NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

How New York Uses Renewable Energy

Renewable energy resources already play an important role in our economy and society, and they have a much larger potential for replacing fossil fuels in the future, supporting a strong economy and maintaining our comfort and convenience. The electric power generation sector is today's most prominent user of renewable energy, but New Yorkers are rapidly adopting direct use of sunlight for space conditioning and hot water, as well as electric vehicles and advanced biofuels for transportation.

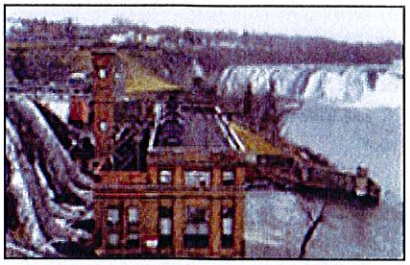
Electric Power Generation

Nearly 23 percent of New York's electric power today comes from a variety of renewable sources, chiefly hydroelectric with significant contributions from wind, biomass and, increasingly, solar resources. Renewable energy lowers the net price of electricity to consumers and creates jobs and economic opportunities. Renewables also help New York meet environmental goals: our electricity today ranks with the nation's cleanest, partly because New Yorkers are America's fifth-largest users of renewable electric power.

Hydroelectric Power

Large Hydro: *New York's large hydroelectric generation portfolio includes the 2.4 gigawatt (GW) Robert Moses Niagara Power Project. (Photo: NY Power Authority)*

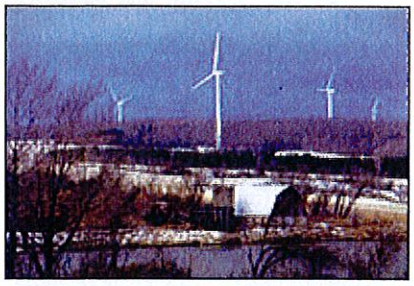
In hydroelectric power plants, the energy in falling water drives turbines that generate electricity. New York produces more hydroelectric power than any other state east of the Rockies, and according to the the International Energy Association (IEA), ranks fourth nationwide in total installed hydropower capacity.



Small Hydro: *The School Street hydroelectric plant in Cohoes can generate 38 MW of electric power. (Photo: Albany Times Union)*

Several large hydroelectric generation facilities and numerous small hydro plants are located in New York. Large hydro plants are capable of generating several hundred megawatts (MW) of power or more. Small hydro facilities, many built a century or more ago to serve a single community or industrial plant, have been upgraded and now contribute electricity to the power grid.

Wind Power



On-shore Wind Generation: *With 20 wind turbines, each rated for 1.5 MW, the Fenner Wind Farm in Madison County has a total generating capacity of 30 MW.*

Wind power technology uses the energy in moving air to turn turbines that generate electricity. In 2007, wind power provided a little more than three percent of New York's renewable electric power, with significant growth since. Today, IEA ranks the state eleventh nationwide in the use of wind power.

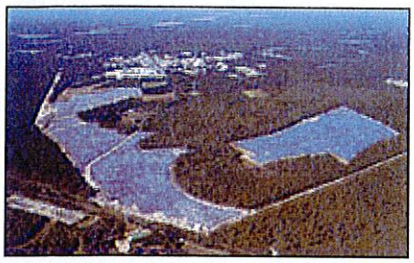
Off-shore Wind Generation: *The nation's first offshore wind farm, Cape Wind off Cape Cod, MA, was recently approved. New York*

Wind measurements show the state's wind generation potential to be significantly greater than current production. Large wind energy projects produce the cheapest electricity, so

significant development is likely of both on-shore and off-shore commercial wind generation facilities in the state.

coastal sites are currently being explored for wind potential.

Solar Photovoltaic (PV) Technology



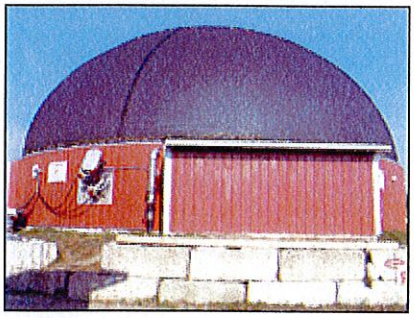
Utility-scale solar PV: *The Long Island Solar Farm at Brookhaven Laboratory is the largest solar power plant in the eastern US. Its 164,000 solar panels can provide up to 32 MW of electricity. (Photo: Brookhaven National Lab)*

Solar photovoltaic technology captures sunlight to directly generate electricity, without mechanical equipment. Today, IEA estimates New York's (2010) solar electricity generation capacity at more than 55 MW, seventh in the nation. Solar photovoltaic use is growing rapidly in the state.

Rooftop Solar PV Arrays: *Electricity generated by a rooftop solar array helps offset power bills for the City of Watervliet. (Photo: City of Watervliet)*

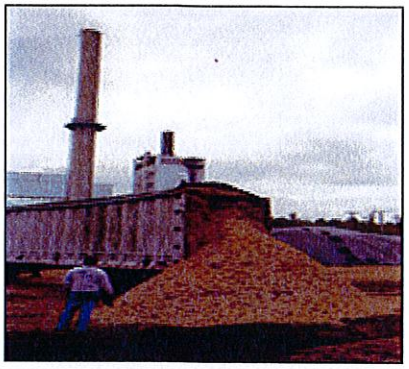
Whether generated by commercial "solar farms" or by panels on rooftop or ground mountings, PV-generated electricity converts easily to be compatible with the power grid. Under the state's net metering law, utilities reimburse PV owners for the electricity they generate, effectively providing the grid as energy storage. Utilities benefit, because solar power generation is greatest when electricity demand is highest -- on hot, sunny summer days.

Bioenergy



Anaerobic digestion: *Wagner Farm in Poestenkill ferments agricultural manure in the digester shown above to yield methane-rich biogas,then combusts the biogas to generate electricity used to operate farm equipment. (Photo: Cornell Dairy Environmental Systems Program)*

New York is well endowed with biomass, which can be used to generate electricity either by direct burning of wood or other plant material or by combusting methane-rich biogas derived from manure, sewage or other organic materials. New York farms and sewage treatment plants are finding that onsite biogas-sourced electricity cuts their power bills while avoiding waste management costs and greenhouse gas emissions.



Direct Biomass Combustion: *A 50 MW electric generating station in Vermont combusts wood chips to generate electricity. (Photo: Nat'l Renewable Energy Lab.)*

Currently, a small number of central electric generation facilities in New York (total capacity around 70 MW) use wood-based fuel. Use of biogas to generate electricity has increased since 2007, when the total capacity of systems located on farms, at municipal waste treatment plants and fuel-cell based installations was estimated at around 12 MW. A new research project currently is recruiting Central and Northern New York farmers to grow shrub willow to burn for electricity.

Space Conditioning and Hot Water for Buildings

Today's building designs and heating technologies are directly using solar and geothermal energy for space heating (and even cooling) and for heating water. Increasingly, buildings are seen as integrated systems with several sources working together to provide heating/cooling, hot water and the full range of energy services.

Active Solar Heating

Active solar panels may look similar to solar photovoltaic panels, but the two technologies work very differently. While PV panels generate electricity, active solar energy panels directly warm either air or an anti-freeze-like liquid that carries solar heat to the building space, a water pre-heat tank or a heat storage system.

Institutional Solar Thermal Hot Water Heating: *The roof of the Glens Falls Hospital Renal Dialysis Center boasts a newly-installed 15-panel solar thermal array to preheat water.*
(Photo: Albany Times Union)

Active solar collectors usually are employed as part of a building-wide system that incorporates auxiliary heating -- an opportunity to tap a second renewable source. Such systems are highly cost-effective when they are used for most of the year (that is, in cold climates with many sunny days), which may explain why designing, manufacturing and retailing renewable energy devices are both popular and profitable in New York.

Integrated Renewable Systems: *At the Wild Center's North Country education facility, solar hot water and a highly efficient wood pellet boiler supplement one another.*
(Photo: The Wild Center)

Passive Solar Design and Geothermal Technology

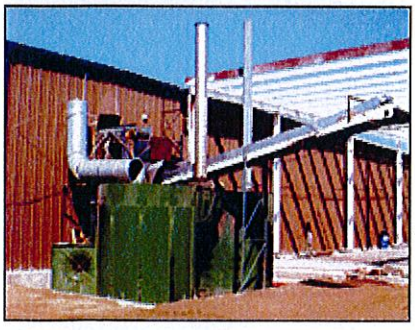
Passive solar space heating: *Engineered sunspaces team up with an efficient biomass heater to warm this Saratoga County home. Passive solar can reduce energy bills without adding a lot to a building's cost.*

Passive solar design uses orientation, glazing and other building features to maximize collection of solar heat. Building mass stores the heat; mechanical controls like shutters and shades exclude sunlight in warm weather. Incorporating passive solar features during construction is relatively inexpensive, and passive solar buildings increase in value as they demonstrate their low energy use.

Geothermal Space Heating: *DEC's Five Rivers Environmental Education Center recently added geothermal to its building space heat system.*

Geothermal space conditioning can tap the earth's heat in much of the United States, even where subsurface water temperature is low or moderate (68°F to 302°F). A geothermal system can be set to either heat or cool the building, making space conditioning as much as 80 percent less expensive than traditional fuels -- with virtually no air pollution or greenhouse gas.

Biomass Space Heating



Biomass heat exchanger *furnaces located outdoors can heat large spaces. A heat exchanger transfers heat from the outdoor furnace to the building's interior.*
(Photo: Energetics)

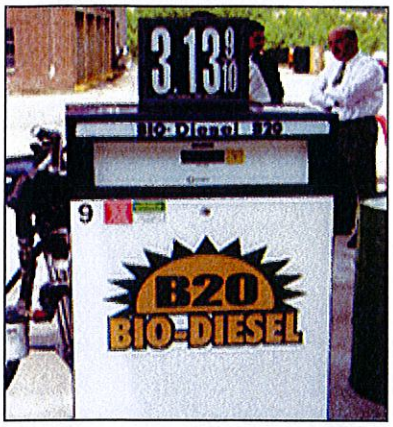
New York's abundant biomass makes this locally-available, renewable heat source a natural -- but wood, like other fuels, requires thoughtful use and resource stewardship. EPA and DEC regulations shape biomass heating devices to keep users and neighbors safe and comfortable. Managing forests and other biomass resources for sustainability ensures that this energy source will remain available.
New York residents use significant amounts of biomass, particularly wood, as a primary fuel. According to the 2009 State Energy Plan, residential use of wood grew by 23 percent between 2001 and 2007; commercial and industrial customers also heat with wood.

EPA-certified wood stoves *emit low pollution. Pairing low-pollution wood heaters with nonpolluting renewable energy sources like passive solar will help limit air pollution and greenhouse gas emissions, and will protect forests and other biomass resources.*

Renewable Energy for Transportation

Bringing renewable energy to the transportation sector is a key element of future energy and climate security. Renewable transportation fuels must contain adequate energy in a volume small enough to carry onboard a vehicle. Also, economically feasible distribution must be available to move the fuels to widespread and convenient fueling stations. In the Transportation Climate Initiative (TCI), eleven Northeastern states and the District of Columbia are working together on clean vehicles and fuels and on other policies that will advance clean transportation in the region.

Alternative Vehicle Fuels



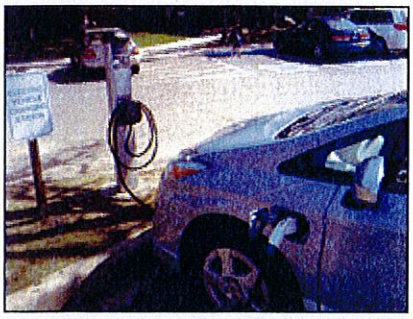
Bio-diesel vehicle fuel *is available at four locations in New York State, including the Mirabito fueling facility near Oswego. (Photo: NYSERDA)*

Energy density. Biomass can be reacted to yield liquid fuels with enough available energy to be practical as transportation fuels. Today's biomass-based transportation fuels include ethanol and biodiesel. Researchers are working to develop sustainable advanced biofuels from plants (e.g. willow and switchgrass) that grow on land not suitable for food crops. Compressed natural gas (CNG), a fossil fuel that pollutes less than petroleum, can serve as a temporary bridge while renewable fuel technologies are being developed.

Shrub willow *is the focus of advanced biofuels research in New York State. These plants take up significant amounts of atmospheric carbon, and can be grown on marginal land, reserving crop lands for food products.*

Fuel distribution. Liquid biofuels can be distributed through existing fossil fuel pipeline networks (though with some some technical complications). Dedicated CNG distribution systems now serve about 30 fueling stations in the state.

Electric Vehicles



All-electric and plug-in hybrid vehicles can charge at home or use a growing network of public charging stations. New York has joined other Northeastern states in developing and promoting a region-wide network of charging stations. (Photo: Nat'l Renewable Energy Lab)

Energy Density. Plug-in electric vehicles (EVs) recently have become available in New York and across the nation at an unprecedented scale. While EV's are very clean (and cheap) to operate anywhere, in New York the prevalence of renewable electricity makes EV greenhouse gas emissions especially low. While electricity (whatever its source) is energy-dense, battery storage capacity still limits the amount of electric "fuel" that can be carried onboard the vehicle. In New York, battery research and development has the potential to lead to an outstanding economic opportunity.

Electricity*, used as a fuel for the first automobiles, has remained in wide use in many countries, and still fuels some types of service vehicles in the US. A New York State incentive helped fund this all-electric delivery vehicle, helping to return electricity to wider use as a vehicle fuel and, as a bonus, to move New York City toward cleaner air. (Photo: NYSERDA)*

Fuel Distribution. The nationwide distribution system for fueling EVs already exists -- the electric power grid -- and is readily accessible to almost all consumers. However, fueling stations in parking lots and other public areas are needed to make use of EVs more convenient and would help extend vehicle mileage until higher-capacity batteries become available. The Northeast EV network project of the TCI is currently working on a foundation for EV and fueling station deployment in the region.

NYSERDA

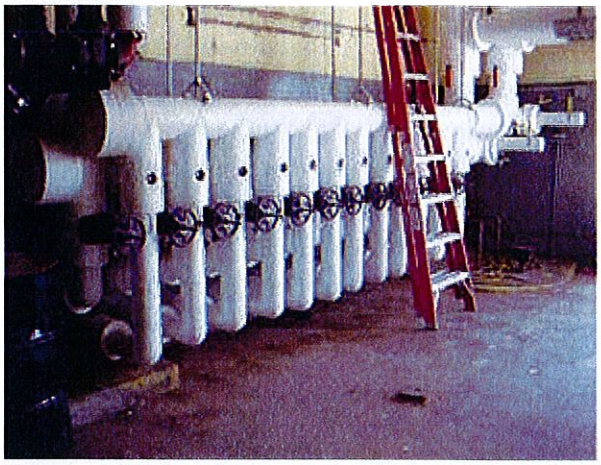
Geothermal Heat Pumps

Some linked content may require an external reader:
Word | Excel | PowerPoint | PDF

Geothermal heat pump systems tap the constant temperature of the earth to provide efficient heating and cooling. The systems operate by using water-source heat pumps which can be distributed throughout the building. Heat energy can be extracted from the earth in the winter, and added to the building. In the summer the process can be reversed. Unwanted heat is extracted from the building and added to the earth.

A Geothermal Heat Pump System

- Geothermal pump systems couple the building's HVAC system to the earth.
- Geothermal heat pump systems eliminate the need for boilers, cooling towers etc.
- The ground provides a nearly constant temperature source of BTU's for efficient heating and serves as a sink for BTU's for efficient cooling.
- Geothermal pump systems are generally distributed systems rather than central systems.
- Energy can be efficiently recovered/ reused in buildings with simultaneous heating and cooling needs.



A geothermal heat pump ground-loop header as it enters the building.

What are the Benefits of Geothermal Heat Pumps

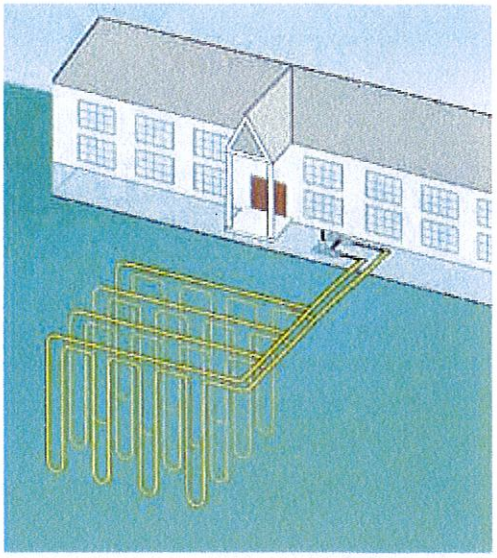
Geothermal heat pump systems have several benefits, including:

- Low Operating Cost
- No Required Exposed Outdoor Equipment
- Level Seasonal Electric Demand
- No On-Site Combustion
- Long Life Expectancy
- Low Cost Integrated Water Heating
- Simplicity
- Low Maintenance
- No Supplemental Heat Required
- Low Environmental Impact

Who Can Benefit

While not a fit for all situations, geothermal pump systems are applicable in both existing and new buildings. In general, their benefits are greatest in buildings with similarly sized annual heating and cooling loads, and those desiring independent climate control of many rooms. The systems can provide efficient heating and cooling of

different zones simultaneously. In New York State, installations have ranged from single family homes to hotels and 500,000-square-foot office buildings.



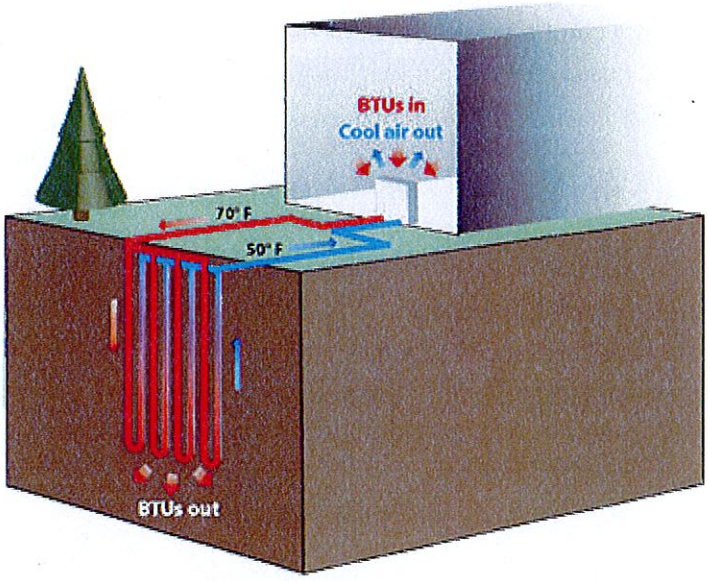
Vertical wells loop-field configuration.

Office buildings and schools are particularly good applications for geothermal heat pumps. These facilities have relatively high occupancy, fluctuating usage schedules, and widely varying heating and cooling requirements within individual zones (offices and classrooms) that are difficult to meet efficiently with conventional systems. Further, efforts to improve the efficiency of conventional systems employ control strategies that can add considerable cost and complexity to the systems, increase maintenance requirements, and often compromise occupant comfort.

How the system works

Geothermal heat pumps transfer heat between the constant temperature of the earth and the building to maintain the building's interior space conditions. Below the surface of the earth throughout New York the temperature remains in the low 50 °F range throughout the year. This stable temperature provides a source for heat in the winter and a means to reject excess heat in the summer. With geothermal heat pump systems, water is circulated between the building and the "ground-loop" piping buried in the ground. In the summer, the water picks up heat from the building and moves it to the ground. In the winter the fluid picks up heat from the ground and moves it to the building. Heat pumps make the collection and transfer of this heat to and from the building possible.

Geothermal pump systems exchange thermal energy between a building and the ground. When the building needs heating, the system extracts heat energy from the ground, and pumps it into the building where it is boosted by the heat pump to a comfortably warm temperature. Conversely, when the building needs cooling, the heat from the building is collected by the heat pumps and sent into the ground, much as a refrigerator's compressor transfers heat from inside the refrigerator to the outside. This exchange of thermal energy makes the system efficient. Rather than creating heat by burning a fuel on site, or chilled water by rejecting heat to the hot summer air, the geothermal heat pump system moves thermal energy between the ground and the building using heat pump technology.

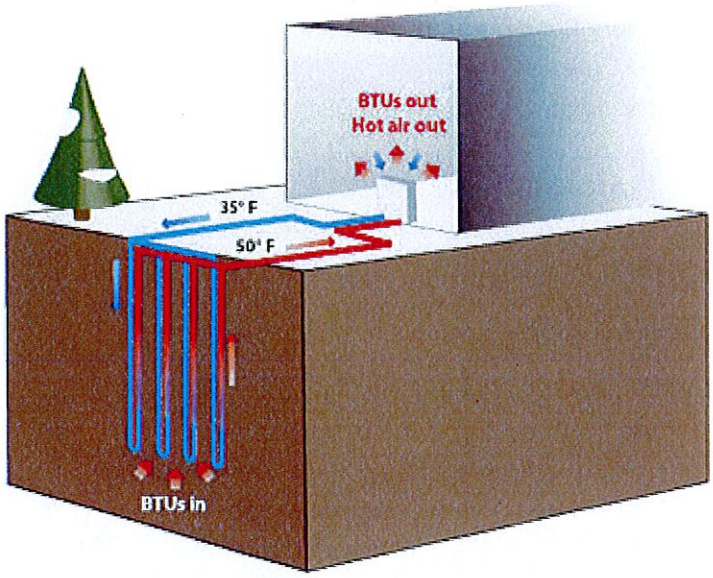


In the summer, the earth acts as a cooling tower.

The relatively constant temperature of the ground makes this energy transfer efficient through out the year - even during the coldest weather. When the building needs cooling the system takes advantage of the relatively constant ground temperature that is usually cooler than the outdoor air in the summer. Alternative systems must move energy from the building to the hotter outdoor air, while the geothermal heat pump system gains efficiency by transferring the energy to the cooler ground.

Geothermal Heat Pump System Manual

This document provides additional information about geothermal heat pump systems, [PDF] how they work, when they should be considered and describes the steps involved in evaluating the cost effectiveness of a geothermal heat pump system. It describes the system and options and attempts to anticipate questions that building owners and designers might have about the technology. This document is designed to assist the layman in understanding the main concepts in geothermal heat pump systems while providing initial sources of information for the designer to pursue a specific project evaluation.



In the winter, the earth acts as the boiler.

New York City Department of Design and Construction

The New York City Department of Design and Construction (DDC) published a useful resource, the Geothermal Heat Pump Manual, which provides definitions, descriptions, and benefits of geothermal heat pumps. In addition the DDC's manual discusses site evaluations, the process of choosing an appropriate ground source heat pump, and the performance and ratings of various systems. The DDC's handbook contains a great deal of valuable information on the entire process of installing geothermal heat pumps and was created for project managers and consulting engineers that were working for the DDC.

New York State Department of Environmental Conservation

The Division of Water regulates registration and certification of geothermal contractors through their Water Well Program for certain wells drilled at depths of 500 feet or less.

The Division of Mineral Resources, within the New York State Department of Environmental Conservation, regulates the drilling, construction, operation and plugging of geothermal wells drilled deeper than five hundred feet below the earth's surface.

Commercial/Industrial Incentive Programs

- New Construction
- Commercial Implementation Assistance Program
- Smart Energy Loan
- FlexTech

Residential Incentive Program

Geothermal systems may be eligible for low-interest financing through the Home Performance with ENERGY STAR® program, as part of a comprehensive and cost-effective package. Please contact a participating Building Performance Institute (BPI)-Accredited Contractor today for more information on the Home Performance with ENERGY STAR Program.

Case Studies

- Albany Molecular Research, Inc. [PDF]
- Tannery Pond Community Center [PDF]
- Bard College [PDF]
- Indian River Central School District [PDF]

Albany Molecular Research uses a groundwater cooling system as an alternative to traditional cooling towers.

Helpful Information Links

Geothermal Heat Pump Consortium

The Geothermal Heat Pump Consortium works on increase the awareness and use of geoexchange technology throughout the United States and the world. The Geothermal Heat Pump Consortium acts as a resource for anyone wishing to know more about geoexchange technology. Its full time staff and industry allies can provide technical expertise, marketing research data and insight, and current industry activity status.

International Ground Source Heat Pump Association

The mission of the International Ground Source Heat Pump Association and its membership is to promote the use of ground source heat pump technology worldwide through communication and education.

New York Geothermal Energy Organization (NY-GEO)

The New York Geothermal Energy Organization is a non-profit organization representing geothermal heat pump (GHP) installers, manufacturers, distributors, general contractors, engineers, renewable energy consultants and industry stakeholders from throughout New York State.

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Geothermal Energy

New York State lacks traditional geothermal energy sources (volcanoes, geysers and hot springs). However, the earth absorbs almost 50% of the sun's energy. Geothermal heat pumps utilize the energy absorbing capacity of the earth to heat indoor air during the cold winter months and remove heat from indoor air during the warm summer months.

The Main Types of Geothermal Systems

- **Closed Loop** - fluid (typically a chemical compound) continuously re-circulates in closed piping from underground to a building or complex and back underground for the purpose of heat exchange.
- **Open Loop** - groundwater or surface water is pumped directly from the earth, used once for the purpose of heat exchange, and then discharged to the surface or underground.
- **Standing Column** - groundwater is pumped up through a central pipe, used once for heat exchange, and then discharged into the upper casing of the same well.

Environmental Benefits and Financial Incentives for Installation of Geothermal Heat Pumps

- a decrease in fossil fuel combustion and corresponding lower levels of air pollution emissions
- significant reductions in both heating and cooling costs
- lower hot water bills
- high initial investment, but low maintenance costs resulting in a quick return on investment
- a 30% federal tax credit for homeowners who install geothermal heat pump systems
- see *Links Leaving DEC's Website* in the right column for additional information on tax credits and other incentives

Regulation of Geothermal Well Installation

- DEC's Division of Mineral Resources regulates the drilling, construction, operation and plugging of geothermal wells drilled deeper than 500 feet below the earth's surface.
- DEC's Division of Water - Water Well Program regulates registration and certification of geothermal contractors for certain wells drilled at depths less than 500 feet.

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Biofuels

Biofuels are solid, liquid or gas fuels made from recently-harvested biological material (biomass). Most biofuel is derived from plants, either crops grown specifically for fuel use or material left over from plants harvested for other uses.

Burning biofuel releases carbon dioxide to the atmosphere, just as burning any other fuel does. However, unlike fossil fuel, biofuel can be renewable and low in carbon intensity -- if it is derived from plants that are grown sustainably (with new growth continuously replacing harvested material).

In New York State there is some unproductive and marginal farmland with the potential for growing dedicated energy crops for cellulosic biofuels production. In addition, more than 18.5 million acres of New York timberland are being renewed at a rate greater than 3 to 1, meaning that low-grade timber can be harvested in a sustainable manner for producing energy.

Emissions, health effects and land use impacts associated with biofuels are not well understood. The State Task Force on Renewable Energy points out the need to examine environmental impacts of biofuel production, particularly on local water and air quality, as well as the land use impact from diversion of crops and the larger impact on the agricultural industry.

Why Biofuels

- Biofuels can be low in carbon intensity (the net amount of carbon released to the atmosphere) - as long as uptake by other growing plants balances the carbon that is released in biofuel production and use.
- Locally-grown biofuel can enhance energy security by increasing independence from petroleum.
- Some biofuels may burn more cleanly than fossil fuels, though considerable study is still needed to identify all biofuel combustion products and pollutants.
- Marketing of biofuel feedstocks can boost the profitability of farming and logging, and improve the economies of rural communities.
- Some biofuel formulations remove materials, such as used cooking oil or logging waste, from the waste stream. In addition to recovering energy that would otherwise be wasted, use of biological wastes for fuel saves the cost, pollution and carbon release associated with traditional disposal.

How Biofuels are Made

The energy that we get from biofuels originally came from the sun. This solar energy was captured through photosynthesis by the plants used as feedstocks (raw materials) for biofuel production, and stored in the plants' cells.

Many different plant materials can be used for biofuel:

- Sugar crops (such as sugar cane or sugar beet), or starch (like corn or maize) can be fermented to produce ethanol, a liquid fuel commonly used for transportation.
- Natural oils from plants like oil palm, soybean, or algae can be burned directly in a diesel engine or a furnace, or blended with petroleum, to produce fuels such as biodiesel.
- Wood and its byproducts can be converted into liquid biofuels, such as methanol or ethanol, or into woodgas.
- Wood can also be burned as solid fuel, like the familiar firewood. Chipped waste biomass, such as the tops of trees discarded by logging operations, can be burned in specially designed furnaces.

Researchers are working to improve biofuel production processes. Before bioenergy can make a larger contribution to the energy economy, feedstocks, agricultural practices, and technologies that are efficient in their use of land, water and fossil fuel must be developed.

Biofuel Today

The federal Energy Independence and Security Act of 2007 called for advanced biofuels, including cellulosic ethanol and biomass-based diesel. Federal law mandates production of 9 billion gallons of renewable fuel by 2008, with production to rise to 36 billion gallons by 2022.

Biofuel is usually used as liquid fuel for transportation, mixed with fossil fuel. The United States produces mainly ethanol (most of it currently from corn) and biodiesel.

Ethanol. The US currently produces some 7.2 billion gallons of ethanol per year. Fourteen per cent of the US corn crop is now dedicated to ethanol production, and the USDA says that is expected to rise to 30 per cent in 2009-2010. Most US cars can run on blends of up to 10 percent ethanol, while "flexible-fuel" vehicles can use gasoline and ethanol blends as high as 85 percent ethanol (E85).

Cellulosic biofuels. Cellulosic biofuels, made from non-food crops, are under development but not yet in production at industrial scale. Research on cellulosic ethanol is currently underway at several major research institutions in New York, focusing on regionally available feedstocks.

Biodiesel. Commercial production of biodiesel in the United States began in the 1990s. The US Energy Information Administration says that the country produces around 500 million gallons of biodiesel per year.

Biodiesel

Biodiesel is a diesel fuel derived from biological sources such as soybean oil, animal fats, waste vegetable oils, or even some strains of algae. In the United States most biodiesel currently is made from soy oil, but this fuel can also be made from other vegetable oils, including rapeseed (canola), palm tree, olive, peanut, safflower, sunflower, and castor. The most common feedstocks for biodiesel production in the United States are soybean oil and yellow grease (primarily recycled cooking oil from restaurants).

Biodiesel can be used in place of, or mixed with, petroleum diesel in commercial and personal vehicles, in oil burners (including home furnaces) and in other diesel engines. A fuel blend that includes up to 20 percent biodiesel can be used in most diesel engines with little or no modification.

In times of high oil prices, some people become interested in producing small quantities of biodiesel for use in their personal vehicles or home heaters. However, biodiesel production can be hazardous, as well as smelly and messy, and requires that producers take care not to contaminate the environment or violate tax laws.

Benefits of Biodiesel

- Biodiesel can be a renewable fuel, if the plants used to produce it are grown sustainably.
- Plant-based biodiesel is a low carbon intensity fuel, if the carbon dioxide (CO2) emissions from burning it are balanced by CO2 uptake into a new crop.
- Domestically-produced biofuel can help reduce dependence on foreign petroleum.
- Biodiesel production is a beneficial re-use of restaurant waste grease and animal fat that otherwise might end up in landfills.

Issues Associated with Biodiesel

- When biodiesel is made from food oils, a potential conflict arises between food and fuel uses of the plants and the land where they are grown.
- Air pollutants produced from biodiesel combustion need additional study and, possibly, control measures.

- Like any other biofuel, biodiesel requires energy to transport the feedstock material, to produce the fuel, and to transport the fuel to where it is used. Calculations of the cost-benefit of biodiesel must include energy consumed in the complete life cycle of the material, from field to delivered fuel.

Biofuels in New York State

Currently, New York's renewable fuels infrastructure is based largely on corn-to-ethanol and soybean-to-biodiesel production. Nearly 400 million gallons of corn-based ethanol and agriculture-based biodiesel capacity are currently either in the planning or construction phase, although energy planners see these fuels as a transition to more beneficial biofuels now under development and biofuel producers are already looking beyond grain-based feedstocks.

Biofuel Issues

Life-cycle environmental consequences

Evaluations of the energy balance of biofuels, and of biofuels' contribution to energy independence are currently incomplete. Most such evaluations do not take into account fossil fuel use and emissions from harvesting and transporting biofuel feedstocks, and for most processing of plant material into biofuel, nor do they include land use impacts of expanding the development and deployment of renewable fuels. Crops grown for biofuels are the most land- and water-intensive of the renewable energy sources. In 2005, for instance, about 12 percent of the nation's corn crop (11 million acres of farmland) was used to produce four billion gallons of ethanol-which equates to about 2 percent of annual US gasoline consumption.

Obtaining sustainable feedstocks

Balance between the carbon released by biofuels and carbon uptake by growing plants can be achieved by producing biofuels from feedstocks (raw materials) that come from managed forests or sustainably cultivated crops. However, the metrics of sustainable management, as well as models and measurement tools to assess management, remain to be developed.

Air pollution

Like any fuel, biofuel can be a source of air pollution. Biofuel air pollution is not yet fully understood. Widespread use of these fuels would necessitate further research and, possibly, emission controls. Any use of waste biological materials for fuel requires special care in evaluating air pollution implications.

Biofuel infrastructure and distribution

Existing oil pipelines are impractical for transporting ethanol, because ethanol is very easy to contaminate with water (commonly present in pipelines), and also because most ethanol is produced far from existing pipeline access points. So ethanol will continue to require fuel-intensive (and expensive) truck transport.

More about Biofuels:

Biodiesel Fact Sheet - Before you consider making biodiesel at home ... Read this fact sheet.

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

Composting and Organic Materials Management

Organic materials come from living plants and animals and are best managed as a resource rather than a waste. From animal manure and crop residue, to leaves and grass, to the uneaten food generated daily in cafeterias, restaurants and homes, to food processing waste, organic materials are a part of life. Managing these materials through reduction, reuse and recycling, including composting, is a high priority for the NYSDEC and New York State.

Reduction and reuse are at the top of the materials management hierarchy followed by recycling and then disposal. Recycling organic materials by composting, anaerobic digestion, land application and other organics recycling technologies reduces the generation of greenhouse gases; creates soil amendments, energy and jobs; and reduces reliance on waste disposal.

More about Composting and Organic Materials Management:

Types of Organic Materials - Organic materials originate from plants and animals. While diverse in nature, they all contain organic matter (carbon based compounds). It is the organic matter and nutrients that lead to the useful products (compost, biogas, digestate, etc.) derived from these materials.

Home Composting and Reducing Wasted Food - Information on easy backyard composting.

Food and Food Scraps from Businesses and Institutions - Managing excess edible food and food scraps most efficiently starts with reduction of wasted food followed by feeding hungry people, feeding animals, organics recycling including composting, anaerobic digestion or other technologies, and finally disposal.

Food Scraps as Animal Feed - The feeding of breads from grocery stores and bakeries to animals on farms has occurred for decades.

Composting and Organics Recycling for Municipalities - State and federal law gives localities the responsibility for planning and implementing materials management strategies. Each municipality and county in New York State is required to be part of a solid waste management planning unit.

Organic Recycling Facilities and Regulations - Organic recycling facilities include composting, anaerobic digestion, land application and other technologies. Under New York State solid waste regulations, there are three levels of regulatory oversight for facilities: exempt, registered and permitted.

Recycling Biosolids from Wastewater Treatment Facilities - Wastewater treatment results in two major outputs, effluent and biosolids. Effluent is discharged to a receiving water, typically a stream or river. The solids can be recycled, incinerated, or landfilled.

Composting/Organics Recycling Technologies - There are many methods to recycle organic materials. Deciding on a method is dependent on a number of factors including the type of material, quantity, agricultural land availability, facility siting availability, markets for soil products, technology cost, government incentives available and other factors.