CLEARVIEW ENERGY BLOG

What is Green Energy?

Posted by Kai Stansberry on Jul 31, 2014 4:30:00 PM

What is Green Energy?

We've all heard of the catch phrase 'green energy' with its promises of reducing our dependence on coal, oil and natural gas. But what exactly is green energy and why should we be interested in promoting it?

Green energy comes from natural resources such as wind, sunlight, rain, tides, plants and geothermal heat. These energy resources are renewable, unlike fossil fuels, which take millions of years to develop. Renewable energy sources have a much smaller impact on the environment than fossil fuels that produce greenhouse gases contributing to climate change.

Types of Green Energy

With the advancements in technology, green energy can replace fossil fuels in the production of electricity. Let's look at the most common types of green energy.

Solar Power – This natural resource is typically produced using photovoltaic cells which capture sunlight and turn it into electricity. Not only is it used to provide natural lighting and cook food, solar power is also used to heat buildings and water. This is the most prevalent type of renewable energy and has become inexpensive enough to power everything from small handheld devices to entire neighborhoods.

Wind Power – People started using wind power centuries ago with windmills, which pumped water and ground grain. Today's modern wind turbine is a highly evolved version of a windmill, most with three blades atop a steel tubular tower. They can range in size from 80 foot tall turbines that can power a single home to over 260 feet tall and power hundreds of homes.

Hydropower – Also called hydroelectric power, hydropower is generated through the water cycle which includes evaporation, rainfall, tides and the force of water running through a dam. This resource depends on high precipitation levels to produce significant amounts of energy.

Geothermal Energy – Energy from the earth's formation and radioactive decay of minerals under the earth's crust produces masses amounts of heat under the earth's crust. Some of this heat comes to or near the surface, melting rock and creating geysers when in contact with water sources. Geothermal energy plants harness this heat brought to the earth's surface to make electricity using steam turbines. In addition, the heat can also be used to heat homes and businesses directly in cooler weather. This is an untapped natural resource that has the potential to produce 10 times as much as electricity as coal currently does.

Biomass – Organic material such as wood, crops, landfill gas, alcohol fuels and trash contain stored energy from the sun and converts this energy into a chemical energy in the form of glucose, or sugar. The chemical energy from biomass is released as heat when burned and can be run through gas or steam turbines to produce electricity.

Biofuels – Sometimes these renewable, organic materials such as corn and sugar cane, are transformed into fuel, such as ethanol and biodiesel. Due to high oil prices, new laws and mandates worldwide have increased ethanol production used for automobile fuel.

Click to learn more about green energy.

Topics: Renewable Energy

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Solar Energy in New York

Large and Small Systems for Heat and Power

SalesSolar energy is abundant, non-polluting and does not emit greenhouse gases responsible for global warming. Even in the northeastern United States, where sunlight is variable, solar energy helps to warm and light many buildings and can make a significant contribution to meeting demand for electricity and hot water.

Solar technologies can be applied at both large and small scales. Large commercial scale solar power plants feed electricity directly to the utility electric grid. Smaller distributed solar electricity generation by individual homes, institutions or businesses is economically feasible because New York has adopted "net metering," which allows excess electricity generated on sunny days to flow back into the electric grid, with credit or payment from the utility company for the power generated.

Long Island Solar Farm is the largest solar power plant in the eastern United States. It consists of 164,000 solar panels that provide up to 32 MW of electricity (Credit: Brookhaven National Laboratory)

Three Main Technologies Harvest Solar Energy

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Solar Photovoltaic (PV)

PV, solar hot water and passive solar work together in this home (Credit: David Parsons, NREL)

Most people are familiar with solar photovoltaic (PV) technology. PV cells (often referred to as "solar cells") convert sunlight directly into electricity. Solar cells are connected together to form solar panels. Multiple panels together form the solar arrays commonly seen on roofs and as free-standing installations. Large-scale PV arrays, sometimes referred to as "solar farms," can generate commercial electric power. Small scale solar PV is providing power to a growing number of individual homes, farms, businesses and institutions, helping to make them energy-independent and adding power to New York's electricity grid during peak demand times on hot summer days.

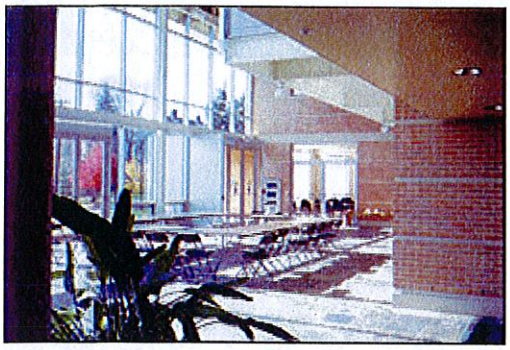
Solar Thermal Energy

Solar water heating is one of the most common ways to directly harvest the heat of the sun. Solar hot water technology has been around for many decades and is quite efficient (typically 65 to 70 percent). The equipment is affordable and usually lasts for decades with very little maintenance -- and, of course, the solar "fuel" is free. A solar hot water system typically consists of a collector, a storage tank, piping and sometimes valves, controls and pumps. In freezing climates like New York's, the systems often use a non-toxic glycol as the collector fluid and a heat exchanger to transfer the thermal energy to the house drinking water system. The most common collector is the robust and well-tested flat-plate collector; a more recent design is the evacuated tube collector.

Direct Concentrating solar power, or CSP, is a form of solar thermal technology that is being adopted in very sunny areas; it is not currently used in New York. In CSP systems, large mirrors or lenses concentrate sunlight onto a small area to produce steam, which then drives an electricity-generating turbine.

Passive Solar Energy

Passive solar energy means heating and lighting buildings directly from sunlight. In passive solar buildings, windows, walls, and floors collect, store, and distribute solar heat in cold seasons; Other elements such as awnings and overhangs shade the building when the weather is warm. Taking advantage of the local climate, passive solar design uses the building's directional orientation, window placement and glazing, shading, thermal insulation and thermal mass to help manage solar heat inputs. Passive solar building designs also offer opportunities for daylighting (controlled admission of direct sunlight and diffuse skylight), which can reduce electric lighting demand and add to energy savings.



College atrium benefits from passive solar (Credit Ed Hancock, NREL)

Promoting Solar Electric Generation in New York

NY-Sun is Governor Andrew M. Cuomo's $1 billion initiative to advance the scale-up of solar and move New York State closer to having a sustainable, self-sufficient solar industry. The growth of solar in the State has increased more than 300 percent from 2011 to 2014, twice the rate of U.S. solar growth overall.

Solar Training, Technical Assistance and Support

As part of NY-Sun, the PV Trainers Network (see link at right) offers education, training, and technical assistance, to help local governments and stakeholders identify opportunities, mitigate barriers, and create programs that drive the development of solar electric (photovoltaic or PV) in their communities. These services are available for:

- Incorporating solar energy into the comprehensive plan
- Drafting solar development regulations
- Streamlining and troubleshooting support of solar permitting and inspection processes
- Identifying local solar financing options
- Procuring solar for municipal facilities

State Solar Energy Incentives

To increase solar energy resources, New York State and the federal government offer financial incentives that help businesses, schools and homeowners defray the upfront cost of installing on-grid solar energy facilities.

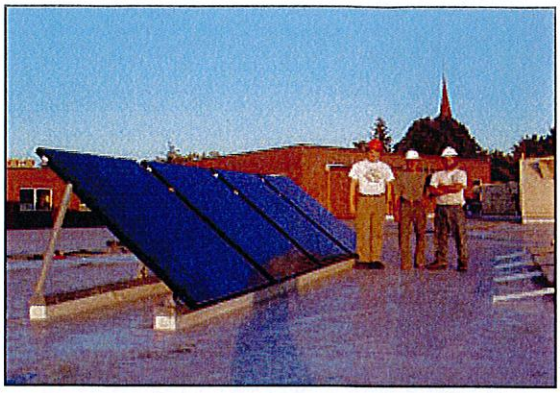
The incentive programs discussed below are the state's chief tools for encouraging individuals, businesses and institutions to adopt solar energy. Additional information about solar incentives for homeowners and commercial customers is available through the NYSERDA Renewable Energy link at right. Also linked is a comprehensive list of renewable energy and energy efficiency incentives for New York compiled by the U.S. Department of Energy (DOE).

NYSERDA Solar Installation Incentives

The NY-Sun Solar PV program offers incentives to reduce the installation costs of solar PV for both residential and commercial customers. See link at right (NY-Sun Solar PV Incentive Program), for incentive information and a solar PV clean power cost estimator. NYSERDA also offers incentives for heating water with the sun (Solar Hot Water link).

Net metering

Net metering is available on a first-come, first-served basis to customers of the state's major investor-owned utilities. Publicly-owned utilities are not obligated to offer net metering; however, the Long Island Power Authority (LIPA) offers net metering on terms similar to those in the state law. New York State law allows net metering for solar photovoltaic systems up to 25 kW in residential buildings, and up to 2 MW in commercial and industrial settings, including systems serving nonprofit organizations, schools, governments and agricultural operations.



Solar panel roof installation (Credit: New York State Energy Research and Development Authority)

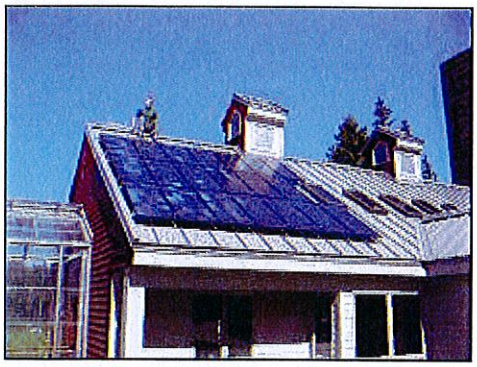
Tax incentives

New York State offers several tax incentives to encourage solar energy. Incentives for residential installations include:

- An income tax credit for 25 percent of the cost of the system ($5,000 maximum) for grid connected and net metered residential (including multi-family) solar electric and solar thermal systems.
- Exemption from state sales tax for passive solar space heat, solar water heat, solar space heat and photovoltaics installed in residential and multi-family residential buildings. *(see link on right to access the Dept of Taxation and Finance Sales Tax Rate Publication 718-S)*
- Subject to local option, a 15-year real property tax exemption for the cost of solar and certain other renewable energy systems constructed in New York State, to ensure that property taxes do not rise because owners install solar energy equipment.

Links at right access additional details about residential tax incentives.

Raising Public Awareness of Solar Energy



School Power...Naturally(SM) is an innovative program from the New York State Energy Research and Development Authority (NYSERDA) designed to educate New Yorkers about energy and, in particular, the role that solar electricity can play in providing clean energy for homes, schools and workplaces.

Solar panels on school roof (Credit: NYSERDA)

Watt is a measure of how much electric power a generator is able to produce. It is used to express the **capacity** of power sources, usually in **kilowatts** (thousand watts) or **megawatts** (million watts), or for very large generators, **gigawatts** (billion watts).

Watt-hour measures the rate at which electric energy is **generated or consumed**. A watt-hour means one watt of power generated or used for one hour. Electric companies usually bill consumer electric use by the **kilowatt-hour** (1,000 watt-hours); megawatt-hours or gigawatt-hours would be used to express large amounts of power, such as annual power generation or consumption for states and nations.

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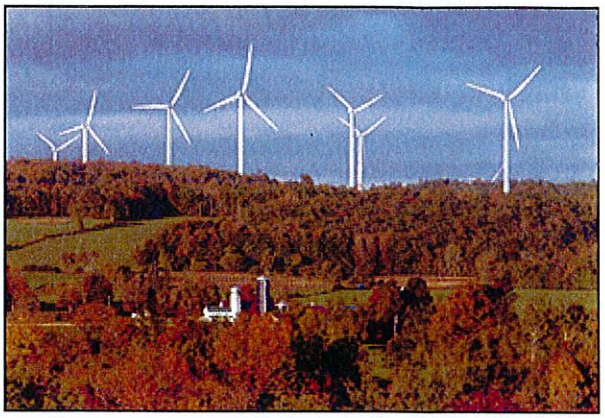
Wind Power

Wind is a powerful and plentiful resource that can provide energy without burning fossil fuel or emitting greenhouse gases.

Since ancient times, sailing vessels and windmills have been turning the energy of the wind into mechanical energy to push ships, pump water and grind grain. Today's advanced wind turbines convert wind energy directly into electricity, which can be moved instantaneously to where it is needed.

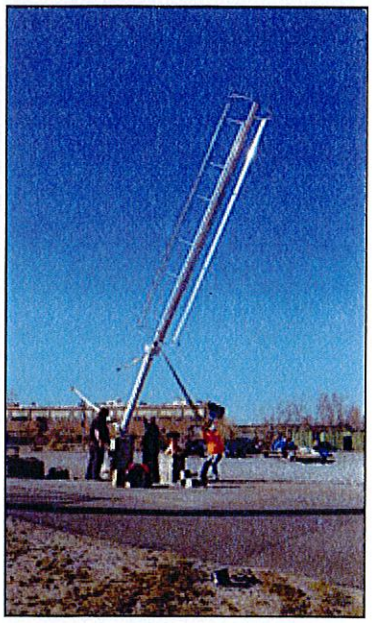
A single small wind turbine can generate enough clean electricity for local use. Connect several large turbines to an electric power grid and you have a wind farm -- a wind energy system generating significant amounts of pollution-free, renewable electric power to be used anywhere power lines reach.



Since 2009, New York has been a member of the "Gigawatt Club" with wind power generation capacity in excess of 1,000 MW. (Photo: Maple Ridge Wind Farm. Credit: Nat'l Renewable Energy Lab)

New York's Wind Power

Wind generation today. Today in New York, wind power makes a small but real contribution to meeting electric power needs.



One of three 33 ft tall wind turbines installed at Union College in Schenectady. Together they supply 40 percent of power for the athletic complex.

The American Wind Energy Association ranks New York eleventh in the nation for installed wind generation capacity. As of Spring 2014, twenty wind energy projects (PDF) (14 KB) are operating with a rated capacity of a little more than 1,812 MW, approximately 2.6 percent of all the electric power available from generation facilities in New York and enough to power more than 500,000 homes. In addition, two wind power projects are under construction in New York, and one is under active review. This wind energy development is critical in meeting New York's renewable energy goals.

Wind generation tomorrow. But today's wind power is only the beginning for New York, the 15th windiest state in the nation. Usable wind sites are found in most parts of the state -- according to the National Renewable Energy Laboratory, New York's wind resource has the potential to fill more than half of the state's current electricity needs.

DEC Environmental Review of Wind Power Proposals

Large wind projects with a capacity to generate 25 megawatts (MW) or more are reviewed according to provisions of the Public Service Law Article 10 siting process (see link in right column leaving DEC website). Article 10 provides a unified review and approval process for major electric generating facilities in New York State by addressing state and local permitting requirements in a single process.

Wind projects with a capacity to generate less than 25 MW do not go through the Article 10 process but are subject to applicable State and local laws or regulations, including the State Environmental Quality Review Act (SEQR). Depending on the specific location of these projects, one or more of the following DEC Permits may be required:

- Freshwater Wetlands
- Use and Protection of Waters
- Article 11 of the Environmental Conservation Law (Part 182)
- State Pollutant Discharge Elimination System (SPDES) General Permit for Stormwater Discharges from Construction Activity (GP-0-15-002)

Guidelines for Conducting Bird and Bat Studies at Commercial Wind Energy Projects

DEC has updated its Guidelines for Conducting Bird and Bat Studies at Commercial Wind Energy Projects (PDF) (468 KB). The recommended methods and analyses described in this document are based on DEC's current knowledge of the best procedures for conducting thorough and meaningful pre-and post-construction studies.

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Hydropower in New York

A Workhorse Renewable Energy Technology

This giant turbine is one of 16 that together can generate more than 900,000 kilowatts [900 MW] of electricity at the St. Lawrence-FDR power project. Operated by the New York Power Authority, the project straddles the St. Lawrence River with a run-of-river hydroelectric station shared by New York and Ontario, Canada. (Photo courtesy of New York Power Authority)

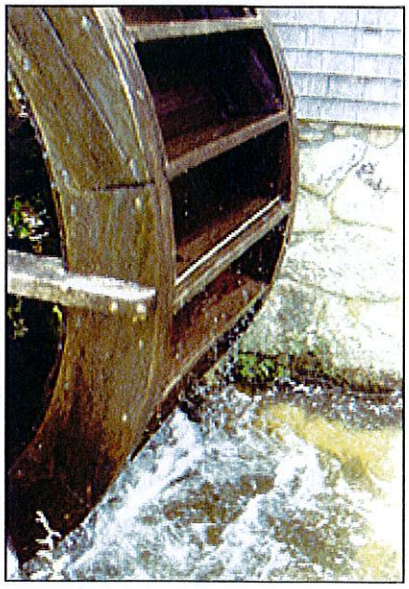
New York is the largest hydroelectric power producer east of the Rocky Mountains and is fourth in the nation in the generation of electricity from hydropower. More than 300 hydroelectric generating stations - some very small, a few very large and many in between -- connect to New York's electric grid. Hydro plants typically meet at least 17 percent of the state's total electricity demand with renewable, clean and inexpensive power.

In a hydroelectric power plant, turbines that are run by moving water generate electricity with no greenhouse gas emissions and little pollution of any kind. DEC works with other New York State agencies and the Federal Energy Regulatory Commission to assess and mitigate possible effects on aquatic life from turbines or power dams.

Hydropower has provided electricity to New York since the first generating plant opened at Niagara Falls more than a century ago. Reliable and able to quickly increase or decrease power output, hydro generation helps to stabilize the electric grid and support less-flexible sources of renewable energy. Some facilities even can store energy for later use.

Hydropower is among the most cost effective of all electricity sources. Because its "fuel" - flowing water - is local and is replenished whenever it rains or snows, the price of hydroelectricity usually remains stable even as markets for other fuels fluctuate.

New York has strategically pursued policies designed to develop hydropower (both conventional and newer hydrokinetic technologies) as part of a diverse portfolio of renewable energy resources. To support economic development and jobs, the Recharge New York program distributes low-cost hydropower to businesses in exchange for commitments to create and retain jobs in the state.



Early New Yorkers harvested energy from falling water to directly drive mills that ground grain and sawed timber. Mature water power technology enabled even small streams to run entire factories - but only if they were located where the stream's course dropped quickly to a lower level. Today, hydroelectricity carries the energy of flowing water far from stream banks, and new turbine technologies can harvest

Hydropower Technologies: Large and Small, Old and New

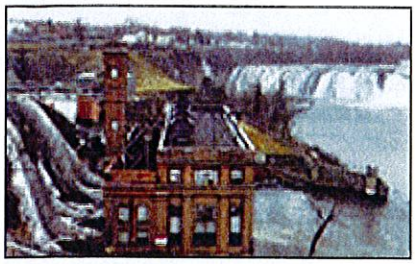
Hydropower generation converts the energy of moving water into electricity. A wide choice of technologies and scales gives hydro the ability to meet both large centralized urban electricity needs and decentralized rural needs.

Conventional hydroelectric technologies

In conventional hydroelectric plants, the turbines that generate electricity are turned by falling water. Some conventional plants store water in reservoirs behind dams, controlling its release to generate predictable electric power (and often providing drinking water, irrigation, flood control or navigation as

well). Other plants (called "run-of-river" facilities) simply take advantage of an elevation drop in free-flowing water, incorporating little or no water storage.

energy from tides and fast streams even without a large elevation drop.



The 38-megawatt School Street hydroelectric plant in Cohoes is owned by a private company that operates several small hydro facilities in New York. Water diverted from the Mohawk River falls 90 feet through five large pipes to turn turbines that generate electricity. The water then flows back into the river below Cohoes Falls. (Photo courtesy Times Union)

Today, conventional hydropower stations generate nearly nine-tenths of all the renewable energy produced in New York. The New York Power Authority (NYPA) owns the two biggest plants, the Niagara River and St. Lawrence Power Projects. These two publicly-owned plants contribute far and away the largest share of New York's total hydroelectricity generation.

The remainder of New York's hydroelectricity comes from numerous small plants, a few owned by NYPA or municipal governments, some by institutions or industries, and many others by private companies whose business is selling electricity to the grid. A 2011 enumeration found a total of 345 conventional hydropower station units operating in the state.

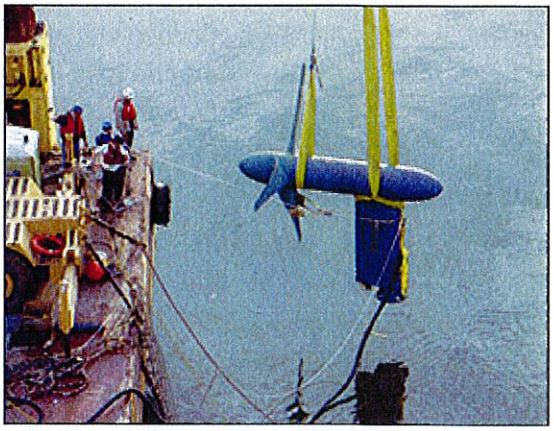
Hydrokinetic systems

Unlike conventional hydropower facilities, which require either a dam or a stream elevation drop to produce energy, newer in-stream or hydrokinetic systems place turbines below the surface of moving water -- in tidal flows, rivers, canals and even wastewater treatment plants.

Tidal in-stream hydrokinetic systems use pivoting turbines that capture energy for the majority of the day regardless of which way the tide flows. These systems are most productive in strong, fast currents, such as are found at the entrances to bays or in "narrows" between land masses. Inland hydrokinetic projects, on the other hand, use fixed turbines to provide round-the-clock electricity whenever streams are flowing.

While hydrokinetic energy is not yet operating at commercial scale, research, development, and demonstration are well along. In New York, new tidal

kinetic hydropower technology installed in New York City's East River was recently connected to the electric grid, and a proposal now under development would test the feasibility of hydrokinetic generation in the Niagara River.



The Roosevelt Island Tidal Energy Project, located in New York City, holds the world's first commercial license for tidal power from its grid-connected array of turbines in New York City's East River. Initiated in 2002, the project completed prototype and six-turbine demonstration phases. (Photo courtesy of Verdant Power)

Pumped storage systems

Pumped storage hydroelectricity is the largest-capacity form of grid energy storage currently available. Pumped-storage units located at Blenheim-Gilboa and Niagara Falls-Lewiston use inexpensive off-peak electricity to pump water to a high elevation, from which it is released to generate power during times of peak demand. Pumped storage facilities use more power for pumping than they generate during operation, but the electricity they produce helps to balance power grid loads and reduce the total cost of electric power.

The Future of Hydropower in New York

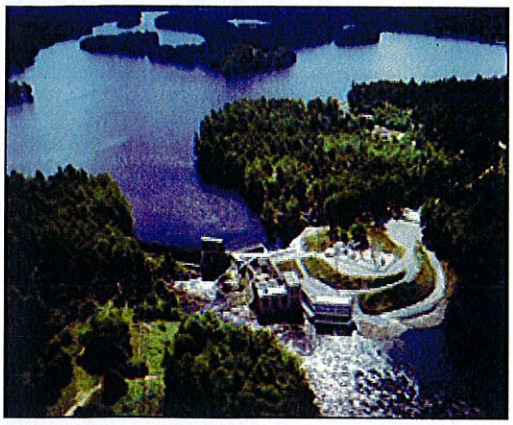
While other forms of renewable energy, such as wind and solar, have greater potential for future expansion, hydro is expected to hold its own or grow slightly as a mainstay of renewable power generation in New York.

Upgrades of existing plants and adoption of high-efficiency small hydro technologies are enabling important incremental increases in the state's hydroelectric generating capacity. In future years New York could see a

significant increase in hydropower from coastline installations if wave conversion or tidal in-stream power technologies prove technically and economically feasible.

Repowering existing generation facilities

Installation of high-efficiency turbines, improvements to power station infrastructure and other upgrades can significantly increase the electricity output of older hydroelectric plants. A recent study of renewable energy in New York found upgrading existing hydropower plants to be one of the least expensive ways to increase renewable electricity generation.



The Higley hydroelectric station, located on Lower Raquette River in St. Lawrence County, underwent a major repowering in 2003-04. A new water intake, penstocks, powerhouse and high efficiency generation equipment increased the plant's output from approximately 4.5 MW to 6.2 MW, a gain large enough to to power more than 1,700 average homes. (Photo courtesy of NYSERDA)

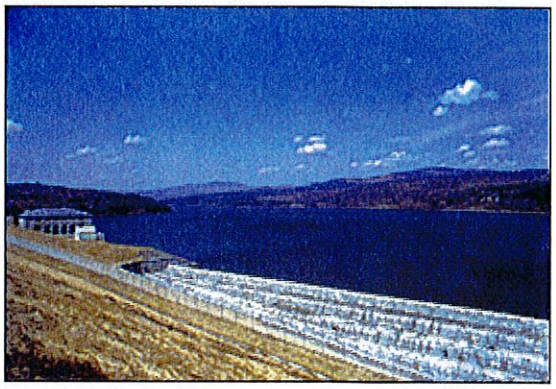
With support from the state's Renewable Portfolio Standard, upgrades to 25 existing hydropower generation stations have been completed or are underway in New York. Renewable Portfolio Standard funding is available for existing plant upgrades and for new low-impact run-of-river facilities up to 30 MW of capacity with no new storage impoundments.

Periodic relicensing of hydropower stations offers opportunities for stakeholders to provide input to license conditions that could include environmental protection and enhancement, economic benefits, and recreational amenities.

Retrofitting non-power dams

Adding generation equipment to existing dams that are now without hydropower is another possibility for increasing New York's total generation capacity with minimal environmental impact. Many existing flood control or water management dams would require only a modest investment in generation equipment to become small hydro generators.

According to the US Department of Energy, hydropower from non-power dams often is found to complement other renewable sources and could help to diversify the distribution of hydropower across the state. The US Department of Energy has estimated that New York could develop as much as 295 MW of generating capacity at existing non-power dams.



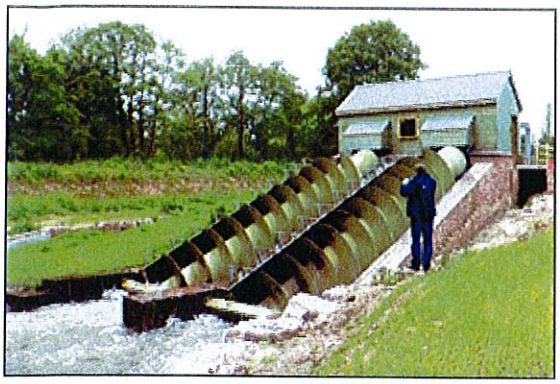
New York City is exploring the feasibility of generating electricity at four dams in the Catskill Mountains that create reservoirs for the city's drinking water system. At Neversink Dam (shown) a valve in the water chamber would be replaced with a 1.9-foot turbine to create an installed capacity of up to 5 MW. No changes are proposed in the water release regime.

Distributed hydroelectric generation

Small or low-head hydropower generation could play a role in making New York's power grid more resilient to climate change. When deployed with energy storage and smart grid technologies, locally-sized hydro

systems can help utilities reduce or manage demand for grid-based electricity, introduce redundancy to back up the system and might be designed to keep power flowing to local users in the event of wider power interruptions. Smart grid technology is needed to facilitate use of small hydro and other renewable resources whose energy output varies with weather conditions or season.

Ocean-based hydropower: a possibility for the future



Small and mini hydro facilities can be part of a distributed electric generation system and provide power for remote areas. They do not need large dams or reservoirs to generate power, and emit no greenhouse gases. (Photo courtesy of Renewable Energy Magazine)

It is estimated that converting less than one-tenth of one percent of the renewable energy within the oceans into electricity could satisfy today's world demand more than five times over.

With more than 120 miles of Atlantic Ocean coastline, New York could benefit significantly from any technology that generated electricity from any or all forms of seawater energy -- potential, kinetic, thermal or chemical. At this time, two technologies, wave energy conversion and tidal in-stream energy conversion, appear to offer the greatest potential for application in New York.