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THANK YOU!
Agenda

— Why choose an engine for biogas utilization? (compared to micro-turbines, etc.) - pros & cons
— Current options
— Greater Lawrence Sanitary District’s experience with recently purchasing, permitting, & installing 2 engines
— Essex Junction’s experience switching from micro-turbines to an engine, including start-up concerns & successes
— Operating & maintaining engines at Lewiston-Auburn WPCA
— Questions & Discussion
New WEF Fact Sheet

Introduction to Funding Opportunities: Bioenergy and GHG Reducing Projects
By: Bob Loneran, Christine Polo, Anni Santos, Sarah Deslauriers, and Rowena Patawaran

The Need for Funding
With rising energy costs, depleting fossil fuel supplies, and increasing concerns of climate change, the use of bioenergy and the reduction of greenhouse gases (GHGs) has gained interest within the wastewater sector.

Funding Programs
- Federal Public Programs
  - Energy Efficiency Block Grants (DOE)
  - Energy Efficiency and Renewable Energy Block Grants
These grants can be used for energy efficiency and conservation programs and projects communitywide, as well as...
New WEF Fact Sheet

Search online for “WEF Fact Sheet CHP Internal Combustion Engines”
## US Installations of CHP Technologies

<table>
<thead>
<tr>
<th>CHP Technology</th>
<th>Number of Sites</th>
<th>Installed Capacity, MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engines</td>
<td>64</td>
<td>158</td>
</tr>
<tr>
<td>Gas Turbines</td>
<td>9</td>
<td>144</td>
</tr>
<tr>
<td>Microturbines</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td>Fuel Cells</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Boiler/Steam Turbine</td>
<td>3</td>
<td>151</td>
</tr>
<tr>
<td>Combined Cycle</td>
<td>1</td>
<td>28</td>
</tr>
</tbody>
</table>
Equipment Cost Comparison
CoGen Engine – Purchasing, Permitting & Installing

- Reciprocating internal combustion engines were determined to be best fit for GLSD
  - Turbines require a very clean continuous gas
  - Micro turbines are generally smaller in size and very finicky to operate
- Reciprocating engines are the most widespread, economical and efficient of all CHP technologies currently used for biogas cogeneration
- Air Quality Permit Required
  - Low Nox engine selected
  - Selective Catalytic Reduction – SCR on exhaust was determined to be necessary
- Digester gas treatment for H2S and Siloxane removal
- Most CoGen sized on lowest of demand of Electric or Heat requirements
- GLSD sizing – based on maximize digester gas production.

The audio recording of this webinar starts with this slide.
The Next Step Towards Net Zero Operation at GLSD

- One of two Caterpillar 1.6 MW CoGen engines during factory testing
CHP Engine Emissions Control

- Oxidation Catalyst (OC) technology to remove volatile organic carbons and carbon monoxide
- Selective Catalytic Reduction (SCR) technology to remove nitrogen oxides
- Best Available Control Technology (BACT) as determined by MassDEP
Installed Caterpillar CoGen Engine at GLSD
# GLSD BIOGAS DATA
(Analysis of 2013 – 2016)

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O2</td>
<td>1.2%</td>
<td></td>
</tr>
<tr>
<td>Nitrogen:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N2</td>
<td>3.8%</td>
<td></td>
</tr>
<tr>
<td>Methane:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH4</td>
<td>60%</td>
<td></td>
</tr>
<tr>
<td>Carbon Dioxide:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>35%</td>
<td></td>
</tr>
<tr>
<td>Hydrogen Sulfide:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2S</td>
<td>73 ppmv</td>
<td>w/ Ferric Chloride</td>
</tr>
<tr>
<td>BTU/CF</td>
<td>605</td>
<td></td>
</tr>
<tr>
<td>Sp. Gravity</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>Siloxanes</td>
<td>1110 ppbv</td>
<td></td>
</tr>
</tbody>
</table>
2 GENERATIONS OF CHP
VILLAGE OF ESSEX JCT.
VERMONT
JIM JUTRAS, WATER QUALITY SUPT.
DESIGN FLOW 3.3 MGD
CURRENT FLOW 1.8 MGD ANNUAL AVERAGE
REGIONAL SERVICE TO THREE COMMUNITIES
WHY THE CHANGE?

- 25 year WWTF rehabilitation project including the Digester Complex
- Core replacement challenges
- “Legacy product”
- Value of the building space vs. maintaining the legacy product
- Already received return on investment
WHY THE SWITCH FROM MICROTURBINES TO RECIPROCATING ENGINE?

Bid solicitation with basis on performance
Power production and heat production based on Gas production and quality.
Life cycle operation and maintenance costs provided as part of bid response.
Return in investment consideration as part of the bid evaluations
TWO GENERATIONS OF CHP
FULL ASSET UTILIZATION
SOLVING A DISPOSAL CHALLENGE
WITH BENEFITS

GUIDING PRINCIPLES:

Process First!
* Run at capacity  * Increase revenues
* Address Environmental Regulations
* Monitor Total Cost  * Return on Investment
* Assets in Hand  * Staff time  * Facilities in place
* Age of assets and anticipated replacement (Opportunity)
QUESTIONS?

Village of Essex Junction
802-878-6943 ext 101
jim@essexjunction.org
LAWPCA Snapshot

• Operating since 1974 as a Wastewater Treatment Plant
• Receives flow from Lewiston and Auburn
• Wastewater treatment
  32 million gallons per day (mgd) facility peak capacity
  12 million gallons per day (mgd) average daily flow
  35,000+ domestic users
  23 significant Industrial users
  26 septic & holding tank waste communities

• Compost Facility in operation since 1993
Combined Heat and Power (CHP) System Selection

- Estimated biogas production = 170,000 ft³/day
- Cogeneration systems considered
  - Microturbines
  - Reciprocating Engines
- Engines selected over microturbines based on:
  - Higher efficiencies
  - Life cycle costs
  - Track record/number of operating installations
- Two – 230 kW engines (received $330,000 Efficiency Maine Grant)
CHP System Selection (Continued)

• Electricity used on site:
  – Provides all power for new digestion equipment
  – Reduces amount of power purchased from the utility for WW treatment

• Heat Reclaimed from engines
  – Provides heat for anaerobic digesters
  – Supplemental heat provided by dual fuel boilers (natural gas/biogas)
Biogas Treatment

- Biogas Treatment System
  - Foam separator and condensate/sediment removal traps
  - \( \text{H}_2\text{S} \) removal using Iron Sponge or SulfaTreat media
  - Moisture removal and gas boosting skid
  - Siloxane removal system to be added in the future, if necessary
Engine failure
Engine failure
LAWPCA Snapshot

- Operating since 1974 as a Wastewater Treatment Plant
- Receives flow from Lewiston and Auburn
- Wastewater treatment
  - 32 million gallons per day (mgd) facility peak capacity
  - 12 million gallons per day (mgd) average daily flow
  - 35,000+ domestic users
  - 23 significant Industrial users
  - 26 septic & holding tank waste communities

- Compost Facility in operation since 1993
Thank you for joining in.

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First Friday each Quarter:
12:00 - 1:00 pm. Have lunch. Digest.
January 5, 2018: Gentlemen and - Women, Start Your Engines!
April 6: How Food Scraps & Other Organics Work in Municipal Digesters: An Update on Co-Digestion Research (Professor Matt Higgins, Bucknell Univ.)
July 6: ADvancements Around the Region - Roundtable
October 5: TBD

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Northeast Digestion Roundtable 2018
Quarterly webinars to share technical operations experiences & advance best practices regarding anaerobic digestion in this region.