Attachment 5 – EF-EMS Roundtable-2

Sustainable Energy Management
For Wastewater Treatment Facilities
Roundtable Meeting and WEF WebCast

Narragansett Bay Commission
One Service Road
Providence, RI 02905
401–461-8848

Wednesday June 24, 2009
12:00 PM – 4:00 PM

MEETING AGENDA

12:00 PM – 1:00 PM
Energy Objectives, Goals and Targets – Working Lunch

Rhode Island Manufacturing Extension Services – John Gilheeney

1:00 PM – 3:00 PM
WEF WebCast - Running An Energy Efficient Wastewater Utility - Modifications That Can Improve Your Bottom Line

This webcast will focus on specific process and management modifications that have optimized energy efficiency and recovered value for utilities. Case Histories of Energy Reductions Achieved by:

- Improving Aeration and Pumping Processes
- Using an EMS to Achieve Energy Sustainability
- Utilizing Performance Contracting or Energy Services Companies

Moderator - Joseph C. Cantwell, Focus on Energy, SAIC/Energy Systems Group

Speakers

- *James J. Newton, Environmental Programs, Kent County, Delaware*
- *Thomas E. Jenkins, Dresser Roots*
- *Joseph C. Cantwell, Focus on Energy, SAIC/Energy Systems Group*
- *Peter Cavagnaro, Johnson Controls*
- *Christopher M. Kalwara, Johnson Controls*

3:00 PM – 4:00 PM
Group Discussion and Project Planning

Intended Audience: This workshop is designed for Wastewater Treatment Facility personnel responsible for energy use and/or management including but not limited to: facility managers and superintendents, and engineering, operations and maintenance staff.

Project Partners

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Sustainable Energy Management for Wastewater Treatment Facilities Roundtable Meeting and WEF Webcast

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[illegible]
[illegible]
[illegible]

Wednesday June 24, 2009
12:00 PM – 4:30 PM

[illegible]

12:00 PM – 1:00 PM
Lunch: [illegible]

[illegible] Manufacturing [illegible] University

[illegible]
WEF Webcast – Becoming an Energy Efficient Wastewater Utility: Modifications That Can Improve Your Bottom Line

This webcast will focus on specific process and management modifications that have been tested to improve efficiency and economic value for utilities. Case examples of Energy Reductions discussed by:

- [illegible] Aeration and Pumping Processes
- Using an EMS to Achieve Energy Sustainability
- [illegible] Energy [illegible]

Moderator – [illegible] Energy [illegible]

Speakers

- *James J. [illegible], Environmental [illegible], [illegible] County, Delaware*
- *[illegible], Director [illegible]*
- *[illegible] Energy [illegible] Group*
- *[illegible]*
- *Christopher M. [illegible]*

2:00 PM – 4:00 PM
[illegible]

[illegible] This workshop is designed for Wastewater Treatment Facilities [illegible] energy [illegible] management [illegible] including [illegible]

Project Partners

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

University of Rhode Island

[illegible]

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RI Department of

Environmental

Management

[illegible]

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RI Manufacturers Extension

Services

John [illegible]

[illegible]

[illegible]

EPA Region I

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NBC State Innovation Grant Project
Roundtable Meeting/WEF Webcast
Wednesday June 24th, 2009
12:00 PM – 4:00 PM

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WEF Webcast

Running an Energy-Efficient Wastewater Utility

Modifications That Can Improve Your Bottom Line

June 24, 2009
1:00 to 3:00 p.m. EDT

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Moderator

Joseph C. Cantwell

Focus on Energy,
SAIC/Energy Systems Group

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Presenters

James Newton, *Environmental Programs, Kent County, Delaware*

Thomas E. Jenkins, *Dresser Roots*

Joseph C. Cantwell, *Focus on Energy, SAIC/Energy Systems Group*

Peter Cavagnaro, *Johnson Controls*

Christopher M. Kalwara, *Johnson Controls*

Agenda

Speaker	Topic
Joe Cantwell	Introduction
Jim Newton	EMS to Promote Energy Efficiency
Tom Jenkins	Aeration Energy Efficiency
Joe Cantwell	Pumping - Energy Intensive
Pete Cavagnaro	Utilizing Performance Contracting
Chris Kalwara	Energy Services Companies
Joe Cantwell	Wrap-up
Presenters & Attendees	Questions & Answers
Attendees	Survey & PDH's

EMS to Promote Energy Efficiency

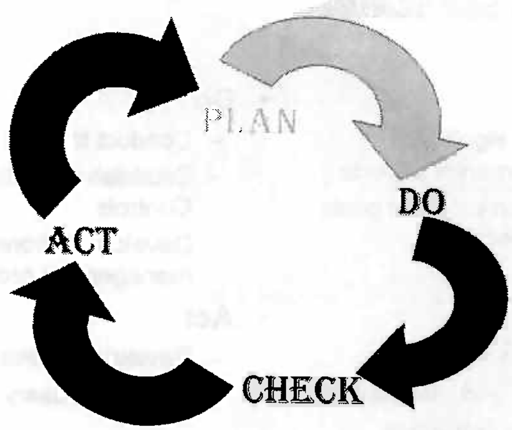
Jim Newton, P.E., BCEE

Environmental Program Manager

Kent County Dept. of Public Works

Water Environment Federation

Basics of an EMS



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Elements of an EMS (ISO 14001)

Environmental Policy	Identifying Environmental Aspects
Legal and Other Requirements	Objectives and Targets
Environmental Management Program(s)	Structure and Responsibility
Training, Awareness, Competency	Communications
EMS Documentation	Document Control
Operational Control	Emergency Preparedness/Response
Monitoring and Measuring	Nonconformance and Corrective Actions
Records	EMS Auditing
Management Review	

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EMS Elements

- **Plan**
  - Identify significant environmental aspects
  - Establish program goals and objectives
  - Develop policy
- **Check**
  - Conduct audits
  - Monitor and measure
  - Prepare corrective actions
- **Do**
  - Conduct training
  - Establish operational Controls
  - Develop environmental management program
- **Act**
  - Review progress
  - Make necessary changes

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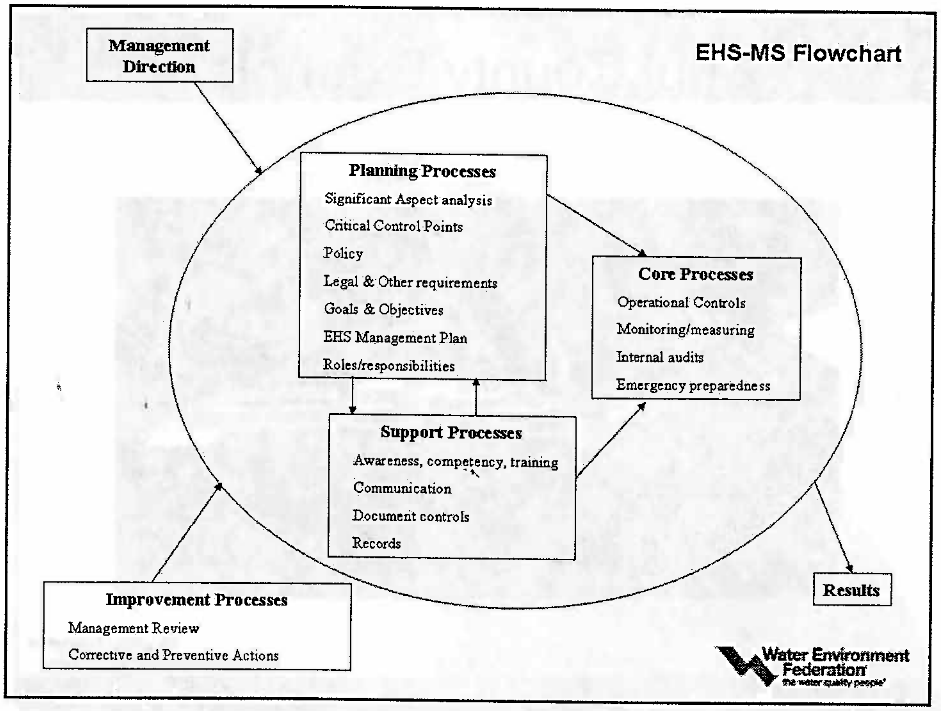

Energy Related Elements of an EMS

- Environmental policy
- Identifying significant aspects
- Setting objectives and targets
- Developing environmental management plans
- Training, awareness, and competency
- Measuring progress
- Management review

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Kent County Example

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Kent County Regional Wastewater Treatment Facility

Startup Date:	October 6, 1973
Employees:	50
Service Population:	130,000
Design Flow:	16.3 MGD
Average Daily Flow:	11.0 MGD
Biosolids production:	7000 tons/yr

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Unit Processes

- 2 3 mm Influent Screens
- 2 Grit chambers
- 2 10 MG aeration basins with fine bubble aeration and biological nutrient removal and denitrification capabilities
- 4 Clarifiers
- 3 Chlorine contact chambers using chlorine gas
- 1 Dechlorination system using sulfur dioxide
- 2 Natural gas-fired thermal heaters
- 4 Mixed waste activated storage tanks that can act as aerobic digesters
- 3 Thermal dryers
- 2 Emergency sludge storage lagoons
- 2 Air scrubbers
- 1 Lime silo with pug mill
- 1 Biosolids storage area
- 3 Belt filter presses

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Recent Awards

- 1997 National Association of Counties Achievement Award – Enhanced Modernization
- 1998 US EPA Region III Operations and Maintenance Excellence Award
- 2000 National Association of Counties Achievement Award – Mudmill Pond Project
- 2004 Facility of the Year – Environmental Protection Magazine
- 2004 2nd Place, Clean Water Act Recognition Award for Pretreatment Program Excellence
- 2004 National Association of Counties Achievement Award – FOG Reduction Program
- 2005 US EPA Region III Operations and Maintenance Excellence Award
- 2006 National Association of Counties Achievement Award – EHS-MS Program
- 2006 Facility of the Year, Honorable Mention – Environmental Protection Magazine
- 2007 1st Place, Clean Water Act Recognition Award for Operation and Maintenance Excellence, Large Advanced Plants
- 2008 US EPA Region III Environmental Achievement Award

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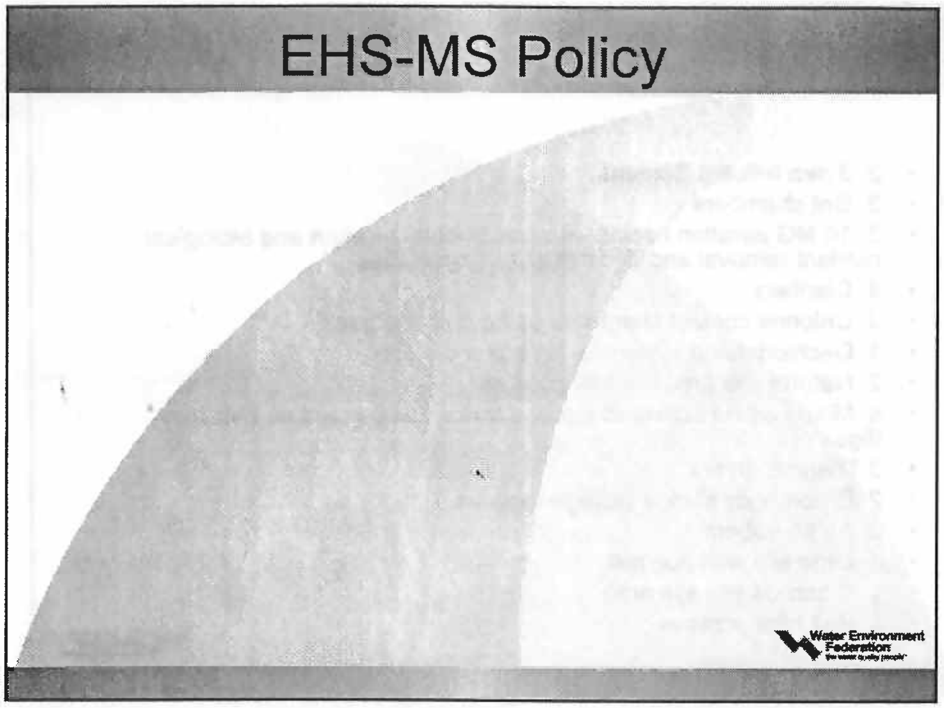

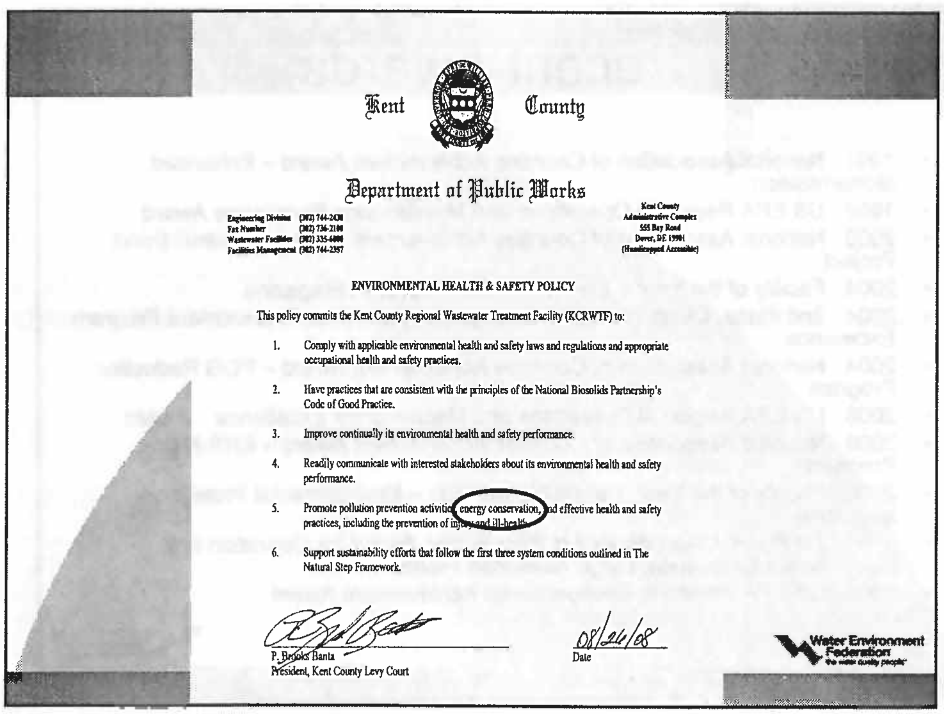

Kent County

Department of Public Works

Engineering Division (302) 744-2430
Fax Number (302) 736-2100
Wastewater Facilities (302) 335-6000
Facilities Management (302) 744-2357

Kent County
Administrative Complex
555 Bay Road
Dover, DE 19901
(Handicapped Accessible)

ENVIRONMENTAL HEALTH & SAFETY POLICY

This policy commits the Kent County Regional Wastewater Treatment Facility (KCRWTF) to:

1. Comply with applicable environmental health and safety laws and regulations and appropriate occupational health and safety practices.
2. Have practices that are consistent with the principles of the National Biosolids Partnership's Code of Good Practice.
3. Improve continually its environmental health and safety performance.
4. Readily communicate with interested stakeholders about its environmental health and safety performance.
5. Promote pollution prevention activities, energy conservation, and effective health and safety practices, including the prevention of injury and ill-health.
6. Support sustainability efforts that follow the first three system conditions outlined in The Natural Step Framework.

P. Brooks Banta
President, Kent County Levy Court

08/26/08
Date

Energy Aspects to Evaluate

- Electrical use
  - Pump stations
  - Plant components
  - HVAC
  - Lighting
- Natural gas use
  - Building heating
  - Plant components

Energy Aspects at KCRWTF

- Electrical
  - Aeration blowers
  - Biosolids processing
  - Building heating
  - Pump stations
- Natural gas
  - Maintenance building heating
  - Biosolids dryers

Determine Significance

- Rank on a scale of 1-5
- Place rankings in a spreadsheet
- Total across all categories
- Example categories
  - Amount of energy use
  - Amount of air pollution (GHG, individual parameters)
  - Amount of water pollution
  - Amount of non-renewable natural resources used

Significant Energy Aspects at KCRWTF

- Electrical
  - Blowers for aeration basins
  - HVAC in admin buildings
  - Pump Stations
- Natural gas
  - Biosolids dryers

Develop Objectives/Targets (Os/Ts)

- Based on significant aspects
- Goal is to reduce the significant aspects
- Two ways
  - Operational controls
  - Energy/Environmental Mgt. Plan
- Objectives should be specific and based on baseline data reductions
- Targets should be defined by dates

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KCRWTF Energy-related Os/Ts

- Reduce electricity usage by 20% from CY 2005 levels
- Reduce NOx and particulate emissions by 50% from CY 2005 levels

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Methods to Reach Os/Ts

- Operational controls
- Energy/Environmental Management Plan

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Operational Controls

- Permits
- SOP's
- Training/Skills
- Engineering controls
- SCADA

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Energy-related Operational Controls at KCRWTF

- Training/skills
- SCADA
- Engineering controls
- SOP's

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Energy/Environmental Management Plans

- Designed to reach Os/Ts
- Should list specific tasks to be conducted
- Should provide target dates for each task
- Should assigned responsibility

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EMP for KCRWTF

Reduce NOx and particulate emissions by 50% from CY 2005 levels			12/31/2009	
	Replace dryer diesel fuel with biodiesel, digester gas or natural gas	Reinhold Betschel	6/1/2008	01/01/08
	Install new scrubber for biosolids dryers	Glenn Bennett	12/31/2009	03/31/2009

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EMP for KCRWTF

Reduce electricity usage by 20% from CY 2005 levels			12/31/2012
	Upgrade to more energy efficient pumps, lights, etc.	Glenn Bennett	12/31/2009
	Seek renewable energy alternatives such as wind, digester gas, etc.	Hans Medlarz	12/31/2010
	Install renewable energy systems at plant.	Hans Medlarz	12/31/2012

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Enhanced Aeration Controls

- Installed hood in basin to read off gases: oxygen, CO_2
- Basin gas readings tied back to blower controls
- Reduced average number of blower used from 3.2 to 2.5
- Reduction of 15% in electric usage about 1.5 million kWh
- GHG reduction equivalent to 1150 metric tons of CO_2

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Renewable Energy Facility

Wind		Solar	
Hydro		Biomass	

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Solar PV

- Installing 300 Kw PV panels to support new UV system
- Financed by low interest loan from DNREC under federal stimulus program
- Located in an unused section of plant
- Investigated roof top system
- Cost expected to be about $1.2 million

Solar Biosolids Drying

- Air drying in a green house
- Passive solar
- Capture heat from blowers to provide heat at night and cloudy days
- Treat 20% of biosolids
- Estimated cost of $3 million
- Included in stimulus project

Wind

- Feasibility study conducted in 2004
- Monitored since 2004 at 100'
- Installed new 3 level monitoring system, 185', 125' and 75' in January 2009
- Studying for new year
- Marginal for wind energy
  - Will turn blades but generate little electricity

Biomass

- Anaerobic digestion to generate biogas then generate electricity using turbines
- Don't currently have a digester
- Limited feedstock
  - Biosolids
  - Yard waste
  - Chicken processing waste
  - Brewery waste
- Estimated cost at $8 million

Geothermal

- Utilize thermal energy in wastewater to heat/cool 2 administration buildings
- Circulate fluid through aeration basins and extract heat or cool using heat exchangers
- Requires modifications to building ductwork
- Use DOE EECBG program to cover costs
- Estimated cost $350,000

Hydroelectric

- Not feasible
- Too flat topography
- Possible to use water tank, but only if wind resources prove feasible

Contact Information

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Questions?

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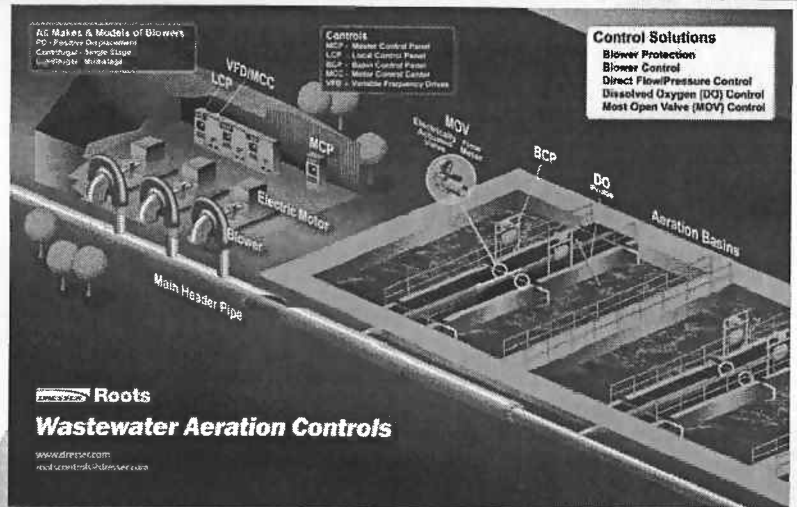
Aeration Energy Efficiency



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Aeration Energy Efficiency

- •Significance of Aeration to Total WWTP Energy Use
- •Opportunities for Energy Reduction
- •Analysis Methods
- •Case Histories
  - –Massillon, OH
  - –Waukesha, WI

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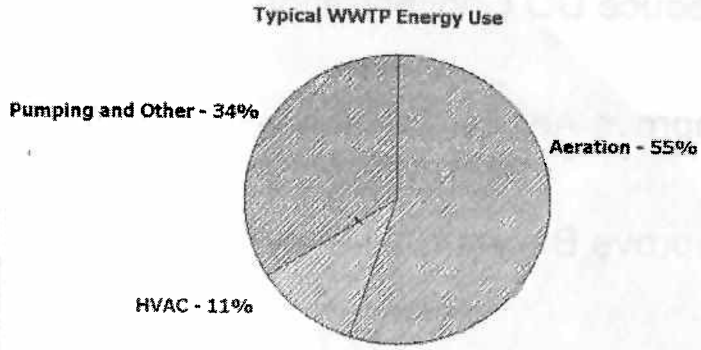
Aeration Energy Efficiency
Significance

Aeration is the Largest Energy Use for most WWTPs



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Aeration Energy Efficiency
Significance

Aerator Type	SAE **lbO2/hp-h (kgO2/kW-h)**	Low SRT AE at 2 mg/L DO	High SRT AE At 2 mg/L DO
High Speed	1.5–2.2 (0.9–1.3)	0.7–1.4 (0.4-0.8)	
Low Speed	2.5–3.5 (1.5–2.1)	1.2-2.5 (0.7–1.5)	
Turbine	2.0-3.0 (1.2-1.8)	0.6-0.9 (0.4-0.6)	0.9-1.4 (0.6-0.8)
Coarse Bubble	1.0-2.5 (0.6 –1.5)	0.5 – 1.2 (0.3-0.7)	0.6–1.6 (0.4-0.9)
Fine Pore	6.0–8.0 (3.6–4.8)	1.2-1.6 (0.7–1.0)	3.3-4.4 (2–2.6)

Data: Doctor M. Stenstrom, UCLA

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Aeration Energy Efficiency
Opportunities

Opportunities for Reducing Energy:

•Reduce DO Concentration

•Improve Aerator Efficiency

•Improve Blower Efficiency

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Aeration Energy Efficiency
Opportunities

•Air supplied to aeration basins provides the oxygen needed to maintain biological activity

•Oxygen required is proportional to organic loading of BOD_5 and ammonia

•Supplied air keeps the bacteria suspended and aids flocculation

•High DO just wastes power

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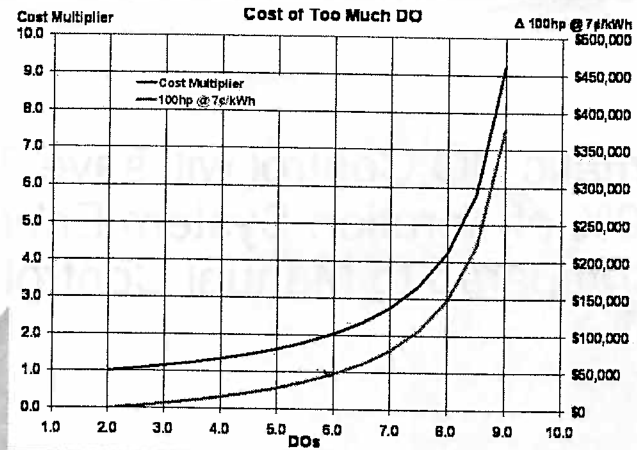
Aeration Energy Efficiency
Opportunities



$$\frac{OTE_2}{OTE_1} = \frac{C^*_\infty - C_2}{C^*_\infty - C_1}$$

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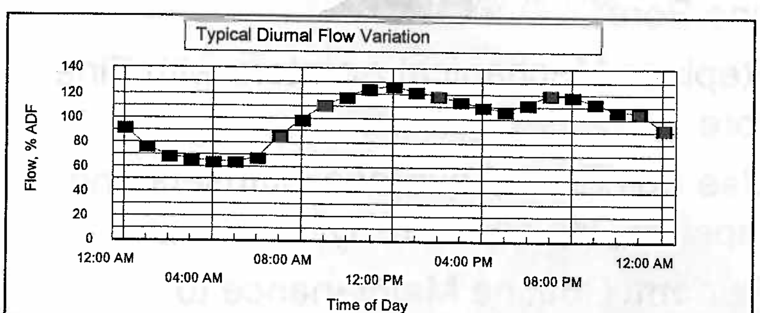
Aeration Energy Efficiency
Opportunities

Oxygen Demand Varies in Time from Diurnal Variations



Ratio of Peak to Minimum Flow is Typically 2:1

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Aeration Energy Efficiency
Opportunities

Automatic DO Control will save 25% to 40% of Aeration System Energy Compared to Manual Control

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Aeration Energy Efficiency
Opportunities

- Replace Coarse Bubble Diffusers with Fine Pore
- Replace Mechanical Aerators with Fine Pore
- Use Full Floor Coverage Diffusers and Tapered Diffuser Density
- Perform Routine Maintenance to Maintain Efficiency

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Aeration Energy Efficiency
Opportunities

- Fine Pore Diffusers Will Reduce Air Requirements by up to 50%
- Over Time Diffuser Fouling Reduces Oxygen Transfer Efficiency (OTE)

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Aeration Energy Efficiency
Opportunities

- Provide Blowers Sized to Meet Process Requirements
  - Inadequate Turndown is Most Common Problem – Replace Original Blowers with Smaller Units, Change Sheaves on PDs
  - Specified Pressure is Often Much Higher than Actual Operating Pressure – Replace Original Impellers and Motors
  - On Smaller Plants No Method Provided for Modulating Blowers – Add VFDs to PD Blowers, Inlet Throttling or VFDs for Centrifugals

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Aeration Energy Efficiency
Opportunities

- On New Designs Select Blowers for Efficiency
  - PDs based on optimum speed and efficiency
  - Turbo Blowers and Single Stage Centrifugals when Appropriate
- Design for Turndown Capability (Most Plants Operate at 1/3 of Design Capacity)
  - Provide **At Least** 5:1 Turndown Compared to Design Flow
  - Use 4 blowers @ 33% of Design Q or 2 blowers @ 25% plus 2 @ 50% of Design Q

Aeration Energy Efficiency
Analysis

1. Measure Actual Power Operating Air Flows, Pressures, and DO Concentrations
2. Calculate Power Reduction Using Design Alternates
3. Evaluate Total **NET** Cost of Design Alternates
4. Determine Simple Payback Period

Aeration Energy Efficiency
Analysis

Payback Calculation:

- Net Cost is (Alternate Equipment + Ancillary Equipment) – (Equipment Eliminated)
  - Example: If using VFDs Starters are Eliminated
- Energy Cost $/year = kWh x $/kWh x 8,760 hours per year
  - Include Demand, Time of Day, and Power Factor Charges if Appropriate
- Savings/year = Original Cost – Alternate Cost
- Payback Period = Net Cost ÷ Savings
  - Most Municipalities Require 1 to 5 Year Payback

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Aeration Energy Efficiency
Case History - Massillon

Photo: Bill Dorman, CTI Environmental

Massillon, OH – Replaced Mechanical Aerators with Diffused Aeration

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Aeration Energy Efficiency
Case History - Massillon

Original System

- Design Flow 12.5 mgd
- Roughing Filters Followed by Three Aeration Basins
- Three Twin Shaft Horizontal Mechanical Aerators Each Basin, 100 hp each
- Total Installed Aeration 900 hp

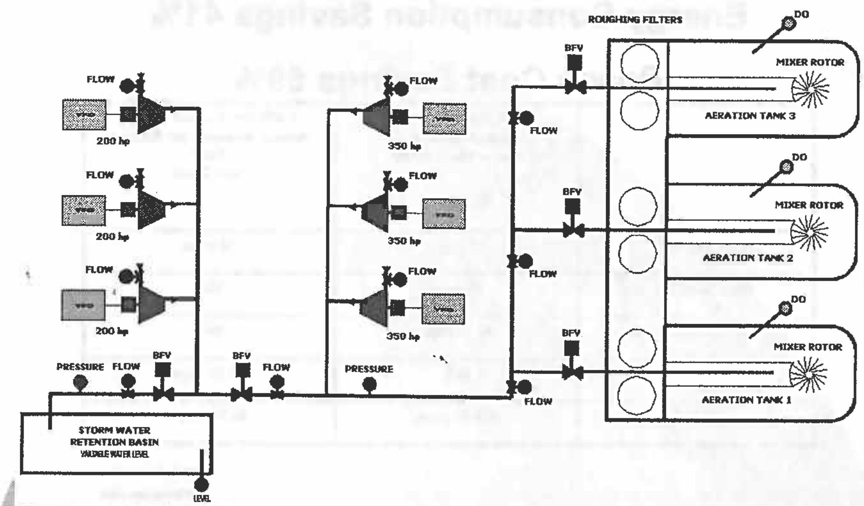
Aeration Energy Efficiency
Case History - Massillon

Upgraded System

- Design Flow 15.8 mgd
- Added Equalization Basins
- Converted to Fine Pore Diffused Aeration
- Multistage Centrifugal Blowers with VFDs
- Three Aeration Blowers
  - 350 hp, Can Aerate Equalization Also
  - 2 Operating Max, 1 Standby
- Three Equalization Basin Blowers
  - 200 hp
  - 2 Operating Max, 1 Standby
- Added Automatic DO Control

Aeration Energy Efficiency

Case History - Massillon



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Aeration Energy Efficiency

Case History - Massillon

Upgraded System
Massillon, OH

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Aeration Energy Efficiency
Case History - Massillon

Energy Consumption Savings 41%

Power Cost Savings 59%

	Brush Rotor System for Aeration Tank No. 2 (Jan. – March 2004)	LANDOX Aeration System Average Amperage per Aeration Tank (Nov. 2004)
Rotor Motor No. 1	71 amps	18 amps
Rotor Motor No. 2	68 amps	N/A
Rotor Motor No. 3	80.33 amps	N/A
Centrifugal Blower(s)	N/A	70.86 amps
TOTAL	**219.33 amps**	**88.86 amps**

Data: Bill Dorman,
CTI Environmental

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Aeration Energy Efficiency
Case History - Waukesha

Waukesha, WI – Replace Oversized Blowers to Improve Turndown

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Aeration Energy Efficiency
Case History - Waukesha

Original System

- Six Fine Pore Diffused Aeration Basins
  - Four Zones Controlled As a Group
  - DO with Pressure Control Not Stable
- Five 700 hp Inlet Throttled Centrifugal Blowers, Medium Voltage Motors
- Could Not Get Sufficient Turndown
- DOs Consistently 4.5 ppm to 6.0 ppm

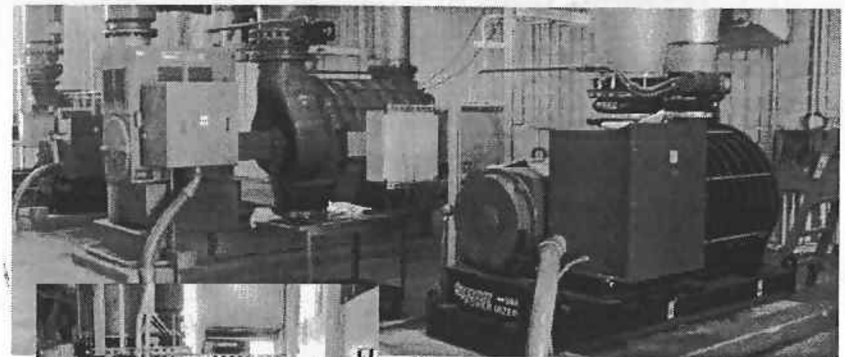
Aeration Energy Efficiency
Case History - Waukesha

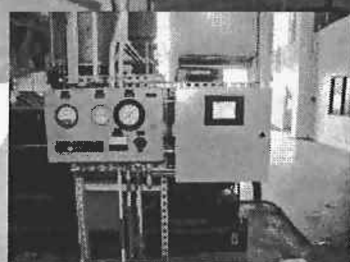
Upgraded System

- Replaced Two 700 hp Blowers with Two 350 hp Blowers
  - VFDs not Cost Effective with 4160 VAC
  - Normally Operate One Blower Only
- Upgraded Automatic DO Control
  - Upgraded DO Probes
  - Kept All Other Existing Basin Instrumentation
- Took Three Basins Out of Service

Aeration Energy Efficiency

Case History - Waukesha





Power Cost Savings
$4,600 per Month (2003)

3 Year Payback

Aeration Energy Efficiency

Questions and Answers

PUMPING – ENERGY INTENSIVE

WEF Webcast

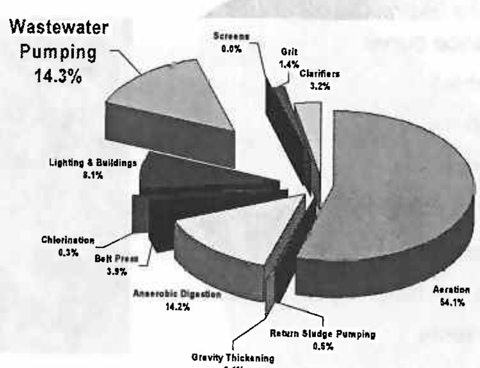
June 24, 2009

Joseph Cantwell
Senior Engineer

Science Applications International Corporation

Water Environment Federation

Energy Intensive Process - Pumping



Electricity Requirements for Activated Sludge Wastewater

Derived from data from the Water Environment Energy Conservation Task Force *Energy Conservation in Wastewater Treatment*

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Energy Intensive Process- Pumping

Energy Baseline and Benchmark

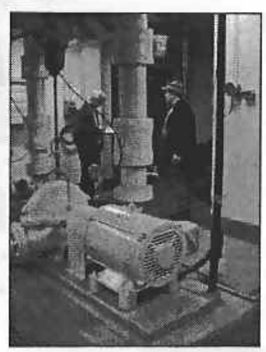
Find out where you're at **(baseline)...**

...so you can figure out where you want to go **(benchmark).**

Energy Intensive Process-Pumping

Pumping Assessment

- Pump performance curve
- Drive (if applicable)
- Motor specifications
- Design information
- Amp draw (field-measured)
- Existing flow conditions
- Discussion with operations personnel
- System components
  - Static
  - Dynamic – conveyance configuration

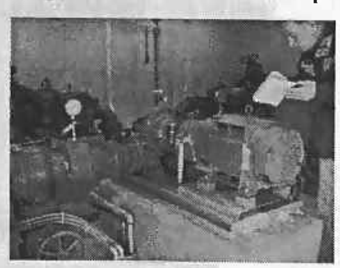


Energy Intensive Process - Pumping

Saving Energy thru Pump Best Practices

- **Motor**
- Drive
- Pump
- Valve throttling

- Poor selection
- Changing application
- Incomplete assessment



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Energy Intensive Process- Pumping

Variable Speed Pump Selection

AFFINITY LAWS—CENTRIFUGAL PUMPS

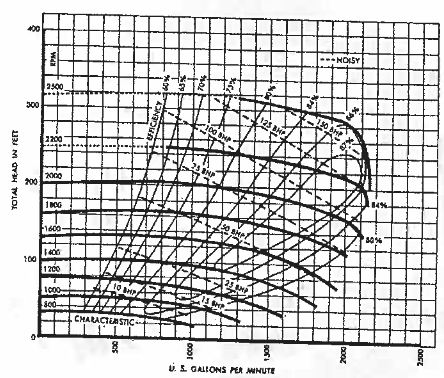

FIG. 13. Typical performance curve of a centrifugal pump with constant impeller diameter but varying speeds.

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Energy Intensive Process - Pumping

Pump System Efficiency

	Range of Efficiency	Low	Ave	High
Motor	85-95	.85	.9	.95
Drive	20-98	.20	.6	.98
Pump	30-85	.30	.6	.85
Efficiency of System		.05	.32	.80

5 to 80%

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Energy Intensive Process - Pumping

Application of Variable Speed Drives

Flow $$\frac{Q_1}{Q_2} = \frac{N_1}{N_2}$$

Head $$\frac{H_1}{H_2} = \left(\frac{N_1}{N_2}\right)^2$$

Power $$\frac{BHP_1}{BHP_2} = \left(\frac{N_1}{N_2}\right)^3$$

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Energy Intensive Process - Pumping

Use of Affinity Laws – Variable Speed Drive Example

A site is presently throttling from 1600 gpm to 1050 gpm. At what speed and horsepower can the same pumping rate be achieved?

Initial Pump Curve Information (@1770 rpm)

GPM	TDH	BHP
800	504	124
1000	474	139
1200	426	153
1400	364	160
1600	294	164

After iterations, the optimal speed identified was:

1510 rpm for 1050 gpm, 303 TDH, and 96 BHP

Efficiency Check:

Water hp = (Q x TDH)/3960

= (1050 gpm x 303 ft)/3960 = 80.3

Efficiency = 80.3 / 96

= 84% efficient

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Sheboygan Regional Wastewater Treatment Facility

- The Sheboygan Regional WWTF serves the City of Sheboygan and six neighboring communities, approximately 85,000 people.
- Energy efficiency opportunities available:
  - change to high-efficiency lighting
  - install premium efficient motors
  - install energy efficient aeration blower
  - assessed its compressed air system
  - address its HVAC systems throughout the WWTF
  - **evaluate its raw sewage pumping system for application of variable frequency drives in lieu of eddy current drives**
  - install ten micro turbines operating on bio gas

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Sheboygan Regional Wastewater Treatment Facility

- In 2007, these energy efficiency modifications produced the following savings shown in Table 2.

Table 2. Energy Efficiency Modifications

Electricity		kWh	Dollars
	North Avenue Pump Station	55,680	5,658
	Kentucky Avenue Pump Station	178,600	16,206
	Influent Pump Station	180,000	12,510
	Aeration System Blowers	358,560	24,920
	Cogeneration (payment from Power Company)		27,118
	Total Electric Savings	772,840	86,412
Natural Gas		Therms	Dollars
	Sludge Boilers	61,125	52,418
TOTAL 2007 ENERGY SAVINGS			$138,830

Source: Energy Reduction Projects Sheboygan Regional WWTP presentation delivered at UW Madison Managing Energy in Water and Wastewater Facilities, April 2008.

Energy Intensive Process - Pumping

Application of Variable Speed Drives

Well No. A (1)

Throttled from 900 gpm to 700 gpm
VFD to save 23% of energy / 33% (2)

Well No. B (1)

Throttled from 1,200 gpm to 870 gpm
VFD to save 36% of energy / 42% (2)

Well No. C

VFD on well delete at grade reservoir
Saves 34%

(1) Using same pump reducing speed
(2) Single measurement

Energy Intensive Process - Pumping

Energy saving opportunities in pump systems ARE available.

Check out the Hydraulic Institute's Pump Systems Matter web site:

www.pumpsystemsmatter.org

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THANK YOU! QUESTIONS?

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Items of Discussion

- EPC Concept & Features
- Financing Sources with EPC
- Typical Improvements
- Examples
- Getting Started EPC
- Summary & References

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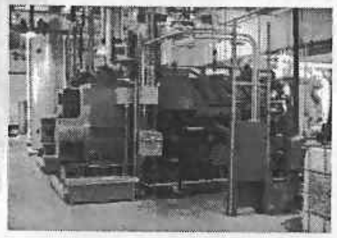
Project Financing Methods

- ARRA
- DOE Grants
- CWSRF Low Interest Loans
- Grants – State, Energy Agency, Utility, USDA, etc.
- Bonds
- Rebates - State Energy Office
- Municipal Lease

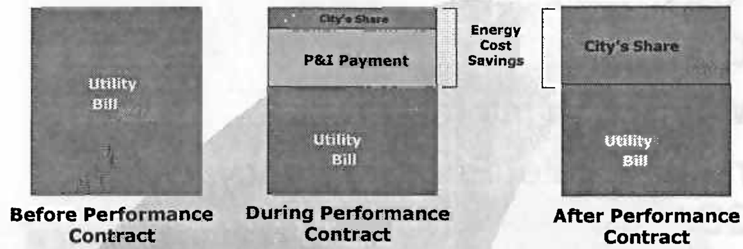


Energy Performance Contracting

- Alternate procurement mechanism
- Enabled by State Law
  - –*ex. NYS Energy Law- Article 9*
- Financed through existing utility budget
- Can be used to implement improvements that reduce energy consumption

EPC Concept

Portion of Utility Budget finances infrastructure improvements:



- Before Performance Contract-
  City's utility budget can be reduced by replacing old inefficient equipment
- During Performance Contract-
  Energy Services Company develops and installs energy efficient equipment
  Savings monitored & verified
  Owner pays back investment with portion of utility savings
- After Performance Contract-
  Owner keeps all the savings after investment is paid off

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Features of EPC

- Paid for through existing appropriated utility budget – no increase to debt service
- Implement associated infrastructure improvements
- Project costs are fixed
- Project outcomes are guaranteed

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Financing

- 3rd party financing available
  - Tax exempt municipal lease
  - 15 year financing typical for municipal projects
  - Preserves capital for other priorities
- Borrowing capacity usually not impacted
- Project benefits must exceed payments
- Assistance available through State Energy Offices

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Wastewater Improvements

- Digester Gas to Energy
- Diffused Aeration Upgrade
- Aeration Controls
- Aeration Blower Upgrade
- Power Monitoring Systems
- Variable Speed Drives
- Pumps
- Motors
- Solar Photovoltaic
- Solar Thermal
- Wind Energy

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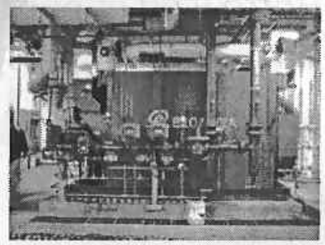
Infrastructure Improvements

- HVAC Upgrades
- Lighting
- Boilers & Chillers
- Building Envelopes (roofs, windows)
- Renewable energy technologies
- Water conservation
- Building Controls
- Energy Management Systems
- Equipment replacement



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City of Baltimore, MD

Back River WWTP

Opportunity

- 1,000,000 cfd DG flared
- Siloxanes in digester gas
- Comfort issues at Administration Building

Johnson Controls - For Internal Use Only 88

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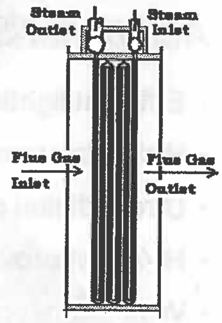
City of Baltimore, MD

Solutions

- Gas Conditioning – ALL gas on site
- Engine Generators – three 1 MW
- Heat Recovery Steam Generator
- Engine jacket water heat recovered to preheat boiler feed water



Heat Recovery Steam Generator

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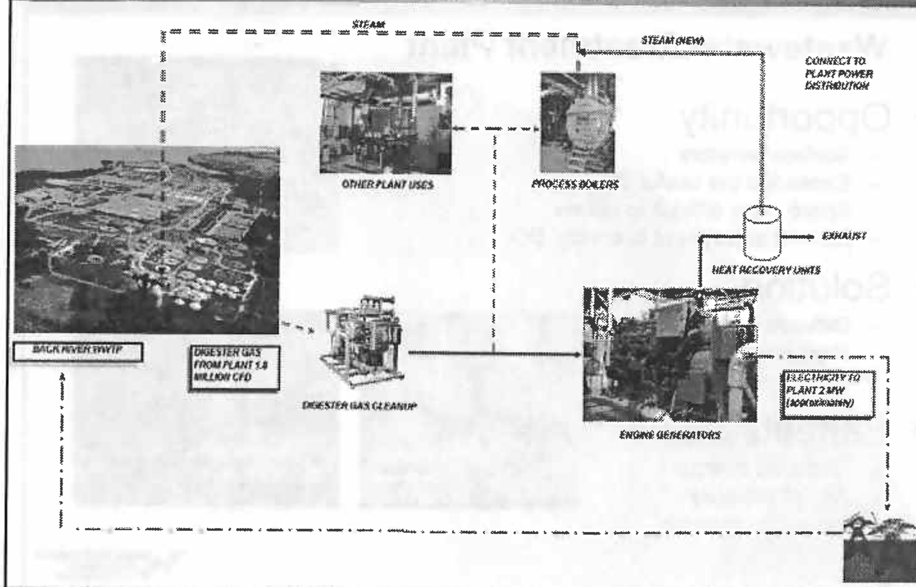
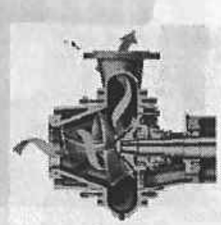
Back River WWTP



City of Baltimore, MD

Additional Savings

- Efficient lighting & occupancy sensors
- Hidrostal pump for digester recirculation
- Direct digital control / ventilation
- HVAC improvements
- Water conservation



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City of Rome, NY

Wastewater Treatment Plant

- Opportunity
  - Surface aerators
  - Exceeded the useful life
  - Spare parts difficult to obtain
  - Manual adjustment to control DO
- Solution
  - Diffused aeration
  - High efficiency diffusers
  - Automatic control
- Benefits
  - Reduced energy
  - Added capacity
  - Increased revenue

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City of Rome, NY

Water Treatment Plant

- Opportunity
  - Low lift pumps
  - Pump discharge throttled
- Solution
  - Install VFDs
- Benefits
  - Reduced power consumption

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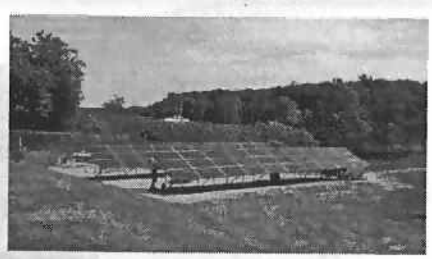
City of Saratoga Springs, NY

Water Treatment Plant



- Opportunity
  - City's commitment to Renewable Energy
- Solution
  - 12.6 kW Solar PV System
  - At entrance to 10 MGD Water Treatment Plant
- Benefits
  - Reduced purchase power
  - Additional source of energy
  - Reduced power costs
  - Reduce risk of future increases in electric rate to annual budget

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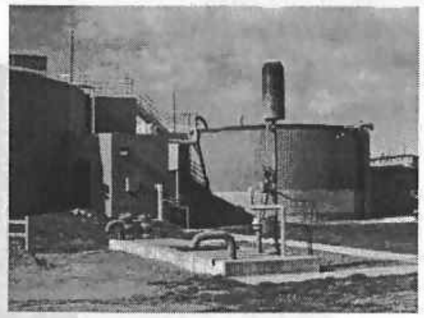
Lafayette, CO

Opportunity
- All digester gas being flared
- City paying for natural gas to heat digesters



Solutions
- Replace corroded piping
- Allow existing boiler to utilize renewable Digester Gas fuel
- Part of city wide PC project

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Can My Municipality Benefit
- Establish goals
  - Develop support within plant
  - Identify potential energy infrastructure needs
  - Consider other benefits
- Size of utility budget
  - Can it fund desired improvements
- Selection of an Energy Services Company

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Energy Services Companies

- What do ESCO's do?
  - Develop & Implement Energy Projects
- How do find an ESCO
  - National Association of Energy Service Companies (www.naesco.org)
  - State energy office
- Selection
  - Qualifications (ESCO and Team Members)
  - NAESCO Accreditation

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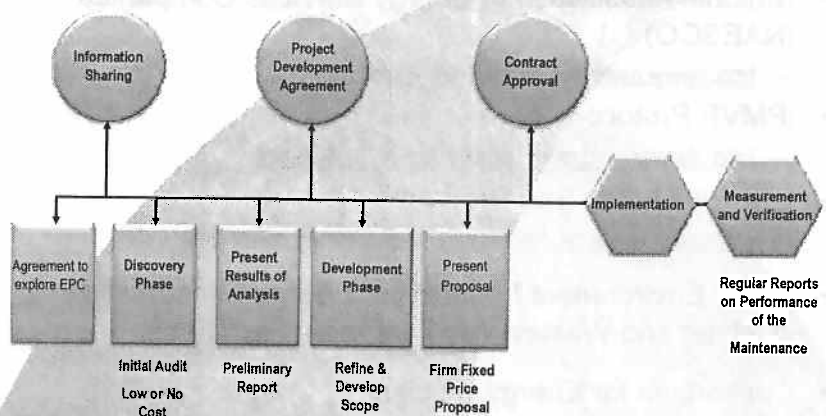
EPC Process



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Advantages of EPC

- Firm fixed price, no change orders
- Owner has control over scope, vendor selection
- Usually does not increase debt service
- Limits equipment substitutions
- Municipality gets exactly what it wants
- ESCO assumes performance risk
- Allows for implementation of associated infrastructure improvement projects

References

- National Association of Energy Services Companies (NAESCO)
  - http://www.naesco.org/resources/esco.htm
- IPMVP Protocol
  - http://www.nrel.gov/docs/fy02osti/31505.pdf
- USEPA Energy Star Program
  - www.energystar.gov/index.cfm?c=guidelines.guidelines_index
- Water Environment Federation, Energy Conservation in Water and Wastewater Treatment Facilities
- Consortium for Energy Efficiency
  - http://www.cee1.org/ind/mot-sys/ww/resources.php3

Questions

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Webcast

- Attendee List – Site Moderators
- Evaluation Form – All Attendees
- Continuing Education Credits (PDHs)
  - Interested Attendees Only

Questions – All Presentations

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Webcast Wrap-up

Thank You!

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