which can be traded
  Possible to “buy out” obligation at current price of £30.51 per MW/h.
• No tax advantage for biogas over NG, but 25% investment support for biogas
  production/recovery plants
Individual Country Positions: Finland

Output: 2002

Gross production - 18 ktoe (No expansion forecast for 2003)

3 ktoe heat
23.3 GWh electricity (= 2 ktoe)

Legislation

• National Climate Change Strategy (2001)
• Action Plan for Renewable Energy Sources (1999) plays important role
  Biogas production supported by grants for investment + tax relief for electricity
  Small projects (0.2 - 2M €) get 20% of investment costs: > € 2M grants and projects employing new technology get up to 40%
  New tax system (2003) provides support of 0.42 € cents/kWh for electricity to grid from plant with capacity >2 MVA (<2 MVA, no support)

Access to grid granted by Electricity Market Law No 386/1995
Fuel Tax Law No. 1280/2003: biogas for transport exempt from taxation
EU Research Projects
On-going projects (1):

- AMONCO (Advanced Prediction, Monitoring and Controlling of Anaerobic Digestion Process Behaviour Towards Biogas Usage in Fuel Cells)
  - identify harmful species in raw gas
  - feedstock composition control (primary measure)
  - advanced process control to maximise CH4 production
  - cost effective gas cleaning to FC specification
  - assessment of effect of biogas in FC (single cell tests)
  - implementation strategy

Impact: Overcome problems with contaminants in biogas used for FC/CHP

Contact Point: Profactor, Austria
Reference: ENK6-CT-2001-00518
On-going projects (2):

- **3A-BIOGAS** (Three-Step Fermentation of Solid State Biowaste for Biogas Production and Sanitation)
  - assessment of end-user requirements
  - optimise 3A (aerobic + anaerobic + aerobic) process at prototype scale
  - series production of modular batch system for dry fermentation with percolation
  - optimised process control system
  - socio-economic assessment
  - preparation for exploitation

Impact: Availability of digestion process to complement common wet processes, particularly in agriculture

Contact Point: Muller Abfallprojekte, Austria
Reference: ENK6-CT-2002-30026
RESEARCH at EU LEVEL

On-going projects (3):

• DIPROWASTE (Enhanced Production of Methane from Anaerobic Digestion with Pre-processed Solid Waste for Renewable Energy)
  - evaluation of waste pretreatment methods
  - assessment of anaerobic digestion of selected wastes
  - quality evaluation of digester products
  - establish digester design criteria
  - system evaluation for large-scale plant
  - economic assessment

Impact: Demonstrated cost effective pre-treatments for enhanced biogas recovery

Contact Point: ABIRER Systems, Germany
Reference: CRAFT-71485-1999
RESEARCH at EU LEVEL

On-going projects (4):

• ENERGATTERT (Agricultural Biogas as Green Energy Supply)
  - evaluation of other, existing installation
  - assessment of different waste mixes for effective digestion
  - use of demonstration plant on 350-unit bovine farm
  - study and optimisation of biomethanisation process
  - assessment of biogas production
  - dissemination and public awareness

Impact: Enabling biomethanisation to be properly assessed as means for energy recovery

Contact Point: Emmanuel Hannick, Belgium
Reference: NNE5-227-2001
On-going projects (5):

• EROB (Development of an Improved Energy Recovery of Biogas by Cooling and Removal of Harmful Substances)
  - analysis of cleaning efficiencies of existing systems
  - verification of cleaning at landfill site
  - design of standard modular cleaning system
  - manufacture, installation and commissioning at landfill site
  - process reliability assessment and plant optimisation
  - Dissemination of results and launch of system on the market

Impact: Increased exploitation of landfill gas for energy recovery

Contact Point: Pro2 Anlagentechnik GmbH, Germany
Reference: ENK5-CT-2000-30004
STATUS OF PROCESSES & APPLICATIONS

- RDF & Sludge
- Co-gasification
- Incineration
- Pyrolysis
- Anaerobic Digestion
- Co-Gasification
- Bioethanol & other novel processes

Technology Strength

Market Potential

Low
Medium
High

Strong
Average
Weak

Slide Courtesy of K.Maniatis: EC-DG TREN
## MARKET OPPORTUNITIES

<table>
<thead>
<tr>
<th>Existing Markets</th>
<th>New Markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Penetration</td>
<td>Market Development</td>
</tr>
<tr>
<td>Incineration</td>
<td>Co-Gasification</td>
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<tr>
<td>Anaerobic Digestion</td>
<td>CHP</td>
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<tr>
<td>New Technology</td>
<td>Resources???</td>
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<tr>
<td>Product Development</td>
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<tr>
<td>Plastics Pyrolysis</td>
<td></td>
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<tr>
<td>RDF, Plastics Gasification</td>
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<tr>
<td>BioEthanol &amp; novel</td>
<td></td>
</tr>
<tr>
<td>Diversification</td>
<td>Waste “refineries”</td>
</tr>
</tbody>
</table>

Source: K. Maniatis, EC-DG TREN
A Summary of FP6 Funding
6th Framework Programme

Sustainable development, global change and ecosystems

- Sustainable energy systems (810 M€)
  - Short and medium term impact (DG TREN)
  - Medium and long term impact (DG RTD)
- Sustainable surface transport (610 M€)
- Global change and ecosystems (700 M€)

Slide Courtesy of K.Maniotis: EC-DG TREN
### Intelligent Energy Europe

**Total budget 215 M€**

**Vertical key actions: to tackle non-technological barriers**

<table>
<thead>
<tr>
<th>SAVE</th>
<th>ALTENER</th>
<th>STEER</th>
<th>COOPENER</th>
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</thead>
<tbody>
<tr>
<td>- Multiplying success in buildings</td>
<td>- RES-Electricity</td>
<td>- Alternative fuels and vehicles</td>
<td>- Create an enabling policy and legislative environment for energy services in developing countries</td>
</tr>
<tr>
<td>- Retrofitting of social houses</td>
<td>- RES-Heat</td>
<td>- Policy measures for and efficient use of energy in transport</td>
<td>- Strengthen local energy expertise and build human capital in the developing countries</td>
</tr>
<tr>
<td>- Innovative approaches in industry</td>
<td>- Small Scale RES Applications</td>
<td>- Transforming the market: Energy Efficient Equipment and Products</td>
<td></td>
</tr>
<tr>
<td>- Transforming the market: Energy Efficient Equipment and Products</td>
<td>- Alternative fuels and vehicles</td>
<td>- Strengthening the knowledge of local management agencies in the transport field</td>
<td></td>
</tr>
</tbody>
</table>

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Slide Courtesy of K.Maniatis: EC-DG TREN
Useful Contact Details and References

- CORDIS:
  http://www.cordis.lu/rtd2002/

- EUROPA:
  http://www.europa.eu.int/comm/dgs/research/index_en.html

- Energy research web site:
  http://europa.eu.int/comm/research/energy/index_en.html

- DG Energy and Transport web site:
  http://europa.eu.int/comm/energy/index_en.html

- Contact Point for Waste and Biomass Related Activities at JRC-Institute for Energy: http://ie.jrc.cec.eu.int/

  David.Baxter@jrc.nl - Tel/Fax: (+31) 22456-5227/5626
Thank you