

Energy Efficiency and Incentive Programs for Wastewater Facilities

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Agenda

- Energy Consumption in WWTP
- Energy Efficiency Opportunities for WWTP
- Incentive Programs for Public Wastewater Facilities

Energy Consumption in WWTP

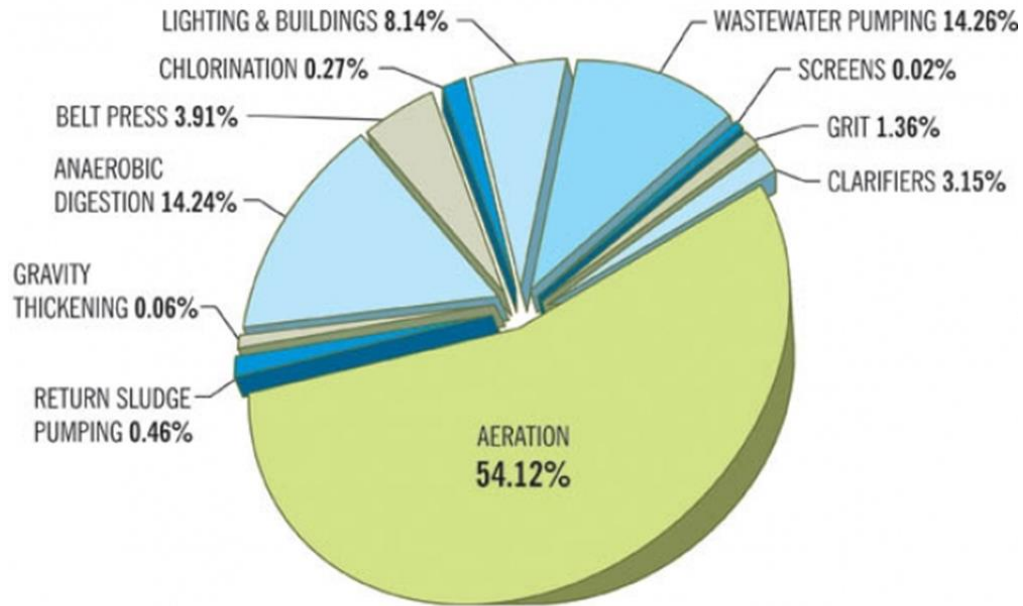
Energy Consumption in WWTP

- Providing safe drinking water and reliable wastewater services requires a substantial amount of energy
- Enormous potential to reduce energy use without compromising quality standards
- Shorter paybacks than industrial counterparts due to longer hours of operation

Wastewater Industry Energy Consumption

- **3% to 4%** of U.S. energy consumption is used for drinking water and wastewater services
- **35%** of a typical municipality energy budget is for water and waste water treatment
- **25-40%** of a typical WWTP operating budget spent on electricity

Energy Consumption Breakdown in WWTP

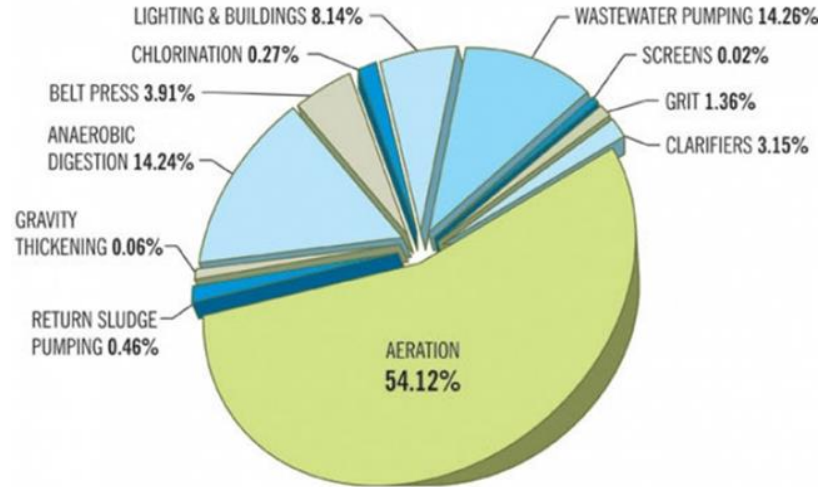


Energy Efficiency Opportunities for WWTP



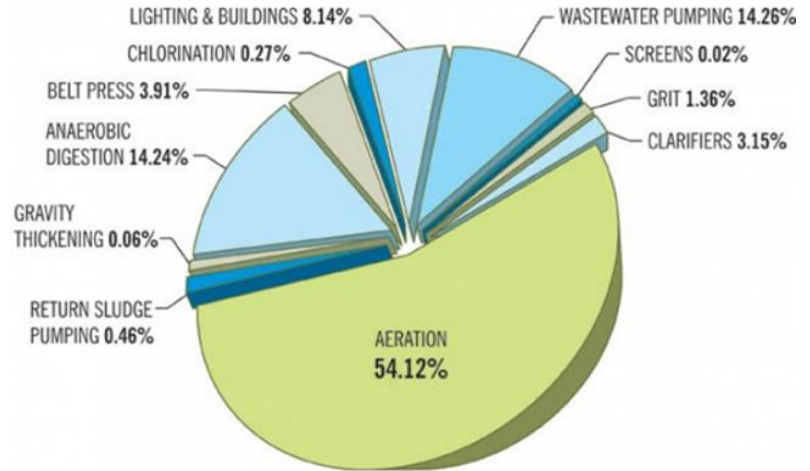
Energy Efficiency Opportunities for WWTP

- Aeration
- Wastewater Pumping
- Anaerobic digestion
- Lighting and Buildings



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Aeration

- Optimize Aeration System

	Transfer Rate (#O ₂ /HP•hr)
Coarse Air Bubble	1.5
Fine Air Bubble	3.3
Mechanical Aeration	3.9
Fine Air Bubble + High Efficiency Blowers + VFD	6.6

- 20-75% typical energy savings of unit of process
- 1-5 years typical payback

Bubble Types



Fine Bubble



Coarse Bubble

Aeration

- Variable Blower air Flow Rate
 - Blower Control: Provide the Correct Air Flow
 - Control Technique Varies With Type of Blower
 - Positive Displacement Blowers with VFD
 - Multistage Centrifugal Blowers with VFD or Inlet valve throttling
 - Single Stage Centrifugal Blower inlet guide-controlled
 - Turbo blower with VFD



Aeration

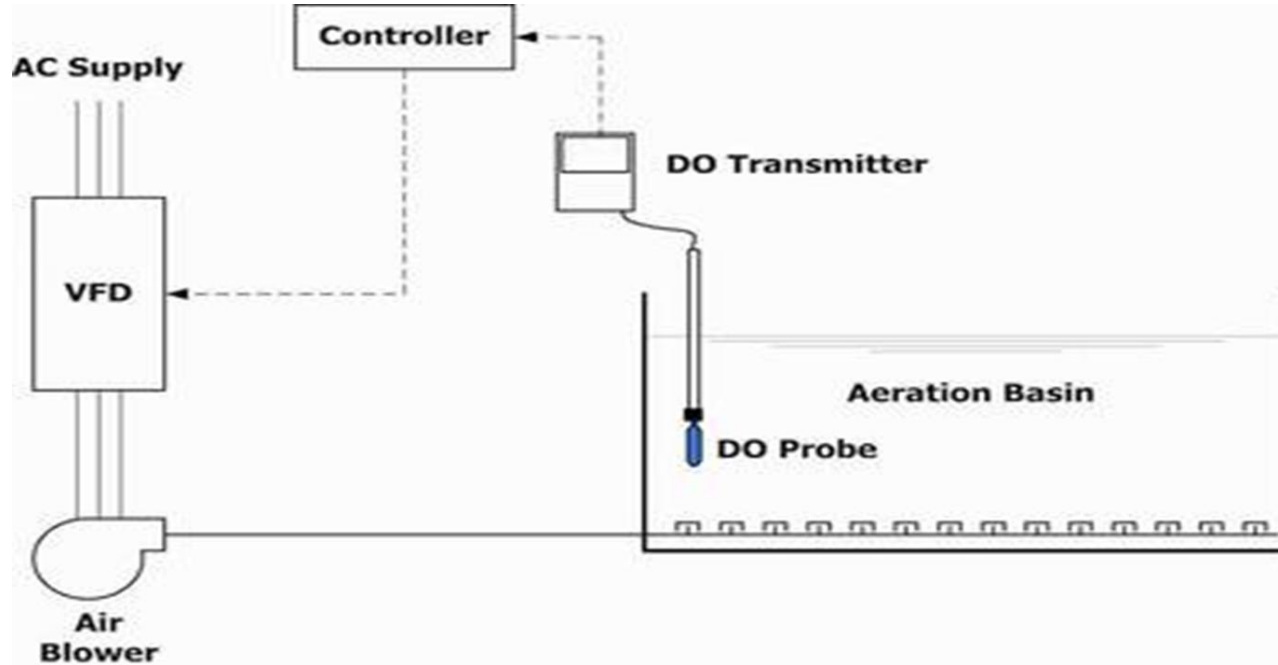
- Variable Blower air Flow Rate
 - 15-50% typical energy savings of unit of process
 - <3 years typical payback
- Applies to all aeration systems
 - Activated Sludge
 - Aerobic Digestion
 - Channel Aeration
 - Post Aeration
 - Aerated Grid

Aeration

- Automatic Dissolved Oxygen Control
 - Monitor and maintain the dissolved oxygen concentration level at a preset control point by varying the air flow rate
 - Variable Flow may be provided Through the use of VFDs
 - 20-50% typical energy savings of unit of process
 - 2-3 years typical payback

Aeration

- Automatic Dissolved Oxygen Control



Aeration

- Blower Technology Options
 - Blower Technology Continually Evolving
 - Blowers are increasingly Energy-Efficient
 - Things to be considered
 - INITIAL COST
 - EFFICIENCY
 - TURN-DOWN CAPABILITY
 - REPAIR & MAINTENANCE
 - 10-25% typical energy savings of unit of process
 - 1-7years typical payback

Aeration

- Blower Technology Options
 - Positive Displacement Rotary lobe blowers
 - Low initial cost
 - Low Efficiency
 - High Turn down Ratio
 - Moderate to Considerable Repair/Maintenance



Aeration

- Blower Technology Options
 - Turbo blowers
 - Higher initial Cost
 - Higher efficiency
 - Limited Turn Down Ratio
 - Minimal Repair/Maintenance



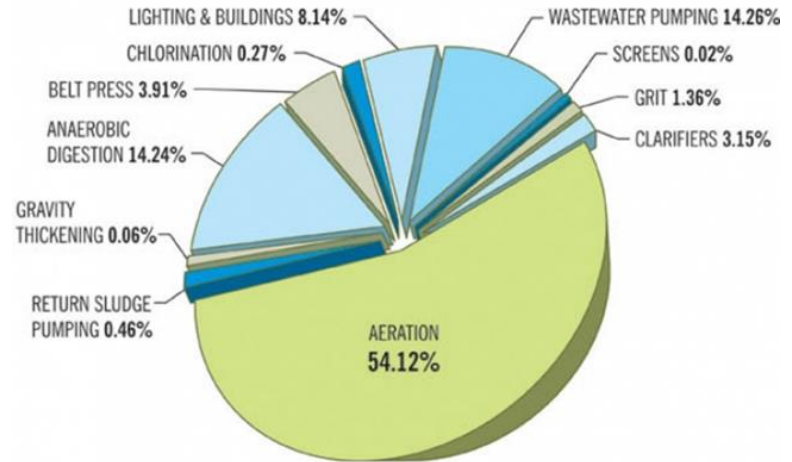
Aeration

- Blower Technology Options
 - Positive Displacement Hybrid rotary lobe-screw blowers
 - High initial Cost (Lower than Turbo Blowers)
 - High efficiency (Lower than Turbo Blowers)
 - High Turn Down Ratio (Comparable to Rotary Lobes)
 - Moderate to Considerable Repair/Maintenance



Energy Efficiency Opportunities for WWTP

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Wastewater Pumping

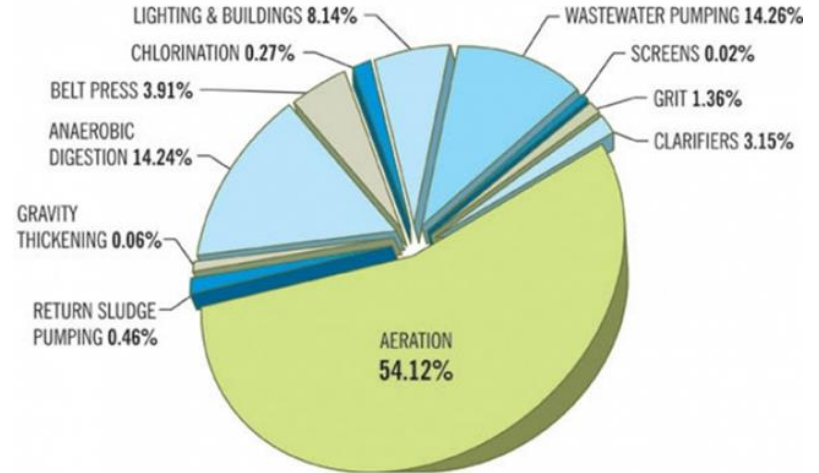
- Install High efficiency Motors and Pumps
 - Typical Max. Eff. Pump: 70%
 - Typical Max. Eff. Motor: 90%
 - Worst Case Pump: 40%
 - Worst Case Motor: 85%
 - 5-10% typical energy savings of unit of process
 - <2 years typical payback

Wastewater Pumping

- Variable Frequency Drive Applications
 - VFDs Match Motor Output Speed To specific Load
 - Can Replace Throttling Valves
 - 10-40% typical energy savings of unit of process
 - 0.5-5 years typical payback
 - Reduce Peak Demand Charges

Energy Efficiency Opportunities for WWTP

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Anaerobic digestion

- Bio-solid Mixing Options
 - Anaerobic Digestion is Highly Dependent Upon Effective Sludge Mixing
 - Could Represent Approximately 10-15% the Energy Use in a Wastewater Treatment Facility
 - Three Types:
 - Gas Recirculation
 - Pumped
 - Mechanical

Anaerobic digestion

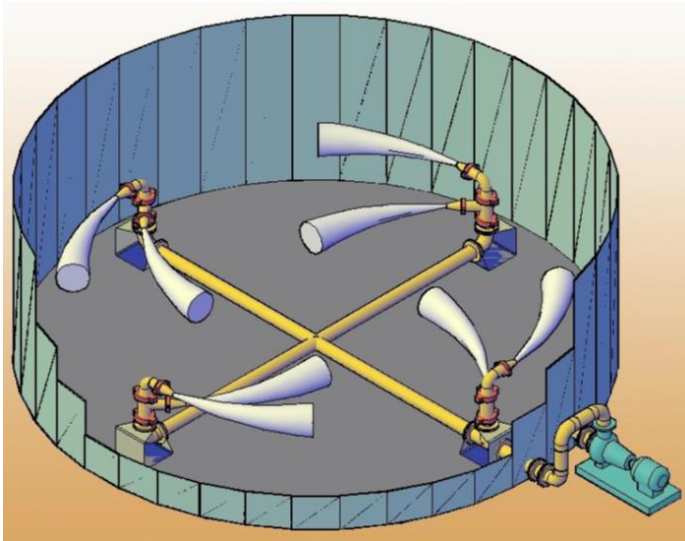
- Bio-solid Mixing Options - Vertical Linear motion mixing
 - Use Vertically Oscillating Disc
 - 50-90% less power than traditional methods
 - Variable Payback (2-16 Years)



Anaerobic digestion

Bio-solid Mixing Options - Jet mixing

- One or more internally or externally mounted pumps deliver a recirculated flow into a series of nozzles.



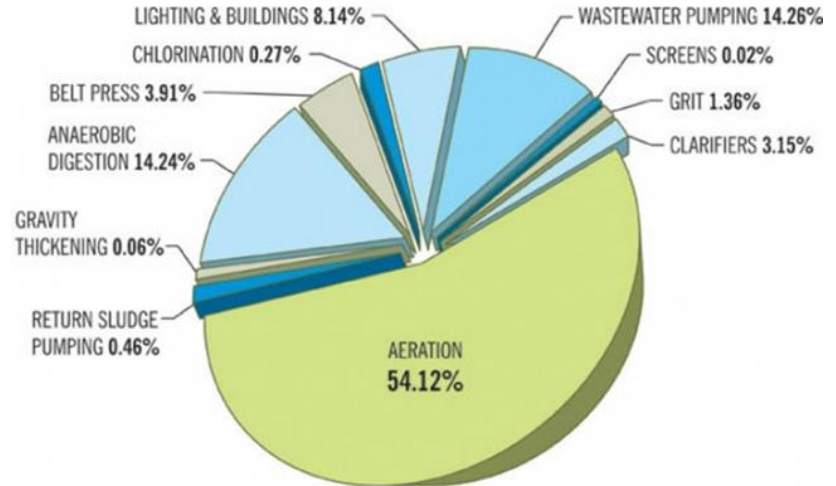
Anaerobic digestion

- Bio-solid Mixing Options - Jet mixing
 - Power Savings of up to 50% or More
 - Reduced maintenance costs
 - Significant Reduction in Tank Cleaning Costs



Energy Efficiency Opportunities for WWTP

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Lighting and Buildings

- High-Efficiency Lighting and Advanced Controls
 - Light Emitting Diode (LED)
 - Energy-Efficient Fluorescent Lighting
 - Multi-Level Lighting controlled by
 - Motion
 - Ambient Day Light
 - Timers
 - Combination of above
 - 10-30% typical energy savings of unit of process
 - <4 years typical payback



Lighting and Buildings

- Existing HVAC Systems Replacement or Recommissioning
 - Recommissioning: Overall evaluation and adjustment of the system to ensure is operating properly and to design conditions
 - Several opportunities for replacement: Variable Refrigerant Flow (VRF) Systems, Condensing Boilers, Energy-Efficient Unitary Systems, Energy Star Windows Units, etc
 - Variable Payback and Energy Savings:
 - Recommissioning can provide savings in operational, maintenance and utility cost, and energy savings of 10-20%
 - Simple Payback depends on size and condition of the existing equipment
 - 4-8 years for replacement projects

Lighting and Buildings

- Install VFD Control on Air Compressors
 - Rotary Screw Air Compressor with Inlet Modulation with unloading is Highly Inefficient, Requires About 20% of the Load in Unloading Mode
 - VFDs on a Rotary Screw Air Compressor Widely Implemented by the Industry
 - Save energy Especially in Part Load Operation
 - Payback and Energy Savings Depend on the Operating Hours and Size of the Compressor
 - Leak repair, reduce system pressure set point, tank storage with flow controller

Incentive Programs for Wastewater Facilities



Ameren Illinois Energy Efficiency Programs

- Public Wastewater facilities as part of the public sector can take advantage of a number of cash incentives to improve the energy efficiency of the plant and reduce energy use.
 - Two primary types of incentives
 - Standard (prescriptive) – pre-determined incentive
 - Custom – incentive based on energy saved



Ameren Illinois Energy Efficiency Programs

- Standard Incentive (prescriptive measures)
 - Lighting (Interior and Exterior LED, Lighting Controls, LED Exit Signs)
 - HVAC (Water Heaters (electric/gas), Chillers, Furnace Replacements, Boiler Replacements, Programmable and Advanced (Smart) Thermostats, Demand Controlled Ventilation)
 - Variable Frequency Drive
 - Specialty Equipment (VFDs Controlling Air Compressor Motors)



Ameren Illinois Energy Efficiency Programs

- Custom Projects
 - Any other projects that reduce energy consumption, including unique projects at WWTP
 - \$0.08/kWh saved annually (non-lighting)
 - \$0.07/kWh saved annually (lighting)
 - \$1.20 therm saved annually
 - Up to 60% of the Project Cost
 - All custom projects require pre-approval



Ameren Illinois Energy Efficiency Programs

- Other Incentives
 - New Construction
 - Retro Commissioning
 - Feasibility Study
 - Metering and Monitoring
 - Pre-approval required for these project types



Other potential funding sources for WWT projects

- Environmental Protection Agency (IEPA)

<http://www.epa.illinois.gov/topics/grants-loans/state-revolving-fund/index>

- Illinois Clean Energy Community Foundation (ICECF)

<https://www.illinoiscleanenergy.org/energy-program/net-zero-energy-wastewater-treatment-plants>

- United States Department of Agriculture (USDA)

<https://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program/il>

- U.S. Department of Energy (DOE)

<https://www.energy.gov/eere/amo/sep-water-wastewater-pilot-project>

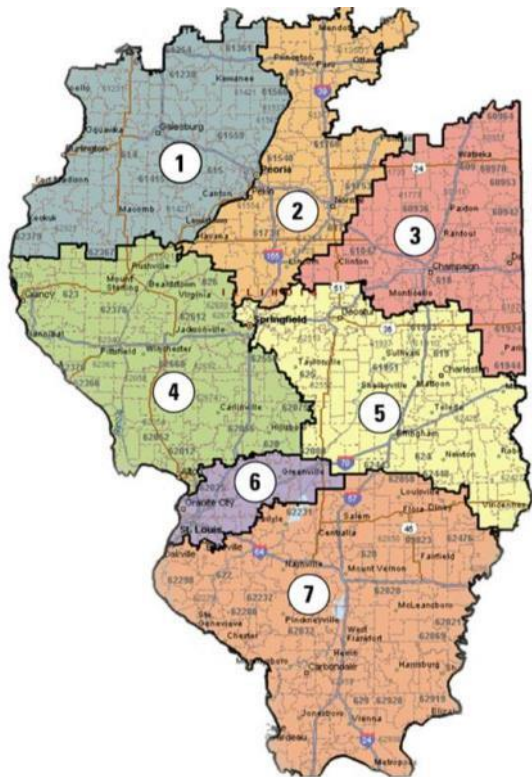


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