ENERGY NEUTRAL WASTEWATER TREATMENT: BUILDING RESILIENCY THROUGH RENEWABLE ENERGY

Logan Olds
VVWRA General Manager
VVWRA covers 446 acres

Victorville, CA
Mojave Desert
85 miles NE of Los Angeles
WERF Barriers to Energy Efficiency Project

- Maintenance to maximize equipment efficiency
- Energy efficient operating strategies
- Controlling energy while adapting to future regulations
- Capital Projects to reduce process energy
- coordinating efficiency improvements with equipment replacements
- Energy Generation
- Building energy improvements
Nutrient Limits Provide Impetus to Address Energy

- Establish credibility by optimizing treatment efficiency and reliability
- Community outreach and staff training
- Additional process efficiency upgrades
- Waste to Energy project
- Focusing on energy for the future

Timeline:
- 2009: Initial idea to use existing assets to move toward energy neutrality
- 2009: Evaluate energy generation alternatives (2008-09)
- 2009: Begin staff-led secondary treatment modifications to meet nutrient requirements (2009-10)
- 2010: NTP for regulatory upgrades (Jan. 2011)
- 2011: First blower and diffuser upgrades (Jan. 2012)
- 2012: Develop DBO RFP to procure developer-financed energy generation infrastructure (April 2012)
- 2012: UV system online (Dec. 2012)
- 2013: Negotiate PPA and begin digester improvements (June 2013)
- 2013: Begin construction of gas conditioning system (Oct. 2013)
- 2013: Coordinate with electrical utility for on-bill financing for diffusers (Dec. 2013)
- 2014: Recuperative thickener digester online (Feb. 2014)
- 2014: Begin installation of two 600 kW CHP units, diffusers, and secondary RAS improvements (April 2014)
- 2014: Start trials to pave the way for large-scale co-digestion (June 2014)
- 2014: Begin UV optimization (July 2014)
- 2014: Install second 400 hp turbo blower and diffusers (Dec. 2014)
The struggle is real!
UV Optimization

UV re-commissioning, supported by electrical utility incentive payments, eliminated overtreatment by using bioassay techniques to determine proper dosing, saving 5% of plant energy consumption. -- $48,846
December 2013

- Coordination with Edison electrical utility regarding On Bill Financing for Aquarius Diffusers--$121,919
Would you throw away your used car?
Gas Conditioning to Reduce Natural Gas Cost

Gas conditioning was sized for double the normal biogas flow at the time of construction— with future co-digestion in mind.
Biogas Generated

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Biogas Produced (cf)</th>
<th>Biogas Used for Power (cf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>116,569,845</td>
<td>0</td>
</tr>
<tr>
<td>2015</td>
<td>253,543,492</td>
<td>75,166,400</td>
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<tr>
<td>2016</td>
<td>252,729,723</td>
<td>115,769,797</td>
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% of Energy Self Produced

<table>
<thead>
<tr>
<th>Year</th>
<th>% of Energy Self Produced</th>
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</thead>
<tbody>
<tr>
<td>2014</td>
<td>65%</td>
</tr>
<tr>
<td>2015</td>
<td>73%</td>
</tr>
<tr>
<td>2016</td>
<td></td>
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</table>
Natural gas expense

Expense ($) vs. Cost Averaging, Compared to 06-07 ($) for FY 06-07 to FY 15-16.
Average Total Nitrogen

2006
- Min: 7.49 mg/L
- Max: 11.9 mg/L

2016
- Min: 2.07 mg/L
- Max: 8.95 mg/L

2006 Avg Dry Weather Q: 12.18 MGD
2016 Avg Dry Weather Q: 10.49 MGD
Public Private Partnerships to mitigate risk

- Off book transactions
- Leveraging existing resources
Energy Efficiency Flattens Power Increase
Codigestion and Cogeneration Lead to Net Zero
Energy Reliability by Producing Renewable Power
June 2013

• Construction of Omnivore digester improvements begins
• Public Private Partnership (PPP) $2.6 million
ADM/FOG/Septage Potential Revenue

- Septage Revenue: $7,301.38
- Potential ADM/FOG Revenue: $78,211.29
- Total of Septage ADM/FOG: $85,512.67
- Savings in Supplemental Natural Gas: $140,930.98
- Total: $226,443.65
Energy Consumption & Production

VVWRA Monthly Power Generated and Consumed

- kWh Produced
- kWh Purchased
- % Generated

Graph showing kWh produced and purchased per month from Sep-15 to Mar-16.
SCE Power Purchased

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost</th>
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<tr>
<td>2014</td>
<td>$1,181,620</td>
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<tr>
<td>2015</td>
<td>$787,519</td>
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<tr>
<td>2016</td>
<td>$495,606</td>
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</table>
Estimated energy cost savings
2015-2034

Electrical energy savings: $11,824,069
Natural gas savings: $8,432,780
Total energy savings: $20,256,849
+ ADM/FOG revenue $4,582,656
DOE Better Plants Program

- Production Energy Intensity (MMBtu/unit production)
- Annual Improvement in Energy Intensity (%)
- Total Improvement in Energy Intensity (%)

<table>
<thead>
<tr>
<th>Reporting Year</th>
<th>Energy Intensity (MMBtu/unit)</th>
<th>Percent Improvement</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>10,000</td>
<td>-20.00%</td>
</tr>
<tr>
<td>2</td>
<td>20,000</td>
<td>-10.00%</td>
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<tr>
<td>3</td>
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<td>0.00%</td>
</tr>
<tr>
<td>4</td>
<td>20,000</td>
<td>20.00%</td>
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Beyond Net Zero

Potential Future Utilization of Surplus Biogas

- Future cost savings and new revenue streams with surplus biogas
- Offset energy costs for future satellite plants
- Sell excess power to grid
- Transport to local industry to use as a propane replacement

WRF electrical consumption

Electrical generation potential of biogas production

kWh
What’s next?

• Privatize three anaerobic digesters
• Building a flow cell battery storage system and microgrid
• Onsite grid reliability
• Reach and surpass net zero goal
Logan Olds

Victor Valley Wastewater Reclamation Authority

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