The Next Generation of Power

Biogas
Harnessing Energy from Wastewater
what is WLSSD
History

- 1971 – Created by Minnesota Legislature
  - St. Louis River horribly polluted
  - Existing facilities inadequate
  - 18 separate river discharges
- 1974 - Legislature added responsibility for solid waste management
- 1978 - Plant began operations
- 1980 - River dramatically improved
- Today - River is active walleye fishery and resource for recreation, commerce and quality of life
Service Area

- 2 counties
- 8 cities, 9 townships
- 4 industries
- 140,000 residents
the vision
District Energy Team

- 7-member multi-discipline core team
  - Executive Director
  - O&M Manager
  - Engineering
  - Finance
  - IT
  - Communications

- Energy policies must be adopted by entire staff
Offset rate increases with energy reduction improvements
Dedicate resources to identify energy reduction opportunities
Establish energy management program
Evaluate energy conservation beyond district consumption (manufacturing, transport)
Goal of utilizing 100% of waste energy
Establish standing capital item for energy reduction improvements
Incorporate energy efficiency, conservation, and technology in all new installations, modifications and replacements to existing process designs
the Opportunity
The Wastewater Treatment Plant

- 48 mgd design
  - 36 mgd average 2013
- 50% industrial
  - kraft paper mill
- No primary treatment
- Pure oxygen
- TPAD, land application
Biosolids Production and Land Application

- $33 million production facility opened in 2001
- Biosolids are applied to local agricultural lands or used in mineland reclamation
- Average 35 tons land applied/day
- 2,000 acres/year
Solid Waste

- Solid waste used as fuel to incinerate wastewater solids through the 1990s
- Solid Waste Transfer Station opened in 1999
- Other SW programs include:
  - Yard Waste and Organics Composting
  - Household Hazardous
  - Materials Recovery Center
  - Recycling Programs
Energy Purchased

- Gasoline
- Diesel
- Fuel oil
- Natural Gas
- Electricity - Collection
- Electricity - Treatment

Annual Energy Cost ($M)
Electricity Rates Projected to Increase a minimum of 5%/year
Purchased Electricity

WLSSD Electricity By the Numbers

- $2.8 million in annual electricity costs
- A third of treatment plant operating costs
- 66.4% increase in electricity rates since 2006
- 34,341,057 kWh used annually
Resource Recovery Facility Uses Majority of Electricity

- Annual Electricity Cost ($M)
  - Collection: 0.9
  - Treatment: 2.0

![Resource Recovery Facility Image]
District Pursuing Largest Opportunity to Improve Efficiency

Average Electricity Use (kWh/MG)

- WLSSD Average
- Industry Benchmark

District Successfully Addressing
District Pursuing Largest Opportunity to Improve Efficiency

Average Electricity Use (kWh/MG)

- WLSSD Average
- Industry Benchmark

- Limited Other Opportunities to Significantly Move the Energy Needle
- Large Capital Costs, Small Efficiency Gains

District Successfully Addressing

Facilities:
- RWW Pumping
- Preliminary Treatment
- HPO/Activated Sludge
- Secondary Clarification
- Filtration
- Solids Thickening
- Anaerobic Digestion
- Solids Dewatering
- Overall
biogas opportunity to reduce energy purchases (costs)
About 25% of Biogas Wasted
Biogas Offers Tremendous Potential to Reduce Purchased Electricity

- Annual Energy Reduction (MkWh)
- % Energy Reduction

Electricity Potential of Biogas: Equivalent to 35% Reduction
Near Term Focus

Biogas Use + More Economical Biogas Use

Purchased Electricity + Electricity + Heat
Current Heating System Overview

- Steam boilers (2-800 hp Natural Gas, 1-300 hp Digester Gas)
- Steam/HW Heat Exchangers
- HHW Distribution System
biogas utilization evaluation
# Technology Evaluation

<table>
<thead>
<tr>
<th>Technology</th>
<th>Engines</th>
<th>Microturbines</th>
<th>Fuel Cells</th>
<th>CNG</th>
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</thead>
<tbody>
<tr>
<td>Cost, $M</td>
<td>7.7</td>
<td>9.5</td>
<td>16.2</td>
<td>7.9</td>
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<tr>
<td>Payback, Yrs</td>
<td>12</td>
<td>19</td>
<td>22</td>
<td>23</td>
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<tr>
<td>Availability, %</td>
<td>90+</td>
<td>95 (30-kW) 50 (200-kW)</td>
<td>Low</td>
<td>N/A</td>
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<tr>
<td>Biogas Experience</td>
<td>Mature</td>
<td>Established</td>
<td>Emerging</td>
<td>Emerging</td>
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<tr>
<td>Testimonials</td>
<td>Good</td>
<td>Mixed</td>
<td>Poor</td>
<td>Good</td>
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*600,000 GGE/yr*
the Plan
Click the image above or visit http://wlssd.com/news/biogas-harnessing-energy-from-wastewater/ to view a video overview of WLSSD's project
## Initial Payback Estimation

<table>
<thead>
<tr>
<th>Near Term Action Item</th>
<th>Description</th>
<th>Replacement Capital ($M)</th>
<th>Efficiency Capital ($M)</th>
<th>Average Annual Savings ($M)</th>
<th>Payback (yrs)</th>
<th>20-Year PW Savings ($M)</th>
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<tr>
<td>1</td>
<td>Hot-Water Plant</td>
<td>7.8</td>
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<td>0.04</td>
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<tr>
<td>2</td>
<td>H2S Control</td>
<td>1.23</td>
<td>0.22</td>
<td>5</td>
<td>2.11</td>
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<td>3</td>
<td>BG Utilization</td>
<td><strong>7.72</strong></td>
<td><strong>0.66</strong></td>
<td><strong>12</strong></td>
<td><strong>1.62</strong></td>
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<tr>
<td>4</td>
<td>DAF</td>
<td>1.10</td>
<td>0.50</td>
<td>0.06</td>
<td>8</td>
<td>0.42</td>
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<tr>
<td>5</td>
<td>Heat Conservation</td>
<td>1.85</td>
<td>0.26</td>
<td>7</td>
<td>1.94</td>
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<td><strong>Total</strong></td>
<td></td>
<td><strong>8.80</strong></td>
<td><strong>11.3</strong></td>
<td><strong>1.21</strong></td>
<td><strong>9</strong></td>
<td><strong>6.09</strong></td>
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**20.10**
Capital Budgeting Process

2016 – 2025 Capital Budget

Interceptor Evaluations

Pump Station Evaluations

WWTP Evaluations

WLSSD Strategic Planning

Biogas / Energy Evaluation
### 2015 Capital Budget - Wastewater

<table>
<thead>
<tr>
<th>Project Category</th>
<th>Amount</th>
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<tr>
<td>Safety Essential</td>
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<td>Permit / Consent Decree Compliance</td>
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<td>Required General Replacement</td>
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<tr>
<td>- Interceptor Replacement/Rehabilitation</td>
<td>200,000</td>
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<tr>
<td>- Pump Station Replacement/Rehabilitation</td>
<td>1,810,000</td>
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<tr>
<td>- General Wastewater Treatment Facility Replacement/Rehabilitation</td>
<td>3,060,000</td>
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<tr>
<td>Process Essential and Energy Improvements</td>
<td>8,210,000</td>
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<tr>
<td>Discretionary</td>
<td>1,000,000</td>
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<td><strong>Total</strong></td>
<td><strong>$14,500,000</strong></td>
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# Wastewater Budget History

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<thead>
<tr>
<th></th>
<th>2011 Budget</th>
<th>2012 Budget</th>
<th>2013 Budget</th>
<th>2014 Budget</th>
<th>2015 Budget</th>
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<tr>
<td>O/M Costs</td>
<td>$15,006</td>
<td>$15,026</td>
<td>$15,332</td>
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<td>Operations Fund</td>
<td>($150)</td>
<td>($170)</td>
<td>($350)</td>
<td>($350)</td>
<td>($233)</td>
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<tr>
<td>Other Revenue + DWA</td>
<td>($635)</td>
<td>($635)</td>
<td>($645)</td>
<td>($645)</td>
<td>($645)</td>
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<tr>
<td>O/M Capital</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
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<tr>
<td>CAF</td>
<td>($300)</td>
<td>($300)</td>
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<td>($320)</td>
<td>($320)</td>
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<tr>
<td>Debt Service</td>
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<td>$8,000</td>
<td>$8,000</td>
<td>$8,250</td>
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<tr>
<td>Total</td>
<td>$24,921</td>
<td>$24,921</td>
<td>$25,017</td>
<td>$25,017</td>
<td>$25,723</td>
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<tr>
<td>% Change</td>
<td><strong>2.78%</strong></td>
<td>0%</td>
<td><strong>0.39%</strong></td>
<td>0%</td>
<td><strong>2.82%</strong></td>
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## Wastewater Budget Projection

<table>
<thead>
<tr>
<th></th>
<th>2016 Budget</th>
<th>2017 Budget</th>
<th>2018 Budget</th>
<th>2019 Budget</th>
<th>2020 Budget</th>
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<tr>
<td>O/M Costs</td>
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<td>Operations Fund</td>
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<td>($300)</td>
<td>($250)</td>
<td>($150)</td>
<td>($150)</td>
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<tr>
<td>Other Revenue + DWA</td>
<td>($645)</td>
<td>($645)</td>
<td>($645)</td>
<td>($645)</td>
<td>($645)</td>
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<tr>
<td>O/M Capital</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
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<tr>
<td>CAF</td>
<td>($320)</td>
<td>($320)</td>
<td>($320)</td>
<td>($320)</td>
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<tr>
<td>Debt Service</td>
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<td>$8,750</td>
<td>$9,000</td>
<td>$9,000</td>
<td>$9,000</td>
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<tr>
<td>Total</td>
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<td>$26,622</td>
<td>$27,245</td>
<td>$27,674</td>
<td>$28,010</td>
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<tr>
<td>% Change</td>
<td>1.1%</td>
<td>2.37%</td>
<td>2.34%</td>
<td>1.58%</td>
<td>1.21%</td>
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Implementation
2015 – Replace steam boilers with nine individual modular boiler units

Old steam boilers (2)  
New modular condensing boilers (9)
2015 – Replace existing steam boilers with nine modular units and biogas conditioning ($11.2 million)

Project Funding:

- Green Project Reserve Grant - $1,000,000
- Principal Forgiveness Grant - $3,127,130
- PFA Loan - $7,029,490
Reduce overall energy consumption through:

a) Modifications to the plant heating and ventilation systems
b) Improvements to digester heat exchangers
c) Improvements to electrical distribution system

Estimated $10.76 million
2017 – 2018 Electrical generation utilizing biogas

a) Install two 825kW engine generators

The generators are estimated to produce electricity on site to meet about 35% of WLSSD’s total wastewater treatment plant electricity needs.

Estimated $12.39 million.
2019 – 2020 – Increase biogas production and electricity generation with high strength waste

a) Directly add high-strength wastes such as fats, oils and grease and food waste into WLSSD’s existing anaerobic digesters.

This will allow WLSSD to generate electricity on site to meet 50-100% of total plant electricity needs.

Estimated $7.25 million.
Phase 1: 2016-2017 Reduce overall energy consumption through modifications to the plant heating and ventilation systems, improvements to digester heat exchangers and to the electrical distribution system—reducing the wastewater treatment plant’s electrical demand, improving system reliability and preparing for future co-generation of heat and power. Estimated $10.76 million

Phase 2: 2017-2018. Install two 825kW engine generators that will use biogas to generate electricity for use in powering the wastewater plant. The generators are estimated to produce electricity on site to meet about 35% of total wastewater treatment plant electricity needs. Estimated $12.39 million

Phase 3: 2019-2020. Increase biogas production and electricity generation by directly adding high-strength wastes such as fats, oils and grease and food waste into existing digesters. Current digester capacity allows for significant increase in biogas production. This will allow WLSSD to generate electricity on site to meet 50-100% of total plant electricity needs. Estimated $7.25 million

TOTAL REQUEST IS FOR 50% FUNDING FOR PHASES 1 and 2 = $11.58 Million
a) If biogas generation meets 100% of plant electrical needs, WLSSD will pursue further investments for compressing gas for use in powering district vehicles and/or selling biofuel.
overcoming the barriers to energy recovery and efficiency
Internal Barriers to Energy Recovery and Efficiency

- Vision: Mission
- Champions
- Money
- Focus
- Commitment
  - Near Term
  - Long Term
External Barriers

- Money
- State priorities
- Time/Talent
- Technical Resources
Harnessing Energy from Wastewater

Sustainable
Cost-effective
Reduces Emissions
Reliable
Renewable
Maximizes use of existing infrastructure
Stabilizes rates
Utilize existing resources currently wasted

Questions?