University of Wisconsin Oshkosh – Sustainability Accelerator: Integrating methane digesters with energy efficiency for a smarter campus

Thomas G. Sonnleitner
Vice Chancellor for Administrative Services
University of Wisconsin Oshkosh

Nadeem Afghan
President and CEO
BIOFerm Energy Systems
Representing Sustainability on Higher Education Campuses

Universities and colleges are, and must continue to be, national leaders in the sustainability and renewable energy movements.
Representing Sustainability on Higher Education Campuses

• American Colleges and Universities President’s Climate Commitment
• Assessments and Footprint Inventories
• Sustainability Councils and Directors
• Student Groups and Research
University of Wisconsin System

Legend
- Four-Year Campuses
- UW Colleges
UWO Interesting Facts

- Third largest university in Wisconsin
- Comprehensive campus
- Founded in 1871
- 14,000 Students, 1,700 faculty and staff
- 74 associate, baccalaureate, master's and doctoral programs
Leading by Example:
University of Wisconsin Oshkosh

- UW Oshkosh was ranked #3 in Sierra Magazine’s “Cool Schools” rating.
- BestColleges.com ranked UW Oshkosh #5 in the nation in its green school rating system.
- In 2013, UW Oshkosh was one of only 21 schools listed in Princeton Review’s “Green Honor Roll” and also earned Gold in the AASHE STARS program.
- In 2011, the University installed a dry fermentation anaerobic biodigester, the first of its kind in the country, and earned the 2011 Silver Waste-to-Energy Excellence Award from the Solid Waste Association of North America.
- UWO’s three biodigesters are rated to generate nearly half of the university’s electricity needs.
- UWO purchases 16% of its electricity from green energy.
- As the first designated Fair Trade Campus in the country, UWO offers an increasing variety of socially and environmentally responsible products including coffee, tea, chocolate, clothing, and household and decorative items.
- UW Oshkosh has been designated a “Tree Campus USA” school every year since 2011, by the National Arbor Day Foundation for its tree canopy, diversity, and educational programming.
- In 2015, campus was designated a Monarch Butterfly Waystation for its monarch-friendly landscaping.
UWO History of Environmental Attention

- Environmental curriculum
- Early adopter of statewide lighting retrofits
- Performance contracts for energy and water efficiency
- Renewable energy purchases
- Environmental Audit
- Green Building Goals
- Governor’s Energy Independence campus
- Campus Sustainability Plan
- Presidents Climate Commitment
- Public/private partnerships
2008 Campus Sustainability Plan

**Sustainable Energy:** independent of fossil fuels for electricity, heating and cooling

**Electricity:** Reduce consumption 20% from 2005 to 2012

**Heating:** Reduce fossil fuel use 50% from 2000 to 2012

**Facilities Planning, Renovation and Construction:** Energy efficient and sustainable design standards on all new construction and renovation projects … meet or exceed a LEED “Silver”

**Transportation:** Reduce automobile trips to campus 20% by 2012

**Assessment:** Establish the means to assess campus sustainability and provide information to students, staff and community.
What’s Needed?

- Emissions today **and a forecast into the future**
- Management plan and tools that allow for updating, tracking and auditing
- Strategies for dealing with supply side and demand side for energy
Reducing Our Carbon Footprint

The University of Wisconsin Oshkosh is committed to cultivating a more just and durable world. To that end, we are embedding sustainable building and learning into our daily living and producing the equivalent of > 50% of campus electrical consumption through renewable energy.
Construction begins at UW Oshkosh

University goal:

*Increase the use of energy from renewable sources.*

September 15, 2010
UW Oshkosh Biogas Systems

City – Dry Fermentation

Small Farm – Plug Flow

Large Farm – Complete Mix
<table>
<thead>
<tr>
<th>Facility Type</th>
<th>BD1</th>
<th>BD2</th>
<th>BD3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>City of Oshkosh</td>
<td>Rosendale Dairy</td>
<td>Allen Farm</td>
</tr>
<tr>
<td>Size/animal type</td>
<td>NA</td>
<td>9000 Cattle Dairy Farm</td>
<td>130 Cattle Dairy Farm</td>
</tr>
<tr>
<td>Feedstock</td>
<td>Bedding – 55%</td>
<td>Manure</td>
<td>Solid Manure – 56%</td>
</tr>
<tr>
<td></td>
<td>Food Waste - 32%</td>
<td></td>
<td>Wash Water – 24%</td>
</tr>
<tr>
<td></td>
<td>Yard Waste – 12%</td>
<td></td>
<td>Bedding – 13%</td>
</tr>
<tr>
<td></td>
<td>Curbside MSW – 1%</td>
<td></td>
<td>Co-Substrates – 7%</td>
</tr>
<tr>
<td>Pre treatment</td>
<td>Mixing via Loader</td>
<td>Sand Separation</td>
<td>Mixing via direct feed and/or Loader</td>
</tr>
</tbody>
</table>
# Digester System

<table>
<thead>
<tr>
<th></th>
<th>BD1</th>
<th>BD2</th>
<th>BD3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology</strong></td>
<td>BIOFerm - Dry</td>
<td>Schmack - COCCUS</td>
<td>Schmack - EUCOlino</td>
</tr>
<tr>
<td><strong>System Type</strong></td>
<td>Dry Batch</td>
<td>Complete Mix</td>
<td>Plug Flow</td>
</tr>
<tr>
<td><strong>Target Temp</strong></td>
<td>Mesophilic <em>(38°C or 100°F)</em></td>
<td>Mesophilic <em>(38°C or 100°F)</em></td>
<td>Mesophilic <em>(38°C or 100°F)</em></td>
</tr>
<tr>
<td><strong>Target Internal Solids Content</strong></td>
<td>25 – 35%</td>
<td>10 – 12%</td>
<td>10 – 15%</td>
</tr>
<tr>
<td><strong>Target HRT</strong></td>
<td>28 days</td>
<td>21 days</td>
<td>30 days</td>
</tr>
<tr>
<td><strong>Tons per Year</strong></td>
<td>10,000</td>
<td>110,000</td>
<td>4,000</td>
</tr>
</tbody>
</table>
# Biogas Use / Digestate Management

<table>
<thead>
<tr>
<th></th>
<th>BD1</th>
<th>BD2</th>
<th>BD3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CHP Size</strong></td>
<td>370 kW</td>
<td>1426 kW</td>
<td>64 kW</td>
</tr>
<tr>
<td><strong>Electric Use</strong></td>
<td>Export – PPA (WPS)</td>
<td>Export – PPA (Alliant)</td>
<td>Export – PPA (WPS)</td>
</tr>
<tr>
<td><strong>Revenue Blended Rate</strong></td>
<td>$0.08</td>
<td>$0.09</td>
<td>$0.08</td>
</tr>
<tr>
<td>($/kWh)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Digestate End Use</strong></td>
<td>Composted</td>
<td>Current – Separated Fiber</td>
<td>Sent to Manure Pit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Future – Further Processing</td>
<td></td>
</tr>
<tr>
<td><strong>Digestate Vale</strong></td>
<td>Organic Compost or Soil Amendment</td>
<td>Current – Farm Use Future – Bedding, Bagged Fertilizer, compost product, etc.</td>
<td>Fertilizer – On-Site Farm Use</td>
</tr>
</tbody>
</table>
BDI: The First Commercial Scale Dry Fermentation System in the Nation!

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

UWO plant 1st in nation

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
BD1: The First Commercial Scale Dry Fermentation System in the Nation!
Case Study: Biodigester

Dry Digester

- Processes 10,000 tons of organic waste
- Produces up to 370 kW of continuous electrical power and 495 kW of continuous thermal energy
- Waste water treatment plant collaboration
- Private/public collaboration
BD1 – Average Feedstock Totals

Annual Organic Material Processed = 10,000 tons per year
Electricity and Heat are generated…

Solid “digestate” → aerobic composter site
UW Oshkosh Biodigester II
Renewable Energy Facility

Wisconsin's largest dairy farm will be home to one of Wisconsin's most dynamic research, renewable energy production and public education facilities as part of an initiative involving the University of Wisconsin Oshkosh's College of Letters and Science and UW Oshkosh Foundation.

On Aug. 24, the UW Oshkosh Foundation Board of Directors unanimously endorsed a proposal to pursue an innovative partnership with Milk Source's Rosendale Dairy and renewable energy companies Viessmann Group and BioFerm Energy Systems of Madison.
University of Wisconsin–Oshkosh
Rosendale Digester (BD2)

- Wet digester – Complete Mix
  - Largest dairy farm in WI
    - 9,000 cows
  - Provides manure management
  - Construction began June 3rd, 2013
  - 110,000 tons annually
  - 1426 kW electrical

- University of Wisconsin–Oshkosh: Rosendale Digester (BD2)
State, UWO Foundation, partners rally around small-farm biodigester project

Biodigesters already come in dry, wet, big and bigger varieties as envisioned and built by the University of Wisconsin Oshkosh Foundation, its College of Letters and Science and engineering partners Viessmann Group and BIOFerm Energy Systems.

However, the latest incarnation of this sustainable energy generation technology is getting smaller – family-farm sized. And that is prompting the state of Wisconsin to get behind the technology in a new way.

On March 6, Wisconsin Department of Administration (DOA) Secretary Mike Huebsch announced support through the DOA and State Energy Program for a feasibility study to install anaerobic digestion units on family farms with fewer than 500 head of dairy cattle. The "EUcoIno" (OY-co-ino) project conducted by BIOFerm™ Energy Systems and the University of Wisconsin Oshkosh, through the UW Oshkosh Foundation, involves the first small-scale biodigester unit in Wisconsin. The feasibility study and test project will be located on the Allen Farm, about six miles northwest of Oshkosh.

"Wisconsin is the national leader for installed anaerobic digestion, and we have the leading minds in the nation working to advance on-farm energy solutions," Huebsch said. "Under the Walker Administration's leadership, the collaborative relationship built by the Allen's, BIOFerm, the University of Wisconsin Oshkosh
University of Wisconsin–Oshkosh
Case Study: Allen Farm

- Small scale prototype, plug flow digester
  - Small scale digester installation
  - Designed for limited waste steam
  - Processes up to 4,000 tons of cattle manure and bedding from ~130 cows
  - Produces 64 kW continuous electrical power and 101 kW of continuous thermal energy
Titan Gold™
Available from regional retailers and UW Oshkosh at:
- [http://www.uwosh.edu/eric/titangold/purchase-titan-gold](http://www.uwosh.edu/eric/titangold/purchase-titan-gold)
Value-added product from digester ‘waste’
Community Collaborations for a Sustainable World

The University of Wisconsin Oshkosh is committed to cultivating a more just and durable world. One of three signature questions in our core curriculum asks students: “How do people understand and create a more sustainable world?”

**Wet Anaerobic Biodigester (2014)** –
A rural, renewable energy biogas facility is created through a partnership with Wisconsin’s largest dairy farm, international experts and area communities.

Removes harmful methane gas ad kills pathogens in 110,000 tons of manure each year

**Great Lakes Beach Restoration Projects (2003-today)** –
UW Oshkosh’s Environmental Research and Innovation Center redesigns 20 Wisconsin beaches.

Creates healthier water resources
Restores natural areas along shorelines

**Oshkosh Sports Complex (2007)** –
Titan Football Field is updated and re-imagined to be a city-wide football, soccer, baseball and track facility.

Eliminates the need for four separate facilities
Includes new turf that saves 850,000 gallons of water per year

**Hotel Partnership (2012)** –
An ailing waterfront hotel in Oshkosh is revitalized by pooling municipal, foundation and community resources.

Revitalizes a seven-story city riverfront building
Supports the city’s and UW Oshkosh’s conference and tourism needs

“Top Coolest School” — Sierra Magazine

UNIVERSITY OF WISCONSIN OSHKOSH

First U.S. Fair Trade Campus
What is the advantage to a comprehensive campus?

- Responsiveness
- Ability to directly connect with top administrators and faculty at the same time.
- Ability to utilize campus for ‘community-scale’ demonstrations of efficiencies and technologies.
- Increased time for faculty and staff to work on targeted projects.
- Better integration between facilities, operations, and academics.
Next steps in energy and sustainability?

- JCI/UWO Collaboration
- Battery Storage
- Development of nutrient extraction technology
- Next generation digesters
- Training next generation of workers
Questions