Energy Efficiency Planning, Funding and Improvements For New Hampshire's Drinking Water and Wastewater Systems

Saving Energy, Water and Dollars

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Prepared by:

New Hampshire Department of Environmental Services
Water Division
29 Hazen Drive; PO Box 95
Concord, New Hampshire 03302-0095
(603) 271-8811
www.des.nh.gov

Thomas Burack
Commissioner

Harry Stewart
Water Division Director

Sarah Pillsbury
Drinking Water and Groundwater Bureau Administrator

Energy Efficiency Strategies for New Hampshire's Water and Wastewater Systems

Introduction

Water and wastewater systems all rely upon energy to operate their utilities. Recently, a number of initiatives have been established to provide technical and financial assistance with implementing energy efficiency. This document summarizes how water and wastewater systems can capitalize on these opportunities. It also summarizes energy efficiency projects that have been recently completed by water and wastewater systems in New Hampshire.

The following information is included in the document:

- Step-by-step guide to developing and implementing an energy efficiency plan. (Pages 2 - 4).
- Listing of technical and financial assistance available. (Appendix A).
- Specific system, procedural and customer improvement measures systems can take to become more energy efficient. (Appendix B).
- Examples of water and wastewater systems from around New Hampshire that are already implementing energy efficiency improvements. (Appendix C).

Why is energy efficiency important for water and wastewater systems?

Providing safe drinking water and the treatment of wastewater consume a lot of energy. Nationally, water treatment facilities spend 11 percent of their operating budgets on energy alone (American Water Works Association Research Foundation). Several studies have suggested that water utilities can reasonably achieve energy savings between 15 to 30 percent.

What can water or wastewater systems do to be more energy efficient?

Water and wastewater systems of all sizes can benefit from increasing their energy efficiency in a variety of ways. The simplest and most important step is to understand the energy use of the entire system. Secondly, each system needs to develop and implement a realistic energy efficiency plan. It is essential to obtain buy-in for an energy efficiency plan from technical and administrative personnel for the plan to be successful. The amount of energy savings realized will depend on the current status of the system, the system design, types of treatment required and the amount of financial assistance available for improvements.

For more in-depth information about energy efficiency and for additional tools and resources to help eliminate energy waste and lower operating costs of water and wastewater utilities, visit the Environmental Protection Agency's (EPA) Energy Star website below.

EPA Energy Star for Wastewater Plants and Drinking Water Systems:
www.energystar.gov/index.cfm?c=water.wastewater_drinking_water

The three most important measures a water or wastewater system can implement to become more energy efficient are:

1) **Know when, where and how much energy the system is using.**
2) **Call the system's electric and/or natural gas utility.** Energy utility companies can assist with understanding a system's bill, conducting energy use assessments, and, in some cases, identifying financial incentives that can be applied towards the cost of replacing equipment.
3) **Develop a plan.** Upfront planning of energy efficiency improvements can save time and money in the long run.

What steps does a water or wastewater system have to take to become more energy efficient?

1. Determine current energy use

Before attempting to reduce a system's energy use, operators need to understand trends in the system's current energy use. Compile the system's energy bills from the last 12 to 36 months, and create a chart that indicates the monthly amount of energy used in kilowatts per hour (kWh), the cost per kilowatt hour, and the volume of water produced or treated (MG). Then calculate the system's monthly and average energy use per volume of water (kWh/MG) or energy used per thousand pounds of BOD per year (kWh/1000lbs BOD/year); this will serve as the system's ***baseline energy use***. The savings can be tracked and compared to this baseline, a process referred to as ***benchmarking.*** The EPA Portfolio Manager referenced below is an interactive energy management tool that allows owners and operators to track and assess energy and water consumption across the entire system online.

EPA Portfolio Manager -
www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

2. System evaluation

Once the baseline energy use has been established, look closely at specific aspects of the system's operations to identify areas where energy efficiency improvements would be most beneficial. This closer look, referred to as an ***energy audit***, asks operators to determine the energy used by major equipment (pumps, motors, aerators, treatment equipment, etc) and energy-using systems (monitoring equipment, heating system, lighting, etc.). To the extent possible, record the system's equipment, the equipment's horsepower (if applicable), hours of operation, general power consumption, and annual electrical consumption (in kWh). Simply understanding the energy consumption associated with specific equipment may lead to more efficient operations through pump scheduling and maintenance activities without the need for large capital expenditures.

Over 90% of energy used for producing and delivering drinking water is for pumping!

Pumps represent the most significant energy costs of a water system. As a result, a reduction in the volume of water actually pumped may represent the largest opportunity for energy improvement in a water system. Reducing leaks in the distribution system through leak detection surveys not only reduces water loss and waste, but reduces energy consumption and revenue loss. Likewise, working with customers to improve water efficiency through engineering and behavioral practices will also reduce demand to the system. **Reducing water consumption by customers also saves energy for wastewater systems by reducing pumping and treatment costs.**

3. Identify and prioritize areas for improvement

Use the baseline energy use of the whole system, the energy audit findings, and the chosen benchmarks to establish an energy savings goal. Some areas of a system use large amounts of energy, such as pumps, but these areas may require more costly or complex improvements to meet an energy efficiency goal. In some areas, such as facility lighting, there may be minimal energy efficiency improvements to implement, but the improvements are inexpensive and

straightforward to execute. When selecting, prioritizing, and determining payback periods for specific improvements, keep in mind the life cycle cost of the equipment, potential funding assistance, timeframe for implementation, associated labor cost and the overall complexity of the improvement.

4. Implement energy efficiency improvements

Developing an energy efficiency plan serves two purposes. First, the plan documents the commitment to improve a water or wastewater system's efficiency. Secondly, the plan outlines the process to implement those improvements. An energy efficiency plan needs to contain the following information for all energy efficiency improvements:

- Priority ranking of each improvement.
- Timeline for implementing the improvement.
- Complexity of implementing the improvement.
- Target energy savings from the improvement.
- Approximate cost (capital and operational) of improvement and possible funding sources.
- Payback time between initial investment and when energy cost savings will be realized.
- Parties responsible for the implementation
- The benchmarks that will be used to evaluate the effectiveness of the improvement to meeting the over all system energy efficiency goal.

5. Track improvement performance and continual system evaluation

When starting an energy efficiency plan, it is important to establish a tracking system to ensure that any improvements are resulting in energy savings. This tracking system should include the baseline energy use of the whole system, the energy use of system components as determined by the audit, the chosen benchmarks for the system (for example kWh used per million gallons treated), and the energy efficiency goal for the whole system. By tracking the system's energy use on a monthly basis, system owners and operators are able to monitor and refine an energy plan to ensure success. Once an energy efficiency plan is up and running it is important to continually evaluate the energy use for the whole system (through routine energy audits and tracking electric bills).

6. Communicate system savings

An essential aspect of any energy efficiency plan is to communicate savings, both in energy and cost savings, to a system's customers, operators and owners. This will help to keep system personnel motivated to seek continuous improvements, and help system customers and owners see the benefit of spending funds on system improvements.

Off-peak pumping: saving on energy costs with little to no capital costs.

Shifting system operations, such as pumping, treatment or dewatering, to occur during off-peak energy use periods can often save water and wastewater systems money through lower electrical rates. Off-peak electrical rate periods can be verified with a system's electric utility, but are typically during the early morning and late evening. Water and wastewater systems can take the following steps to meet system demands, while optimizing lower, off-peak electrical rates:

1) Assess electric bills to understand peak demand charges and examine system operations to determine which can be shifted to occur during off-peak periods.
2) Develop an operational strategy that meets system demands and minimizes pumping and specific treatment processes during peak power periods. The use of system storage, adding additional storage capacity or delaying the time of operations should all be considered.

Energy savings with this strategy are minor; however, energy cost savings may be significant. The payback period is generally very short because modifications are largely procedural. *Note that some smaller systems may not be charged different electrical rates during off-peak periods due to their relatively low energy use. A system's electric utility can verify whether a particular user qualifies for off-peak electrical rates, if any.*

Appendix A

What technical and financial assistance is available for water and wastewater systems?

There are a wide variety of resources for technical and funding assistance in New Hampshire for increasing a water or wastewater system's energy efficiency. Financial assistance resources are indicated with a "*$*".

New Hampshire Electrical Utilities' Programs and Incentives

$ NH Saves – New Hampshire Electric Utilities' Rebate Programs
www.nhsaves.com

The mission of nhsaves is to advance the efficient use of energy, while caring for the environment and promoting economic development in New Hampshire. The electric utilities in New Hampshire have worked together to establish several core programs and incentives that can be used to assist water and wastewater systems in the replacement or retrofitting of equipment to more efficient models, assist in energy efficiency planning for major building projects, and help reduce costs through managing when systems use energy. The programs outlined below are part of this effort. Contact the water or wastewater system's electrical utility for additional information on these programs.

- ***National Grid's Programs & Incentives***
  www.powerofaction.com/efficiency/

  Electric Territory

  $ New Hampshire Large Business New Construction Program - Electric Energy Strategies and Incentives for New Construction
  www.powerofaction.com/nhlbncenergystratincentives/

  The Large Business Program offers technical assistance and financial incentives to large commercial and industrial customers who are building new facilities, adding capacity for manufacturing, replacing failed equipment, or undergoing major renovations. This program targets time-dependent opportunities by incorporating energy efficient equipment and systems into the project design.

  $ New Hampshire Large Business Existing Facility Electric: Energy Initiative
  www.powerofaction.com/nhlbefeenergyinitiativeprogramoverview/

  Most water system energy conservation measures would fall under National Grid's Custom Incentives. Custom incentives from National Grid can cover up to 50 percent of the total costs of more efficient equipment, or an amount that buys down the cost of the project to a 1.5 year simple payback. These incentives accelerate the payback period and maximize the opportunity to reduce operating costs and enhance building value.

Gas Territory

$ New Hampshire C&I Gas: Natural Gas Heating
www.powerofaction.com/newhampshirecigascustomprojects/

Most water system energy conservation measures would fall under National Grid's Custom Incentives. For gas-saving measures not eligible for prescriptive rebates, we offer custom rebates and incentives. Pre-approved projects receive a one-time rebate based on estimated first-year savings up to 50 percent of project costs, to a maximum of $250,000 for newly constructed facilities.

- ***New Hampshire Electric Coop's Programs & Incentives***

$ Small Business Energy Solutions
http://www.nhec.com/business_energysolutions_smallbusiness.php
This program identifies opportunities to enhance energy efficiencies within a small business (those using less than 100 kilowatts) while reducing energy costs. The Co-op will conduct an assessment of a company's energy consumption, recommend efficiencies through products and services to reduce consumption, and provide rebates of up to 50 percent toward the cost of implementing the recommendations.

$ Large Business Energy Solutions
http://www.nhec.com/business_energysolutions_largebusiness.php

The Large Business Energy Solutions program assumes that you are replacing existing equipment with more efficient equipment that will save electricity. This rebate offers prescriptive and custom rebates. Any projects with a one-year or less simple payback do not qualify for rebates. All projects must be pre-approved by the program coordinator prior to commencing the project. To qualify for rebates, the business must be a non-residential property, an NHEC member, have electricity demand of 100 kilowatts or greater, and the proposed measures will save electricity and pass a benefits/cost test. Rebates are available for: lighting retrofits and controls, energy-efficient motors, and variable frequency drives (VFDs).

$ New Equipment & Construction
www.nhec.com/business_energysolutions_newbusiness.php

This program targets any commercial/industrial member building a new facility, undergoing a major renovation, or replacing failed (end-of-life) equipment. The program offers prescriptive and custom rebates. All projects must be pre-approved by the program coordinator prior to commencing the project.

$ Fossil Fuel Savings
www.nhec.com/business_fossil_fuel_savings.php

NHEC offers incentives for Commercial & Industrial members to save fossil fuels. Typical installations will include, but are not limited to, energy-efficient boilers, boiler controls, insulation and weatherization. Rebates are available of 50 percent of the

installed cost up to $5,000 per installation. Members may also be able to take advantage of federal tax credits for energy efficiency improvements.

$ **smartSTART Project Financing**
www.nhec.com/business_energysolutions_smartstart.php

The SmartSTART (Savings through Affordable Retrofit Technologies) advantage is simple-pay nothing out of pocket to have energy efficiency products and services installed. The cost of the improvements is repaid over time, using the savings generated by the products themselves! For instance, if a business installed energy efficiency products worth $1,000, and those products saved $100 per month, the pay for the product in easy monthly payments on the electric bill equal to three-quarters of the savings, or $75 per month. The business still realized overall savings on their electric bill while paying for energy efficiency improvements that will save money for years to come. If the business moved and the installed products stay, the business's obligation to pay for them ends. The next occupant will "pay as they save."

The SmartSTART program can be used for:

- Weatherization; including air sealing, insulation and recommended through a Whole Building Energy Analysis.
- Lighting and lighting controls recommended through a Business Energy Analysis.
- Other verifiable energy savings measures (requires Co-op approval).

- ***Public Service of New Hampshire's Programs & Incentives***
  www.psnh.com/SaveEnergyMoney/Large-Power/Programs-Incentives.aspx

  $ **New Equipment & Construction Program**
  www.psnh.com/SaveEnergyMoney/Large-Power/New-Equipment---Construction-Program.aspx

  This program offers prescriptive and custom rebates designed to help customers purchase more energy efficient equipment, such as energy efficient lighting, motors, HVAC systems, chillers, variable frequency drives, and air compressors. There are also custom rebates for all non-prescriptive equipment and other qualifying measures where kWh savings can be realized.

  $ **Large Business Retrofit Program**
  www.psnh.com/SaveEnergyMoney/Large-Power/Large-Business-Retrofit-Program.aspx

  Through this program, PSNH can help facilities improve the efficiency of their facility through services including installation of variable frequency drives, replacement of motors, air compressors, and lighting upgrades. Rebates are available for custom projects where kWh savings can be realized as well. Technical assistance is also offered through the Retrofit Program, including project evaluation, measure identification, equipment monitoring, and energy audits. To help fund these improvements, this program offers prescriptive and custom rebates to customers who replace equipment at their facility with more energy efficient equipment.

$ Energy Rewards Program
www.psnh.com/SaveEnergyMoney/Large-Power/Energy-Rewards-Program.aspx

The PSNH Energy Rewards Program offers incentives on a competitive basis to our commercial and industrial customers who achieve measurable energy savings through the installation of energy efficiency measures. Under this program, PSNH accepts proposals from any qualified party for electrical energy efficiency projects to be implemented at the facilities of commercial and industrial PSNH customers with a demand of 350 kW or more.

$ PeakSmart
www.psnh.com/SaveEnergyMoney/Large-Power/PeakSmart.aspx

PeakSmart is a program that enables local businesses to help prevent energy shortages on days of extremely high demand for electricity. On certain days of the year, consumers demand significantly more electricity than normal, creating a "peak demand" situation. Large electricity customers can help to prevent an energy shortage by participating in the voluntary PeakSmart program.

- ***Unitil's Programs & Incentives***
www.unitil.com/energy-efficiency/commercial-industrial-programs-rebates-assistance

$ Small Business Energy Efficiency Services

This program is designed specifically for smaller business customers (less than 200 kW/month). Unitil offers technical and financial assistance to help small buisinesses find ways to become more energy efficient - and save money. An energy contractor will complete a free technical assessment of your facility. Recommended energy efficiency opportunities will be provided along with the associated costs and benefits. Incentives that cover a portion of the installed cost are available on prescribed equipment. Eligible technologies include lighting, efficient motors, ocucumancy csensors, and HVAC systems. Custom projects may also qualify.

$ Large Business Retrofit Program

This program is for large business customers with average monthly demands greater than 200 kW/month. Until provide financial and technical services to facilitate the replacement of old, inefficient equipment with new energy efficient equipment in existing facilities. Prescriptive and custom incentives are available to cover the lesser of a one year payback or 35 percent of the installed cost of the equipment. Unitil also offers detailed energy audits (a customer co-payment of up to 25 percent of the audit cost may be required), reviews of specific energy efficiency projects, equipment and building commissioning, and educational programs and seminars.

$ Commercial & Industrial (C&I) New Equipment & Construction Program

The New Equipment & Construction Program offers financial and technical services to commercial, industrial and institutional customers building a new facility, undergoing a major renovation, or replacing failed equipment. Prescriptive and custom incentives are

available to cover the lesser of a one-year payback or 75 percent of the incremental cost of the efficient over standard equipment. Unitil provides detailed plan reivews, including assessment of specific energy eficient projects and equipment and building commissioning.

State Agencies' Available Resources and Assistance

New Hampshire Department of Environmental Services – www.des.nh.gov

$ **New Hampshire Drinking Water & Clean Water State Revolving Fund**
http://des.nh.gov/organization/divisions/water/dwgb/capacity/dwsrf.htm
http://des.nh.gov/organization/divisions/water/wweb/grants.htm#srf

The Drinking Water State Revolving Fund (DWSRF) and Clean Water State Revolving Funds (CWSRF) provides assistance in the form of low interest loans and principal forgiveness to public water systems and wastewater systems to finance the cost of drinking water and wastewater infrastructure.

Energy Efficiency Programs and Resources List
http://des.nh.gov/organization/divisions/air/tsb/tps/energy/index.htm

Water Conservation Efficiency Assistance
http://des.nh.gov/organization/divisions/water/dwgb/water_conservation/index.htm

New Hampshire Department of Resources and Economic Development - www.dred.state.nh.us/

New Hampshire Business Resource Center- Energy Efficiency Programs
www.nheconomy.com/business-services/energy-efficiency-programs.aspx

The New Hampshire Business Resource Center (BRC) offers many programs and resources to assist New Hampshire companies, businesses and municipalities with energy efficiency and pollution prevention. BRC and its partners will work with you to provide information on audits, workshops, training, new technologies, research and design, and financing opportunities that relate to improving productivity and energy efficiency

New Hampshire Office of Energy and Planning – www.nh.gov/oep

Energy Technical Assistance Planning Program (ETAP)
www.etapnhc.org/.

The program offers energy efficiency technical assistance at no charge to municipalities and counties in New Hampshire. ETAP's goal is to advance energy efficiency in all New Hampshire municipalities and provide the tools communities need to monitor energy performance. Engineers working for ETAP assist with inventorying energy usage, make recommendations, and assist municipalities connect to additional resources. ETAP has worked extensively with wastewater utilities in the past.

Renewable Energy Incentives: Local, State, Federal
www.nh.gov/oep/programs/energy/RenewableEnergyIncentives.htm

Financial incentive programs have been developed on the local, state and federal levels to help encourage the development of renewable energy. This page includes links to lists of possible funding opportunities for energy efficiency and renewable energy applications.

New Hampshire Public Utilities Commission - www.puc.state.nh.us

$ **Pay for Performance Program**
www.nhp4p.com

The Pay for Performance Program comprehensively addresses the energy efficiency needs of the commercial, industrial, and municipal government sectors by working with participants, such as developers, building owners and their representatives, to improve energy efficiency of commercial and industrial buildings. The program is implemented through a network of qualified Program Partners. Partners will be selected based on their demonstrated experience to develop comprehensive energy efficiency work scopes in commercial and industrial facilities, oversee the installation of the proposed scope, and verify that the installation will achieve the estimated energy performance. The program offers a three tiered incentive program that offers rebates for energy efficiency upgrades. The program is only available to large energy users, which is defined as users who have an electric demand of 100kw.

Community Development Finance Authority

$ **Municipal Energy Reduction Fund** (funds for municipalities only)
www.nhcdfa.org/web/erp/merf/merf_overview.html

CDFA's Municipal Energy Reduction Fund is available to help municipalities improve the energy efficiency of their municipal buildings, street lighting, water and sewer treatment facilities, and where appropriate, electrical distribution systems. The goal is to reduce energy usage and costs. Loans to municipalities are structured based on energy savings. Savings are calculated based on the last several years of energy usage and several years of future projected usage. The terms of the loans are flexible and can be structured as a service contract if desired by the town.

General Energy Efficiency Guidance for Water Treatment Plants

Water & Waster Energy Management Best Management Practices - New York State Energy Research & Development Authority (2010)
www.nyserda.org/programs/Environment/best_practice_handbook.pdf

Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities - Environmental Protection Agency (2008)
www.epa.gov/owm/waterinfrastructure/pdfs/guidebook_si_energymanagement.pdf

The *Guidebook* was specifically written to provide water and wastewater utility managers with a step-by-step method to identify, implement, measure, and improve energy efficiency and renewable opportunities at their utilities.

Energy Efficiency RFP Guidance for Water and Wastewater Facilities – Consortium for Energy Efficiency
www.cee1.org/ind/mot-sys/ww/rfp/index.php3

This document provides guidance on how to clearly and effectively include energy efficiency in project proposals.

Energy Audit Assistance and Tools

Energy Audit Tool - Environmental Protection Agency
http://water.epa.gov/infrastructure/sustain/baseline_energy.cfm

The ENERGY STAR program recently added wastewater and drinking water treatment facilities to the suite of facilities addressed under its Portfolio Manager an interactive energy management tool that can be used to track and assess energy and water consumption. The tool can help a utility set targets for investment priorities, verify efficiency improvements, and calculate its carbon footprint.

$ Rural Energy for America Program Grants/Energy Audit and Renewable Energy Development Assistance – US Department of Agriculture (for municipalities only)
www.rurdev.usda.gov/rbs/busp/REAPEA.htm

The grants are awarded on a competitive basis and can be up $100,000. Recipients of an energy audit are required to pay at least 25 percent of the cost of the audit. Eligible entities include a unit of State, tribal, or local government; institutions of higher education; rural electric cooperatives; or a public power entity. Energy audits and renewable energy development assistance will allow agriculture producers and rural small businesses to become more energy efficient and use renewable technologies. To apply for funding for the REAP Grant Program; please contact the Rural Development State Office. For all projects, the system must be located in a rural area, must be technically feasible, and must be owned by the applicant.

Energy Star Benchmarking Starter Kit
www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager_benchmarking

Benchmarking a water or wastewater system's energy performance is a key first step to understanding and reducing energy consumption. Treatment facilities can assess their energy performance, water efficiency, and carbon emissions using the Energy Star Portfolio Manager.

Energy Efficiency Strategies for New Hampshire's Water and Wastewater Systems

System and Facility Improvements

Improving Pumping System Performance - US Department of Energy
www1.eere.energy.gov/industry/bestpractices/pdfs/pump.pdf

This sourcebook is designed to provide pumping system users with a reference that outlines opportunities for improving system performance.

Pump System Assessment Tool (PSAT) – US Department of Energy
www.pumpsystemsmatter.org/content_detail.aspx?id=110

A free, online tool available for water systems to assess energy savings for existing pumping systems.

Water Efficiency Resources

Water Audit Software – American Water Works Association
www.awwa.org/Resources/WaterLossControl.cfm?ItemNumber=48511&showLogin=N

The free Water Audit Software includes ten worksheets in a spreadsheet file. The first worksheet provides instructions on the use of the software. The majority of data is entered on the second worksheet – The Reporting Worksheet – which prompts the user to enter standard water supply information such as the volume of water supplied, customer consumption, distribution system attributes and quantities of losses.

Control and Mitigation of Drinking Water Losses in Distribution Systems – Environmental Protection Agency (2010)
http://water.epa.gov/type/drink/pws/smallsystems/upload/Water_Loss_Control_508_FINALDEc.pdf

Renewable Energy Options Information

Energy Efficiency and Renewable Energy Clearinghouse – US Department of Energy
www.eere.energy.gov

General background information with some funding opportunities.

Database of State Incentives for Renewable and Efficiency - US Department of Energy
www.dsireusa.org/

Renewable Energy Incentives: Local, State Federal – NH Office of Energy and Planning
www.nh.gov/oep/programs/energy/RenewableEnergyIncentives.htm

Appendix B

Energy Efficiency Improvements

Potential improvements are organized by physical improvements that could be implements, procedural improvements, and improvements in customer behavior that can result in reduced energy use and cost. Those improvements that are specifically intended for drinking water systems or wastewater systems are identified as follows:

(DW) – Improvement specifically for drinking water systems.
(WW) – Improvement specifically for wastewater treatment systems.

Improvement	Details	Energy Use and Cost Savings
Automated Controls	Use of automatic controls on systems help to monitor and optimize energy consumption in relation to system demands.	Savings will vary based on system design. Continued monitoring can assist in identifying additional energy efficiency improvements.
Leak Detection and Repair (DW)	Detecting leaks and repairing them can increase energy efficiency of a system by reducing pumping requirements. Costs associated with treatment are also reduced by reduced water demand.	Savings will vary and are determined by extent of leaks and repair costs. Potential long-term cost savings are high.
Variable Speed Drives and Technologies	Installing variable speed drives (VSDs) can yield significant savings especially for systems that experience peak demand that is much higher than average demand. Variable speed technology allows systems to operate based on demand as opposed to running at full capacity continuously. VSDs are most easily installed with new motors; retrofits on older motors can be more complex and may not yield anticipated energy savings.	Energy and energy cost savings will vary depending on drive size, load and operating hours, however, savings are generally high.
Discontinue Pump Discharge Throttling	The use of variable speed drive technology, such as variable frequency drives, instead of using throttling valves to control flow rates can result in significant energy savings.	In addition to energy savings, the ability to adjust flow based on system demand can reduce pump maintenance costs.
Correctly Sized Motors	Proper size motors for the specific application. Motors should be sized to run primarily in the 65% to 100% load range. In applications that require oversizing for peak loads, alternative strategies, such as the use of a correctly sized motor backed up with a smaller motor that only operates during peak demand, should be considered.	Motors that are oversized by more than 50% should be replaced with correctly sized motors that are high-efficiency or premium-efficiency.
Install High Efficiency Motors	Survey existing motors for possible replacement with high efficiency motors and specify the most energy efficient motors on all new installed and inventoried equipment. Include an emergency motor replacement program that specifies energy efficient motors.	Energy saving will vary based on motor size and usage; however, savings of 5 to 10% can be expected. Payback on upgrade may be very short.

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Improvement	Details	Energy Use and Cost Savings
Optimize Pump System	Inefficiencies in pumping often come from a mismatch between the pump and the system it serves due to improper pump selection, changes in operating conditions, or the expectation that the pump will operate over a wide range of conditions. By matching the pump size to the typical system demand the system's energy use is optimized; installation and use of a smaller, pony-pump can be uses to meet peak system demand.	Energy and cost savings will vary dependent on if the pump is new or retrofitted, but a payback period of less than three years is likely. Optimizing pumping systems can reduce overall system efficiency and effectiveness further reducing costs.
Optimizing Storage Capacity (DW)	For systems with existing storage capacity, developing a pumping schedule that shifts pumping for system storage to off-peak energy periods and use of stored water during peak energy periods can reduce overall pumping costs.	The capital costs with adding storage capacity should be balanced with any projected energy cost savings.
Reducing Infiltration Inflow (WW)	Reducing stormwater and groundwater entering wastewater systems by repairing collection system piping to reduce the volume of water that must be handled and treated at the wastewater treatment facility. Reducing the volume may also postpone or eliminate the need to invest in future system capacity and treatment improvements.	Reducing the amount of wastewater in need of pumping and treatment reduces the overall system energy needs. Payback will vary depending on current system conditions and capacity.
Sequence Back-Washing	A filtration system can have high energy costs, and the highest energy users for filtration systems are typically the backwash pumps. Consider sequencing of backwash cycles and off-peak backwash times to reduce the electric demand. In some applications, it is possible to pump at a lower rate over longer time to a water storage tank located at a higher elevation, and backwash by gravity.	Operating pumps during off peak hours reduces energy cost, but may results in minimal energy savings.
Managing Well Protection and Drawdown (DW)	Monitor, compile and review the physical characteristics and operations of each well, including pumping rates, recharge capabilities, draw-down and recharge areas. Develop a performance chart that presents historic and current conditions. Use this information to optimize the operation and planning of pumps, motors and the control system. Particularly, monitor well draw-down during pump operation to detect any production changes over time. Diminishing production may expose potential for pump failure, or other mechanical problems. The water level may also drop to a point where pumping is inefficient.	Payback will be a direct function of the identified opportunities for energy savings. Many additional benefits may accrue: lower stress on system; reduced pumping rate; reduced electric peak demand charge.
Sequence Well Operation (DW)	Compile and review all information available on each well. Observe the functional characteristics and the production capability of each well, noting that many wells are brought on line with equipment sized to achieve full capacity production, which may not be necessary. From these data, identify the proper sequence of operations, beginning with the most energy efficient well and ending with the least energy efficient.	Savings vary from system to system depending on the condition of existing equipment and current operations.

Energy Efficiency Strategies for New Hampshire's Water and Wastewater Systems

Improvement	Details	Energy Use and Cost Savings
Utilizing New Aeration Technology – Turbo Blowers (WW)	Turbo blowers deliver air to diffusers using improved construction over conventional blowers. By using air or magnetic bearings to reduce friction between components the rotating parts are able to turn faster with less horsepower thus reducing energy inputs. These blowers can be combined with different technologies, including VSD (see above) to supply the minimum air flow needed to meet a system's various load demand resulting in minimized energy usage.	This technology can be implemented on new or existing facilities regardless of size. Energy savings will vary depending on system conditions and load; however, significant energy savings may be realized with a short payback periods particularly for new facilities.
Fine Bubble Diffusers (WW)	Fine bubble diffusers are non-mechanical devices placed in a tight grid pattern at the bottom of a tank. By breaking up compressed air into very small bubbles the diffusers create more air-water surface area that increases the oxygen transfer that breaks down organic matter. Utilizing fine bubble diffusers at activated sludge treatment facilities can increase the organic treatment, reduce polymer use, and result in better clarification which decreases treatment energy usage and costs.	Energy savings will vary depending on system conditions and load; however, significant energy savings may be realized with short payback periods particularly for new facilities. Utilization these diffusers with turbo blowers can maximize energy efficiency.
Laminar Flow and Submerged Mixers in Storage Tanks (DW)	For systems with water storage tanks, the use of a mixer can replace large pumps used to mix water to prevent water from stratifying. These mixers can circulate up to 10,000 gallons per minute; they require very little power due to the minimal head, or lift, in the up-flow pump design. Solar-powered mixers are also available, further reducing operation cost.	Using mixers can reduce operation and maintenance costs by reducing treatment costs associated with stratified water from storage tanks and by reducing damage to tanks caused by ice formation.
Pipework and Reducing Pumping Head	Reducing the total system head losses, which include static head and friction head losses (due to velocity, bends, pipe size, etc.), is directly related to energy uses. Keep pumps low relative to suction top water levels.	Potential energy savings and associated costs depend on current system design and cost associated with system improvements.
HVAC System	Incorporating an energy efficient heating, ventilation and air conditioning (HVAC) system is best done when building a new facility; however, older systems can be retrofitted.	Savings will vary based on facility conditions and usage. Actual energy cost savings may be minimal.
UV Light Disinfection System Improvement	Consider low-pressure or low-pressure, high output UV systems, which are more energy efficient than medium pressure UV systems. Install lamp intensity adjustment based on flow rate or water quality, particularly UV transmittance (UVT), for low-pressure high output and medium-pressure systems. Regularly clean lamps, as lamp sleeve fouling affects equipment performance.	Low-pressure, high-output UV lamps use about 50% less energy than medium-pressure lamps. Sleeve cleaning alone can save 10% of UV system energy costs. Payback periods for system improvements may be longer for non-continuously operating systems.

Energy Efficiency Strategies for New Hampshire's Water and Wastewater Systems

Improvement	Details	Energy Use and Cost Savings
Anaerobic Digesters for Supplemental Power Generation (WW)	Standard aerobic digesters require large amounts of energy, while anaerobic digesters use considerably less energy and may produce biogas that can capture for onsite power generation. Installation of an anaerobic digester is considerably more expensive than an aerobic digester; however, savings from onsite power generation may offset upfront capital costs.	The energy savings, potential energy production, capital costs and payback period must be evaluated on an individual system basis. In many cases, onsite power generated from anaerobic digester's biogas is sufficient to meet all system and facility power needs.

Management Improvements

Routine Facility Energy Assessment	Routinely conducting an annual energy audit for all major systems can help a water system continuously seek opportunities to improve energy efficiencies.	Savings will very based on audit findings; however, routine system monitoring can also identify issues in timelier manner.
Energy Education for System Owners and Operators	Educating involved parties (system owners and operators) on the long-term and short-term benefits, and necessarily improvements and monitoring, is essential energy efficiency efforts to succeed.	Long-term energy savings and operating costs may result increased investment in initial capital costs of improvements.
Real-Time Energy Monitoring – SCADA Systems	Real-time monitoring allows for detailed analysis of a system's energy use allowing for continuous system adjustments to maximized efficiency. The use of monitoring tools, such as a Supervisor Control and Data Acquisition (SCADA) system allows system operators to monitor energy use which can verify if system improvements are resulting in expected energy savings.	Capital costs for installation of a SCADA system can be cost prohibitive for some smaller utilities. Utilities that already use SCADA will also incur some additional capital costs for adding energy monitoring capabilities and defining energy benchmarking reports.
Electric Peak Reduction	Implementing operating procedure for a water system can reduce energy demand during peak energy use (generally morning and evening). These procedures mainly entail shifting storage pumping and treatment times to occur during off-peak energy use times.	Energy cost savings payback is typically short, with minimal capital costs since changes are mainly procedural. Actual energy savings are minimal.
Manage Electric Rate Structure	Working with the water system's electrical utility to review the systems' electric rate structure may help the water system identify the most appropriate pricing structure and determine peak energy use hours.	This improvement will not result in energy savings, but can result in energy cost savings.
Turning Equipment Off	When possible, non-essential equipment should idle or turned off, particularly during peak power demand. When conducting routing energy assessment (or audits) note what equipment may be feasible to turn off or idled.	Payback for idling or shutting equipment off is often short, with minimal to no capital costs.
Managing Facility Lighting	Using high efficiency lighting for outdoor and indoor lighting, occupancy detectors to reduce lighting when not needed, and maintaining lights are energy savings steps that can be implemented at all water systems.	Energy savings will typically be small, but capital costs are also minimal.

Energy Efficiency Strategies for New Hampshire's Water and Wastewater Systems

Improvement	Details	Energy Use and Cost Savings
Planning for Today and Tomorrow	Energy efficiency improvements goals and objective should be included in all current and future system plans. Evaluating current and future system needs can help water and wastewater systems identify areas where system energy efficiency improvement may result in the largest savings When identifying improvements it is important to look at savings in the long-term, as savings from initial capital investments may not be recouped for several years.	Sound planning and system design can help systems optimize operating and capital budgets.
Allowing for System Flexibility	Commonly, systems are designed to operate for projected peak demand rather than current, typical demand which can lead to over-sized pumps and motors that are operated inefficiently which shortens their operating life and increases maintenance costs. Systems designed for current, typical demands (with small, supplemental pumps and motors used during peak demand) are often more efficient and put less stress on the whole system.	
Supplemental Use of Generators	Generators installed for emergency back-up power can also be used to supplement system power needs during peak energy usage hours.	Using generators will not result in decreased energy usage by a water system, but may result in energy cost savings.
Renewable Energy Options	Increasingly, systems are installing renewable energy sources, such as solar, wind, biogas and geothermal, to supplement their energy use. The feasibility and efficiency of various renewable energy sources and systems is site specific. For more information see additional resources listed in the section below.	The payback period for any renewable energy project will vary; however, available funding assistance exists and should be factored in to any cost assessment.

Customer Activity Improvements

Promote Water Conservation	Promoting reduced water use among customers results in reduced energy costs because of reduced pumping requirements. Promotion can include education and outreach, fixture replacement and outdoor watering policies.	Reduced water use will also result in savings due to reduced treatment and system maintenance costs.
Reduced Water Use - Metering	Installation of water meters coupled with consumption based rate structures promotes energy reduction through water use reductions.	Savings may also be realized though reduced pumping and treatment costs, and reduced wear and tear on the distribution or collection system.
Outdoor Water Use Management (DW)	Promote energy and water conservation by establishing landscape requirements to promote water efficiency. Guidelines may include reductions in total irrigated area, topsoil requirements, and minimum efficiency requirements for irritation systems.	
Managing High Volume Users	Working with a system's high volume users to identify potential water savings modifications to their operations can reduce overall system demands.	

Appendix C

Energy Efficiency Implementation - Examples From Around New Hampshire

DRINKING WATER

Concord Water Treatment Facility – Replacing outdated equipment with efficient models

The city of Concord water system supplies its 12,000 service connections from Penacook Lake. Originally built in 1974, the plant typically treats 4.5 million gallons per day, far short of its 10 million gallon per day capacity. The plant's equipment, three raw water lift pumps and drives, are all the original equipment. Though the equipment received regular maintenance, it has been known for many years that the equipment was significantly oversized, inefficient and nearing the end of its serviceable life. On several occasions, the pumps were observed to be operating with cavitations, potentially causing a loss of service to the system due to a malfunction. Based upon pump conditions, the city chose to completely overhaul one pump, and retrofit two remaining pumps with energy efficient appurtenances. A 2009 assessment using the Department of Energy *Pump System Assessment Tool* (see page 11 for more information), indicated that the proposed improvements would increase backwash pumps, motors and drives efficiency by approximately 50 percent, raw water pump efficiency by approximately 10 percent, and finished water pump efficiency approximately 15 percent.

Concord applied for a loan amount of $490,000 under the NHDES Drinking Water SRF Program, using the American Recovery and Reinvestment Act (ARRA) funds for this project. This project qualified as a Green Project under the SRF Program. Additionally, from the projects inception Concord contacted Unitil, the city's electrical utility, regarding potential energy efficiency rebates. Unitil required the new pumps and motors to be installed and that the water system provide the specification and pump curves from the original equipment prior to issuing Concord a rebate for $128,873.

- Estimated energy savings: 67,200 kWh/year
- Estimated cost savings: $11,800/year
- Rebates from Unitil: (Electrical utility) $128,873

Total project cost: **$490,000**

Newmarket Water Department – Meter improvements to reduce treatment and pumping costs

The town of Newmarket serves approximately 5,000 residents, with 1,933 service connections with an average water use of 0.5 million gallons per day (MGD). A water system improvement study conducted in 2006 revealed about 23 percent of the total water produced was unaccounted for, and in 2009, 33.6 percent of water produced was unaccounted for based on pumping versus billing totals. In 2005, Newmarket residents voted to replace the manual-read service meters with automatic-read meters in part to increase meter readings from quarterly to monthly. This increased allows for monthly water audits to detect system and homeowner leaks sooner and minimize water losses. Automatic-read meters also reduced fuel costs for the system because personnel no longer needed to drive around town to read meters. Monthly billing also allows

customers to better understand their water usage and take measure to conserve water, resulting in further reductions in energy use through water conservation.

Newmarket applied for a loan amount of $600,000 under the NHDES Drinking Water SRF Program, using the American Recovery and Reinvestment Act (ARRA) funds for this project.

- Estimated energy savings: Approximately 330 gallons of gasoline, kWh savings were not calculated directly.
- Estimated cost savings: $27,686 total with energy savings of $7,037 to pump and treat water and $891 in fuel costs required to read manual meters.

Total project cost: **$600,000**

Keene Water Treatment Facility – Using excess head pressure for hydropower

The city of Keene provides water to approximately 5,100 service connections, of which 90 percent are residential connections. Keene's water supply is the Babbage Reservoir which sits at a higher elevation than the water treatment facility resulting in a head pressure. The water pressure at the treatment facility is too high for proper operation of the facilities treatment units; historically, the system released the excess pressure to the atmosphere. A feasibility study determined that harnessing the excess pressure though a turbine on the system's influence line would produce approximately 129,000 megawatts if electricity annually. This output is more electricity than required for the treatment plant operations so excess power is able to be sold back to the electrical grid.

In 2009, the city applied for a loan amount of $573,862 under the NHDES Drinking Water SRF Program, using the American Recovery and Reinvestment Act (ARRA) funds for this project. This project qualified as a Green Project under the SRF Program.

- Estimated energy savings: 129,000 kWh/year
- Estimated cost savings: $18,500/year

Total project cost: **$573,862**

WASTEWATER

Franklin Wastewater Treatment Facility – Utilizing new blower technology for better efficiency

The biggest component of the power budget at the DES-owned Winnipesauke River Basin Program's Franklin Wastewater Treatment Facility is one item: supplying oxygen to the activated sludge treatment tanks for the growth of beneficial microorganisms that treat the incoming wastewater. There recently has come onto the market a piece of machinery that uses a combination of existing and new concepts to deliver diffused air to these tanks for a fraction of the power input of older equipment. Blowers with magnetic or air bearings that spin with much less friction and at much greater speeds can supply the air required but with greatly reduced horsepower. In Franklin, the total electricity budget for 2010 was $548,000. The older aeration blowers accounted for approximately 38 percent of the total power used at the plant. The new blowers have cut that percentage by more than 50 percent and have realized a saving of approximately $107,000. The equipment cost was in the order of $781,000 for three blowers.

There are several additional benefits like drastically reduced noise and temperature levels in the room in which the blowers are located. The new blowers also take up a fraction of the space of the old units.

The funds for this project were provided though the DES Clean Water State Revolving Fund, under the American Recovery and Reinvestment Act (ARRA), for a loan amount of $2,523,000. As of July 2011, a total of $1,646,192 has been requested from the loan for the project. The construction portion of this project reached final completion in October 2010. Through ARRA, the Winnipesauke River Basin Program the will be offered principal forgiveness for a total of 50 percent of the funds used for the project. In addition to the ARRA funds, DES also worked with Public Service of New Hampshire (PSNH) to secure over $100,000 in energy efficiency incentives for the blower project, and the installation of a "green roof" and efficient lighting for additional energy savings. All of these improvements represent a significant step in reducing the energy usage at New Hampshire state facilities, which saves all state residents money.

- Estimated energy savings: Unknown
- Estimated cost savings: $107,000/year
- Efficiency incentives secured through PSNH: $105,870 (Electrical utility)

Total project cost: $2,523,000

North Conway Wastewater Treatment – Supplying power and heat using solar and geothermal energy production

The power supply at the North Conway Wastewater Facility is being augmented by 744 solar panels, while 16 geothermal wells use the ground's thermal energy for the heating, ventilation and air conditioning system. These combined efforts will offset energy requirements by providing more than 200,000 kilowatt hours of electricity annually. The geothermal system and new high-efficiency boilers will help the facility save 6,000 gallons of oil per year. "People might not think that New Hampshire is a viable solar venue," notes Bernier, "but there isn't a huge reduction between panels in Arizona and in New Hampshire. Cooler air temperatures actually help the electron balance; our highest production comes on sunny days in the winter. These improvements will reduce fossil fuel energy consumption and provide significant long-term cost and environmental benefits to the precinct and its ratepayers.

The funds for this project were provided though the DES Clean Water State Revolving Fund, under the American Recovery and Reinvestment Act (ARRA), for a loan amount of $2,400,000 to support both of the projects (solar and geothermal). As of July 2011, North Conway has requested disbursements from the loan in the amount of $2,294.745. Again, through ARRA, NCWP will be offered principal forgiveness for a total of 50 percent of the funds used for the projects.

- Estimated energy savings: 200,000kWh/year and 6,000 gallons of oil
- Estimated cost savings: Unknown

Total project cost: $2,400,000