Wisconsin Farm Biogas Development

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Status of Farm Digesters in Wisconsin

- 25 – Farms w/ Operating Digesters
- 12 – New Farms with Digesters Proposed w/ (8) Under Construction

- 15 Mixed-Flow Mesophilic
  - 6 proposed
- 5 Complete Mix Mesophilic
  - 3 proposed
- 3 Complete Mix Thermophilic
- 3 Up-Flow Anaerobic Sludge Blanket digesters proposed

March 1, 2011
Farm Digester Growth Trends in Wisconsin

- 2009 – Three new systems were placed on-line
- 2010 – One new system was placed on-line
- 2011- 12 systems proposed, 8 under construction
- Why the recent jump in activity?
  - Focus on Energy Bonus incentive offerings for specific utility customers (up to $500,000 incentive)
  - Investment Tax Credit/ US Treasury Grant
    - 30% Federal treasury grant due to Exp. 12/31/2010
    - Extended for one year in the day leading to the deadline
  - Push for outside investment and finance assistance
  - Favorable utility buy-back rates by select utilities
## WI Utility Electric Buyback Rates

### Biogas Electric Production

<table>
<thead>
<tr>
<th>Company</th>
<th>Rate</th>
<th>Size</th>
<th>On-Peak hr</th>
<th>Off-Peak hr</th>
<th>On-peak $/kwh</th>
<th>Off-peak $/kwh</th>
<th>RE Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xcel</td>
<td>Pg-2</td>
<td>&gt; 100 kW</td>
<td>3059</td>
<td>5707</td>
<td>$0.103</td>
<td>$0.044</td>
<td>NA</td>
</tr>
<tr>
<td>Xcel</td>
<td>ART</td>
<td>&lt; 800 kW</td>
<td>n/a</td>
<td>n/a</td>
<td>$0.073</td>
<td>$0.073</td>
<td>Yes</td>
</tr>
<tr>
<td>WE Energies</td>
<td>CGS 1</td>
<td>&gt; 20 kW</td>
<td>3059</td>
<td>5707</td>
<td>$</td>
<td>$</td>
<td>NA</td>
</tr>
<tr>
<td>WE Energies</td>
<td>CGS 5</td>
<td>&lt;= 2 MW</td>
<td>3059</td>
<td>5707</td>
<td>$0.155</td>
<td>$0.061</td>
<td>Yes</td>
</tr>
<tr>
<td>WPS</td>
<td>PG-2</td>
<td>&gt; 20 kW</td>
<td>3850</td>
<td>4916</td>
<td>$0.4096</td>
<td>$0.0247</td>
<td>NA</td>
</tr>
<tr>
<td>WPS</td>
<td>PG-BioGas</td>
<td>&lt; 2 MW</td>
<td>3850</td>
<td>4916</td>
<td>$0.10355</td>
<td>$0.05917</td>
<td>Yes</td>
</tr>
<tr>
<td>Alliant</td>
<td>Pgs-1</td>
<td>&lt; 20 kW</td>
<td>3569</td>
<td>5197</td>
<td>$0.083</td>
<td>$0.036</td>
<td>NA</td>
</tr>
<tr>
<td>Alliant</td>
<td>Pgs-ART</td>
<td>&lt; 2 MW</td>
<td>3569</td>
<td>5197</td>
<td>$0.120</td>
<td>$0.0735</td>
<td>Yes</td>
</tr>
<tr>
<td>MGE ('10)</td>
<td>Pg-1</td>
<td>&gt; 20 kW</td>
<td>2803</td>
<td>5963</td>
<td>$0.063</td>
<td>$0.044</td>
<td>NA</td>
</tr>
<tr>
<td>MGE ('10)</td>
<td>Pg-3</td>
<td>&gt; 20 kW</td>
<td>n/a</td>
<td>n/a</td>
<td>$0.061</td>
<td>$0.061</td>
<td>Yes</td>
</tr>
<tr>
<td>Dairyland</td>
<td>DG-5</td>
<td>&gt; 40 kW</td>
<td>3640</td>
<td>5120</td>
<td>$0.105</td>
<td>$0.054</td>
<td>NA</td>
</tr>
</tbody>
</table>

(Average rate, based on day by day wholesale value)

(Limited to the first 10 MW of Biogas projects)

(Program is fully subscribed and not offered for 2011)
US Farm Biogas Systems

<table>
<thead>
<tr>
<th>Farm Type</th>
<th>Numbers of Ads</th>
<th>Installed Capacity (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy</td>
<td>120</td>
<td>42,307</td>
</tr>
<tr>
<td>Swine</td>
<td>22</td>
<td>2,909</td>
</tr>
<tr>
<td>Poultry</td>
<td>3</td>
<td>675</td>
</tr>
<tr>
<td>Beef</td>
<td>2</td>
<td>2,600</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>147</strong></td>
<td><strong>48,491</strong></td>
</tr>
</tbody>
</table>

In comparison, 5,000 anaerobic digesters in Germany.
Germany: Renewable Electricity

Structure of electricity supply from renewable energy sources in Germany 2009

- Hydropower: 20.3%
- Photovoltaics: 6.6%
- Landfill gas: 1.0%
- Biogenic share of waste: 5.3%
- Biogenic liquid fuels: 1.6%
- Biogenic solid fuels: 12.9%
- Biogas: 10.7%
- Sewage gas: 1.1%
- Wind energy: 40.4%
- Photovoltaics: 6.6%

Total: 93.5 TWh

Share of biomass*: approx. 33%

* Solid, liquid, gaseous biomass, biogenic share of waste, landfill and sewage gas; Deviations in the totals are due to rounding.
Source: BMU-KI III 1 according to Working Group on Renewable Energies-Statistics (AGEE-Stat); all figures provisional.
Installed Farm Biogas Capcities

Sources: German Biogas Association 2010
4 Key drivers to German success?

1. Comprehensive climate and energy policy with ambitious targets
2. Proactive German Farm Bureau and renewable energy industry
3. Social catalysts in Germany
4. Rural communities striving for 100% renewables
What do investors want from policy?

Investors essentially look for 3 key drivers in policy:

- **Transparency**
- **Longevity**
- **Certainty and Consistency**

In assessing the potential success of policies, these factors should be taken into account.
Driver #1: comprehensive climate and energy policy with ambitious targets

- > targets for 2020:
  • 40% less GHG emissions (270 Mio. Tons)
  • 30% share of renewable energy in electricity
  • 14% share of renewable energy in heating
  • (EU energy package: 20-20-20 by 2020)

- > Policies:
  • carbon taxes in 1999
  • feed-in tariffs in 2000
  • Cap & trade in 2005
  • Renewable Energy Action Plan in 2010
Feed-in tariff (FIT) rates (biogas example)

- Guaranteed grid access and long-term contracts for electricity generators
- Rate based on cost of generation plus reasonable profit
- Decreasing payment levels over time

<table>
<thead>
<tr>
<th>Technology or Feedstock</th>
<th>2009</th>
<th>2010</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Feed-in tariff (FIT)</td>
<td>0.117</td>
<td>0.116</td>
<td>capacity&lt;150 kW</td>
</tr>
<tr>
<td>Premium if technology is agricultural biogas</td>
<td>0.070</td>
<td>0.069</td>
<td>capacity&lt;500 kW</td>
</tr>
<tr>
<td>Premium if biogas unit uses 30% liquid manure feedstock</td>
<td>0.040</td>
<td>0.040</td>
<td>capacity&lt;150 kW</td>
</tr>
<tr>
<td>Premium if primary feedstock is &quot;waste from cleaning natural open spaces&quot;</td>
<td>0.020</td>
<td>0.020</td>
<td>capacity&lt;500 kW</td>
</tr>
<tr>
<td>Premium if unit employs cogeneration</td>
<td>0.030</td>
<td>0.030</td>
<td>capacity&lt;20,000 kW</td>
</tr>
</tbody>
</table>

Source: Beyond Biofuels: Renewable Energy Opportunities for US Farmers-Nov 2010 Presentation, Jungjohann, Arne and Hilary Flynn
Renewable energies = new jobs

Figures for 2008 and 2009 are provisional estimate;
Source: BMU-KI III Projekt "Gross employment from renewable energy in Germany in the year 2009, a first estimate"; Image: BMU / Christoph Busse / transit

- Wind energy
  - 2004: 63,900
  - 2008: 85,100
  - 2009: 109,000

- Biomass
  - 2004: 56,800
  - 2008: 79,600
  - 2009: 109,000

- Solar energy
  - 2004: 25,100
  - 2008: 74,400
  - 2009: 87,100

- Hydropower
  - 2004: 9,000
  - 2008: 9,300
  - 2009: 9,100

- Geothermal energy
  - 2004: 1,800
  - 2008: 3,400
  - 2009: 4,300

- Public / non-profit - sector jobs
  - 2004: 1,800
  - 2008: 4,300
  - 2009: 6,500

Increase: approx. 87%
Biogas – Jobs and Influence on Economy

- **Germany is the global market leader in the biogas industry** and has a target to achieve 25% of total electricity production from biogas by 2020.

- 8.7% of the electricity from renewables in Germany is generated from Biogas (2009), representing 1.3% of total electricity supply and 67% of renewable electricity supply.

- There were over 4,000 biogas plants in Germany at the end of 2009 and this is expected to rise to over 5,300

- An estimated **11,000** people are employed in the sector in Germany and this is expected to rise to over 12,000

<table>
<thead>
<tr>
<th>German Biogas Industry</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Plants</td>
<td>2,600</td>
<td>3,500</td>
<td>3,710</td>
<td>1,168</td>
<td>4,000</td>
<td>5,300</td>
</tr>
<tr>
<td>Installed Capacity (MW)</td>
<td>6,500</td>
<td>11,000</td>
<td>1,270</td>
<td>1,370</td>
<td>1,740</td>
<td>1,950</td>
</tr>
<tr>
<td>Employment</td>
<td>500</td>
<td>1,000</td>
<td>10,000</td>
<td>11,000</td>
<td>12,000</td>
<td></td>
</tr>
</tbody>
</table>

*Source: German Biogas Industry; IFAT, 2010; Fachverband Biogas e.V, 2009; German Society for Sustainable Biogas and Bioenergy Utilisation, 2009; European Biogas Association, 2010; German Federal Ministry of Economics and Technology; DBCCA Analysis, 2010.*
• Ontario mandates a “Feed in Tariff” for Renewable Energy Production
• RE generators engage in a 20 year contract with the utility “Hydropower”
• FIT is developed under a mandated Price Schedule that is revised every 2 years
• Producer receives payment from the utility
• Utility is not compensated for costs incurred

<table>
<thead>
<tr>
<th></th>
<th>Farm Biogas Rate</th>
<th>Non-Farm Biogas Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100 KW</td>
<td>$0.195 / kwh</td>
<td></td>
</tr>
<tr>
<td>&gt;100 KW</td>
<td>$0.185 / kwh</td>
<td>$0.16 / kwh</td>
</tr>
<tr>
<td>500 KW-10 MW</td>
<td>$0.185 / kwh</td>
<td>$0.147 / kwh</td>
</tr>
<tr>
<td>&gt; 10 MW</td>
<td>$0.104 / kwh</td>
<td></td>
</tr>
</tbody>
</table>
“Vermont’s Sustainably Priced Energy Development Program was enacted by the Vermont Legislature and Governor in June 2005 in 30 V.S.A. § 8005 and § 8001. The goal of the law authorizing the SPEED program is to promote the development of in-state energy sources which use renewable fuels (SPEED resources) to ensure that to the greatest extent possible the economic benefits of these new energy sources flow to the Vermont economy in general, and to the rate paying citizens of the state in particular.”

Source: http://vermontspeed.squarespace.com/
Vermont SPEED Program

- Enacted by Vermont Legislature and Governor in June 2005.
- Goal of the law is to promote the development of in-state energy sources which use renewable fuels (SPEED Resources)
- Significantly amended in May 2009
- Created “Standard Offer” contracts and “Feed In Tariffs” for SPEED resources <2.2 MW
- SPEED Agent monitors and meters the electricity produced, bill utilities based on % of load
  - Minimum goal of generating 5% of 2005 load (294,283 MWH) with SPEED resources
  - Long-term goal is to generate 20% of load by 2017

### Annual Price Schedule ($/MWH)

<table>
<thead>
<tr>
<th>Year</th>
<th>Solar PV</th>
<th>Hydro</th>
<th>Landfill Gas</th>
<th>Farm Methane</th>
<th>Wind 1.5MW</th>
<th>Wind 100kW</th>
<th>Biomass</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>240</td>
<td>118.8</td>
<td>86.9</td>
<td>135.9</td>
<td>112.5</td>
<td>208.3</td>
<td>120.8</td>
</tr>
<tr>
<td>2</td>
<td>240</td>
<td>119.4</td>
<td>87.3</td>
<td>136.6</td>
<td>113.1</td>
<td>209.3</td>
<td>121.4</td>
</tr>
<tr>
<td>3</td>
<td>240</td>
<td>120</td>
<td>87.9</td>
<td>137.3</td>
<td>113.6</td>
<td>210.3</td>
<td>122.1</td>
</tr>
<tr>
<td>4</td>
<td>240</td>
<td>120.6</td>
<td>88.5</td>
<td>137.9</td>
<td>114.2</td>
<td>211.3</td>
<td>123</td>
</tr>
<tr>
<td>5</td>
<td>240</td>
<td>121.2</td>
<td>89.1</td>
<td>138.6</td>
<td>114.8</td>
<td>212.4</td>
<td>123.9</td>
</tr>
<tr>
<td>6</td>
<td>240</td>
<td>121.8</td>
<td>89.8</td>
<td>139.3</td>
<td>115.3</td>
<td>213.5</td>
<td>124.8</td>
</tr>
<tr>
<td>7</td>
<td>240</td>
<td>122.4</td>
<td>90.5</td>
<td>140</td>
<td>115.9</td>
<td>214.5</td>
<td>125.7</td>
</tr>
<tr>
<td>8</td>
<td>240</td>
<td>123</td>
<td>91.2</td>
<td>140.7</td>
<td>116.5</td>
<td>215.6</td>
<td>126.7</td>
</tr>
<tr>
<td>9</td>
<td>240</td>
<td>123.7</td>
<td>91.9</td>
<td>141.5</td>
<td>117.1</td>
<td>216.8</td>
<td>127.7</td>
</tr>
<tr>
<td>10</td>
<td>240</td>
<td>124.3</td>
<td>92.6</td>
<td>142.2</td>
<td>117.7</td>
<td>217.9</td>
<td></td>
</tr>
</tbody>
</table>
# Program Adoption - Vermont SPEED

## Operating SPEED Projects

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Type/Fuel</th>
<th>Annual Output (MWH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coventry Landfill</td>
<td>Landfill gas</td>
<td>50,000</td>
</tr>
<tr>
<td>North Hartland Hydroelectric</td>
<td>Hydroelectric-rehabed</td>
<td>17,000</td>
</tr>
<tr>
<td>Blue Spruce Farm</td>
<td>Cow Power</td>
<td>1,300</td>
</tr>
<tr>
<td>Green Mountain Dairy</td>
<td>Cow Power</td>
<td>1,600</td>
</tr>
<tr>
<td>Montagne Farm</td>
<td>Cow Power</td>
<td>1,100</td>
</tr>
<tr>
<td>Berkshire Cow Power</td>
<td>Cow Power</td>
<td>3,300</td>
</tr>
<tr>
<td>Gervais Family Farm</td>
<td>Cow Power</td>
<td>800</td>
</tr>
<tr>
<td>Maxwell Farm</td>
<td>Cow Power</td>
<td>900</td>
</tr>
<tr>
<td>Moretown Landfill</td>
<td>Cow Power, Landfill Gas</td>
<td>24,000</td>
</tr>
<tr>
<td>McNeil Upgrade</td>
<td>Emissions Upgrade</td>
<td>87,000</td>
</tr>
<tr>
<td>Westminster Farm Digester</td>
<td>Cow Power</td>
<td>1400</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>188,400</td>
</tr>
</tbody>
</table>

* 7% reduction in load demand since program inception

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![2010 Estimate - Vermont Load Growth](image.png)

SPEED Goal = 5% of 2005 Statewide Retail Sales

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www.gdsassociates.com
Central Vermont Public Service

• Voluntary “Customer Driven” program
• Rate payers pay premium credit for electricity
• The funds gathered in program are directly distributed back specifically to farm producers
• CVPS purchases the REC and environmental attributes from the Farm Biogas producers at a rate of $0.04/kwh
• Farm producer gets the Standard SPEED Program rate and the CVPS premium
  2010: ($0.136/kwh + $0.04/kwh) = $0.176/kwh
• CVPS has 8 Farms w/ digesters feeding into the program
  -Due to customer popularity/demand, the utility has extended coverage to three farms outside of CVPS coverage

Source:
New York State’s Biogas Rate Structuring

- Net metering approved for farm producers with production capacity up to 1 MW (Extended in 2010)
- In 2010, the State created an RFP with $20.0 Million to be distributed to Farm Biogas projects
  - Not to exceed $1.0 million/farm
  - $350,000 is a direct offset for generation system costs, after 1 year of proven production
  - The remainder, up to $650,000 is distributed annually for 3 years on a “Pay By Performance” basis
- Law mandates that Utility costs to the RE producer can not exceed $5,000
  - The mandate does not hold utilities to cover costs of grid upgrade, capacity increase, and regional substation improvements

www.gdsassociates.com
Michigan FIT Proposal

- Legislation was brought forth in 2010 to develop an “Ontario” style FIT.
- Established rate structures for different RE’s and Tiers
  - 3 Tier system, small <150 kW, <550 kW, <5.0 MW
  - FIT rates proposed were $0.20-$0.25/kwh
- The measure may have done better if it was more reasonable, at a rate of around $0.12 - 0.15 /kwh according to Dana Kirk, MSU
- The measure was voted down due to cost
The Grid- A Disconnect for Projects

- Grid interconnection costs, line and service station upgrades have been a major hurdle for implementation
- Final Utility quotes occur just before or during actual project installation
- Utility cost can equal 10%-40% of the total project cost
- Cost is not the only issue, getting the necessary service, promptly is an issue
- Who’s responsible for these costs?
## Rural Infrastructure is Costly

<table>
<thead>
<tr>
<th>Typical Capital Cost of Transmission Per Mile</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>345 kV Single Circuit</td>
<td>$915,000</td>
</tr>
<tr>
<td>138 kV Single Circuit</td>
<td>$390,000</td>
</tr>
<tr>
<td>69 kV Single Circuit</td>
<td>$285,000</td>
</tr>
<tr>
<td>Upgrade to 138 kV</td>
<td>$400,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Average Cost Per Customer Per mile (138 kV)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural Electric Cooperatives</td>
<td>$55,700</td>
</tr>
<tr>
<td>Investor Owned Utilities</td>
<td>$11,100</td>
</tr>
<tr>
<td>Municipal Owned</td>
<td>$8,400</td>
</tr>
</tbody>
</table>

Costly Variables for Wisconsin Projects

- Grid interconnection, switch gear, and metering costs
  - $40,000-$100,000
- Line upgrade costs
  - $50,000-$200,000
- Substation Upgrades
  - $250,000-$500,000
- Fiber-optic communications line
  - $167,000
Proposed Utility Costs on Actual Projects

- **2 MW Dairy Digester A:** $947,000 or $749,000
  - $482,000 or $680,000 substation and line upgrades
  - $167,000 for a fiber-optic communications line
  - $100,000 for switch gear, metering equipment, and transformers

- **1.1 MW Dairy Digester B:** $937,000
  - Costs associated with fiber-optics line, electrical line and substation upgrades to the farm

- **1.4 MW Dairy Digester C:** $961,000
  - 7 mile line upgrade, 8 KV system to 24.9 KV system
  - 500 KW system proposed cost of $350,000.
Alternatives to Mitigate Costs

- **Farm Level**
  - Reduce or minimize load
  - Dump load
  - Develop on-site alternative for biogas use, added load

- **Utility Level**
  - Factoring of deferred costs
  - Utility financing for costs associated with the infrastructure upgrades
Take-Home Points

- Large-scale, farm biogas adoption will require clear and concise governmental, societal, and utility supports
  - Governmental: clear National policy
  - Societal: Local buy-in to projects, cooperative benefits
  - Utility: Collective value of large-scale implementation

- Policies and support must have longevity
  - Year to year mandated tax breaks – Negative
  - Rising utility rates – Positive
  - “Clean Energy” and Carbon Markets - Unknown
Happy Trails to You

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