The technology platform for agricultural based lignocellulosic substrates – Case examples from R&D and full scale implementations.

The 3.rd IBBA workshop,
Malmoe, Sweden, September 10.th , 2015

by
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Sustainable Global Energy

Global Primary Energy in E/year


→ Bioenergy will be here to stay, and grow!
Comparison of the basic principles of the petroleum refinery and the biorefinery, Source: Kamm et al. 2006

Two-platform biorefinery concept
Source: NREL 2006, Biomass Program, DOE/US]
Energy potential of pig and cattle manure in EU-27

<table>
<thead>
<tr>
<th>Total manure</th>
<th>Biogas</th>
<th>Methane</th>
<th>Potential</th>
<th>Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10^6 tons]</td>
<td>[10^6 m^3]</td>
<td>[10^6 m^3]</td>
<td>[PJ]</td>
<td>[Mtoe]</td>
</tr>
<tr>
<td>1,578</td>
<td>31,568</td>
<td>20,519</td>
<td>827</td>
<td>18.5</td>
</tr>
</tbody>
</table>

Methane heat of combustion: 40.3 MJ/m^3; 1 Mtoe = 44.8 PJ
Assumed methane content in biogas: 65%

Biogas Production & Forecast:
- Actual 2010 production of biogas in EU 27: 10 Mtoe
- 2012-2015 EU forecast: 15 Mtoe
- Manure potentials: 18.5-20 Mtoe
- Organic waste and byproducts: 15-20 Mtoe
- Crops and crop residuals: 20-30 Mtoe
- Total long term forecast Biogas: 60 Mtoe
- Biogas can cover 1/3 of EU’s total RES 20% demands year 2020
AD Co-digestion - heterogeneous feedstock's

- Manure
- Food waste
- Organic by-products
- Crops
Biogas

- **Redistribution and treatment facilities**
  - Bioslurry, biofibres and other biomasses.
  - Redistribution and surplus treatment as organic fertilizer sale products
  - Electricity, heat and transportation fuels
  - Water environment, Climate combat and odour reduction
  - Further treatment of fibres
  - Digested fibre incineration / gasification

- **Organic fertilizer plants**

- **Increased utilisation of biogas**
  - Local and further distances from the biogas plants – gas
  - CHP utilisation and the transport sector

*Biogas are biorefinery platforms step 1.*
- This is the future challenge 2012-2020
- Need fast tracks, by all new projects
Use of Straw in Energy Production

- In Denmark a large share of the collected straw is used for energy.
- Annual turn-over from straw for farmers is €65 million.

Use of straw million tons average 2006-2010:

- Turn-over of €65 mill. annually
- 2.098 Left in field
- 1.642 Energy
- 1.125 Feed
- 693 Bedding
- 5.558 Total straw
Figure 30 Product container directly after the flash, releasing a lot of steam.

Figure 31 Left: straw series; Right: willow series.

Figure 32 Left: willow without flash; Middle: willow at same conditions with one flash; Right: willow at same conditions with double flash.
Koczała biogas plant (2009) – 2 x 1063 kW
# POLDANOR’S BIOGAS PLANTS

<table>
<thead>
<tr>
<th>No.</th>
<th>BIOGAS PLANT</th>
<th>LOCATION (commune)</th>
<th>COMMISSIONED</th>
<th>POWER [kWe]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Pawłówko</td>
<td>Przechlewo</td>
<td>2005</td>
<td>946</td>
</tr>
<tr>
<td>2.</td>
<td>Płaszczyna</td>
<td>Przechlewo</td>
<td>2008</td>
<td>625</td>
</tr>
<tr>
<td>3.</td>
<td>Kujanki</td>
<td>Człuchów</td>
<td>2008</td>
<td>330</td>
</tr>
<tr>
<td>4.</td>
<td>Koczała</td>
<td>PKoczała</td>
<td>2009</td>
<td>2126</td>
</tr>
<tr>
<td>5.</td>
<td>Nacław</td>
<td>Polanów</td>
<td>2010</td>
<td>625</td>
</tr>
<tr>
<td>6.</td>
<td>Świelino</td>
<td>Bobolice</td>
<td>2010</td>
<td>625</td>
</tr>
<tr>
<td>7.</td>
<td>Uniechówek</td>
<td>Debrzno</td>
<td>2011</td>
<td>1064</td>
</tr>
<tr>
<td>8.</td>
<td>Giżyno</td>
<td>Kalisz Pomorski</td>
<td>2011</td>
<td>1064</td>
</tr>
</tbody>
</table>

Total installed capacity: **7,405 MW el.** and **8,140 MW heat**
Large Scale Bioenergy Lab

Project focus 2012 -2015. New biomass, innovations technologies, meeting the challenges, peoples acceptance and green jobs in the cross border region.

Identification, Analysis, Mapping and Management of Sustainable Biomass Resources in the Region of Southern Denmark-Sleswig-K.E.R.N., Germany:

- Biomass from nature conservation
  - Protected nature: meadow, marshland
- Biomass from permanent grassland
- Agricultural residues
  - Manure / straw
- Biomass from other areas
  - Airports
  - Roadside grass
- Biomass from recreational areas
  - Parks
  - Football fields/ Golf courses etc.
- Others..
  - Algae, seaweed
  - Household waste
  - Industrial waste
Potential from unutilised grass production from agricultural land

Uncertainties:

- Grass yields (DK ↑)
- Different systems for feeding!
- Differences in data level!
”Engen er agerens moder”
(Meadow - the ”mother” of arable land)
Nature conservation-Biogas projects

Energy

Biodiversity

Environment
Naturpleje græs (Fersk eng og strandeng)
Overskudsproduktion af græs fra landbrugsarealer
(Græs i omdrift og permanente græsarealer)
Overskudsproduktion af græs fra landbrugsarealer
(Græs i omdrift og permanente græsarealer)
ENVIRONMENTAL AND NATURE CONSERVATION CONSIDERATIONS: PERMANENT GRASSLAND AND PASTURES – AT SUCH AREAS THE NATURE HAS THE HIGHEST PRIORI

- TO SUPPORT THE MANAGEMENT OF SPECIES-RICH GRASSLAND, TO MAINTAIN A HIGH BIODIVERSITY
MEC konceptet

Udnyttelse af synergi i råvareomsætning og procesanlæg

- Biomasse
- Biogas
- 2 G. Bioethanol
- Biomasse Kraftvarme
- Transportbrænds tof
- EI & varme
- VE - gas
- Gødning
Thank you for your attention!

Q & A ‘s

R, D & D cooperation partners in LSBEL:

- **University of Flensburg**: Center for Renewable Energy Systems (ZNES); Sönke Bohm, Simon Laros and Olav Hohmeyer

- **FHF, Germany**: Biogas R&D group - Lars Jürgensen, Torsten Stefan, Miria Frances Agunyo & Jens Born

- **AAU-Campus Esbjerg, Denmark**: Bioenergy Research Group; - Ane Katharina Paarup Meyer, Chitra Sangaraju Raju & Jens Bo Holm-Nielsen

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