Renewable Energy Projects and the Green Project Reserve

Factsheet Purpose and Overview

This factsheet introduces the potential benefits and challenges associated with implementing renewable energy projects at water systems. Lessons learned from the American Recovery and Reinvestment Act (Recovery Act) are also provided. This factsheet is intended for owners, managers and operators of water systems; technical assistance providers; and state personnel.

The Green Project Reserve (GPR) was established in 2009 under the Recovery Act and has continued in 2010 and 2011 through the Drinking Water State Revolving Fund (DWSRF) base program. While energy efficiency, water efficiency, green infrastructure and environmentally innovative projects have always been eligible under the DWSRF program, the GPR helps dedicate funding for these types of projects. Eligible projects also include those that produce electricity on-site using renewable resources such as wind, solar, hydroelectric, geothermal and biogas-powered combined heat and power. Improving energy efficiency through the use of renewable energy technology will result in the increased ability of water systems to provide ***higher quality water service*** and ***improved public health protection.***

How Can Water Systems Benefit From Renewable Energy Projects?

Renewable energy decentralizes energy generation, makes water systems more self-sufficient and may decrease demand for electricity supplied by an electric utility (which is typically fossil fuel generated). Therefore, renewable energy benefits water systems by reducing operational costs, increasing system sustainability, improving reliability (especially during a disruption to the electricity grid) and reducing the environmental footprint. The money saved and reliability gained from quality renewable energy projects can help water systems protect public health and provide better service. Specific benefits include the following:

1. Solving a public health problem

Renewable energy projects may provide solutions to otherwise difficult or significantly costly public health problems. Renewable energy can be independent of the electric grid, making it an excellent resource, especially in remote areas.

For example, solar photovoltaic (PV) mixers for storage tanks or reservoirs can be used in locations where electricity from the energy grid is unavailable or cost prohibitive. Solar mixers protect public health by circulating water, which acts as a form of treatment to reduce thermal stratification and water stagnation, improve taste and odor and increase dissolved oxygen and pH levels. Without an independent source of energy, mixer installation may not be feasible in some cases due to the costs of connecting these units to the electric grid. Where tank mixing systems are already connected to an electricity source, using solar energy can reduce demand for purchased electricity.

> North Carolina used the Recovery Act to fund 12 solar mixer projects. These projects used Recovery Act funds to install solar-powered mixers or circulating systems on finished water storage tanks, allowing systems to use renewable energy to improve drinking water quality.

2. Improving water system operations

Water systems' standard operations may create opportunities to harness renewable energy. For example, water systems may be able to use inline hydroelectric generators to capture the kinetic energy from water flowing out of a storage tank or through a distribution line. These hydroelectric generators may work instead of, or in conjunction with, lock valves or pressure valves. The scale of power generated by a hydroelectric system will be proportional to the flow of water and electricity can be generated as long as water is flowing through the system.

Water systems may also be able to improve operations by harnessing thermal energy generated by their system or available onsite. For example, some drinking water treatment systems produce effluent at high temperatures, which contains thermal energy that may be recaptured using various techniques (e.g., thermoelectric generator, heat pump, etc.). Systems may also be able to use geothermal systems that take advantage of the difference between above- and below-ground temperatures to heat or cool buildings.

> The Recovery Act funded the Massachusetts Water Resources Authority's conversion to a hydroelectric turbine to regulate the water distribution system's flow and pressure. The turbine replaced an existing pressure reducing valve allowing the generation of clean and renewable power from water flowing between two storage facilities.

3. Creating financial savings

Saving money on energy is the most common reason water systems invest in renewable energy. These savings allow a water system to make other investments with direct benefits to public health, such as spending to improve operations and maintenance or on other capital projects. The amount of savings realized depends on several factors, including the source of renewable energy, site and system design, as well as financial incentives and the price of electricity from the grid. Financial incentives vary by region and may include federal and state incentives, such as tax credits, rebate programs, Renewable Energy Credits (RECs) and the sale of excess electricity back to the grid (e.g., net metering[1]), as well as electric utility loan and rebate programs.

4. Contributing to broader municipal and state environmental goals

Water systems can contribute to achieving local and state environmental goals through renewable energy projects. In addition to reducing strain on the electric grid, these projects may generate greenhouse gas emissions reductions. States with Renewable Portfolio Standards create a market for environmental attributes such as RECs. Water systems with renewable energy financially benefit from those markets while supporting the state's Renewable Portfolio Standards program.

> The Recovery Act-funded filtration plant photovoltaic installation in Wilmington, DE helped the city achieve a meaningful reduction in its energy footprint and reduce greenhouse gas emissions. One of the primary goals of Wilmington's new sustainability initiative is to reduce its greenhouse gas emissions by 20 percent from current levels by the year 2020.

What Key Factors Should Be Considered For Renewable Energy Projects?

Done properly, renewable energy projects can provide public health benefits and improve service to customers. Renewable energy projects are complex undertakings, however, and should not distract from a system's primary goal to deliver high quality, safe drinking water to customers. Water systems can start investigating project feasibility by carefully considering the following key issues ***during the project planning phase***:

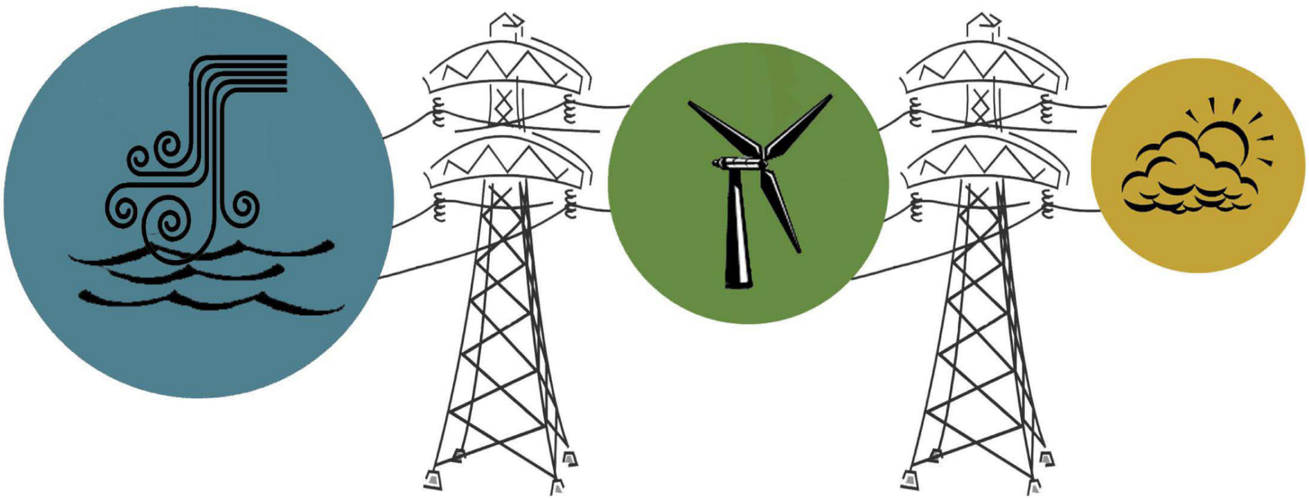
- **Evaluate Project Barriers**: The renewable energy development process includes navigating siting regulations, permitting requirements and interconnection agreements with their electric utilities. To help navigate potential challenges, drinking water systems can conduct early "fatal flaws" analyses, followed by more ***comprehensive technical and financial feasibility studies*** using current, site-specific details. Water systems may benefit from technical assistance support provided by state energy departments, National Renewable Energy Lab (NREL), renewable energy advocacy organizations or other experts. Identifying project barriers may require some upfront financial investment in feasibility studies, but by gaining an understanding of renewable energy, the development process and operational requirements, water systems can more fully assess how a potential project may benefit their operations and finances.

- **Assess Energy Production Potential**: The availability and quality of a renewable resource has a critical impact on energy output and cost effectiveness. The expected energy and financial benefits of a project can be

[1] Depending on a renewable energy system's output and electricity needs at a water system, those water systems connected to the grid may use all of the electricity generated on-site, or they may generate excess electricity that can be sold back to the grid. This incentive, available in some states, is called net metering.

significantly impacted by inaccurate production estimates. However, free online tools such as the NREL "In My Backyard" tool for solar and wind power[2] can provide systems with preliminary production estimates.

While renewable energy development may seem dominated by solar and wind projects, hydroelectric projects may be particularly well suited for water systems. Wind and solar power are limited by the intermittency of the renewable resource. However, hydroelectric systems can take advantage of regular high pressure flows—through pipes or out of a storage facility—to produce consistent renewable energy.[3]



- **Examine Economic Costs and Benefits of a Project**: Renewable energy projects can be costly, so water systems need to carefully evaluate project economics. Preliminary financial modeling will alert systems to major feasibility barriers. If the project passes this initial screening, systems should continue to evaluate the economics to distinguish between good and bad projects. Incomplete, inaccurate or unrealistic assumptions in financial modeling can significantly impact a cost-effectiveness determination for a project. To properly evaluate the financial impact of a project, a financial model must incorporate current electricity rates,[4] conservative operation and maintenance costs for the renewable energy system over the expected lifetime of the project, a reasonable annual inflation rate, a discount rate and incentives.

  Funding and incentive programs dramatically affect the financial benefits and feasibility of renewable energy projects. Maximizing financial incentives, including GPR funding, and well-structured financing helps reduce or eliminate the need for rate increases that would otherwise be required to service project debt.[5] Because incentives are constantly changing, the availability and expected value of incentives should be reviewed repeatedly throughout project planning, development and operation. Using the most accurate information will help water systems achieve a clear understanding of expected benefits and costs.

- **Consider the Long-Term Commitment to Operations and Maintenance:** Renewable energy projects cannot be seen as a one-time capital investment. These technologies require a commitment to monitoring and maintaining the renewable energy system to fully capture the expected benefits. The lifespan of solar PV, wind and other renewable energy systems typically exceeds 20 years. Water systems may oversee operations and maintenance internally or seek outside help from a contractor. A conservative estimate used by energy experts for the lifetime cost of operations and maintenance of a renewable energy system is 20 percent of the project's total installed cost.

[2] http://www.nrel.gov/eis/imby/

[3] Capacity factor is the ratio of actual generation during a time period of performance (typically one year) to the maximum possible generation assuming continuous output at full system capacity. Capacity factors are project specific.

[4] The most current all-in rate (i.e., transmission, distribution and supply) paid for electricity in cents per kWh should be utilized. Financial models should also examine project economics using future electricity rates or rate escalations if they are known or can be estimated.

[5] The Database of State Incentives for Renewables and Efficiency (DSIRE) provides comprehensive information on federal, state, local and utility incentives and policies for renewable energy and energy efficiency. http://www.dsireusa.org/

How Can Systems Measure the Benefits of Renewable Energy Projects?

Appropriately sited and well-executed renewable energy projects have benefits that can be measured, recognized and shared. Project benefit evaluations vary significantly among systems, sites and technologies. Many project impacts, such as the educational value of community exposure to renewable energy, cannot be quantified. Yet many benefits can be measured with simple strategies including:

- **Estimating the reduced demand for purchased electricity** by multiplying the expected renewable energy system annual output in kilowatt-hours (kWh) with the all-in electricity rate (cents per kWh) paid to the electric utility.
- **Measuring the change in electricity demand and total electricity costs** after construction using historical electricity billing information (e.g., compare the monthly electricity use of two consecutive years).
- **Determine pounds of greenhouse gas emissions avoided** using U.S. Energy Information Administration conversion factors and multiplying renewable energy system annual output (kWh) with pounds of emissions avoided (lbs. CO_2 per kWh).

Projects can also be evaluated using the levelized cost of energy (LCOE). LCOE captures the full costs of a project over time and allows for comparison across diverse project sizes and technologies. This metric reveals the cost effectiveness of the renewable energy system on a per kWh basis. To generate savings, project LCOE should be lower than the electricity rate paid by the water system.

Lessons Learned Under the Recovery Act

Of the 1,345 assistance agreements for drinking water projects funded through the Recovery Act, 38 GPR projects (3 percent) had a renewable energy component. Renewable energy technologies varied: an estimated 26 projects had a solar power component, eight had a hydropower component and four had a wind power component. Water systems were primarily motivated by the potential financial benefits of renewable energy. Systems that implemented projects under the Recovery Act realized a range of financial benefits, due in some part to the regional variability in incentives. The figure below illustrates the range of annual savings seen with seven Recovery Act projects and the associated project capacity (kW). Solar mixers are not represented because they generate electricity independent of the grid. Therefore, while solar mixers have direct public health benefits, the financial benefits are more difficult to capture.

The numbers in the black circles associated with each project illustrate the payback periods associated with the project (in years). This figure illustrates some of the most advantageous technologies for water systems. For instance, systems interested in renewable energy may be able to take advantage of hydroelectric systems that complement or improve water system operations.