

Typical Water Utility and Wastewater Utility High Energy Use Operations and Potential Operational and Equipment Related Energy Savings/ Conservation Measures¹

High Energy Use Operation	Potential Energy Saving Measures
Water Utility	Wastewater Utility
<p><u>Aeration</u></p> <ul style="list-style-type: none"> • Process not typically applicable to water utility operations 	<p><u>Aeration (highest energy demand operation ~ up to 60% of total plant energy use)</u></p> <ul style="list-style-type: none"> • Fine bubble diffusers • Ultra-fine bubble diffusers <ul style="list-style-type: none"> ○ Parkson HyOx membrane panel ○ Enviroquip AeroStrip membrane strip • Surface aerator innovations <ul style="list-style-type: none"> ○ VFD control of oxidation ditch rotor speed in response to DO concentration ○ EIMCO dual impeller aerator ○ Adjustable submergence height impeller ○ Premium efficiency motors • Blower innovations <ul style="list-style-type: none"> ○ Single stage centrifugal blowers w/inlet diffusers and adjustable outlet guide vanes ○ Motor speed control using VFDs/DO concentration ○ High speed, high efficiency turbo blowers ○ Premium efficiency motors • MBR air scour control algorithms <ul style="list-style-type: none"> ○ GE Zenon Eco Aeration fouling controller / algorithm • Off gas [DO] mass balance monitoring • Proprietary Activated Sludge Process Control Algorithms <ul style="list-style-type: none"> ○ Critical O₂ Point / Respirometry (Strathkelvin Instruments) ○ SRT / DO control (Ekster Associates) • Proprietary Biological Nitrogen Removal Process Control Algorithms <ul style="list-style-type: none"> ○ Bioprocess Intelligent Optimization System (Biochem Technologies) ○ Symbio NADH Monitoring (EIMCO)

High Energy Use Operation	Potential Energy Saving Measures
Water Utility	Wastewater Utility
<p><u>Pumping (highest energy demand operation ~ 80% total plant energy use)</u></p> <ul style="list-style-type: none"> • Reduce Load (leak loss reduction and water conservation programs) 	<p><u>Pumping (second highest energy demand operation)</u></p> <ul style="list-style-type: none"> • Reduce Load (I/I reduction)
<ul style="list-style-type: none"> • Microhydro turbines vs. pressure reducing valves 	<ul style="list-style-type: none"> • Micro-hydro turbines (for elevated discharge energy recovery)
<ul style="list-style-type: none"> • Pump selection (meeting peak flow demand and maintaining Best Efficiency Point (BEP) at normal operating condition(s)) • Motor selection <ul style="list-style-type: none"> ○ High efficiency ○ Premium efficiency • VFD control (vs. throttling and recirculation flow control) • For pumps oversized or operating outside BEP range <ul style="list-style-type: none"> ○ Trim impeller ○ Add smaller pump(s) to accommodate low flow and/or normal flow conditions • Pump and motor efficiency evaluations/audits • Manage load (peak shaving, where possible) • Innovative and emerging motor efficiency technologies <ul style="list-style-type: none"> ○ Ultra-efficient copper rotor squirrel cage-type induction motors (Siemens Energy) - 1.4% energy efficiency improvement over premium efficiency motors ○ Ultra-efficient / power dense electric motor – 15% reduction in motor energy loss over premium efficiency motors (under development by Baldor and US Department of Energy) 	
<p style="text-align: center;"><u>Dewatering</u></p> <ul style="list-style-type: none"> • Replace vacuum systems • Premium efficiency motors • VFD for plant water pump 	

¹ Adapted from *An Overview of Utility Efficiency Programs*, Massachusetts Electric, NEWEA Conference, 2004, by Stephen Couture, The Cadmus Group, March 2010.

High Energy Use Operation	Potential Energy Saving Measures
Water Utility	Wastewater Utility
<p style="text-align: center;"><u>Lighting Systems</u></p> <ul style="list-style-type: none"> • Motion sensors • Energy efficient fluorescent lighting (vs. incandescent) <ul style="list-style-type: none"> ○ T5 low and high bay lighting ○ T8 super efficient ○ Indirect fluorescent lighting • Pulse start metal halide lighting (vs. incandescent) • Comprehensive lighting systems controls for large buildings 	
<p style="text-align: center;"><u>Heating, Ventilation and Air Conditioning Systems (HVAC)</u></p>	
<ul style="list-style-type: none"> • Groundwater source heat pump 	<ul style="list-style-type: none"> • Groundwater and effluent source heat pump
<ul style="list-style-type: none"> • Prescriptive utility incentives (e.g. roof top HVAC units) • Custom utility incentives for larger HVAC units • Occupancy controls • Low volume fume hoods • Ventilation/makeup air system air-to-air heat exchangers • Anaerobic digestion / methane energy recovery in CHP systems <ul style="list-style-type: none"> ○ Engine generator (e.g., GE Jenbacher) ○ Microturbines ○ Fuel cells 	