



Sustainable Energy Solutions for Wastewater Utilities

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Sustainable Energy Solutions for Wastewater Utilities

- Drivers
- Energy Management Strategies
- Methods of Energy Optimization
- Methods of Cost Optimization
- Resources



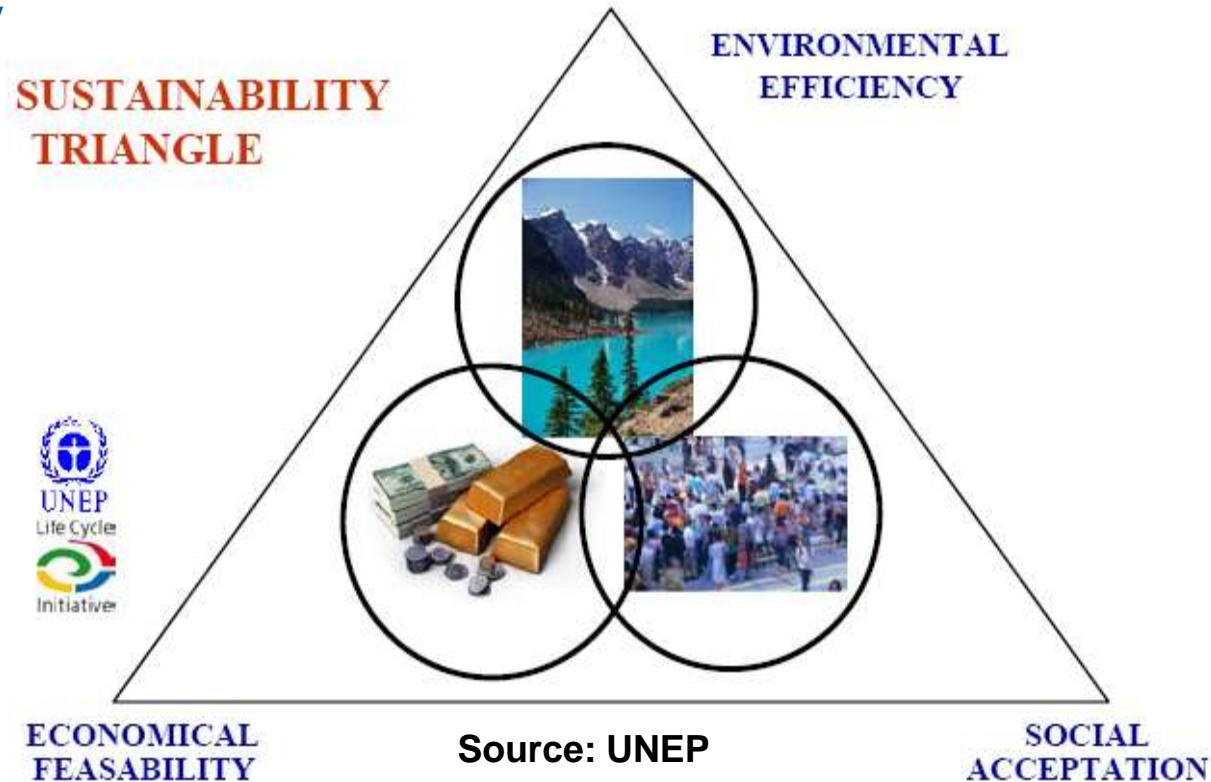
Energy Consumption in the Wastewater Industry

Water & Sustainability (Volume 4): U.S. Electricity Consumption for Water Supply & Treatment - The Next Half Century, Electric Power Research Institute (EPRI), 2002:

“Some 4% of the nation’s electricity use goes towards moving (80%) and treating water/wastewater.

Approximately 80% of municipal water processing and distribution costs are for electricity...”

Drivers for Energy Optimization



- Economic Drivers
 - Reduction in Operating Costs
 - Available Funding Resources
 - Regulatory Requirements that Increase Operating Costs
 - Offsetting High Energy Treatment Processes

Drivers for Energy Optimization

- Social Drivers
 - Community Impact
 - Industry Leadership
- Environmental Drivers
 - Carbon Footprint Reduction
 - Energy Use Reduction
 - Sustainability of Energy Resources



Water and wastewater facilities are energy intensive, accounting for up to 35 percent of municipal energy usage.*

***Consortium For Energy Efficiency (CEE)**

Energy Management Strategies

- Energy Optimization – Reduction in utility energy demand that results from energy efficiency improvements and implementation of renewable energy sources.
- Cost Optimization – Reduction in energy costs achieved through changes in operations that reduce operating costs while not actually reducing consumption.
 - Shifting operations to off-peak hours
 - Doesn't save energy, but reduces peak demand on the utility grid.

Methods of Energy Optimization

- Energy Audits
- Automated Control Strategies
- Equipment Replacement
- Energy Recovery
- Renewables



Energy Audit

- Walk-through and analyze “low hanging fruit” for energy optimization
- Develop Energy Conservation Measures (ECMs) and determine payback cycles.
- Implementation
 - Prioritized implementation projects.
 - Targeted improvements integral to process improvements.
 - Performance Contracting Approach – Financed improvements with savings payback and performance guarantees.

Energy Audits Wastewater Treatment Facilities

- Plant Operational Audits
 - Motors and Drive Systems
 - Pump Efficiency
 - Process and Control Optimization
 - Electrical Equipment Efficiency
- Facility Structure Audits
 - Building Envelope
 - HVAC
 - Lighting Systems

Low Hanging Fruit – Focus Areas

- Pumping Systems – Highest Energy Consumer in Wastewater Treatment Systems
- Consider the Complete System
 - Pump
 - Motor
 - Drive System
- Wire-to-Water Efficiency = Complete Efficiency of the Pump, Motor, and Drive Combination



Pumping Systems

- Pump selection - *Improving Pumping System Performance: A Sourcebook for Industry*, U.S. Department of Energy's Industrial Technologies Program (ITP) and the Hydraulic Institute (HI):
<http://www1.eere.energy.gov/industry/bestpractices/pdfs/pump.pdf>
- Motor efficiency
 - Inventory and consider replacement of aging motors with low efficiency



www.nema.org/gov/energy/efficiency/premium



Motor Decisions Matter

<http://www.motorsmatter.org/>

Pumping Systems

- Evaluate complete adjustable speed drive system
 - Drive systems may be variable frequency drives, magnetic clutch drive, fluid coupling
- Affinity laws for centrifugal loads
 - Volume of flow is directly proportional to speed
 - Pressure (or head) is proportional to the square of the speed
 - Input power is proportional to the cube of the speed
 - Actual losses in head and efficiency can reduce the power savings, conservatively estimate power proportional to the square of the speed.

Pumping Systems

- Operating at 70% volume requires only 49% of the power needed to run the system at 100% volume.
- Opportunity for significant energy savings at relatively high operating speeds.
- Utilize field instrumentation and control strategies to optimize efficiency.

Renewables

- Solar
 - Photovoltaic
 - Thermal
- Wind
 - Turbines
- Water
 - Hydroelectric Dams
 - In-Line Hydro Generators
- Biomass
 - Landfill Gas
 - Anaerobic Digestion



Renewable Energy Costs

	Capacity Factor	Capital Cost, US\$/kW	Levelized Cost of Generation, US\$/megawatt-hour
Solid Biomass	70 to 90	3,000 to 5,000	70 to 150
Cofired Biomass	70 to 90	300 to 500	0 to 20
Landfill Gas	70 to 90	1,200 to 2,000	50 to 80
Solar Thermal	26 to 29	3,600 to 4,200	140 to 180
Solar Photovoltaic	25 to 30	6,500 to 7,500	200 to 280
Hydroelectric	40 to 60	2,500 to 4,000	60 to 140
Wind	25 to 40	1,900 to 2,400	60 to 130
Geothermal	70 to 90	3,000 to 5,000	50 to 110

Notes:

Source: Black & Veatch estimates for typical projects based in the United States.

Levelized Cost includes currently applicable incentives, subsidies, etc.

Renewable Energy Options for Water and Wastewater Systems, by Mark Kleveter and Keene Matsuda of Black & Veatch, APWA Reporter, February 2009

Renewables – Pros and Cons

	Pros	Cons	Initial Cost	Subsidies
Wind	Inexpensive	Limited Resource Difficult to permit Few small turbine options	\$\$	\$\$
Solar PV	Generation profile Minimal maintenance Modular Easy to site	Expensive	\$\$\$\$	\$\$
Biomass	Leverages digester gas	O&M	\$	\$
Hydro		Limited Opportunities	\$\$	

Methods of Cost Optimization

- Electric Utility Service Audits
 - Rate Structure Analysis
 - Off-Peak Operations – Reduce maximum demand during peak rate periods by shifting non-continuous process operations
 - Storage Tank Filling
 - Solids Processing



Methods of Cost Optimization

- Distribution Optimization – Software Solutions to Manage:
 - Pumping Systems
 - Monitoring Systems
 - Utility Rate
- Backup / Peak shaving generators



Resources for Energy Optimization

- Tools
 - Benchmarking
 - Plant-wide Energy Monitoring Systems
- Informational Resources
 - Government
 - Consortia
 - Industry Associations

Benchmarking with Energy Star



- EPA's Energy Star Program
 - Portfolio Manager – EPA's online benchmarking tool
 - Wastewater Plants can track energy use, energy costs, and associated carbon emissions.
 - Wastewater facilities can utilize the performance rating system of Portfolio Manager to compare performance with peer plants (not available for Water Facilities)

Energy Star

- http://www.energystar.gov/index.cfm?c=water.wastewater_drinking_water
- *EPA Energy Management Guidebook for Wastewater and Water Utilities* (January 2008)
- *Portfolio Manager* benchmarking tool

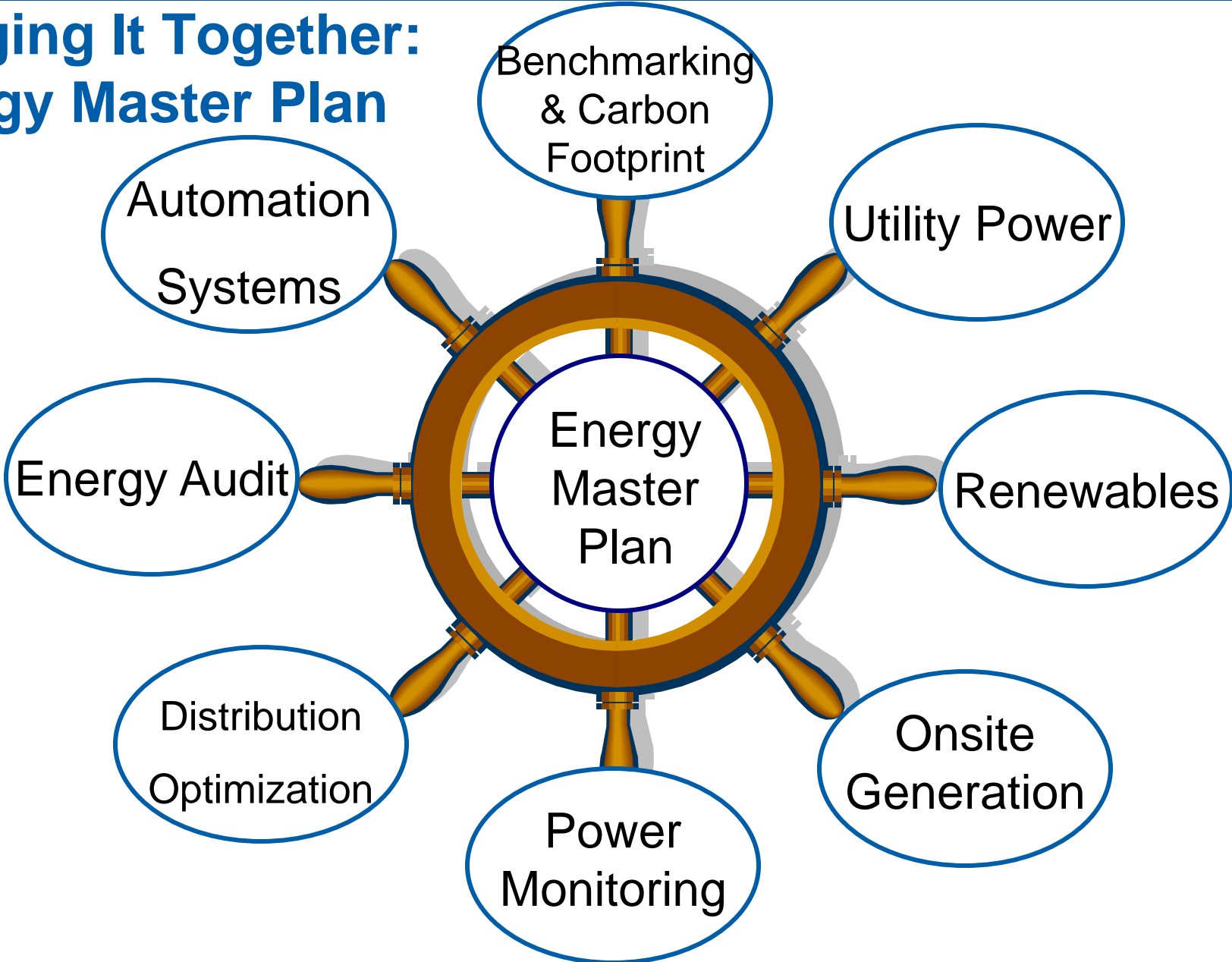


Monitoring Tools: Plant-Wide Energy Monitoring Systems

- Where is my power going?
- Utilize power monitoring systems at major power buses and a power monitoring network to collect data.
 - Pinpoint major loads
 - Log maximum power demand
 - Targeted Optimization Project or Energy Audit for the facility in question.



Bringing It Together: Energy Master Plan



Resources

US Department of Energy

www.eere.energy.gov

Consortium for Energy Efficiency

www.motorsmatter.org www.cee1.org

EPA / Energy Star

www.epa.gov/waterinfrastructure/bettermanagement_energy.html

www.energystar.gov

NEMA

www.nema.org/gov/energy/efficiency/premium

DSIRE – Renewable & Efficiency Incentive Database

www.dsireusa.org

Questions?

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