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Wastewater Treatment Energy Efficiency

June 4, 2009 Presentation by

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Energy Trust of Oregon, Inc.

Agenda

- Why Energy Efficiency First?
- Typical Inefficiencies in Wastewater Systems
- Energy Efficiency Measures
- Energy Trust Production Efficiency Program
- Examples of Energy Efficiency Projects
- Contact Info

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Why Energy Efficiency First?

Energy Efficiency is the cheapest and greenest source of energy.

If you do not use the electricity, you do not have to generate it.

Why Energy Efficiency First?

But it is not sexy like solar and wind!

Why Energy Efficiency First?

You have to eat your energy efficiency vegetables first before you can have your renewable energy dessert.

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What are Process Inefficiencies in Wastewater?

- Typically Observed Causes of Energy Inefficiency:
  - Outdated facilities and equipment
  - Increasing Regulatory Requirements
  - Designs Focused on Capacity, not Operating Cost
  - Inadequate Capital allocated for Optimized Process Control: Aeration
  - Incorrect pump selections, over-aeration, incorrect system set-points

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Wastewater Energy Efficiency Measures

Aeration Systems:

- Use 45% - 70% of Plant electricity
- Blowers:
  - Properly sized, multiple units
  - High speed turbo blowers: air bearings with VFD's & controls
- Mixing & Oxygen Transfer:
  - Fine bubble diffusers & mechanical mixers
  - Controls – DO Monitoring, modulating valves, VFD's, time clocks
- Process Change: Aerobic Solids Digestion to Facultative or Anaerobic Digestion Processes

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Wastewater Energy Efficiency Measures

Motors and Pumps: Pump Stations, Plant Influent & 3 Water Pumps usually operate 24/7 and were designed for peak flow

- Use Premium Efficiency Motors
- Use VFD's rather than throttling pump output:
- Pumps:
  - Size for Best Efficiency Point at average flow
  - Install multiple pumps to meet peak demand & provide reliability
  - VFD's verses ON-OFF Operation

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AFFINITY LAWS—CENTRIFUGAL PUMPS

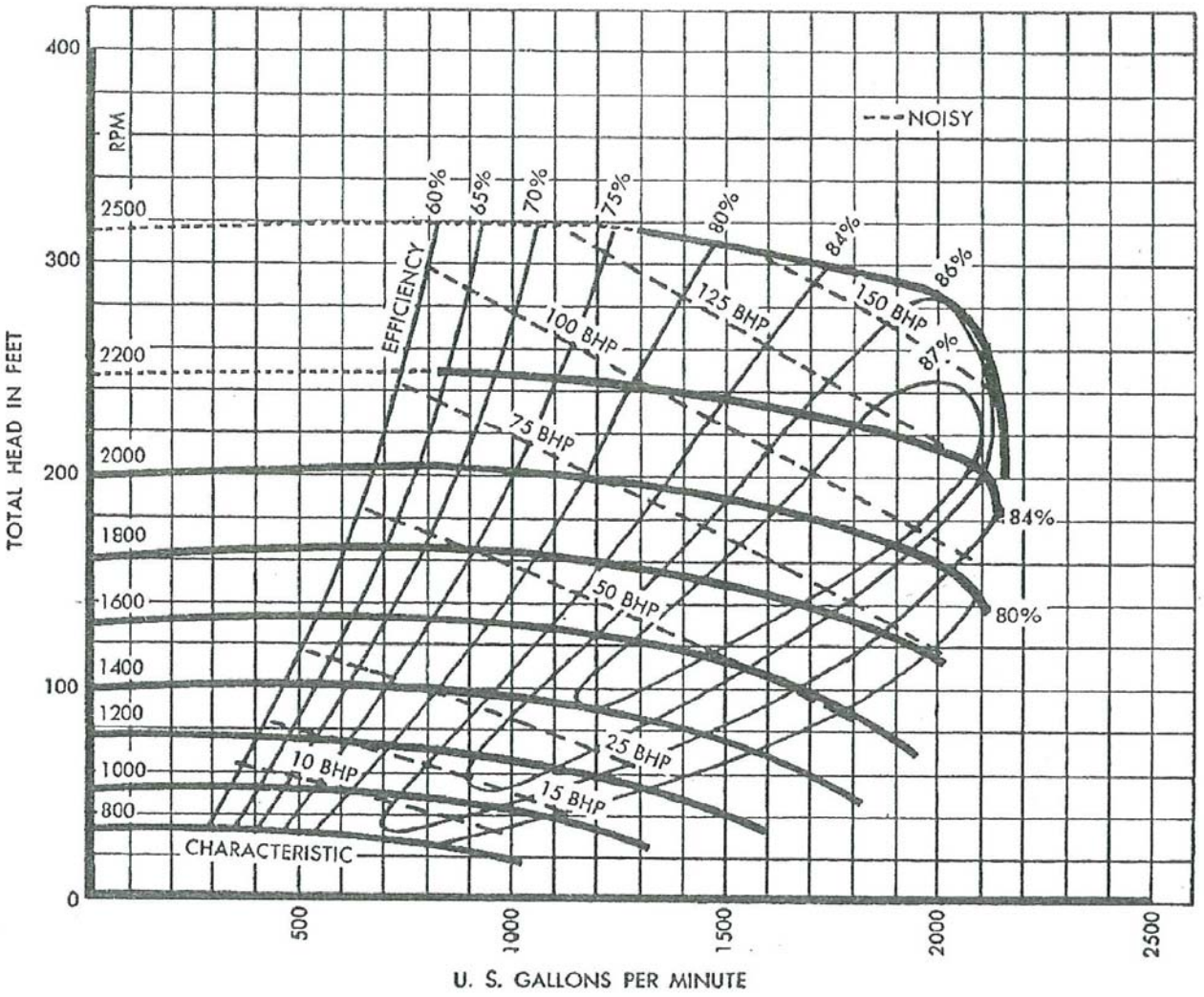

FIG. 13. Typical performance curve of a centrifugal pump with constant impeller diameter but varying speeds.

Wastewater Energy Efficiency Measures

Compressed Air Systems: for diaphragm pumps, valve actuators, and instrumentation

- Set compressor control to lowest pressure needed
- Check air lines and fix leaks
- Use VFD rather than throttling output
- Use cycling air dryer rather than continuously operating dryer

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Wastewater Energy Efficiency Measures

Lighting:

- T5 fluorescent bulbs & electronic ballasts for continuously occupied area
- Occupancy sensors for intermittently occupied areas

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Wastewater Energy Efficiency Measures

HVAC: Heating, Ventilation, & Air Conditioning

- Seal air leaks at doors, windows, and wall and roof penetrations
- Insulate ceilings first, and then walls
- Upgrade HVAC equipment
- Use waste heat from blower motors, boilers, and engine generators

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Energy Trust Production Efficiency Program

- Funded by public purpose charges collected from Oregon customers of Pacific Power, Portland General Electric, NW Natural, and Cascade Natural Gas
- Technical assistance to identify potential savings
  - We typically pay full cost of energy study
- Cash Incentives to improve the efficiency of manufacturing processes, water and wastewater treatment, and agriculture:
- Custom & Prescriptive Measures
  - Custom municipal projects: $0.32/kWh annual savings up to 50% project cost
  - Prescriptive incentive of $10/ HP for premium efficiency motors
- Our incentives, combined with Oregon tax credits (BETC) and a pass through option, make efficiency projects possible for all sizes of communities.

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Production Efficiency Process for Municipal Water & Wastewater Projects

Time Frame	Municipal Project Process	Energy Trust (ET) Process
Phase I: Multiple years	**Facility Plan** for next 20 years of System expansion and upgrades	**Scoping Report** (by ET) identifying possible energy saving opportunities warranting future study
	Capital Improvement Plan identifying specific projects in sequenced phases to implement Facility Plan	

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Production Efficiency Process for Municipal Water & Wastewater Projects

Time Frame	Municipal Project Process	Energy Trust (ET) Process
Phase II: 2 – 18 Months	**Preliminary Design** of specific projects	**Technical Analysis Study** (TAS) of energy efficient measures (EEM's) for identified projects done by Municipality's engineer or ET Contractor (ATAC)
	Final Design of projects	**Incentive offer ($'s) by ET** for cost-effective measures identified in TAS
		Municipality accepts Incentive Offer

Production Efficiency Process for Municipal Water & Wastewater Projects

Time Frame	Municipal Project Process	Energy Trust (ET) Process
Phase III: 3 – 24 Months	**Bid & Award of contract and/or purchase of equipment**	
	Project Construction	
	Completion & Startup of Project	**Inspection** of completed EEM's
		Payment of Incentive $

Wastewater - Incentive Example 1

Summary: A local Wastewater Treatment Facility realized opportunity to increase efficiency of its course bubble secondary treatment and anaerobic digestion processes.

Technical Study: Study was paid for by Energy Trust ($25,375) to determine the inefficiencies and energy savings opportunities.

Findings: The study recommended replacement of facility's aeration system with Vertical Loop Reactors and replacement of anaerobic digestion, solids dewatering, and land application process with Cannibal facultative process.

Savings: identified at over 2,500,000 kWh/ year which qualified for a $500,000 incentive

Result: The facility is in the process of project construction

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Water Incentive Example 2

- Summary: A local Water District realized opportunity to increase efficiency of its well and pumping process.
- Technical Study: Study was paid for by Energy Trust ($25,270) to determine the inefficiencies and energy savings opportunities.
- Findings: Existing submersible well pump and centrifugal booster pump could be replaced with one vertical turbine well pump and 250 HP premium efficiency motor.
- Savings: The savings were estimated at 442,460 kWh/ year and qualified for a $135,428 incentive equal to 50% of eligible project cost.
- Result: The facility has recently finished implementing the improvements.

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Working for Oregon

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Renewable Resource Programs

- Solar Electric
- Community Wind
- Small Hydropower
- Biopower
  - Digesters at wastewater treatment facilities

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Renewable Energy Opportunities –Biopower Program

What we offer:

Financial assistance for projects that use organic waste as fuel for power generation

- Free on-site visits and consultation
- Cost-share for feasibility studies
- Cash incentives to help pay for projects

Anaerobic digester projects at wastewater facilities:

- Fuel for CHP (**C**ombined **H**eat & **P**ower) system is a byproduct of anaerobic digestion (combustible gas – 60% methane, 40% CO_2)
- Example: City of Gresham's 400 kW engine generator system at its 20 MGD facility produces over half of energy needs and uses waste heat for processes.
  - Biogas treatment process eliminates moisture and impurities
  - Waste heat recovered to heat digesters to maintain bacteria's biological reaction rate

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Case Study: Gresham WWTP

- Project drivers:
  - Too much downtime for existing 250 KW Generator
  - Manufacturer discontinued replacement parts
  - Gas production exceeded engine capacity
- New 400 KW “co-generator” produces electricity & heat
  - The power provides 50 – 55% of the plant’s electricity
  - The heat warms the plant’s digester, which must maintain a temperature of about 98º F, and also provides space heat for buildings

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The “bottom line”: Gresham WWTP

- Total energy produced:*
  - 5.198 million kWh
- Equivalent cost of energy produced:*
  - $ 380,503.00
- Anticipated break-even date:**
  - January 2011

*As of June 30, 2007

**When capital costs less Energy Trust grant and BETC pass-thru, plus operational costs (media change out, parts, Veolia and Halton costs, etc.) equal Energy Production equivalent cost (based on observed/anticipated co-generator performance).

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Origins of Energy Trust

- Emerged from 1999 energy restructuring legislation (SB 1149)
- Mandate from the Oregon Public Utility Commission created Energy Trust as a nonprofit organization
- Funded by public purpose funds collected from Oregon customers of Pacific Power, Portland General Electric, NW Natural, and Cascade Natural Gas
- Began work in March 2002
- NW Natural signed on in 2003, Cascade Natural Gas in 2006

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