Community Partnerships for a University-based Renewable Energy Biodigester

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Director of Sustainability

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Biomass is the Lead Renewable

The Role of Renewable Energy in the Nation's Energy Supply, 2009

Total = 99.578 Quadrillion Btu

- Petroleum 37%
- Natural Gas 25%
- Coal 21%
- Nuclear Electric Power 9%

Total Renewable Energy = 8%
- Hydropower 35%
- Wind 9%
- Geothermal 5%
- Solar 1%

- Biomass 50%

Note: Sum of components may not equal 100% due to independent rounding.
Biofuels Available: Gases

- **Biogas**
  - **Methane** from anaerobic (no oxygen) digestion of biomass
  - Same use as Natural Gas
    - clean/separate water, CO$_2$, odor
    - Produced in liquid tanks, solid piles, landfills

- **Syngas**
  - **Hydrogen** from pyrolysis (low-oxygen combustion) of biomass
    - More energy than combustion of biomass
    - Use like natural gas
Biomass as Biogas

- **Methane** from anaerobic (no oxygen) digestion of biomass
- Same use as Natural Gas
  - Need to clean/separate water, CO\(_2\), odor
- Produced in liquid tanks, solid piles, landfills
- Typical composition:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Methane</td>
<td>45-70 %</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>25-55 %</td>
</tr>
<tr>
<td>Water Vapor</td>
<td>0-10%</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>0-1%</td>
</tr>
</tbody>
</table>

Higher methane content = more energy

Landfill gas is usually lower quality (45% methane)
Land use efficiency of biofuels

<table>
<thead>
<tr>
<th>Conversion Type</th>
<th>Energy for Production</th>
<th>Net Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass to heat</td>
<td></td>
<td></td>
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<tr>
<td>Corn to gas</td>
<td></td>
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</tr>
<tr>
<td>Grass to gas</td>
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<tr>
<td>Grass to liquid</td>
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<td></td>
</tr>
<tr>
<td>Corn to liquid</td>
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<tr>
<td>Soy to liquid</td>
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</tbody>
</table>
Biomass Resources of the United States
Total Biomass per Square Kilometer

This study estimates the biomass resources currently available in the United States by county. It includes the following feedstock categories: crop residues (5 year average: 2003-2007), forest and primary mill residues (2007), secondary mill and urban wood waste (2002), methane emissions from landfills (2008), domestic wastewater treatment (2007), and animal manure (2002). For more information on the data development, please refer to http://www.nrel.gov/docs/fy08osti/39981.pdf. Although, the document contains the methodology for the development of an older assessment, the information is applicable to this assessment as well. The difference is only in the data's time period.

Author: Billy Roberts - September 23, 2009

This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy.
UW Oshkosh Facts

- Third largest university in Wisconsin
- Founded in 1871 (downtown, waterfront)
- 13,600 Students, 1700 faculty and staff
- Listed in Princeton Review Guide to Green Colleges
UW Oshkosh Limitations:
-- Dense Urban Setting; 2\textsuperscript{nd} most crowded campus in the UW

Mike Baldwin
THE BIOFERM™ PLANT AT THE UWO CAMPUS

The First Commercial Scale Dry Fermentation System in the Americas

UWO to construct nation’s first-of-its-kind biodigester

Biodigester will turn food waste to energy

UW-Oshkosh to be 1st in nation to use energy from food

One-of-a-kind biodigester will be constructed beginning in fall 2010, will use left-over campus waste, expired groceries, yard waste to power 5 percent of campus
UW Oshkosh: opportunities and challenges

Allendorf Germany
Biomass to Energy

Biomass (Food, Agriculture Waste, Yard Waste)

Anaerobic Dry Fermentation Digester

Biogas (Methane)

Generator (CHP = Combined Heat and Power)

Electricity, Heat and Compost

www.biofermenergy.com/us
BioFerm System: 3 Basic Components

GAS STORAGE

GENERATOR

Sealed Chamber
“Dry” Process – water is recycled (no wastewater produced)

“Percolate” – water, nutrients, microbes
Add Biomass to Chamber…
Oxygen is used up; methane is produced...
Electricity and Heat are generated...

Electricity and Heat are generated from PERCOLATE. Solid “digestate” goes to aerobic composter site (can be custom batched – e.g. organic).
ARGUMENTS AGAINST-

NUCLEAR

OIL

COAL

IT'S IN MY BACKYARD!
The BIOFerm™ plant at the UWO campus

Odor Management

- Enclosed mixing lobby reduces odorous air emissions.
- Ventilated with 1.5 air exchanges per hour.
- Process air released via a biofilter.
URBAN SITING

-- Next to Facilities Management Building (refurbished supermarket)

-- across the river from campus

-- Zoned for light industry
URBAN SITING

-- Next to Facilities Management Building (refurbished supermarket)
-- across the river from campus
-- Zoned for light industry
-- Other Neighbors:
  -- sewage treatment plant
  -- yard waste dropoff site
  -- technical college
  -- senior center
ChP Generator: 370 kW
Annual Electric: 2,400 MWh (ca. 8% of UWO)
Annual Heat: 2,700 MWh (ca. 8% of UWO)
Hypothetical Feedstock Source Profile

Tons/Year

Year (Note: Facility lifetime is >20 yrs)
THE BIOFERM™ PLANT AT THE UWO CAMPUS

Collaboration between:
UW Oshkosh Foundation
University of Wisconsin Oshkosh
BIOFerm™ Energy Systems.

The UWO Plant is a close copy of the BIOFerm™ plant built at the Viessmann Corporate headquarters in Allendorf, Germany
1. **Renewable Energy Facilities** serve as Learning Labs
   -- Major: Biomass and solar
   -- Minor: Geothermal
   -- Demonstration: Wind

2. **Research Laboratories** for Service and Training:
   -- Biosolids and Water Testing
     (UWO strengths in Chemistry and Microbiology)

3. **Renewable Energy Institute** for Professional Development
   -- Short Courses, certificates, visiting scholars
Questions?
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