Initial Co-Digestion Feasibility Study at the Rockland WWTP

October 17, 2019 – Springfield, MA
Agenda

- Definition and Motivation
- Planning Considerations
- Rockland, MA Case Study
Rockland, MA WRRF

- Managed by Town of Rockland Sewer Dept (SUEZ contract ops)
- Avg. Annual Flow: 2.5 MGD
- One of six WRRFs with AD in Mass
MassCEC Organics-to-Energy Program

• Supports the development of facilities that convert source-separated organic materials and sewage sludge into heat, electricity and/or compressed natural gas

• Published >10 studies since program creation in 2012

• Three stages of funding
  • **Feasibility Study**  Max Grant Level: $60K
  • Technical Study
  • Implementation and Pilot Project
Co-digestion opportunities at smaller WRRFs

Electricity generation from WRRF sludge with MAD + ICE

2.5 MGD / 2.5 DTPD +65 kW

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<th>WRRF Electricity Usage, kWh/MG</th>
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Rockland

* Assumes 6k gallon tanker truck, FOG liquid waste at 5% TS
Looking past increased gas production

- **Feedstock / Offloading**
- **Screening / Degritting**
- **Sewage Sludge**
- **Energy Recovery**
- **Disposal / End Use**
- **Recycle**

**Process Flow:**
1. **Feedstock / Offloading**
2. **Screening / Degritting**
3. **Sewage Sludge**
4. **Blending**
5. **Anaerobic Digestion**
6. **Dewatering**
7. **Disposal / End Use**
8. **Recycle**

**Key Terms:**
- **Capital Investments**
- **Process Impact**
- **O&M**
Co-digestion feasibility study framework
Plant Operations
Current Conditions/Benchmarking

45-ft dia. Digesters (0.46 MG)

- Primary Digester
- Secondary Digester No. 2

Out of Service: Tilted cover

35-ft dia. Digesters (0.11 MG)

- Primary Digester No. 1
- Secondary Digester No. 1

Out of Service: Suspected tank crack

Co-settled primary and waste activated sludge

Overflow to head of WWTP

Flare

Boiler

BFP
Residuals Management
Limited by existing state of equipment

- Current residuals generation: ~5 wtpd at 19%TS using belt filter press
- Difficult to maintain digestion temperatures required for Class B requirements
  - Co-settled PS and WAS feed is relatively thin (~2.4% TS) and variable given seasonal loading
- Hauled under long-term agreement to multiple disposal sites (incineration and landfill)
  - At time of study: $100/ton, has since increased to $111/ton
Plant Operations
State-of-good-repair projects required

• Mechanical WAS Thickening
  • Unlock digester capacity, control heat load

• Digester Rehabilitation
  • Covers, heat, mixing

• Digester Gas Management
  • Update to design codes and standards
  • Provide short-term storage
  • Change out all CS piping

• Blend tank
  • Homogenize loading to digester
## Plant Operations
Project scope evaluated at varying scales

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<tr>
<th>Alternative A</th>
<th>Alternative B</th>
<th>Alternative C</th>
</tr>
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<tbody>
<tr>
<td>No Organics</td>
<td>Moderate Org. (17k gpd)</td>
<td>Aggressive Org. (35k gpd)</td>
</tr>
<tr>
<td>0 trucks/d</td>
<td>3 trucks/d*</td>
<td>6 trucks/d*</td>
</tr>
<tr>
<td>80 kW gen.</td>
<td>300 kW gen.</td>
<td>500 kW gen.</td>
</tr>
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</table>

**Legend**
- New Construction
- Modify Existing

* Assumes 6k gallon tanker truck, FOG liquid waste at 5% TS
Targeted outreach to 16 potential, liquid HSW sources

- **Primary Generators**: production/manufacturing facilities
- **Indirect Sources**: hauling companies/brokers

Typical Liquid HSW Sources

- Hydrophilic – Non Oily
  - Expired soda, whey, food/beverage production
- Hydrophobic – Oily
  - DAF waste, dairy/meat processing waste, FOG
Tipping Fees
Positive response from 16 potential sources

• Interest gauged on specific drivers
  • Cost reduction
  • Disposal reliability
  • Sustainability initiatives

• Results
  • Significant interest – current market for rate of disposal of organic wastes ranges from $0.06 to $0.10 per gallon, depending on waste type
Biogas Utilization
Universe of Alternatives

Generate Power and Heat On-Site
- Gas Turbine Generators
- IC Engine Generators
- Fuel Cells
- Microturbines
- Stirling Cycle Engines
- Organic Rankine Cycle

Other On-Site Uses
- Boiler/Heat (hot water, steam)
- Product drying (via steam, hot air/oil/water)

Off-Site Sale/Use
- “As-Is” Unscrubbed
- Scrub CO$_2$, biomethane pipeline injection
- Scrub CO$_2$, Vehicle Fuel (rCNG)
Biogas Utilization
Kilowatts, therms, gallons ... How do you compare value?

Relative value of energy (adjusted for conversion efficiency)

Rockland goal: onsite power generation
- Gas upgrading introduced too many variables at this stage
Biogas Utilization
Projecting value of onsite power generation

• Parse apart usage charge from power bill ($0.14/kWh)
  • Disregard non-bypassable and standby charges
  • Potential to limit demand charge

• Calculate value from electricity export
  • National Grid has met net metering quota in area
  • Electricity sold back at wholesale rate of $0.035/kWh

• Consider opportunities for regional and state incentives
  • National Grid Power Offset: $0.075/kWh
  • REC value determined under Renewable Portfolio Standard
Biogas Utilization
Renewable Portfolio Standard

- Requirement on retail electric suppliers to provide a minimum percentage or amount of their retail load with eligible sources of renewable energy
- Renewable energy certificate (REC) program to facilitate compliance
- NE states participate in a single power pool

REC value projected at all-time low at time of study ($0.005/kWh). MA and ME have since increased RPS targets/demand.
First Cut Financial Evaluation
20-Yr NPV shows counter-intuitive results

- 17k gpd HSW
- 30k gpd HSW
- 0 gpd HSW

Bar chart showing financial evaluation for different capacities.
What’s limiting O&M benefits?
Residuals Management Costs increase

<table>
<thead>
<tr>
<th>tens of millions</th>
<th>PB</th>
<th>Alt A</th>
<th>Alt B</th>
<th>Alt C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solids Hauling and Disposal</td>
<td>$0.0</td>
<td>$0.0</td>
<td>$0.4</td>
<td>$0.6</td>
</tr>
<tr>
<td>Natural Gas Cost</td>
<td>$0.2</td>
<td>$0.2</td>
<td>$0.2</td>
<td>$0.2</td>
</tr>
<tr>
<td>Electricity Costs</td>
<td>$0.4</td>
<td>$0.4</td>
<td>$0.6</td>
<td>$0.6</td>
</tr>
<tr>
<td>Polymer Costs</td>
<td>$0.4</td>
<td>$0.4</td>
<td>$0.6</td>
<td>$0.6</td>
</tr>
<tr>
<td>Contract/Annual Maintenance</td>
<td>$0.0</td>
<td>$0.0</td>
<td>$0.0</td>
<td>$0.0</td>
</tr>
<tr>
<td>Labor</td>
<td>$0.2</td>
<td>$0.2</td>
<td>$0.2</td>
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60% increase
140% increase
Impact of Revenue
Limited with electricity export

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<tr>
<th>Revenue</th>
<th>Planning Baseline</th>
<th>Alt A: No Organics</th>
<th>Alt B: Moderate Organics</th>
<th>Alt C: Aggressive Organics</th>
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<td>Annual Avg. Production</td>
<td>0</td>
<td>80 kW</td>
<td>300 kW</td>
<td>500 kW</td>
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<tr>
<td>Electricity Offset/Sale</td>
<td>$0</td>
<td>$220,000</td>
<td>$440,000</td>
<td>$580,000</td>
</tr>
<tr>
<td>Organics Tipping Fees</td>
<td>$0</td>
<td>$0</td>
<td>$370,000</td>
<td>$770,000</td>
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These are rough estimates based on experience. The ultimate values may vary a little or moderately depending on regulatory impacts, inflation or local impacts.
Tipping fee increases provide better alignment

$0.06/gal

$0.08/gal
Substantial swing in economics available with improved residuals management costs

Comparison of Alt C (30k gpd) to Do-Nothing

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<th>Feedstock %VS / %VSR</th>
<th>Residuals Management Cost ($/wet ton)</th>
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<tr>
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<td>$100 (Raw disposal)</td>
</tr>
<tr>
<td>85% / 85%</td>
<td>+$4.9M</td>
</tr>
<tr>
<td>90% / 90%</td>
<td>+$1.6M</td>
</tr>
<tr>
<td>95% / 95%</td>
<td>-$1.8M</td>
</tr>
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Conclusions

• Plant Operations
  • Co-digestion requires integration with state-of-good-repair projects

• Tipping Fees
  • Economics impacted by HSW disposal market; saw interest in project with some variability in pricing

• Biogas Utilization
  • With power generation, revenue limited with electricity export

• Residuals Management
  • Improved residuals management rate with readily degradable feedstocks required for favorable economics at increased HSW loading
Acknowledgements

**Brown and Caldwell**
Chris Muller Principal Engineer
Natalie Sierra Senior Review
Tracy Chouinard Process Model Lead
Alison Nojima Energy Lead
Camilla Kuo-Dahab Sidestream impacts

**Town of Rockland**
John Loughlin Superintendent
Rick Kotouch Plant Ops PM (SUEZ)
Ed Mcauliffe Plant Ops (SUEZ)
Thank you

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